Dimensions of sustainability: Case study of new housing in Adelaide and Hanoi

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Abstract

Since the 1970s, it has been repeatedly argued in literature and public forums that humans are living in a way that is rapidly depleting the Earth's natural resources and causing environmental degradation. The concept of sustainability that entered the discourse in the late 1980s, points to the interrelationships that exist between the social/cultural, economic, and environmental dimensions of the development issue. Many authors describe housing projects to be sustainable architecture but focus mainly on some individual aspects such as energy conservation, or respect for the site, and do not consider the multiple dimensions of sustainability. This thesis suggests that projects conceived in this one-dimensional approach will not ensure true sustainability.

This study proposes the development of a comprehensive and adaptable framework to evaluate the sustainability of housing projects. This framework has multiple dimensions, multiple instruments and takes into account the involved actors. The multi - dimensions include the social, economic, and environmental aspects of the project. The technological, social, and economical instruments of project implementation define the opportunities and barriers for sustainable solutions. The study suggests that to ensure a sustainable housing project the interactions between these instruments must be considered along with taking into account the collaborations between different actors involved in the project including housing industry stakeholders and the users (householders).

Case studies of housing projects in two very different cities Adelaide, Australia and Hanoi, Vietnam are compared to investigate the contextually dependent character of sustainable housing and to build up the evaluation framework. The result shows that because of the very different social, economic and environmental condition of each locality, the elements within the evaluation framework and their values are different in Adelaide and Hanoi. The implication is that the nature of sustainable housing can only be defined contextually and is subject to change with changing socio-economic and political conditions over time.

The application of the analysis framework is illustrated by developing guidelines for sustainable housing in Hanoi. This gives an example of how a sustainable housing project could be promoted in other areas of the world.

Signed Statement

This thesis contains no material that has been accepted for the award of any other degree or diploma in any University. To the best of my knowledge and belief, it contains no material previously published or written by another person, except where due reference is made in the text. I consent to this thesis being available for photocopying and loan if applicable if accepted for the award for the degree.

Nguyen Viet Huong

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Adelaide, 11st March 2004

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Abbreviations and Terms

ABS: Australian Bureau of Statistic
AD: Adelaide
AMCORD: Australian Model Code for Residential Development
AUD: Australian Dollar
AUc: Australian Cent
CD: Compact Disk
CDHRD: Commonwealth Department of Housing and Regional Development
CDRC: Canadian Development Research Centre
CFCs: Chloroflourocarbons
CH4 : Methane
CO2: Carbon Dioxide
CO: Carbon Mono Oxide
DEH: Department of the Environment and Heritage
EVN: Vietnam Electricity
FDI: Foreign Direct Investment
GDP: Gross Domestic Product
GSO: General Statistic Office
GST: General Services Tax
ha: hectare
HCHCs: Chlorofluorocarbons
HHs: Households
HN: Hanoi
HPC: Hanoi People Committee
HUD: Hanoi Urban Development
HAU: Hanoi Architectural University
IPCC: Intergovernmental Protocol on Climate Change
IUCN: International Union for the Conservation of Nature and Natural Resources, World Conservation Union, United Nation Environment Program, and World Wide Fund for Nature
ICLEI: International Council for Local Environmental Initiatives
KWh: Kilo Watt hours
N2O: Nitrogen Oxide
NOx: Nitrogen Oxides
OECD: Organization of European Countries
SO2: Sulfur Dioxide
SAHT: South Australian Housing Trust
PC: Personal Computer
TV: Television
USD: United State Dollar
US cent: United State Cent
UNDP: United Nation Development Program
UNCEP: United Nation Committee Environment Program
Vietkieu: Vietnamese immigrated abroad
VCD: Video Compact Disk
VOCs: Volatile Organic Compounds in Air
WCED: World Commission on Environment and Development
WB: World Bank
WRI: World Resource Institute
WWI: World Watch Institute

Chapter 1 Introduction

1.1 Overview

Since the 1970s, it has been repeatedly argued in literature and public forums that humans are living in a way that is rapidly depleting the Earth's natural resources and causing environmental degradation (for example see Meadows, Meadows, Randers & Behrens, 1972; Vale & Vale, 1975 & 1991; Shearman & Sauer-Thomson, 1997). The root causes of these 'non-sustainable' practices in terms of resource depletion are claimed to be due to increasing population and the increasing consumption of resources due to modern lifestyles (see for example Ehrlich and Ehrlich, 1972). Environmental damage such as global warming, ozone depletion, and environmental pollution are claimed as going beyond the limit of the carrying capacity of the earth (see for example, Meadows, Meadows & Randers, 1992; Wackernagel & Rees, 1996). A range of United Nation reports have examined the state of our environment (see for example, UNEP, 1997), and a number of international conferences have been held (for example Conference on the Human Environment 1972, Habitat I – Vancouver 1976, Earth Summit - Rio de Janeiro 1992, Habitat II - Istanbul 1996, World Summit on Sustainable Development – Johannesburg 2002) where Governments from many nations met and tried to solve environmental and related development problems. The Istanbul Declaration on Human Settlements of the Habitat II conference in 1996 aimed to achieve improvements in the living environment of all humanity on a sustainable basis. This declaration in part said,

> "We, the Heads of State or Government and the official delegations of countries assembled at the United Nations Conference on Human Settlements (Habitat II) in Istanbul...[commit ourselves]...To improve the quality of life within human settlements, we must combat the deterioration of conditions that in most cases, particularly in developing countries, have reached crisis proportions. To this end, we must address comprehensively, inter alia, unsustainable consumption and production patterns, particularly in industrialized countries; unsustainable population changes, including changes in structure and distribution, giving priority consideration to the tendency towards excessive population concentration; homelessness; increasing poverty; unemployment; social exclusion; family instability; inadequate resources; lack of basic infrastructure and services; lack of adequate planning; growing insecurity and violence; environmental degradation; and increased vulnerability to disasters."
>
> (UNDP, 1996a)

Housing is an important issue when considering sustainable practices not only because of its mass consumption of energy and resources but also its direct effects on human life. Housing always has practical, social, economic, and emotional values. Sustainable housing "involves the active participation of the community, which accommodates its values, relates to its vernacular traditions while meeting its aspirations and which remains substantially as the housing of and by the people" (Oliver, 2000, p. 125). The concept of sustainable development is seen as embracing multiple dimensions that include society, culture, economy, politics, the environment, and morals (Scott, 1998, p. ix; Turner, 1993, p. 4; Vale & Vale, 1991, p. 115; Auty & Brown, 1997; Edwards, 1998). Housing practice in reality has to deal with all issues in a complex context, and to be ethical, housing practices must not only provide human benefit but also should not compromise the interests of other species and of ecosystems as a whole.

1.2 Definition of problems and research questions

Many housing projects that have been claimed to be sustainable[1] seem not to have considered the multiple dimensions of sustainability. Although often being aware of the multiple aspects of sustainability many authors have described projects that have focused mainly on some individual aspects such as energy conservation or respect for the site, and do not consider the multiple dimensions of sustainability. This one-dimensional approach itself may be the reason for the current failure in achieving sustainability, because "the key dimensions of sustainability [that] are at all levels and in all contexts", are not considered (Scott, 1998, p. ix). For example, generally, energy and resources used for the construction of the 'green projects' and the social and health effects on occupants are rarely mentioned when being introduced in literature. Bhatti (2001, p. 39) argued, "housing studies have much to contribute to the debate about sustainable futures and yet there has been lack of engagement with environmentalism".

Although some public buildings may reach a sustainable level with good design, careful material selection and well-managed operation, housing is more difficult because of its inherent characteristics. The provision of the indoor environment in public buildings is often controlled by mechanical systems or computers and is aimed at serving some specific functions at a specific period of time in a day. The same level of control becomes a tenuous proposition if intended to apply to the operation of a house when it has to suit all social demands and economic conditions of a family. If efficient energy design of housing or urban pattern does not fit into the cultural lifestyle of a community, it would hardly be successful. Renewable energy appliances are not the choice of many families due to economic affordability at present and are not the priority of investment when conventional options are available and cheaper. As Vale & Vale (1991, p. 151) argue, "it is not easy to find buildings that embody all the principles of green architecture", similarly in the literature about sustainable buildings it is not easy to find descriptions that considered the multiple dimensions of sustainability. "[A]rchitecture is part of the conflicting and contradictory

[1] Many authors use sustainable (and sustainability) and 'green' as interchangeable terms.

struggle of differing forces" (Borden and Dunster, 1995, p. 4 quoted in Guy and Farmer, 2000, p. 85), thus, this indeed raises doubts about the possibility of defining solutions to housing that embody the multiple dimensions of sustainability.

While it is often recognized that probably no one solution can be found for sustainable housing, context is often ignored when introducing sustainable housing in the literature. The current Westernization of lifestyles, the open availability of technological information, and the transformation of the free trade economy around the world give many different societies opportunities to apply advanced technologies, but at the same time, could be detrimental to the cultural diversity of different communities in the world. As Guy and Farmer (2000) suggest, sustainable solutions need to be defined locally. Sustainability cannot be created in abstract as recognition of purely contemporary concerns for environmental, social and economic issues, but must also be a reflection of a long and complex intermingling of history and ideals. This necessity relates to the differences in values local people put on aspects of sustainability. The value of an aspect (instrument or end) of sustainability concerns the priorities and accepted or expected satiation level in the local context.

Moreover, applying concepts of sustainable housing directed to long-term futures in developing countries, when the needs of people at present are not met, becomes problematic. As the author of this thesis has been living in the developing city of Hanoi, Vietnam, this work addresses this central issue.

This thesis therefore addresses the following research questions:

1. *How can housing projects (existing or proposed) be meaningfully evaluated by stakeholders as sustainable? What would be the nature and form of an assessment framework (including its elements)? Would this framework embody multiple dimensions?*

2. *Is the meaning of sustainable housing context specific? If so, how would the framework and/or the values of some of the elements be different in Adelaide and Hanoi?*

3. *What guidelines could be suggested for sustainable housing in present day Hanoi?*

In order to answer these questions, this thesis first examines the literature on sustainable development and housing to gain an understanding of the dimensions of the issue as well as the instruments suggested to achieve appropriate outcomes. Secondly, two case studies are undertaken to define specific elements of the assessment framework and to examine the context dependent characteristics of the problem.

The literature review helps in establishing theory to build up a framework of sustainable housing, responding to research question 1, and helps to identify the opportunities and barriers of the instruments employed to approach sustainability. The case studies help to understand environmental, social, and economic conditions in a local context. As "[i]t is possible to design a good building and have it badly driven by its users" (DEH, 2001), a study of users' behaviour in housing therefore is critical in orientating solutions to sustainable housing. Housing projects in Adelaide, Australia, and Hanoi, Vietnam were selected as case studies that focused on examining people's perceptions and behaviours. These two very different cities bring the element of sustainable housing clearly into focus and enable the differences to be compared. These case studies first helped in addressing research question 1 by identifying elements of the assessment framework not dealt with in the literature. Secondly, comparisons of the applicable elements and their values in the assessment frameworks of the two cases point to the contextually dependent character of sustainable housing to answer the research question 2. Finally, the developed framework for sustainable housing is used to construct the guidelines for sustainable housing in Hanoi to answer research question 3 and to illustrate how the assessment framework could be used for developing guidelines for sustainable housing.

1.3 Research objectives

Following from the research questions the objectives of this work are summarized as follow:

1. This research investigates the nature of sustainability and sustainable housing in order to build up a framework to evaluate sustainable housing.
2. The research reviews the nature and practice of housing in Adelaide and Hanoi to:
    a. Define the elements for sustainable housing in each context to complete the framework of sustainable housing.
    b. Compare sustainable housing in the two contexts to examine the context dependent characteristics of sustainability
3. The research then proposes guidelines for sustainable housing for Hanoi based on this framework.

1.4 Significance of the research

Mawhinney (2002) describes a number of theories around which the debates on sustainable development are formed. These include social centered 'equality-inequality' theories, the 'techno-centred' theories and the theories of 'balance'. The balanced approach has its roots in the 1987, the World Commission on Environment and Development report *Our Common Future* (also known as the *Brundtland Report*). The Rio Earth Summit in 1992 also promoted the understanding that sustainable development revolved around a balance of three pillars - environmental protection, social progress, and economic growth. More recently the Johannesburg World Summit on Sustainable Development reaffirmed and emphasized that sustainable development should have the overall aims of eradicating poverty, changing unsustainable patterns of consumption and production, and protecting and managing the natural resources. This, it was acknowledged, also required taking a long-term perspective and broad-based stakeholder participation in decision-making.

While the intention of the 'balanced' approach to sustainable development is clear in these declarations, the method to achieve and solution for sustainable housing have not been fully explained.

This research aims at establishing the extent to which it may be possible to define solutions for housing that embody multi dimensions of sustainability. This could alleviate the failure of current practices to solve problems in housing and enhance the future success of sustainable housing projects.

Study of the context specific character of housing problems explores ways to approach sustainability from local conditions. This can avoid mistakes when transferring technologies from place to place. The comparative study of Hanoi and Adelaide would be beneficial for each to consider the experiences of the other and thus to avoid repeating mistakes, save time and finance, and enhance sustainability.

The guidelines for sustainable housing in Hanoi will help to orientate the housing practices in this city into a more sustainable direction. This will illustrate a process of how a sustainable housing project could be promoted in other areas of the world.

1.5 Methodology

This research uses both qualitative and quantitative methodologies in the study. Adjacent to this, literature reviews and field studies are combined in the study. This research is conducted in four main steps, as follows:

1. A literature review on the topics of sustainability, sustainable development, sustainable housing, and housing practice in Adelaide and Hanoi is conducted to define the nature of sustainability and sustainable housing, and to evaluate housing development in the two cities. The literature review aims to also define elements of the framework of sustainability in housing in general and of the two cities.
2. A field survey of the perceptions of the principal stakeholders involved in housing including householders, planners, developers, and architects in Adelaide and Hanoi collects data of the local context in multiple dimensions for an in depth understanding of the local context. The field survey gathers all elements related to sustainable housing.
3. The collected data is analyzed to elaborate the essential elements of the assessment framework and allows comparison of the values of the elements to examine the

contextually dependent character of sustainable housing. The framework is applied to investigate the problems and opportunities for sustainable housing for Hanoi and guidelines are developed to approach this issue. This is intended to illustrate how the assessment framework could be used for evaluating housing projects and developing guidelines for sustainable housing.

4. The results are discussed and conclusions drawn.

1.5.1 Step 1. Literature review and framework development

Literature is first studied to explore the meaning of sustainability and sustainable development to build up an initial assessment framework of sustainable housing that embodies multiple dimensions. Although having been used widely since the mid-1980s in connection with environmental related issues, generally, sustainability has vague meanings (Becker, Jahn, & Tiessies, 1999, p. 19) and can be understood in many different ways. It becomes even more confusing when the term *sustainable development* appears in official conferences and documents such as the Brundtland Report (UNCEP, 1987), Habitat II Conference (UNDP, 1996a), and World Summit on Sustainable Development (WSSD, 2002). It is therefore necessary to carefully study and clarify the meaning of sustainability to create a basis for establishing the definition of sustainable housing.

Studies in sustainable housing need to address all social, environmental, and economic aspects. "The challenge for sustainable development - for sustainability in its widest sense - requires information gathered in many different dimensions of complex *ecological, social and economic systems*" (Auty & Brown, 1997, p. 97). The "interdependence between social, economic and environmental sustainability" (Pugh, 1996, p.15) shows that problems are no longer seen in isolation. Housing tightly connects with human behaviour through the use of natural resources (land, water, energy) and domestic goods, the release of waste into the environment (domestic wastes and transportation emission), and the social relationships within local communities. The total gamut of housing concerns represents the socio-economic and environmental circumstances of a local community.

This research focuses on defining and solving problems from the *means (instruments)* rather than the *ends*. The interdependent impacts on the *ends* and the feedback to the *instruments* could be analyzed as this determines the success of the *instruments* of sustainability. The current conventional solutions of fixing the *end*s have experienced many mistakes or inefficiencies because present problems *(ends)* can be created by many different and interrelated causes (means). Thus, fixing an *end* may create another problem. For example, many modern waste recycling systems at present have not ensured high efficiency rates in energy consumption, transportation and treatment, and in economic benefits. Reducing the amount of waste in the first place may be a more efficient solution and this could be obtained by manipulating the social related *instrument* of lifestyle.

The current instruments to achieve sustainability are often introduced in the literature separately. Instruments that can be identified in the literature include adopting particular technologies (Vale & Vale, 1975; Vale & Vale, 1991; Rathenau, TUDelft, & UNDP, 1997; Jones, 1998; Langston & Ding, 2001), economic stratagems (Turner, 1993; Daly & Cobb, 1989), or altering social behaviour (Oliver, 2000; Fox, 2000; Becker & Jahn, 1999). Only a few authors such as Turner have attempted to combine multiple instruments:

- Provision of basic needs, starting with the needs of the poorest;
- Participation for the community itself;
- The use of appropriate or intermediate technology.

(Turner, 1993, p. 4)

In order to provide the basic needs of the poorest, Mitlin and Satterthwaite (1996, p. 26) argue that *economic development* is needed in association with an *ethical and cultural basis* for the participation of individuals and community, and the application of appropriate *technologies.*

As the efficient use of the *instruments* is decided by behaviours of the stakeholders, studies of the user's behaviour seem to be of critical importance in defining sustainable housing. Sustainability depends crucially on the participation of the stakeholders involved in housing development because the *instruments* cannot do anything by themselves without the participation of human society. Although literature seems to have covered many issues related to sustainability, from defining problems to proposing solutions, the reality shows that many projects have failed when they do not involve the housing users in the process. Several authors have asserted the importance of taking users' perspectives into account in environmental-behaviour studies.

> Environmental-design researchers have gradually introduced what seems a surer method of taking user needs and preferences into account in design and planning decisions. It requires decision makers to raise questions about the needs and preferences of prospective users, to seek verifiable answers to those questions to final design or plan.
>
> (Cherulnik, 1993, p. 3)

And Scheneedloth (1987) in Cherulnik (1993) agrees:

> ...each project takes place in a specific context, subject to the operation of diverse constraints on user' behaviours, including their personal characteristics and those of environmental decision makers, socio-historical factors, and organizational policies...

As all *instruments* are operated by different stakeholders and most problems have roots in human behaviour, and since the human has become the dominant species on earth, it is important to understand the perception and behaviours of the stakeholders involved in housing as it influences sustainability in housing. This research therefore takes into account the perception and behaviours of stakeholders involved in the housing sector that include *householders, architects, developers, and urban planners.* The discussion above can be summarized in the following diagram that represents the outline of the first proposal for an assessment framework of sustainable housing (Figure 1).

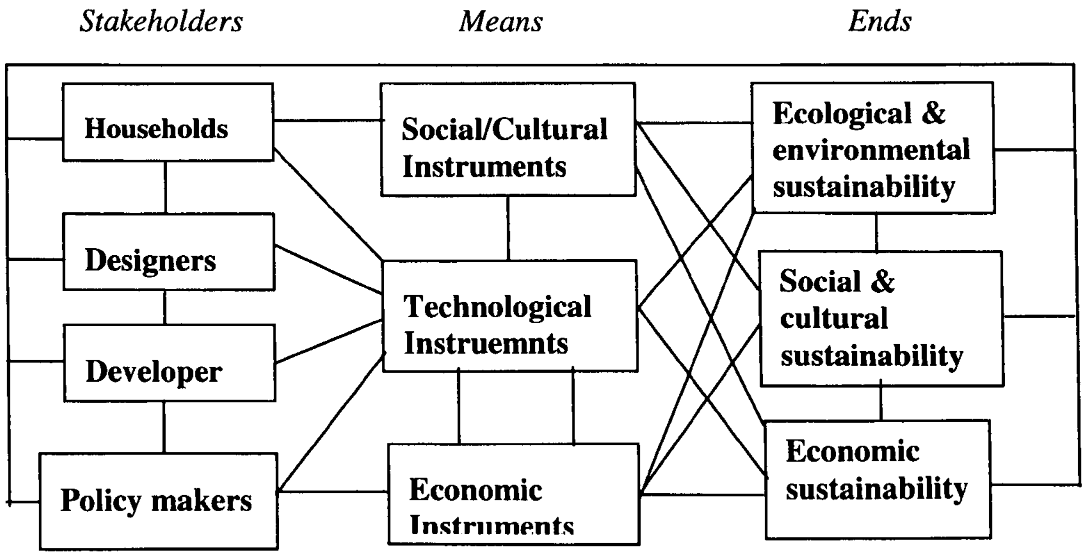

Figure 1 Outline of the first proposal for an assessment framework

1.5.2. Step 2 - Field survey purpose and scope

To elaborate the proposed theoretical assessment framework, this research examines two new housing projects in Adelaide, Australia, and Hanoi, Vietnam, as case studies. These housing projects in very different situations were chosen to represent the latest technical, social, economic standards, and the policy and political potentials at different ends of the development spectrum. In addition the author was familiar with both situations. The particular locations selected are the relatively new housing areas of Novar Gardens, City of Marion and Coventry Gardens, City of West Torrens in Adelaide, and Linh Dam Lakes in a suburb of Hanoi. These projects were built between 1997 and 2000. They are each located between seven and nine kilometres away from city centres.

The stakeholders to be interviewed include *householders, designers/ architects, developers, and urban policy makers/ planners.*

- *Householders* are a good source for defining *human needs* in technical, social, and economic instruments in housing. The understanding of people's perceptions, attitudes, and behaviour on sustainability may be important to define the *willingness to pay* for environmental costs and *barriers* preventing the change of lifestyle. The research comprises in depth interviews of about forty households in multiple aspects such as society, the environment and the economy in each city.

- *Architects and designers* of housing decide the efficient level of energy and resources used in the construction and operation of the house and the comfort of the living environment for occupants. This research interviews some designers/ architects about their advanced housing designs and their priorities and concerns in housing design in relation to social, economic and environmental issues.

- *Developers* seem to give a priority for the economic feasibility of housing development. Some interviews in each case are conducted to define solutions to economic feasibility.

- *Urban planners and policy makers* have been trying to promote sustainability by developing institutional frameworks. Some key policy makers are interviewed to find out what would be the barrier to the implementation of current policies.

Surveys of the principal stakeholders in the case study projects and the housing sector in general were intended to collect data for a deep understanding of the local context. These surveys gather information about all elements of the assessment framework from the stakeholders' perspective. This strengthens the success of the research since it is based on "grass-roots participation" (Werner, 1999, p. 224).

The environment-behaviour studies have been introduced in literature as a powerful instrument in making better decisions and develop knowledge (Zeisel, 1981, p. xi). Zeisel (1981, p. xi) clarified, "[b]ehaviour refers to things people do, including thinking, feeling, and seeing, as well as talking with others and moving around". This research will therefore investigate the relationship between people's *knowledge, perception, attitudes and actions* in achieving sustainable housing in order to identify the roots of problems in each local context. Although studied on a large scale, there are uncertainties in the relationships between attitudes and behaviour due to the complexity of human psychology and other social aspects (Upmeyer, 1989). Also "there is no substantial body of research showing a simple, clear and strong relationship between attitudes and environmental behaviour" (Werner, 1999, p. 228). This research therefore does not try to predict behaviour from attitudes, but investigates the gaps between the *perceptions, attitudes and actions* in human behaviour. A cross-actors' study will identify gaps between them to address the *instruments*. Filling these gaps may enable the capacity of *instruments* to achieve sustainability.

This study uses the survey method of "using structured questionnaires to gather data about perceptions, attitudes, and aspirations that can be summarized across individuals to groups" – this is one among five methods described by Zeisel (1981, p. xii). Structured questionnaires are used to investigate stakeholders' *perceptions, attitudes, aspirations, and actions* (see Chapter 5). The survey questions are divided into categories informed by the literature review. In the householder survey, there were six categories – general social issues, housing preference, domestic transportation, energy and water consumption, application of domestic systems and appliances, attitude to environmental issues, and housing design. The survey questions for the other stakeholders were divided into four categories including general information about the respondents, housing issues, the application of systems and appliances, and environmental issues.

The questions were standardized and aimed at comparing answers in personal interviews by asking the questions in the same way. Zeisel (1981, p. 155) terms this the method of "scheduled interviews". A pilot survey of ten households in Adelaide was conducted to test and edit the questionnaires for the householder surveys.

The household samples within each case study area were selected to follow a combination of "random and matching process...to reduce overall generalization error in a particular situation" (Zeisel, 1981, p. 29). Households were selected randomly, "left to chance, so that every member of the population and every combination of members have the same opportunity of being selected" (Zeisel, 1981, p. 30). The method of door-by-door knocking was used randomly at all periods of the day, and days of the week. If a householder was busy, an appointment was made for a convenient time for the interview. Matching was made by selecting a reasonable rate of numbers of households in each group before interview. The proportion of women and men is fairly equal.

Designers, developers, and urban policy makers included in the study were chosen not on the basis of their involvement in the housing projects used for field survey but on their known involvement or interest in sustainable housing issues.

1.5.3 Step 3 - Data analysis

Analysis of the data collected in the survey can be seen to have three aims in the context of this research. The first aim is to *identify elements* required to *elaborate the assessment framework.* The second aim is to *compare the values of the elements* in the framework between the two cases to *examine the context dependent characteristics of sustainable housing*. The last aim is to *define problems and opportunities* for sustainability of housing in Hanoi in order to *propose guidelines* for housing development in this city.

The analysis to be adopted is both quantitative and qualitative. Quantitative analysis provides data for comparison between the two cases studies. The statistical analysis computer program SPSS (Field, 2000) was used to interrogate the information collected. Qualitative analysis reports the anecdotal issues raised during the interviews. The data collected in the two cases are always presented side by side.

As discussed above, this research focuses on defining and solving problems from *instruments* rather than the *ends.* The data analysis therefore focuses on investigating the application of instruments of sustainable housing. The analysis examines technological, social, and economical instruments applied in both cases. Additional to this, perception and behaviour of stakeholders about sustainability and sustainable housing issues are analyzed to define problems and opportunities for approaching sustainable housing.

1.5.4 Step 4 - Discussion and conclusion

An exploration of the relationships between traditional culture and human life styles is highlighted when discussing the perception, attitude and behaviour of the users. Many authors have raised the important role of cultural and traditional factors of communities in defining solutions to sustainability. Auty and Brown (1997, p. 13) argued, "it is more to do with cultural mores and traditional community practices than the apparatus of centralized policy making". Traditional ecological knowledge may be important, and therefore, cultural and biological diversity may go hand in hand to promote long-term social survival (Turner, 1993). Fox (2000, p. 6) argued "achieving a sustainable way of living is not just a technical issue (although it is often discussed as if it were), but also (and fundamentally) an ethical one".

Moreover, this thesis argues that sustainable housing may change over time. The values of the elements of the framework of sustainable housing may be changeable. In fact, the environment itself is progressively changed over time even without the huge disturbance caused by the human species. Economic development has experienced different stages from a predominantly agricultural base to an industrial base, from local economic self-supply to coming 'globalization'. Human social life has changed as most human life styles have moved far away from traditional life styles. As Mitlin & Satterthwaite (1996, p. 25) argued, "sustainable development requires social change". A mass change in socio-economic condition and the environment is occurring. As these changes depend basically on world political and economic trends, this thesis is concerned with the change of social and political issues in defining solutions for sustainability. This also suggests that a sustainable housing framework is built in *flexible* ways.

1.6 Organization of the thesis

Chapter 2 aims to build up through a literature survey an initial assessment framework by investigating the nature and dimensions of sustainability in housing. The Chapter first studies the history and meaning of sustainability in contemporary discourse and Asian philosophy to declare the meaning of sustainability in this research. Secondly, the current global environmental situation, the risks of current human behaviour, and the reasons for delay of actions for sustainability are investigated. The current instruments of sustainability are identified together with their benefits and limitations. Housing has very important meaning and carries many values in sustainability, and this Chapter therefore explores the different material and spiritual values of housing and the notion of sustainable housing. Current housing projects that are claimed to be sustainable are reviewed. This assessment is based on the current application of social, technological, and economic *instruments* (means) and their impact on the *ends* of sustainability. Finally, best practices of Local agenda 21 around the world are reviewed to learn experience in implementation.

Chapter 3 and Chapter 4 are reviews of the housing situations in Adelaide and Hanoi. These chapters examine the environmental, social, cultural, and economic background of Adelaide and Hanoi and assess the application of *instruments* of sustainability in housing practices to define problems, priorities, and barriers in approaching sustainability. These investigations add elements to the framework for sustainable housing developed in Chapter 2.

Chapter 5 introduces the field survey of housing and sustainability for the two case studies. It describes the context of the selected cases, analyses the purpose, scope, and the construction of questionnaires, reports the process of conducting interviews, and proposes tools to analyze the collected data.

Chapter 6 reports the findings from interviewing households in the fieldwork. The analysis identifies more elements for the framework of sustainable housing and the value of the elements in the context of Hanoi and Adelaide. A comparison between the two cases about the elements and the value of these elements as ranked by the respondents provide answer to the research question 2. Though this Chapter explores a large number of comparisons on many aspects to seek and show the differences, the meaning of only some differences will be drawn in Chapter 8 to focus on the purpose of this research.

Chapter 7 reports the findings from interviewing stakeholders involved in housing including householders, architects, developers, and planners. It compares the perception of these stakeholders about sustainable housing to define gaps that need to be bridged to promote sustainable housing.

Chapter 8 proposes a framework of sustainable housing based on the frameworks proposed in the previous chapters and the fieldwork. Based on this framework, sustainable housing guidelines for Hanoi are proposed.

Chapter 9 – the last chapter - contains summary, conclusion and discussion. A suggestion for further study is also included.

Chapter 2 Literature review and framework development

This Chapter develops an initial assessment framework for sustainability in housing. After a discussion of the notion of sustainability, a framework was developed in three steps that relate to the instruments of sustainability, the multiple aspects of housing, and sustainable housing.

2.1 History and definition of sustainability

Hajer (1995) suggests that there was a turn in human history in December 1968, when for the first time a photograph of the Earth was taken from the Apollo 8 spaceship. This raised "the conflicting impressions of a world that is both bounded and manageable...small and vulnerable" (Williamson, Radford, & Bennett, 2003, p. 9). After this event and the oil crises in the early 1970s, many scientific groups in the world such as discussed in Meadows et al. (1972) started to focus their professional works on defining problems and solutions to environmental problems on Earth. The worldwide concern for these issues can also be seen in a range of United Nation conferences such as Stockholm 1972, Montreal 1987, Rio de Janeiro 1992, Istanbul 1996, and Kyoto 1997, where governments met and tried to solve perceived environmental problems.

The notion of sustainability began to appear in the literature from the mid 1980s and has evolved over time. First, the term 'sustainable development' was introduced showing the wish of humans to conserve the Earth's resources, and addressing the aim of maintaining economic development on Earth. The terms 'green' and 'eco' have appeared in the literature and represented concerns about the ecosystem of the Earth. A range of studies focusing on ecological sustainability such as "eco-economic", "eco-architecture", "eco-agriculture", and even "eco-tourism" have appeared since the 1980s. Only when the Habitat II conference was held in Istanbul (UNDP, 1996b), were the terms 'sustainable environment', 'sustainable society', 'sustainable economy', and 'sustainable politic' introduced. Sustainability was reinforced to be seen as having multiple dimensions.

2.1.1 Anthropocentricity – A starting point

Human benefit, for both present and future generations, is generally seen at the centre of meanings of sustainability, and sustainability is often seen as a tool to provide material wellbeing for the human species, and not much for other agents. A sustainable society, economy and political situation only benefit human species, and a sustainable environment is seen to serve human life better. Resource conservation is aimed at maintaining continuous economic growth and a sustainable economy seems to be the main goal in most discussions about sustainable development. This means human benefit has been listed as higher than other agents including other species, nature, or even the biosphere. The definition of sustainable development of the World Resources Institute showed clearly the exclusion of ecological issues. In this case sustainable development is that which uses the

> "... natural renewable resources in a manner that does not eliminate or degrade them or otherwise diminish their renewable usefulness of future generations while maintaining effectively constant or non-declining stocks of natural resources such as soil, ground-water, and biomass"
>
> (WRI, 1992, p. 2)

Ecosystems are concerned in other definitions but often treated as supporter or provider for human species. For example, sustainable development has been described to improve "the quality of human life while living within the carrying capacity of supporting ecosystems" (WRI, 1992).

In other ethical viewpoints, all species including human, the environment, and even ecosystems have equal rights (Des Jardins, 2001; Beder, 1993). Many authors consider that putting human benefit above all others is not only unethical but also unfeasible (and stupid) because "the biosphere system can survive without human system but the human system cannot survive outside the biosphere system" (Eichler, 1999, p. 192). People can not be happy when living in unbreathable air and having no clean water to drink although they may have all other social and economic needs. Ensuring a sustainable environment on Earth can therefore be considered more important than ensuring the social and economic benefit of human societies (Fox, 2000). Recently, NASA had a research project that tried to build a living environment on Mars (Nyström & Reuterswärd, 2003) and if it is successful, humans may not have to worry about the destruction of the earth. However, ethically, the human species has no right to destroy the Earth that also belongs to other species.

2.1.2 The vague meaning of sustainability

The meaning of 'sustainability' in literature is often vague. The most widely quoted definition of sustainable development by the World Commission in Environment and Development (WCED) in the report *Our Common Future* (also known as the Bruntland Report), "... development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (UNCEP, 1987, p. 8), is short and general and therefore unclear. Is it a development to meet the needs of human species or of all other species on Earth? How much is enough for the human needs? (Sachs, 1999, p. 27) How can we know the needs of future generations? In addition, do the needs include social and environmental issues? More recently the 2002 Johannesburg World Summit on Sustainable Development provided some clarification of these issues by emphasizing that sustainable development should have the overall aims of eradicating poverty, changing unsustainable patterns of consumption and production, and protecting and managing the natural resources and that decision-making should take a long-term perspective and involve a broad-based stakeholder participation (UN, 2002).

Eichler (1999, p. 182) asserted, "there is no consensus on the meaning of the term sustainability". Dovers and Handmer (2002) pointed out many contradictions in the meaning of sustainability. In the 1970s, the main concern was about conserving natural resources for continuous economic growth because the world's natural resources were perceived to be limited and may be depleted at a rate that could be detrimental to economic growth. The clarification of WCED in 1987 has emphasised the need for continued economic development, including *economic growth* "[because] development is seen as ... desirable for the entire world, ... most particular for those nations which are currently 'underdeveloped'" (Eichler, 1999, p. 185). This contrasts with the argument given by Meadows et al. (1972) that economic growth is the cause of environmental destruction.

The term *sustainable development* that was popularised by WCED made the meaning of sustainability to be even more vague (Eichler, 1994). The combination of two words *sustainable* and *development* has raised confusion because the meaning of these words seems to be different and in opposition. Development used to be understood as economic growth, which has been claimed to be the cause of today's unsustainable situation in the ecosystem. The word 'sustain' in the dictionary means to *bear, strengthen, maintain, preserve, assist, and endure* while 'development' is a process of *growing* (Grosset, 1994). Auty and Brown (1997) even asserted that strong sustainability is zero economic growth and this means zero development. The term 'development' itself also has been understood differently. Eichler (1999, p. 186) summaries that there seems to be an agreement that the least industrialised countries need development, whereas highly industrialised countries do not, and the term development in this case was likely to refer to a *quantitative* increase in the economy of the country. Similarly, the term 'development' from the WCED states that those underdeveloped nations would need a *quantitative* growth in their economy to provide basic needs. However, Daly and Cobb (1989) argued differently. They assert that growth refers to *quantitative* increase while development refers to *qualitative* increase of an economic system. So saying industrialised countries do not need development is not accurate because the cultural and environmental quality in industrialised countries is not always better than in less industrialised countries.

Realising the disagreement in the meaning of development, Eichler (1999, p. 186) proposed a new term *redevelopment* in her statement: "while of course less industrialised countries should be encouraged towards sustainable forms of *development*, highly industrialised countries are as much or more in need of *redeveloping* themselves in more sustainable forms". She explains *redevelopment* as a change of the current system into using resources more efficiently - a qualitative change. However, even here the term 'development' in her statement was again not clear, whether it aims at increases in the qualitative or quantitative aspects of an economic system. Nevertheless, there is a valuable contribution from her work when she proposes that a change is needed and sustainability should not be seen only in the economic field. Sustainability started to be seen in a wider perspective.

2.1.3 Different meanings of sustainability

The exploration of the meaning of sustainability in different scientific fields has not reached a consensus. Economic scientists have distinguished weak sustainability and strong sustainability in market systems (Turner et al., 1993). However, as argued by social scientist Gowdy (1999, p. 168), both weak sustainability and strong sustainability will end up with the depletion of resources because at different levels, they both attempt to put value on natural (environmental) capital and consider this within a market system. Weak and strong sustainability in the market system may be sustainable economically, but may not be sustainable socially and environmentally. Environmental scientists on the other hand, claimed that many human activities have caused destruction to the ecosystem by altering its structure (Jackson & Jackson, 1997) and this would not ensure sustainability of the Earth. Most of what we call the technological inventions of the modern world, such as current agricultural and industrial practices particularly the use of motor vehicles, have caused many environmental impacts such as pollution, resources depletion, loss of biodiversity, and global climate change. Sustainability from a deep ecological point of view requires no development (Auty & Brown, 1997), however, this may not ensure sustainability socially and economically for humans as species within the ecosystem.

2.1.4 Multiple dimensions of sustainability

The UNDP's clarification of sustainability of human settlements embodies multiple dimensions of society/ culture, economy, and the environment.

> Sustainability of human settlements entails their balanced geographical distribution or other appropriate distribution in keeping with national conditions, promotion of economic and social development, human health and education, and the conservation of biological diversity and the sustainable use of its components, and maintenance of cultural diversity as well as air, water, forest, vegetation and soil qualities at standards sufficient to sustain human life and well-being for future generations.
>
> (UNDP, 1996b)

Many authors such as Sachs, Acselrad, Braidotti, Guha, Choucri, Eichler, and Reboratti (in Becker & Jahn, 1999), Turners (1993), Vale and Vale (1991), and Woolley, Kimmins, Harrison, and Harrison (1997) have asserted the need to embody social, economic, environmental, and even political dimensions in the meaning of sustainability. As all dimensions are related to each other in a whole complex system, a failure of one would put negative impacts on others and the whole system.

Model 1 Model 2

Figure 2 Models of sustainability

This study proposes a model of sustainability that includes multiple dimensions with the environmental dimension as a setting for other concerns. The model of sustainability proposed by the World Bank (see the Model 1 on Figure 2.1) has included three dimensions in which the environment was seen as equal to society and the economy. As "the biosphere system can survive without human system but the human system cannot survive outside the biosphere system" (Eichler, 1999, p. 192), this study argues that environmental dimension is more important than, and embodies, the other dimensions. A simple model of sustainability can be seen in the Model 2 in Figure 2.1. It is important to note, however, that social and economic dimensions are crucially important to the survival of the environmental dimension because violent societies (for example, in causing nuclear war) can destroy the whole earth, and economic poverty can lead people to destroy the environment to meet their daily needs. It must be noted that this view of 'balance' in approaching sustainable development is conceptually different from notion reinforced at the Johannesburg World Summit of Sustainable Development that saw the three components as 'interdependent and mutually reinforcing pillars' (UN, 2002).

Presenting a comprehensive meaning of sustainability has made up a desirable picture as a goal for humans on earth. However, no one knows if it can be achieved, and if it can, how to achieve it. As shown above, the disagreement in the meaning of sustainability may lead people to do different things. At present, many new technologies and alternative materials are invented to reduce environmental impacts, but the alternative materials sometimes create other environmental impacts. Some of the practices seem to work to meet environmental benefits, but may not meet the social needs such as affordability (for example installing Photovoltaic at home) or convenience (for example doing household composting).

2.1.5 The meaning of sustainability in Asian philosophy

While solutions to sustainability are not clearly indicated in contemporary discourse, Asian philosophy has introduced its meaning and solution long ago. In Asian philosophy, the term *sustainability is* often seen under 'stability' and 'longevity'. "One of the great concerns of Chinese mythology is the maintenance of ...stability" (Whittaker, 1989, p. 26) and 'longevity' is one among three important indicators of the wellbeing of human life including 'happiness', 'wealth', and 'long life'[2].

While Western philosophies tend to see humans as *dominators* of the universe (Becker & Jahn, 1999), Eastern philosophies see humans *as a part* of nature and should be *in harmony* with nature (Waterlow, 1994). Eastern philosophies see the "human body... as that which perceives nature which it also inhabits", "a microcosm of the external universe" (Morley, 2001, p. 75). The mythology of ancient China about the giant Pangu told how the universe is one unique interdependent system (Whittaker, 1989, p. 20 - 21).

Eastern philosophies also assert a close relation between humans and the environment as "all that is thingly real in the surrounding world of the ego had its relation to the body" (Edmund Husserl, cited in Morley, 2001, p. 80). In Vietnamese folklore, for example, humans are seen as only one among four important elements, including *climate, time, earth, and humans*, needed for success[3]. Human wellbeing depends very much on the environment. Lao Zi believed "people should live in harmony with nature, letting life carry them along" (Waterlow, 1994, p. 17). This can be seen in the application of Feng Shui introduced by Taoism in China around the 6^{th} century BC that deals with water and wind as "a method of determining the positioning of buildings [and interior] so that they did not offend the spirit of the site" (Whittaker, 1989, p. 17), or the surrounding environment, to gain fortune and luck. The basic principle of Feng Shui aims to ensure the harmonies between human, the built, and the natural environment (Nguyen, 1996) because human, built environment, and natural environment were seen as tightly dependent on each other. The principle for sustainability proposed by Laozi (McGreal, 1995) is *flexibility*. He said "life is soft while death is stiff"; soft and flexible principles can ensure life while hard and inflexible ones cannot. We have to be flexible and willing to change to be suitable to new situations.

While current developments in the modern world seem not to pay attention to the benefit of future and the past, Buddhism teaches people to respect all time stages. Buddhism proposes

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[2] Most families in Vietnam have three statues that carry symbols of happiness, wealth, and longevity (Phúc Lộc Thọ) in their home altar.

[3] The "Thiên thời địa lợi nhân hòa" Vietnamese folklore indicated four important elements for a success including good weather/climate, right time, good local ground, and harmony human.

that the past, present, and future are equally important[4]. Western development tends to abuse the environment to provide abundant material for human life at present and therefore ignores the safety and sustainability for future generations. In the East, humans are advised not to seek a material life but to seek a spiritual life, not for riches but for a *'poor but decent'* life[5].

While individualism in Western modern culture may exclude the interest of community and other agents, Confucianism highlighted the benefit of *a whole*. Lai (1995) affirmed:

> 'Western' views often construct morality on an individualistic basis whereby more weight is assigned to the character, virtue, or behaviour of the individual moral agent than to the interests and lives of other agents. They focus on what each person, qua moral agent, does, rather than on what the community as a whole does together. The latter is one of the primary characteristics of Confucian thought.
>
> (Lai, 1995, p. 249)

Eastern traditional medicine has a very comprehensive view. "[H]ealth and illness were complex matters and were not limited to a person's body, as they often are in modern Western medicine...[but] health entailed a physiological, emotional, and moral balance" (Birdwhistell, 1995, p. 3). This shows that, sustainability in Eastern philosophy is seen in a comprehensive way.

As sustainability in Eastern philosophy includes a whole rather than individual, it also is *a balance* of a whole. The environmental philosophy of *yin* and *yang* in Eastern philosophy is actually the principle of balance and harmony of the universe and everything in it (Patterson, 2000). *Yin* is negative, female, soft and *yang* is positive, male, hard, but the distinction between these terms is not clear because one effect or object may be *yin* to some effects or objects but at the same time it can be *yang* to other effects or objects, and when one reaches its extreme it reverts to the other (McGreal, 1995, p. 14). There is nothing absolutely positive or negative in the universe. One can gain something *(yang)* in the universe but at the same time, have to pay some costs *(yin)*. This principle ensures that "there is a natural cycle of

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[4] There is a statue suit including three statues presenting for the pass, present and future. 'Tam thế' is a statues suit that available in many Buddhist temples in Vietnam.

[5] Many folklores in Vietnam praise a poor but decent life (Thanh ban). Some of them were collected while having personal communication with Phan (Personal meeting in December 2002) as below (translated into English by the author)

Three nice vegetable meals daily
Five hours sleep well at night
Peaceful life with unlocked doors

Although the house has 10,000 rooms, only 2m is needed for sleeping.
Although the store is full of rice, only three meals a day are needed.

Why silk while it is all right with fresh brown cotton.

Having more things means having less freedom because of the worry in keeping things.

reciprocity" and "the cycle often enough ensures that, one way or another, payment is made for what is taken" (Patterson, 2000, p. 238). The human domination of the world and individualism in Western culture now requires a payback in the cost of cleaning the environment, resource depletion, poor human health, and ecological damage. Patterson suggests:

> In a world where the way of *yang mana* has become the norm, the scope for personal growth through *yin mana* is enormous ... this does not mean that we denied the pursuit of self-interests; participating in and achieving collective *yin mana* can lead to personal growth... And interning to this way, we can benefit not only ourselves but also many of the creatures with whom we share the planet.
>
> (Patterson, 2000, p. 238)

The practice of the *balance* can also be seen in traditional Eastern medicine practices (Birdwhistell, 1995, p. 3). In eastern traditional medicine, health was seen as a balance of systems in the human body while illness was seen as a disorder or imbalance. Western medicines, while removing some 'negative' impacts on one part of the body, sometimes create negative impacts on other parts of the body (side effects). Eastern traditional medicine on the other hand, aims to help patients to gain a balance status between *negative* and *positive* impacts on the human body.

2.1.6 Declaring the meaning of sustainability in this study

Bringing together the notions of Eastern philosophy and current Western discourse, this research proposes a comprehensive understanding of the nature of sustainability and ways to obtain it. Although aware of the diversity and uncertainty in the meaning of sustainability, it is honourable to work for a better status of all systems on earth that are in danger of depletion. This research would like to bravely clarify the meaning of sustainability and propose the ways to achieve it. Based on Eastern philosophy and current Western literature, the study defines *sustainability as a balanced status of multiple dimensions including social, economic, and environmental dimensions that ensure a better status for a whole in a long term perspective.* In order to obtain this, the perception of sustainability has to ensure respect for the environment to obtain a harmonised relationship between humanity and nature in all dimensions.

It is also necessary to clarify terms that will be used in this study. The terms 'sustainable development' and 'sustainability' seem to be used interchangeably in the literature. If they aim for the same thing – for a better status of the earth and its species and resources - they are interchangeable. However, since 'sustainable development' has been studied in isolation from other issues and not in a comprehensive way, it does not have the same meaning as 'sustainability'. Due to the disagreements in the meaning of 'development' analysed above, and the different shades between these two terms, this study prefers to use the terms 'sustainability' and 'sustainable' unless citing from other authors.

Based on the clarification of the meaning of sustainability above, the current situation related to the multiple dimensional ends of sustainability is now reviewed. This aims to identify and focus on problems that need to be solved to improve the quality of sustainable ends.

2.2 The current unsustainable ends

Many writers asserted the unsustainability of the world by providing evidence of the failures in dimensions such as environmental degradations, social destruction, and economic activities that have lead to resource depletion and poverty. Reviewing the status of each dimension will help identify the main ends of dimensions of sustainability.

Environmental degradations are often pointed out as including pollution, resource depletion, and ecosystem destruction. "[We are living] on human-dominated planet...altering the planet's major biological and chemical cycles, and eliminating species at a rate unseen for 65 million years away" (Lubchenco, 1998 cited in Gowdy, 1999, p. 163).

Agricultural land and ecosystem destruction has been declared:

> Each year another 6 million hectares of productive dry land turns into worthless desert...More than 11 million hectares of forests are destroyed yearly...The burning of fossil fuels puts into the atmosphere carbon dioxide, which is causing gradual global warming. This 'greenhouse effect' may by early next century have increased average global temperatures enough to shift agricultural production areas, raise sea levels to flood coastal cities, and disrupt national economies.
>
> (UNCEP, 1987)

> The amount of forested land in Africa and Asia is now less than 35% of what it was 200 year ago (WWI, 1998a). Some 20 % of all bird species are now under threat of extinction (Pearson, 1998). The number of people with an assured water supply is projected to drop from 92 % to 58 % by 2050 (WWI, 1998b).
>
> (Internationalist, 2002)

Stratosphere ozone depletion, acid rain, the loss of species, and air, soil and water pollution have put many impacts on the environment and human health (Shearman & Sauer-Thomson, 1997; Jackson & Jackson, 1997). Gowdy (1999, p 169-170) has gathered much evidence from recent studies:

> ...acid rain has resulted in 'no-growth' forest in the US...Ozone levels near the earth's surface have doubled in the Northern Hemisphere over this century and are beginning to have serious localized effects on human health (Slaper et al., 1996)...Tilman et al. (1994) warn of an 'extinction debt' that is building up as larger numbers of individual species are being pushed below stable population thresholds. The world-wide build-up of atmospheric mercury could become a serious health problem by the middle of the twenty first century (Slemer and Langer, 1992). Evidence indicates that the world's oceans are losing nitrate, a limitational factor in plant growth (Cadispoti, 1995). A permanent decline in ocean nitrate could adversely affect fish population and reduce the ability of the ocean to absorb carbon dioxide. The world-wide decline in amphibians is now well

> documented...replacement compounds [for CFC that cause ozone depletion] may have a persistent adverse effect on the biota of wetlands (Schwartzbach, 1995).

Potential climatic change caused by increasing levels of atmospheric greenhouse gases is also seen as a major issue that may cause significant impacts on the ecological systems that will affect human and other species on earth (IPCC, 2001). Although there are arguments about the uncertainties in the relationship between global climatic change and environmental impacts due to the lack of scientific evidence, it is time now for a change toward a more sustainable dynasty of human history if we do not want to be 'gone' (Woolley et al., 1997). The *precautionary principle* should be applied to avoid irreparable damages before it is too late (Williamson & Radford, 2000). The uncertainty of greenhouse gas effects cannot be used as an excuse for not acting to avoid the potential destruction of the environment and societies in many places on Earth.

Unfortunately, there have been few practical actions for sustainability. The evidence points to the current continuing dependence on non-renewable resources (Vale & Vale, 1991) and usage of CFCs and HFCs in many countries (Edwards, 1998). The commitment in 1992 at the Rio de Janeiro Earth Summit when the industrialised countries signed the United Nation Framework Convention on Climate Change (UNFCCC, 1992) to reduce greenhouse gas emission to 1990 levels by 2000 has "barely been fulfilled" (Jones, 1998, p. 43).

> *State of the World 2002* points to several significant impediments that have slowed progress towards building a sustainable world over the last decade. Environmental policies remain a low priority. The growing number of international environmental treaties and other initiatives suffer from weak commitments and inadequate funding...at the same time, military expenditures [that often lead to wars that cause destruction to the environment and human life] by the world governments are running at more than two billion dollar a day.
>
> (Internationalist, 2002, p. 7)

And

> There are 500 million vehicles today, six times the number there were in 1950 (WWI, 2000a). While energy use doubled between 1900 and 1940, it quadrupled between 1980 and on current trends will have done so again by 2020 (WWI, 2000b). While the US population doubled in the 20th century, materials consumed per head grew more than 10 times (WWI, 2000c).
>
> (Internationalist, 2002, p. 19)

This evidence is sufficient to assert that humans have put little effort into solving environmental problems. As Meadows et al. (1972) said, this inertia is risky. Moreover, the current delay in actions to protect the environment we depend on is evidence of the failure or unsustainability of our current societies. Social destruction is also often pointed out as including the loss of traditional knowledge, culture, and identity and the growth of social inequity. Economic failures are evident in the distribution of wealth so that while some have too much, others do not access to basic needs.

> The present inequitable distribution of income and wealth at the global scale; the homogenisation of societies and the loss of traditional knowledge and culture; and the global environmental changes apparent from the populated parts of the world to the most remote areas are the evidences of the unsustainability of the 'development' as it has been perceived and practiced.
>
> (Turner et al., 1990 in Auty & Brown, 1997, p. 3)

In short, sustainability has not been ensured in all dimensions. The main ends of environmental dimensions include reducing pollution, conserving resources, and protecting ecosystems. The main ends of social dimensions include ensuring human wellbeing and collective and cultural conservation while the main ends of economic dimensions is to provide basic needs for all. There is a need to define instruments to improve the main ends of the dimensions.

2.3 Instruments of Sustainability

Understanding the instruments of sustainability can help us to use them more effectively to improve the sustainable ends mentioned above. The current principal types of instruments (means) of sustainability relate to technological, social, and economic measures.

2.3.1 Technological instruments

Technology is believed to be an instrument of sustainability that can be applied to help satisfy the increasing material wants of the lifestyles of an increasing population for two basic reasons. First, this is due to its ability to increase the efficiency of resource use, therefore making resources last longer, and secondly to allow substitution of materials, especially when the supply of particular resources is reduced.

Technology can play an important role in reducing environmental impacts. There is a strong belief that "technological change provides at least the possibility of increasing welfare from a shrinking capital stock" (Auty & Brown, 1997, p. 9). To demonstrate this, the use of appropriate technologies has been widely discussed in literature, for example, Meadows et al., 1992; Scott, 1998; Vale & Vale, 1975 & 1991; and Woolley et al., 1997. Efficient and clean technology is important because it can save resources and reduce environmental impacts. For example, cars run by solar energy, buses run by natural gas, or autonomous and energy saving buildings are often seen to have many advantages.

However, technological instrument alone cannot ensure sustainability due to many limitations. One of the limitations is the lack of balance between the need to satisfy the over-consumption of an increasing population and the speed that technology can be developed. This can be expressed as the function that describes the relationship between environmental impact and population, consumption, and technology[6]. This is risky because by the time technology may be developed, the environment may have been damaged. Because there is no one hundred percent efficient technology, non-renewable resources will be depleted anyway by the continuing increase in consumption. "[T]he role of technology was principally that of raising output from scarce resources" (Redclift, 1999, p. 62). This raises the question "[h]ow can natural resources be 'maintained' if they are 'used up'?" (Gowdy, 1999, p. 167).

"[E]very new technology always has side-effects" (Meadows et al., 1972, p. 146) and technological applications have limitations. Due to the limit of today's knowledge, many human inventions of technologies have been found harmful for the environment only after decades of use (Shearman & Sauer-Thomson, 1997; Vale & Vale, 1991). The production of some renewable energy types still requires resources consumption and causes environmental damage in the construction site and in operation. For example, large scale hydropower plants can have huge negative hydrological, ecological, and social impacts such as affecting local water supply and irrigation, destroying the ecological environment downstream, and sometimes requiring the relocation of traditional villages for the construction site (Salay, 1997). Nuclear power was seen as advanced technology in the 1970s by producing energy from 'nothing', and more recently, its advantage of 'zero CO_2 emission' is highlighted (Vale & Vale 1990). However, it can create a disaster for humanity and the environment through nuclear accidents as seen in the Chernobyl nuclear reactor disaster in Ukraine when radioactive fallout was carried by the wind thousands of kilometres before it was deposited and affected several areas within the Baltic and northern European region (Morovic & Tuschy, in Salay, 1997). Although accidents may not occur often, the massive resources and energy used in the construction of reactors and their protection systems, the use of non-renewable resources, the consumption of limited radioactive material, and the dumping of nuclear wastes can cause enormous damage to the environment (Vale & Vale, 1991).

Although solar, wind, biomass, and biogas energies seem to have few environmental impacts, their applications are limited by the "site available and the power that can be produced from [them]" (Vale & Vale, 1975, p. 12). Solar and wind energies depend on local climatic and geographical conditions that may limit the capacity and reliability of power output. Large-scale wind generators are sometimes claimed to create noise, affect the view, and disturb the landscape (Salay, 1997). Some photovoltaic cells that rely on chemical elements scarce in the Earth crust are not sustainable (Kaberger, in Salay, 1997, p. 45). Biomass, when growing, absorbs carbon dioxide, and the photosynthesis transforms carbon into biomass and releases oxygen, but requires time to grow. The creation of biogas (a mixture of methane and carbon dioxide) produces a renewable fuel source and at the same time, can recycle organic waste to

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[6] "Environmental impacts of a group = Population X Consumption X Technology" (Sylvan and Bennett, 1994, p. 47).

produce organic fertiliser. However, a large quantity of the particular organic waste types required to manufacture biogas may not be available locally. The environmental cost of waste transportation is also considerable.

The application of these new technological systems depends on the local availability, quality of technical services, affordability, and social acceptability. The failure of an application often relates to the lack of local capacity in its maintenance and operation (Hifab, 2000). Besides the technical service problems, at present even people in developed nations could not afford its high cost, so it is too futuristic to apply these systems in the developing nations. Although the *cost* may be reduced by time, these systems still may not be used widely due to the social unacceptability. For example, installing solar panels on the roof of a house may be seen as causing glare and making the house look ugly. Planning guidelines are sometimes imposed requiring that such devices should not be highly visible from public streets (Delfin Realty, 2000, p. 11).

Moreover, technology is aimed primarily at supporting the current generation and does not necessarily ensure benefits for future generations. Gowdy (1999, p. 169) asks "[i]s it permissible to assume that substitution which is now desirable within today's culture and technology would be feasible within the technology of the future?" He goes on to suggest that "[n]either weak [n]or strong sustainability ensures that a technology can perpetuate itself indefinitely because they both permit the draw down of funds in order to support current production".

Traditional natural materials used in building housing are often claimed as more sustainable than the modern ones due to their local availability, renewability, having minimum toxicity to the environment (Woolley et al., 1997), and they also reflect cultural conservation. However, the use of modern materials seems to be unavoidable because most traditional building materials are not in sufficient supply. While using modern building materials is often criticised as departing from traditional architecture values and consuming more energy and non-renewable resources, Woolley et al. (1997) assert that it is not sure that natural building materials are more sustainable than artificial materials (for example steel) due to their durability. In a similar way using slow growing tropical hard wood for building houses may be unsustainable and to address this problem Woolley et al. (1997) describe some houses that they suggest as sustainable using wood from sustainable managed forests. He however argues that the concept of a sustainable managed forest resource is misleading due to alteration of the original state of nature. Such a resource does not consider the preservation of the biological resources of the original forest system, or the maintenance of environmental services such as watershed management and soil conservation. It also does not recognise the indigenous peoples' rights or the provision of jobs, food, and materials for the local community, and the limitation of knowledge about how much resources can be taken and not returned to the soil before it loses structure and fertility (Woolley et al., 1997). A further issue relates to a lack of authoritative certification as to the sources of materials claimed to be sustainable. This may limit the use of renewable resources or cause the uncertainties in the use of so-called green products. Woolley et al. (1997, p. 67) give the example of the UK timber label Woodmarks that claims their products to be green but they perform "no site visits or inspections" of the sources of the timber.

Many believe that natural materials have less embodied energy than modern manufactured materials, but at present there is no universally agreed basis for embodied energy calculations and experts either refuse to divulge their figures or disagree about the accuracy (Woolley et al., 1997, p. 7). Some products such as aluminium may have a high-embodied energy per unit weight, however it requires a lower mass than for a lower embodied energy product such as clay tiles.

> Moreover, green buildings should embody all dimensions of sustainability. Green building is not simply about protecting the biosphere and natural resources from over-exploitation or over-consumption, nor it is simply about saving energy to reduce our heating bills, it considers the impact of buildings and materials on occupants and the impacts of our lives on the future of the Earth.
>
> (Woolley et al., 1997, p. 146)

Beside the environmental dimension of the sustainability of using natural building materials, there are also social and economic dimensions in which natural building materials need to be considered. Take an example of the thatched house in Vietnam. Although the house provides a cooler atmosphere than a concrete house in the hot weather, users have to rebuild or replace its components (like roof and walls) every few years (Phan, 1993). This rebuilding requires considerable work - human energy, resources, and time. It is more costly in the end to maintain this type of house. The traditional form of a house also often creates dust and unhygienic conditions for the occupants, since the natural organic materials often are food for germs or insects.

Another social issue appears when the users who live in this type of traditional house feel ashamed that they are not able to afford 'modern' brick walls and a concrete flat roof on their house. A brick house with flat concrete roof has become a symbol of wealth in the Vietnamese society. A previous research project by the author, conducted in a village of Thai Nguyen City, Vietnam, noted this mindset. A person living in a house built using the traditional natural building materials of clay, straw, and bamboo said, "no girl would like to marry a boy who lives in such a house, because the house shows the poverty and the backward lifestyle of the family". An observation by Wilk and Wilhite in 1987 (Werner, 1999, p. 232) ascertained similar reasons for households to adopt 'weatherizing' guidelines. The respondents' norms required glamorous and visible 'home improvement' so they could show off to friends and neighbours (such as an expensive wood stove). Weather stripping was categorised as a repair job that had no social benefits and was even a little embarrassing.

Using natural building materials in housing may have some environmental benefits, but the social value may be more-or-less negative. It is difficult to judge this social value as it puts human health, convenience, the feeling of wealth, economic benefit, and time saving above environmental benefits.

In conclusion, technological instruments have many benefits but also limitations. The application of any technology needs to suit to the social and economic requirements of a context.

2.3.2 Social instruments

As most environmental and social problems today are caused by human activities, the key social instruments for improving sustainability are human behaviour, including individuals, local community (city), and national / global groupings. Understanding human thinking and behaviour is one way to find suitable means to achieve sustainable ends. This part explores human attitude and behaviour to define social instruments.

Many authors point out that the anthropocentricism in the relationship between humans and nature may be the primary cause for today's potentially unsustainability on earth (in Becker & Jahn, 1999; Sylvan & Bennet, 1994). To reverse this, humans may need to change its current lifestyles to be more responsible towards nature. Raising concern for the environment, other species, and theirs own children or grandchildren is needed. Sachs (1999, p. 27) suggests social development ethics that:

> "...should assume the responsibility of human societies to protect biodiversity and nurture nature as part of the co-evolution of the socio-sphere and biosphere in which natural history and human history have been rightly interwoven. The right to a healthy and pleasant environment should be life wise incorporated into the compact of human right."

People in developing countries need not imitate the culture of developed nations of over consumption while people in developed nations may need to reduce consumption. Individuals can play an important role as consumers and citizens (Turner, 1993, p. 16, Sachs, 1999, p. 31). Mitlin and Satterthwaite (1996, p. 26) determined that sustainability "includes strong and explicit social objectives and change, not sustainability in the sense of keeping them going continuously". The change of cultural values does not mean to remove the traditional knowledge but "to recognise and respect it within development" (Mitlin & Satterthwaite, 1996, p. 26). So, although the change may "stress social capital", a change of social and ethical values in human society may mitigate this stress.

It is also argued that humans are overconfident because there is a belief that "mankind has always solved every problem that arises" (Vale & Vale, 1975, p. 17). However, if the fable of Atlantics that a civilisation has developed but then is lost so dramatically is true, it shows that human species are not able to deal with all problems that arise. In addition, famine, wars, and floods coming at once had cleared the civilisation of ancient Egypt (Ponting, 1993). If humanity delays actions and waits until the problems become immediate, then it may be too late due to irreparable damages. Therefore being aware of the limitations of human society in dealing with problems and not delaying acting is necessary.

The response of humans to risk is often mitigated when they get used to it, therefore humans are often not able to realise environmental problems that accumulate slowly (Lofstedt & Frewer, 1998). For example, humans have the ability to adapt to adverse situations such as the noise when living near busy traffic roads. Often the effects are invisible until they have already destroyed human health and the environment. Therefore providing sufficient information about environmental problems and their possible impacts is important.

Moreover, humans seem to care for themselves individually, not for the community. As Gowdy (1997 in Gowdy, 1999, p. 179) found, in a "conflict between individual self-interest and the collective good", most individuals often act for the benefit of themselves and not of others. However, collective choice would provide benefit for all, including individuals, while an individual choice may cause a negative impact on collective interests including the individual. Therefore, there is a need for change in the way of human thinking from self-interest to community benefit. It is important to include also future generations in the community as they are our children and grandchildren.

The delay in action is also due to the uncertainties of environmental problems and the confusion in meaning and solutions of sustainability. As human actions are often shaped from "beliefs, values, and the basic norms" (Choucri, 1999, p. 277), a lack of belief may be the cause of the delay in actions. There are too many "different policies ranging from promoting economic growth in order to finance environmental protection (the Brundtland Report), zero growth of the physical through put of the economy (Daly, 1977), or a reduction in population and economic activity (Georgescu-Roegen, 1976; Gowdy, 1994a)" (Gowdy, 1999, p. 164) to achieve sustainability. Many people, in order to fulfil their material greed, even use the uncertainty and vagueness in the meaning of sustainability as an excuse for their actions that possibly cause environmental destruction. While there may be many uncertainties, there is obvious evidence of social, economic, and environmental degradation such as air and water pollution, deforestation, resource depletion, flooding, poverty, social exclusion, and so on (UNCEP, 1987; Gowdy, 1999; Auty & Brown, 1997; & Internationalist, 2002).

Besides having short-term thinking or being ignorant, humans seem to ignore environmental problems to fulfil their cupidity. Although people may be aware of the potential of a local disaster, humans often think that they will be excluded from the disaster (Lofstedt & Frewer, 1998). In addition, human species are used to solving problems that are close in time and small in scale, while many environmental problems have long time scales and are global in nature (Meadows, et al., 1972). People often do not understand the effects of their daily actions. Few people in remote areas would appreciate that when they clear a forest, they may also create environmental disasters such as famine and flooding for distant communities. Providing information, education, and implementation guidelines and facilities, building up regulations and well-managed norms as well as encouraging community activities for sustainability are possible instruments for action.

There is a common belief that wealth is equal to wellbeing. "Wealth was regarded as a good thing, itself" (Redclift, 1999, p. 62). Humans may have an easier life by using modern appliances such as driving cars instead of riding a bicycle. However, as they will have to breathe more polluted air, eat more chemically contaminated food, drink more polluted water, have to spend time and money to sweat in the gyms to digest their enriched nutrient food 'in their all-day-no-move body', well-being seems not to be ensured. Moreover, if wealth is obtained from the destruction of the environment and lives of other species, and the robbery of the opportunity to meet the basic needs of future generations, it may not be seen as good. Humans (especially people in developed nations) may need to change "the culture of consumption" and "money as power" (Shearman & Sauer-Thomson, 1997, p. 129) to a more spiritually meaningful lifestyle.

While imitating the high consumption lifestyle in developed nations, many developing nations may have experienced losing their own environment, culture, and economy. Besides social destruction due to the loss of traditional culture, local environment and economy are also affected. A high material demand requires massive resource consumption and creates environmental degradations such as pollution and ecosystem degradation. As most resources from developing nations are extracted and sold cheaply to developed nations, this can have bad effects on resource reservoirs and therefore on economic developments in developing nations in the very near future (Watkins, 1997).

This situation is worsened by the fact that poor nations often have no power to control the situation when they still have to feed their large poor population. "The very poverty and powerlessness of the South imply a lack of alternatives to the trade in raw materials" and the "[e]xtractive economies often produce poverty at a local level, and an absence of political power, leading to the inability to slow down the rate of resource extraction or to raise prices" (Martinez-alier, 1999, p. 122).

Therefore "the moral lead ought to be taken by the rich countries" (Turner, 1993, p. 7) and "the North should agree to moderate its conspicuous consumption patterns and transfer resources massively to the South" (Sachs, 1999, p. 31). The huge consumers in developed nations may take for themselves too much of the resources that should be saved for people in the other regions on earth who have not reached their basic needs, or for use by future generations. At present, the material living standard for most people in developed countries is already adequate, but that would be luxurious for developing countries (Vale & Vale, 1975).

This leads to the fact that "25 percent of the world's population [in developed countries] is using 75 percent of the world's energy" (Spencer, quoted in Scott, 1998, p.117). As Redclift (1999, p. 61) points out, the rich nations "consume goods unavailable to others", and "define our needs in ways which effectively exclude others meeting theirs, and in the process increase the long-term risks for the sustainability of their livelihoods".

However, aids from the rich to the poor countries have been experienced as "being returned to the rich" (Turner, 1993, p. 39) and resources flowing from developing nations to developed nations are continuing. For example, a major part of funding from developed nations to development projects in developing countries is used to pay for the travel and consultancy fees of experts from these developed nations to work on these projects. Many investments by developed nations in developing nations have resulted in the cheap exploitation of local natural resources and labour. This has been pointed out by Martinez-alier (1999, p.122) as "internationally ... ecologically unequal trade". This seems to create a new type of colonisation, as the poorer nations may eventually lose their political powers (Watkins, 1997).

Nevertheless, while the rich nations pay little attention to helping the poor nations, they also may eventually be affected with the degradation of the environment, economy and society of the poor nations because the global environment, economics and even society are interdependent (Guy & Farmer, 2000; Newman & Kenworthy, 1999; Turner, 1993). Some rich nations are trying to be self-sustainable regionally. Initiatives to promote a sustainable Germany (Becker et al., 1999, p. 7) and a sustainable Baltic region have been described (Salay, 1997). This is not entirely feasible. Sweden, for example, cannot be sustainable when acid rain that kills forest and fish is caused by polluted industries in other European nations. Moreover, a sustainable resources conservation solution for a region, that uses non-renewable resources and shares utilities from other regions is illogical and would not lead to a sustainable world. These examples show a lack of information and understanding of sustainability. Access to information and education in sustainability is needed.

Applying these social instruments seems to require a lot of change in human behaviour. In order to make this process happen, economic instruments can provide opportunities for implementing actions and enhancing people's willingness to change.

2.3.3 Economic instruments

Economic instruments for the construction industry can usually be divided into three categories: Monetary, Fiscal, and Others (Shutt, 1982, p. 229). Mc Taggart, Findlay, and Parkin (1999, p. 33 · 21) raised four policy instruments at the disposal of policy makers including: Fiscal policy, Monetary policy, Wages and incomes policy, and Trade and industry policy. A government's choice of an expenditure policy and a tax and transfer policy is called the fiscal policy (Mc Taggart et al., 1999, 25 · 4). The fiscal instruments include spending money through means such as rebates and subsidies to encourage certain activities or introducing means such as taxation to discourage certain activities. Monetary policy is the attempt to moderate the business cycle and control inflation by changing the quantity of money in circulation to change interest rates (Mc Taggart et al., 1999, 27 · 2). The monetary instruments deal with overall economic activities of a society and its ability to distribute or redistribute wealth among the society.

This study argues that economic growth and institutional development are also important instruments. Economic growth is needed to generate wealth and provide basic need for all. Institutional development deals with organising banks and local money systems to provide finance for sustainable projects. This thesis suggests four economic instruments including Economic growth, Fiscal, Monetary, and Institutional to achieve sustainability. The following text will discuss opportunities and barriers of these instruments.

'Growth or not growth' to achieve sustainability has been widely discussed in literature. In the dominant neoclassical economics, sustainability is ensured when resources, using price and market mechanisms, are applied to their most valuable uses. In this model, economic growth, competitive markets, deregulation, privatisation and integration into global economies are emphasised (Turner, 1993). Bhatti (2001) in analyzing neo-classical economics where "it is the market-place that takes the lead" suggests that, "because the environment is treated as a zero-priced resource, the market does not reflect the full cost of the production of goods". Bhatti (2001) in giving a Marxist's critic of the market driven capital economy, points out that such a system has many weak points. As capitalism is based upon the generation of profit by exploitation of labour, it may cause a separation between capitalist classes in the society. The profit motive in capitalism entails a "growth or die" attitude (Bhatti, 2000), requires continual growth, and of its nature does not respect ecological limits of the Earth's resources. Competition in the capitalist economy forces a reduction in cost that places the negative effects of growth on to those least able to resist. Moreover, capitalism produces uneven developments that cause regular crises. This gives priority to short-terms gain over long-term benefit, and this will cause renewable and non-renewable resources depletion that will be detrimental to future generations. The sub-urbanization, the wide spread of home ownership, and consumption-based lifestyle cause over-accumulation by continuously creating new markets. The circulation of already created surplus value in housing that favours new developments will take more land, resources, and energy for development. Moreover, capitalism may be incompatible with social equity and sustainability objectives. Inequitable access to environmental goods and services causes social exclusion for the low-income groups from these environmental goods and services.

Yet, many see economic growth, based on the short-term imperatives of a materialistic society driven by what they perceive as capitalist greed, as the reason for environmental and social problems:

> The root cause of the mess lies in an overwhelming emphasis on consumption and the route to human happiness and economic growth as the means of achieving it.... Economic growth in the conventional sense is the problem ... its pursuit damages the environment, leads to social injustice, and is detrimental to real economic development.
>
> (Smith, Whitelegg, & Williams, 1998, p. 210)

Economic growth has also been claimed to lead to development that goes beyond the limits of the carrying capacity of the environment (Meadows et al., 1992; Auty & Brown, 1997). Pearce et al. (1990) and Pearce and Turner (1990) (in Turner, 1993, p. 6) argue that if a development can ensure a "non declining stock of natural capital over time", then the development is sustainable. This is described as weak sustainability because it "is permissible to put natural and manufactured capital together and be concerned only about maintaining the total capital stock" (Gowdy, 1999, p. 165). Gowdy (1999, p. 166) also argued, "most of the Northern industrialized countries are judged to be sustainable (in a weak sense), as the world economy as a whole given the dominance of the North in total gross world product". The weak sustainability therefore may cause social and political inequity. It is further argued that economic growth within a market economy often fails to account in a realistic way for issues external to the project at hand (Martinez-alier, 1999, p. 115). Externalities that may include pollution, soil degradation, etc when not cost as part of a project, result in the benefits of the project being over estimated (Redclift, 1994).

Auty and Brown (1997, p. 6) argued, "strong sustainability is zero economic growth", and "the relationship between development and the environment [is] seen as in conflict" because economic growth requires the draw out of resources. In addition, the theory of strong sustainability that ensures the harvest rate is lower than the natural regeneration rate – maximising the sustainable yield of renewable resources seems to be infeasible. Because it depends on many factors such as environmental conditions and the management of harvest rate "[i]t is scientifically impossible accurately to calculate yields over time" (Gowdy, 1999, p. 168). The theory of strong sustainability with the sense of zero economic growth can also be criticised. "The focus of strong sustainability on the optimal scale of economic activity" not on social or biological aspects therefore "fails to come to grips with the conflict between markets, social stability and cohesion, and ecosystems" (Gowdy, 1999, p. 167).

Many authors, however, argue that economic growth and the development that it could fund would help one fifth of the today's world population, who have not yet achieved their basic needs (UNCEP, 1987; Mitlin & Satterthwaite, 1996, p. 26). Economic growth can help promoting the application of advanced technologies by providing people with the opportunity to meet the expense of the high initial cost of advanced technologies.

Because of various failings in leading to sustainability many authors advocate abandoning economic growth as a measure of a society's success. Others, however, suggest a modification of the concept to account for externalities will result in sustainable outcomes. Heal (1997 in Gowdy, 1999, p. 178) argues that if "environmental 'externalities' can be priced to reflect their true economic costs, the world can be made a better place. If the value of essential environmental services can enter the market, the chances that they will be preserved are greater".

To implement this, fiscal instruments including taxation and subsidies are introduced. The economic instrument of full cost system that is accounting for externalities (Mc Taggart et al., 1999, 18 · 1) is introduced and believed to be able to control economic growth within the limit of the carrying capacity of the environment (Thampapillai, 1991, in Turner, 1993). It is believed that this could orient individual choice towards more sustainable behaviours. The full cost system includes not only the cost of manufacture and transportation but also all external costs of pollution and damage caused to the Earth's ecosystem and resources as well as to society. However, the full cost system is not practicable (Turner, 1993, p. 5) as there is no basis to place an intrinsic value on resources, especially non-renewable resources, (Seregaldin, 1993; 1995, in Mitlin & Satterthwaite, 1996, p. 58) or to put a price on natural resources, for example, the value of a species (Beder, 1993). The application of the full cost system may cause social stress and inequity if this results in higher costs. As a gap is growing between rich and poor countries (Turner, 1993; Shearman & Sauer-Thomson, 1997; Watkins, 1997), the economic instrument of full cost and techniques such as 'tradeable pollution certificates' or 'carbon tax credits' may give license to polluters who can afford the high price (Turner, 1993).

As sustainable development activities often require higher initial costs than the conventional ones, subsidies have been applied to projects to promote sustainable activities. Subsidies help people to modify present practices, for example, being able to afford and apply advanced and efficient technologies. However, due to shortage of finance, subsidies are often only available in small amounts. The availability of subsidies can also create an attitude of reliance for some people, and even social inequity between those who do and do not receive subsidies. An observation was noted by the author (2000):

> Some households in a village on an island in the Red River close to Hanoi received free solar panels or wind generators from the Energy Institute to demonstrate renewable energies. The other households in the village were expected to see the advantages of these technologies and to buy for themselves. However, these households said, "we will wait to get these devices for free like our neighbours", "why do we have to buy when other households get it for free?"

As most developers have to borrow money from banks for developing projects, monetary instruments should moderate interest rate to ensure financial benefit for the project and affordability for consumers (for example house buyers).

Institutional instruments deal with providing banks and financial loans for environmental service, housing, and other sustainable projects. Many government, Non Government Organisations (NGOs), and non-benefit groups in the world have created no interest funding for local self-help projects where local people contribute labours in building their houses or improving their living environment.

All the economic instruments discussed above have advantages but also limitations and uncertainties. Therefore, these instruments have to be used in combination with other technological and social instruments.

2.3.4 Instruments and ends summary and discussion

The review of the instruments of sustainability above shows that the instruments are interdependent. Thus, the approach to sustainability cannot be done by one single instrument but by a *combination* of all instruments. At present, many developed countries focus mainly on technological development in approaching sustainability, not very much on social and/or economic instruments. As Pugh (1996) determined, adaptability, balance, and reconciliation are needed for sustainability. So there is a need for a combination of the multiple instruments of sustainability. The instruments discussed above can be gathered in the Table 2.1 below.

Table 2.1 Instruments of sustainability

Technological instruments	Social instruments	Economical instrument
Applying efficient technologies Using clean technologies Reducing and avoiding side effects of technologies Renewable energies Reducing embodied energy Reducing environmental damaged Reducing consumption of resources Making sure the availability of renewable energy Understand local natural condition Recycling wastes/ water Ensuring maintenance and operation Implementing of new technologies Available modern/ traditional building material Considering time and human energy consumption, health impact, and social reputation when selecting technologies	Seeing the health of the environment as of oneself Responsibility to nature/ environment Reduce the risk to the environment? Time for action is urgent Provide basic needs for all people on earth Reduce material consumption Empower the poor nation Community involvement The rich nations have to take moral lead Ensure the aids from the rich to the poor Ensure equity to housing and environmental services Individuals, society and culture has to concern with sustainability Change from individualism to communism Change and adapt culture to a more sustainable culture Ensure accessibility to information of environment knowledge Promoting education in sustainability	Ensure economic growth to increase income Apply taxation and externalities charges on environmental and social negative impacts Subsidise sustainable projects Ensure interest rates that are affordable for developers and users Provide bank system to support sustainable activities and services

The study of ends and instruments of dimensions of sustainability above could give a basis for investigation of ends and instruments of sustainable housing. While most ends and instruments of dimensions of sustainability will be employed in the study of sustainable housing below, an in depth study on sustainable housing itself will explore and identify in detail ends elements for the framework of sustainable housing.

2.4 Sustainable housing

Based on the understanding of sustainability that comes from the UNDP Habitat II conference in 1996, sustainable housing has a comprehensive meaning and includes the multiple dimensions of sustainability. It can be defined as a balanced development of technology, the economy, and society within the context of the carrying capacity of the environment and involves

> ... efficient use of resources within the carrying capacity of ecosystems and tak[ing] into account the precautionary principle approach, and by providing all people, in particular those belonging to vulnerable and disadvantaged groups, with equal opportunities for a healthy, safe and productive life in harmony with nature and their cultural heritage and spiritual and cultural values, and which ensures economic and social development and environmental protection, thereby contributing to the achievement of national sustainable development goals ...
>
> (UNDP, 1996c)

In order to understand what are sustainable housing and its dimensions, it is important to study "housing" and its embodied aspects.

2.4.1 Housing

The full meaning of sustainability can be seen clearly in the context of housing because housing has physical and spiritual values in human societies. Housing has been defined as a human right (UNDP, 1948) where every person has the *right* to have access to an adequate living standard home. It is often clear that a house does not only portray the living standard but also the socio-economic circumstance of the owner.

Affordability is a big issue in housing, deciding the access to home ownership. The affordability of a house relates to income and the proportion of that income devoted to housing costs, including purchase cost and operating costs. In affluent countries most people have a high income and can borrow money from a bank (paying interest and adding costs to housing) to get access to the housing market, therefore home ownership is high in these countries. With low-income level (for example in Vietnam), affordability of a house is very low as people spend most their income on food and clothes. Furthermore, in many developing countries such as Vietnam, a home loan system has not been developed. Buying a house by cash means limited home ownership in these countries.

Housing represents the knowledge level of the art of architecture and cultural characteristics of the residents and designers/architects in a particular region. Housing design is often influenced by the environmental condition, and historical, economic, and cultural development in a specific time of a region. As many people have spent a lot of money to decorate their house, a house provides aesthetic values for the spiritual demands of human life. Housing has been a symbol of wealth and power, for example, the castles of the Royals. Oliver (2000, p. 9) calls for a respect for the "values, mores, building skills, experience and wisdom of the cultures" in housing design.

Housing represents the technological development of a region through building skills, building structure, and the development level of construction technologies. For example, multi-floor apartments are products of industrialisation and modernisation (Dang, 1996).

Different from other architectural buildings, a house has the emotional feeling of *home* (Paris, 1993) and of personal privacy. Jones (1998, p. 107) argued "a dwelling has always had two aspects, practical and emotional: *house* and *home*" and it is more than a shelter for comfort and convenience for its occupants, "the dwelling is the focus of belonging, of self-expression, status of symbol and place of refuge". It is the personal space of the individual where a person has the greatest freedom in physical and spiritual life.

The expression of spiritual life can also be seen in the influence of religious belief in housing. Feng Shui has been applied in housing design in China and Vietnam to gain a most fortunate life. Although Feng Shui was seen as "based on religious and spiritual belief systems...[and] are mistakenly presented as scientific principles or practical tools" (Woolley, in Fox, 2000, p. 53-54), it may have a true benefit that is unknown in current contemporary science. As a lot of environmental damage has been done by current modern science, it may be necessary to give respect to the traditions that have been used and tested for thousands of years. Moreover, in contrast to the current "strong strand of cutting through divisions between humans and environment" (Fox, 2000, p. 141) that often causes non-sustainable practices, Feng Shui and other traditions connect tightly the human to the natural and built environments. Feng Shui principles define good position and orientation for a house and its elements to fit into its particular environment and to suit its owners (Nguyen, 1996).

Although housing carries the personal freedoms of the owners, it is a product of society. The development of a house for individuals is a product of communication in a community in the exchange of knowledge and experience in building houses (Dripps, 1997). In addition, community involvement in housing design (in its widest sense) is necessary since people often live in groups – in a community. Community interests therefore have to be considered when seeking to satisfy personal interests. Community involvement has created great success in optimising housing construction and design (Rudlin & Falk, 1999) and "[h]ousing that involves the active participation of the community...is the most likely to succeed" (Oliver, 2000, p. 9).

Besides the multiple meanings of housing, the values of these meanings are likely to be contextually dependent. As the physical and spiritual values of housing are different in different societies, housing seems to be different in different contexts. The values placed on types and forms of housing respond to factors such as local climate, the availability of land and building materials in relation to local population and construction techniques, but also to social processes, such as fashion and symbolic expressions.

Obviously, these conditions are different in different places. When traditional local building materials are not sufficient for increased populations, they may be replaced by non traditional building material such as concrete or brick, but equally those materials may be used to express a difference from traditional ways. While some people in the tropics build a house with verandahs to protect them from direct sun, others in temperate climates may construct a verandah for 'outdoor' entertainment.

The physical comfort conditions people find satisfactory are also different between cultures. In terms of *type of houses*, many people in Europe are content to live a modern lifestyle in a compact multi-floor inner city flat (Jephcott, 1971) while the majority of Australians enjoy garden houses in the suburbs (Paris, 1993). Spiritual values seem to be more complicated when investigating the preference for a desirable living atmosphere. While some want the peace and quietness of a home in a low-density area, others feel bored and prefer a house in an exciting, busy, and crowded street. Traditional old style houses, for example in the Old Quarter of Hanoi[7], that are highly valued by cultural and historical experts or tourists may not be the choice of householders today because these houses do not suit a modern lifestyle, and require time and money spent on their conservation.

Current Westernisation of lifestyle through industrialisation and global trade may create a single world culture dominated by a single type of capital economy and therefore will degrade the diversity of housing types in different corners on Earth. Since sustainability should

[7] The "Old Quarter" has been an important residential and trading centre for almost 1000 years. Wrapped around the north shore of Ho Hoan Kiem (The Lake of the Restored Sword) and confined by the Red River to the northeast and the old citadel wall on the west, the area in total extends over 85.5 ha. The area was first settled around 2000 years ago and the oldest remaining building dates from 1031. The area developed during the 13th century as skilled craft workers came to Hanoi to meet the needs of the royal palace. Guild villages evolved outside the walled palace. Many of the street names relate to the original trade conducted by the inhabitants. Others refer to some geographical position, or a specific feature. Many street names begin with Hang, which means merchandise or shop. For example, silversmiths occupy one of the most ancient streets in Hanoi, Hang Bac (meaning silver) Street.

The area continues to occupy a special place in the hearts of the people of Hanoi because it hosts special cultural events, celebrations, and other traditional and religious activities. The 50 years or so of economic hardship caused by the wars for independence meant little investment had occurred on improving the infrastructure of the area and many of the buildings now exhibit physical deterioration.

address the maintenance of the diversity in cultural heritages, achieving sustainability in housing needs to address this issue.

The Table 2.2 below includes all issues about housing discussed in the text above.

Table 2.2 Multiple aspects of housing

Environmental	Social	Economic
Fit to local natural condition	***Human well-being:***	***Affordability***
Land use	Right to adequate house	Income
Available building materials	Equality in housing	Housing cost
Density	Aesthetic	Operating cost
	Symbol of status (power/ wealth)	Interest
	Comfort,	
	Convenience	
	Freedom	
	Religious belief	
	Belonging (home ownership)	
	Privacy	
	Quietness	
	Relation between human and nature	
	Personal identity/ self expression	
	Type of house	
	Exciting/ peace atmosphere	
	Health	
	Community involvement/ relation	
	Cultural conservation	
	Mores	
	Wisdom of culture	
	Technological development	
	Building skills/experience	
	Cultural value/ heritage	

2.4.2 Current housing that is labelled 'sustainable'

Many housing projects that are claimed to be sustainable (or green) in Cottom-Winslow (1990), Jones (1998), King, Rudder, Prasad, & Ballinger (1996), Scott (1998), and Vale & Vale (1991) often, in their description, do not take into account the multiple dimensions of sustainability. Most of these authors attribute the sustainability of the housing projects only to the use of technological instruments. While this may obtain some environmental benefits, they seem to forget about the social and economic issues. For example, the Drop City in Colorado, built from panels of scrapped cars and vans fulfils the principle of employing 'waste as resources', and the Chinese underground houses may embody the principle of 'respect for site' (Vale & Vale, 1991, p. 60; 143), however, in both these cases, the human spiritual and social needs seem not to have been addressed adequately.

Bio-climatic technologies (Scott, 1998; Jones, 1998) and autonomous houses (Vale & Vale, 1975) may reduce end-use energy consumption, but the energy and resources used in the construction as well as social and health impacts on occupants in operating and paying initial costs that could be enormous have rarely been mentioned. Also, autonomous houses often require large land areas and are located in a remote area (Rudlin & Falk, 1999). This in the end will cause urban sprawl that requires long travel distances. As Woolley et al. (1997, p. 46) argues, the general public fails to recognise the impacts that building and building materials have on our health and the environment because energy conserving houses are "often [constructed] using materials which, in themselves, use a lot of energy to produce and have damaging effects on the environment". The impact of this 'embodied energy' that includes the energy used in mining, transportation, and production of the building material and in building construction is often ignored. In addition, the sustainability or otherwise, of the source of most materials is left unclear. Many authors have also criticised 'energy conserving' buildings for ignoring environmental and health effects. Woolley summarises points made by several authors,

> Conventional insulation materials such as extruded polystyrene or UPVC windows use a lot of energy to produce and potentially cause a great deal of damage to the environment, using up petrochemical products and creating toxic waste by-products... There is little doubt that the more highly sealed and energy efficient a house becomes, the greater the exposure to a cocktail of toxic chemicals from building materials, even, if singly, the levels of emission are quite low. A study at the Building Research Establishment (BRE) identified 254 toxic substances emitted in a study of new houses built on the BRE site ....many toxic materials used in building cause occupational asthma in the factories where they are produced.
>
> (Woolley, in Fox, 2000, p. 46-48)

Although there is an argument that embodied energy can be paid back in energy conserving buildings by saving operating energy after a certain period of time (Girardet, 2001; Jones, 1998), there is little evidence of total energy saving due to the uncertainty in counting embodied energies. The costs of environmental and human health damages caused by mining, transportation, and production of building materials, especially the cost of impact on human health when living in an energy conserving buildings seem not to be generally taken into account.

Besides the weakness in ensuring the benefit of the environment and human health, in a lack of concern for the local socio-economic condition leads to the failure of housing projects because as mentioned above, housing has spiritual, emotional, and economical meaning. For example, a group of Swedish experts came to build houses for the poor rural people in Tanzania. These houses did not suit the local lifestyle therefore most of the residents moved out after only one or two nights (Astrånd, 1996). The project *Housing for the poor* in Ho Chi Minh City, Vietnam provided new housing in a suburb for the slum dwellers living along the Saigon River. Most of the people eventually relocated to their slum area where they could more easily have access to jobs in the city centre (Nguyen et al., 1996).

Sociology studies for defining social instruments of sustainability play an important role, but the quantity is small. Only recently, some social scientists have started to examine 'sustainability' as an issue. Becker and Jahn (1999) and Guy and Shove (2000) also agreed that environmental issues actually are social issues because environmental problems cannot be realised without the awareness of human society. This would suggest that, if environmental problems are realised and often created by human activities, an *ethical change* in human society is likely to be essential in approaching sustainability, especially in housing. It is clear that although a house may be designed for energy saving, "no guarantee is given that energy costs savings will be achieved" because "[i]ndividual energy usage patterns and household lifestyle will have a significant impact on total energy consumption" (Delfin Realty, 2000).

Realising opportunities but also limitation of each instrument, some authors in Becker and Jahn (1999) and Vale and Vale (1991) have suggested the need to embody multiple dimensions in sustainable projects.

2.4.3 Multiple dimensional descriptions

Some descriptions of housing, together with urban, neighbourhood, settlements and architecture in general have attempted to include multiple instruments for achieving sustainability. Rudlin and Falk (1999) have considered many social, economic, and environmental aspects in creating their model of a sustainable urban neighbourhood, however, they did not provide enough evidence of the acceptance or involvement of the residents in this model. They proposed a housing model for London based on traditional three to four storey terrace building types around a square or an open space. Although the housing project is shown to provide net benefits in terms of energy and land use, human comfort and satisfaction are not ensured, especially when they propose a new tax for the roads and housing. This model may also create monotony in the urban pattern or neighbourhood when most of the houses will be three to four storey apartments. Moreover, as their main viewpoint was to create an attractive sustainable neighbourhood for the residents, this likely means the residents need to put no effort for achieving sustainability. This may not succeed, because sustainability can happen only when people are knowledgeable and willing to contribute their effort to achieve sustainability. Sustainability concerns not only social and physical issues but also requires a whole human's mind, spirit, and body approach (Girardet, 1999).

A checklist for sustainable architecture was proposed by Williamson et al. (2003) to deal with the impacts *(ends)* including: climate change, pollution, resources depletion, ecology (bio-diversity, indigenous flora and fauna), society and culture, health, comfort, cost effectiveness, and longevity (see Appendix A). Although the economic dimension of 'cost effectiveness' in this checklist has mentioned net benefit and return on investment, affordability or affordable prices were not included. As many efficient technologies require high investment cost, this checklist may not be fully applicable in the region where finance is short. The *means* in this checklist is based on an architect's view, and dealing mainly with architecture and building issues but little with the occupants' lifestyles. The list includes social instruments of encouraging users and stakeholders to apply some building technologies, but not the social instruments of changing unsustainable lifestyles that cause negative impacts on sustainability.

A checklist for a sustainable city introduced by Roger et al. (1998, in Girardet, 1999, p. 72) indicated the *ends* for a sustainable city (see Appendix A). Although the 'just' city can ensure a fair distribution of resources to satisfy human needs, the lack of economic considerations in their description means that a mechanism for both resource creation and distribution is missing. This checklist seems to be more applicable to the developed countries than the developing countries.

These descriptions of Girardet, Roger, Rudlin, and Falk above have focused on city or urban scale while the checklist proposed by Williamson et al. (2003) focused on architecture. These multiple dimensional descriptions can be useful when developing housing projects in a city and can inform our understanding of the effects these projects can have on the large city scale. However, sustainable housing seems to need more than that. Sustainable housing has also to make sure of the sustainability of the social life of occupants in an estate.

A checklist proposed by Glasson, Therivel, & Chadwick (1994, p. 115) for use in Environmental Impact Assessment (EIA) is based on assessing the possible effects of a proposed project on elements on earth including human beings, buildings, man-made features, flora, fauna and geology, on land, water, air and climate. An overview of this process (Erickson, 1994, p. 14) showed that these assessments focused more on design, planning, and management of projects. Another checklist for EIA introduced by Erickson (1994) covered the two major headings of the physical and social environment, which included economic, health and cultural impacts (see Appendix A). Even here, however, it was found that the lifestyle of the occupants was not adequately covered.

Moreover, most checklists/descriptions introduced above are mainly theoretically-based and may have little practical application because their potential users may not believe in or agree with them, and therefore, will not comply with them. There also seems to be little possibility to fulfil all elements in a checklist because the elements may require different choices of actions or may lead to conflicting results. For instance, most of these checklists have considered only superficially the cost issue while the cost issue often is the first priority in the perception of many users when selecting choices in housing design. The way these checklists work in practice has been rarely illustrated.

Local agenda 21 and the best practices of sustainable development following up Habitat II - The United Nation Conference on Sustainable Housing in Istanbul 1996 - demonstrate many practical applications. The following section will describe some best practice projects in the world.

2.4.4 Local Agenda 21 and best practices in sustainable housing

Following up the Rio Earth Summit since 1992, more than 1800 local governments in 64 countries have established Local Agenda 21 to implement Agenda 21 at a local level to work for sustainable development. This has given increased responsibilities to local government for environmental protection and social programs. Some 'best practice' developments in many regions on earth are evidence of the potential of this program. The International Council for Local Environmental Initiatives (ICLEI) in describing the effect of the program said,

> The greatest impacts of local government actions have been in the areas of institutional development, public participation, and improved management systems. In thousands of cities and towns individual "best practice" projects also have produced concrete, positive impacts in specific areas of management.
>
> (ICLEI, 1997, p. 1)

Best practices have covered many issues such as:

- Poverty reduction and job creation
- Crime prevention and social justice
- Access to shelter and land
- Development of urban agriculture
- Improved production/consumption cycles
- Gender and social diversity
- Infrastructure, water and energy supply
- Enterprise and economic development
- Innovative use of technology
- Waste recycling and re-use
- Environmental protection and communication
- Participatory governance and planning
- Self-help development techniques
- Women's bank and local money systems

(Girardet, 1999, p. 60)

However, Local Agenda 21 also has some limitations. ICLEI (1997, p. 1) critically asserted, "few local governments have yet demonstrated their capacity to achieve dramatic improvements in social and environmental trends except in certain key areas… such as solid waste managements and water pollution control". Also best practices have generally been isolated, and limited in a number of cases. The limitation of finance and resources at local government level and the lack of cooperation between different institutions and nations are also barriers to the success of the practices. A number of best practices around the world have been introduced in ICLEI (1997). The following paragraphs will review these best practices.

A Provincial Sustainable Development Plan Cajamarca, Peru has been set up to decentralise the provincial government to reflect better the needs of many small and remote communities. The projects have provided portable water, sanitation, environmental education, and rural electrification on a budget of more than USD 21,000,000 since 1993. (ICLEI, 1997, p. 16-17)

Another best practice was implemented in Austin, United States, where an Energy Code and the *Green Builder Program* were established. A recent study of the actual consumption of Green Builder homes that complied with Energy Code showed that they consumed 48% less electricity, 34% less natural gas, 114,000 less gallons of fresh water and created 22,000 less gallons *of* grey water per year (ICLEI, 1997, p. 17-18). However, the number of this type of house is very small.

Projects in Hannover and Saarbrucken in Germany demonstrate that environmental goals can be achieved without damaging local economic health. In response to the UN Framework Convention on Climate Change, Hannover and Saarbrucken completed their local climate action plans in 1994. Both have been worldwide leaders in *local energy* efficiency and renewable energy strategies achieved by reducing heating and electricity demand in residential, commercial, and industrial buildings. In Hannover, CO_2 emissions measured in 1997 have annually reduced by 2.2% from buildings and industries, and a 1.8% reduction in total CO_2 equivalent emissions since 1990. The way they achieved this was by changes in energy cost to encourage energy retrofit activities in buildings, and creating "green pricing" from wind energy for utility customers. Saarbrucken used an innovative program to finance solar energy conversions for residential and commercial buildings and this has resulted in an annual reduction of CO_2 emissions of 1% between 1990 and 1996. However, these municipalities are unlikely to achieve their 25% reduction target in CO_2 without cooperation with other institutions to apply energy taxes and measures to reduce the growth of private automobile transportation and enhance industrial efficiency. (ICLEI, 1997, p. 18-19)

Besides the application of new technologies, minor works such as establishing an ecological park system in the city of Durban, South Africa can do a lot for sustainable development. Durban employed a holistic approach when it incorporates social and ecological criteria in designing and managing parks in the inner city. The municipality involved residents in park developments with the aim at establishing social and environmental awareness among local people. The parks were linked through corridors that allow genetic transfers between them and maintaining diversity both in species number and genetic material within a species. The parks were designed to meet the recreational, educational, health, and economic needs of a diverse group of citizens. (ICLEI, 1997, p. 20-21)

The innovation of the above best practices is undeniable and should be applied worldwide whenever suitable. On the other hand, best practice may also be achieved by providing a better living for the poor. In Habitat II conference in Istanbul 1996, a huge exhibition of best practice was presented. Among them, the exhibition of the development of *new housing in China* took a large proportion. Although it did not adequately take into account some environmental and social issues, these projects provided better living conditions for a vast number of urban poor. (Observed by the author of this thesis when attending Habitat II Conference 1996).

Moreover, a small effort can create huge positive effects on the environment. The simple work of separating and collecting household waste materials can be done anywhere, but this has not been carried out in many parts of the world. The city of Curitiba has become well known for its active participation in waste recycling and use of public transport. A program that combines waste recycling, use of public transport, and ecological food provision has been successful. It encourages local people to actively participate in the program by exchanging bus tickets or eco-vegetables for the collection of waste. The innovation in bus waiting-hubs has created convenience for the passengers and enhanced more use of buses for travel in the city (Nyström, 1997; Girardet, 2001).

The examples of best practices above have shown that each sustainable development project is a compromise and a balance between different forces. While these practices are real, the descriptions discussed before are based on theory. These practices had fulfilled only some issues in the descriptions or checklists of sustainability, but on the other hand, had covered more issues that are not included in these checklists such as gender diversity or financial support (for example women banks). This suggests that it is not necessary and may be impossible to fulfil all elements in the checklists.

Another lesson that can be learned from the best practice cases is that the key issue did not rely on technological instruments or economic resources, but more on the willingness to act for sustainability of local people and on the power, ethical stance, and enthusiasm of the community. Many current guidelines and checklists concentrate more on technological instruments with little social instruments for enabling the willingness to act of local people. The technological instruments are useless if the people are not willing to take any action. As discussed above, the delay of environmental action today is not due to the application of technology development but due to human psychology, lifestyle, and economic conditions.

2.5 Summary and discussion

The study of meaning and measures to obtain sustainability and sustainable housing in the literature and best practices above has identified main ends and instruments of multiple dimensions of sustainable housing. Sustainable housing has three key dimensions of the *environment, society, and economy* and three key instruments including *technology, society, and the economy.*

The environmental dimension has three main ends of *reducing pollution, conserving resources, and protecting ecosystems.* The social dimension of sustainable housing includes three ends of *social individual well-being (including physical comfort), collective well-being, and cultural conservation.* Economic dimension of sustainable housing includes the ends of long term *economic growth* to provide opportunity for generating and distributing wealth and *affordability.*

The technological instruments of sustainable housing can be seen as falling into four categories including *planning, design, materials, and systems and appliances.* Social instruments of sustainable housing appeared to employ action from all levels, from *individuals, local governments (city), to nation/global.* Economic instruments of sustainable housing studied above can be summarised as including four main instruments of *economic growth, fiscal, monetary,* and *institutional.*

Based on these key elements, an assessment framework of sustainable housing at this stage can be built as seen in Table 2.3. Although sustainable housing does not necessarily utilise all elements of the assessment framework, the framework should be complete so as to not miss any important issue. Each community and/or individual can make decisions based on this framework to choose elements that are relevant to their own local context. The framework includes requirements for sustainability at city, housing, and architecture scale because sustainable housing has to ensure the sustainability not only in the housing scale but also at urban and city scale as they belong to it.

Many elements in this framework are *means* but also are *ends* for more than one dimension of sustainable housing. For example, creating walkable streets is not only the means for the *ends* of reducing pollution and saving resources, but also the desirable *ends* of a lively urban place. As in Oriental philosophy, the whole world is a unique organism; it is impossible to divide the elements of the table separately. Although the framework classified the elements as ends or means categories, the border between them is very opaque. Many elements in this framework belong to more than one category, as they are all interdependent. For instance, conserving resources does not only protect the environment and ecosystem but can also ensure long term economic growth. Protecting the environment can also improve social human well-being.

Another point is that checklists or descriptions in literature often use some *means* to fix some *ends* (issues). As one *end* can be caused by a combination (and sometimes the indirect impact) of many *means*, fixing some means may not be sufficient to obtain desirable *ends*, and may cause other *(ends)* problems. For example, waste recycling is often seen as a means to fix the ends of resources depletion. However, the recycling process may require a lot of resources and energy consumption, and may create other damage to the environment. The solution of building high-rise apartments in the inner city was proposed to solve urban sprawl problems *(ends).* However, the majority of these high-rise apartments in Sydney are currently occupied by single owners, which means the average floor area and domestic appliances per head is higher than the previous housing forms (Tonkinwise, 2002). So solving the *ends* today may create problems of tomorrow.

This study therefore has proposed and followed a different approach to sustainable housing uses four working principles. First, this study is based on knowledge obtained from a combination of the *East and West philosophies.* Secondly, this study does not seek only problems (yins) but also successes (yangs), to *recognise and enhance sustainable features of current housing practices*. Solutions to sustainable housing will focus not much on fixing failures (yins) but with promoting successes (yangs) so that the system can be balanced and the problem will be alleviated by itself. For example, if people are happy to consume less, the need for recycling is less, and the need to clean the air caused by goods manufacturing industry is reduced. In addition, if more people want to share a house, the need to minimise the size of the house or replace detached garden houses with high-rise apartments may be not necessary. Thirdly, this study is based on *means* rather than on *ends* to define sustainable housing. This can minimise the negative side impact of fixing the *ends* solution described above. This study aims at defining the status where benefit (yang) and losses (yin) are balanced, cohabitation ensures a better result for all but it is not necessary to eliminate failure (yin) because there is no way to only have benefits (yangs). The best practices above have proved this. This study therefore will examine the instruments of sustainability in housing. The instruments include the lifestyle, the technologies of housing construction, energy, and water technologies, and the opportunity of economic development in the case studies in Adelaide and Hanoi. Fourthly, this study bases not only on a theoretical approach but also and more on importantly reality of field studies. This will help to close the gaps between theory and reality, and to test the feasibility of theory. Case studies of housing in Adelaide and Hanoi enable this approach. The following two Chapters will describe the background situation and housing practices in Adelaide and Hanoi to set the scene for the case studies.

Table 2.3 Framework of sustainable housing (literature based)

	Environmental ends: reduce pollution, conserve resource, and protect ecosystem	**Social ends: ensure individual well-being, collective well-being, and cultural conservation**	**Economic ends: long term economic growth and affordability**
Technological instruments	***Planning*** Respect for site Select building site that has little impacts on biodiversity Use brown, not green field [8] Create landscape rich in biodiversity Minimise footprint Minimise disturbance to surrounding vegetation Leave movement corridor/sanctuaries for wildlife Encourage urban/ suburban agriculture Provide public transport Provide green space	***Planning*** Provide exciting & peaceful living place Provide recreational opportunities Ensure easy access to jobs and services Provide infrastructure, water, and energy Emphasise on public spaces Provide lively streets Design permeable and walkable streets Create mass of activities Express culture features in neighbour hood Maintain cultural heritages Protect spiritual and cultural values Maintain existing scale and typology of site Respect existing context Create landmarks, vistas, and focal points	***Planning*** Enhance urban economic Assess to job Create job opportunities Create new business Create residential property values Retain existing business Encourage urban/ suburban agriculture Ensure affordable housing Conserve resources (see column environment) Create mix of spaces for living, trade, and social activities

[8] Brown fields are abandoned or run down sites while green field is naturally original site, a rich agricultural product land, or park land.

	Environmental ends: reduce pollution, conserve resource, and protect ecosystem	Social ends: ensure individual well-being, collective well-being, and cultural conservation	Economic ends: long term economic growth and affordability
Technological instruments	***Design*** Integrate with nature (ventilation & lighting) Integrate multiple functions in a space Harmonise with nature Response to climate Build compact[9] & dense Need low maintenance Reduce inputs Minimise waste Design small blocks Recycle old buildings Design energy efficient housing Optimise functions of the house Apply eco-design[10] Apply bio-climatic technologies Apply autonomous house[11]	***Design*** Adapt existing design techniques Ensure equity (gender, age) Ensure diversity Ensure safety Ensure integration Ensure convenience for use and maintain Ensure privacy Ensure freedom Express oneself/ identity, symbol of status (power/ wealth) Respect belief Build healthy house Harmonise with nature Ensure easy contact and mobility Ensure creativeness Provide spiritual values Ensure social development Provide thermal, visual, and aural comfort Apply new technologies in construction Use mores/ wisdom of culture in design Use local skills for construction and maintenance	***Design*** Create business space (shop/ office) at home Ensure affordable purchasing and operating costs of housing Conserve resources (see the environment column)

[9] Small and economically designed (Nguyen, 1996, p. 210)

[10] Eco design (see Rathenau et al., 1997, p.37)

[11] Autonomous house (see Vale & Vale, 1975)

	Environmental ends: reduce pollution, conserve resource, and protect ecosystem	**Social ends: ensure individual well-being, collective well-being, and cultural conservation**	**Economic ends: long term economic growth and affordability**
	Materials Use materials have less toxic, pollution, and greenhouse gas emission in extraction, manufacture, transport, and use Use local/less good freight materials Use materials that have less polluted surface water run off Use recycled materials Use renewable resources	***Materials*** Use local resources Use plenty resources	***Materials*** Conserve resources (see environment column) Use affordable price materials
	Systems and appliances Apply renewable energies Recycle water and waste Use efficient appliances Use greenhouse gas free /clean energies	***Systems and appliances*** Apply new technologies (renewable energies and waste and water recycling)	***Systems and appliances*** Conserve resources (see environment column) Ensure affordable costs (purchasing and running the systems and appliances)

	Environmental ends: reduce pollution, conserve resource, and protect ecosystem	Social ends: ensure individual well-being, collective well-being, and cultural conservation	Economic ends: Long term economic growth and affordability
Social instruments: Individual, local, and national/global actions	***Individual*** Be concerned with the health of the environment Access to environmental information & education Support and participate environmental activities Use clean energies Plant tree Use energy efficient appliances Control birth rate Use public transport Use less private motor vehicles Save end-use energy Reduce consumption Share products (home, car...) Protect local animals and plantations	***Individual*** Select suitable type of house Support and participate sustainable activities Self-help Live in extended family (productive and efficient life style) Participate in housing design and construction Consider collective benefit Change lifestyles to be more sustainable	***Individual*** Create jobs and economic opportunities at home (open shop or business) Have a productive lifestyle Conserve resources (see column on the left)
	City Provide environmental information & education Promote dematerialised lifestyles Organise environmental protection activities Control population Provide public transport Provide facilities for environmental actions (recycling) Promote using efficient appliances Promote using renewable energies Promote waste and water recycling	***City*** Provide information & education about sustainable housing Promote sustainable lifestyles Organise sustainable activities Create justice and equity in access to housing Ensure equal distribution of income and wealth Provide accessibility to shelter and land Ensure legibility	***City*** Create jobs in environmental services and management Create jobs for technical supports on the environment Conserve resources (see environment column) Build variable types and standards housing with different prices Build low cost housing
	National/ global Rich nations take moral lead Aids from rich to poor nations/communities	***National/ global*** Rich nations take moral lead Aids from rich to poor nations/communities	***National/ global*** Rich nations take moral lead Aids from rich to poor nations/communities

	Environmental ends: reduce pollution, conserve resource, and protect ecosystem	Social ends: individual well-being, collective well-being, and cultural conservation	Economic ends: long term economic development and affordability
Economic instruments	***Economic growth*** Create beneficial business on environmental technologies and services (recycle, renewable energies)	***Economic growth*** Create beneficial business on environmental technologies and services Create jobs in housing development and in environmental services	***Economic growth*** Create beneficial business on environmental technologies, housing, and services (recycle, renewable energies) Increase GDP to reduce poverty and provide basic need for all
	Monetary Control interest rate to encourage sustainable project	***Monetary*** Control interest rate to encourage access to housing Increase GDP to provide basic need for all	***Monetary*** Control interest rate to ensure affordability to implement sustainable project
	Fiscal Set up environmental taxes (pollution, consumption, long distance goods) Include transportation, mining and production costs into products' prices Include costs of social/ health impacts into products' prices Subsidise environmental activities	***Fiscal*** Include social/ health impacts costs into products' prices Distribute resources, income, and wealth equally Tax on high income earners Subsidise low income earners	***Fiscal*** Subsidise first home buyers
	Institutional Create bank facilities for sustainable projects	***Institutional*** Create bank facility for home loan and sustainable projects	***Institutional*** Create bank facility for home loan and sustainable projects

Chapter 3 The Adelaide context

3.1 Socio-economic and environmental situation in Australia

Australia is a huge continent of 7,682,300 km^2 with a relatively small population of 19,357,594 (CIA, 2001a). Aborigines were the first people to live on in the continent and they are believed to have arrived about forty thousand years before the colonization by Britain in the late 1700s (EmulateMe, 2003a). At present, Australia has a multicultural society with the majority of the population immigrated from overseas. Australia's GDP per capita is USD 24,000 with an economic growth at the rate of 2.3% in 2001 (EmulateMe, 2003a). This places Australia amongst the wealthiest countries in the world. Australia is a major exporter of agricultural products, minerals, metals, and fossil fuels (CIA, 2001a).

Although Australia is a developed country, sustainability has not been ensured in the country. As one of the main economic activities is mining that extracts the limited non-renewable resources for export, the sustainability of the economy and the environment seems not to have been ensured. Australia also faces environmental problems such as "beach, river and air pollution in many cities and towns; soil erosion and other forms of land degradation; contamination of land and ground water; and damage to coastal eco-systems and so on, caused by rapid urbanization" (CDHRD, 1995c, p. 199). The hole in the stratospheric ozone layer that appears over the South Pole causes a high-risk rate of skin cancer in southern Australia. Desertification, water salinization, natural habitat degradation, limited natural fresh water resources, and natural hazards such as cyclones along the coast, and frequent droughts exist (EmulateMe, 2003a).

The low density of cities along the coasts causes many impacts on the sustainability of the country. It sounds unnecessary to worry about agricultural land since Australia is a huge continent. However, 90% of the population is living on prime agricultural and environmentally sensitive land along the coasts (CDHRD, 1995c; King et al., 1996). This has caused environmental impact to sensitive coastal ecosystems and caused agricultural land degradation. The low density of residential areas causes urban sprawl that has many impacts on the environment, such as high transport demand due to longer distances within major population centers (ABS, 1999a) which has created high consumption of resources in running motor vehicles and constructing the roads (King et al., 1996). It also creates barriers for disadvantaged people in accessing and conducting long distance travel. High transport volume has caused air pollution in Australia's urban areas as "90 percent of the airborne lead in Australia's major cities comes from lead petrol ... and generates serious health effects...for example... the risk of asthma due to high ozone levels" (CDHRD, 1995c, p. 195; 191).

The major gases and particulates emitted outdoors in Australia include CO_2, CO, CFCs, HCFCs, HFCd, Pb, CH_4, Nox, N_2O, SO_2, and VOCs (SoE, 1996, p. 5-7). CO_2 emission in Australia has sources from fossil fuel burning in energy generators and car use. CO_2 and other greenhouse gases emission in Australia are high compared to other nations and are increasing rapidly (Bush, Harris, & Luan, 1997). The impacts are well documented:

> "Human health impacts of poor air quality in Australia are estimated to range between $3.0 and $5.3 billion dollars each year"... "Damage to materials, property and buildings is estimated to be of the order of 1% of GDP per year (in approximately the same range as the costs of human health impacts)"... "yellow-brown haze of photochemical smog that affects visibility and elicits most negative comment from the population at large can prove damaging to a city's image and efforts to attract both investment and tourist"... "Rates for NOx, VOCs, the photochemical smog precursors, and CO, are all similar to or worse than US cities...and more than double the levels found in European cities..."
>
> (AHURI, 1997, p. ix)

NOx emission from road traffic causes Stratospheric ozone depletion and acid rain (Jackson & Jackson, 1998). It also creates Tropospheric ozone that causes respiratory disease and thereby affects lung function (AHURI, 1997, p. 15). High concentration of CO can cause an "increase in illness due to schematic heart diseases" (AHURI, 1997, p. 15). "Ozone losses [of] 40% over the Antarctic during parts of the year" (Shearman & Sauer-Thomson, 1997, p. 25) that cause high skin cancer rates in Australia (Meadows et al., 1992) can be the consequence of transboundary pollution from all over the world including Australia.

In addition, the lifestyle of Australians also impacts on the limited carrying capacity of the environment. The high rate of private car ownership of Australians creates significant traffic congestion in big cities, shortage of parking places, increased pollution, and the need for additional road construction. In March 2000, 89% of Australian households owned registered vehicles, with 48% owning two or more (ABS, 2001). Only about 12% of households in Australia used public transport for daily travel to work or study (ABS, 2001). Although the majority of vehicles in Australia were run with unleaded petrol, some Australians' vehicles are still using leaded fuel. South Australian has the highest percentage of household vehicles using leaded fuel (24%) (ABS, 2001). Motor vehicles contribute around 16% of all greenhouse gas emission (AGO, 1999a; AHURI, 1997, p. 17). Furthermore, the current trend of households owning two cars requires dwellings to have larger garages that cause higher use of land and building material.

The high consumption lifestyle draws on the limited resources of the Earth and also creates more wastes and pollution. There is a high level of solid waste in residential areas. This wastefully uses resources and energy in transporting and treating wastes, and causes the risk of hazards to the environment and human health.

> Australians generate very high levels of solid waste...It is estimated that Australians produced about 13 to 14 million tones of waste annually...This is due to high consumption levels...and suburban garden, with garden waste accounting for 20% of domestic waste.
>
> CDHRD (1995c, p. 200)

At present, waste recycling has been introduced in Australia but has not been practiced by all households. The most common items recycled by Australian households are paper (85%), old clothing or rags, and plastic bags (83%), glass (82%), plastic bottles (81%) and cans (75%) (ABS, 2001). However, less then 7% of Australian households recycle all these items and 3% of Australian did not participate in any recycling. Only just over a third of Australian households knew of services or facilities that were available in their area for the safe disposal of households' hazardous waste. More households have abandoned the practice of taking their household hazardous waste to the dump or a central collection point (30% in 1996 and 21% in 2000) (ABS, 2001).

The Australian government has tried to promote environmental protection. Australia has been involved in many international agreements such as the Protocol on Environmental Protection to the Antarctic Treaty, Convention on International Trade in Endangered Species of Wild Fauna and Flora, Environmental Modification Convention, International Hazardous Waste Conventions, Convention of Biological Diversity, Climate Change Convention, Oceans and Law of the Sea, International Convention on the Prevention of Marine Pollution by Dumping of Wastes and other matter, Nuclear Test Ban Treaty, Convention on Protecting the Ozone Layer, International Convention for Prevention of Pollution from Ships, International Tropical Timber Agreement 1983, International Convention for the Regulation of Whaling, Convention on Combating Desertification and the Effects of Drought (CIA, 2001a). Many programs have been introduced that are aimed at aspects of environmental protection such as reducing greenhouse gas emission in energy sectors and so on, nevertheless, their effect is likely to be minimal. Australia is ranked 18 out of 21 in terms of environmental performance of all OECD members with "highest per capita disposal rate of solid waste, third highest rate of CO_2 emission, second highest rate of SO_2 emission, and second highest dependence on private transport" (CDHRD, 1995c, p. 187).

3.2 Energy sector

The energy sector in Australia has been studied to find solutions to the current increase in greenhouse gas emissions. The strong dependence on fossil fuel in generating electricity supply causes difficulties for Australia in switching into alternative energy types to stabilize or to reduce CO_2 emission.

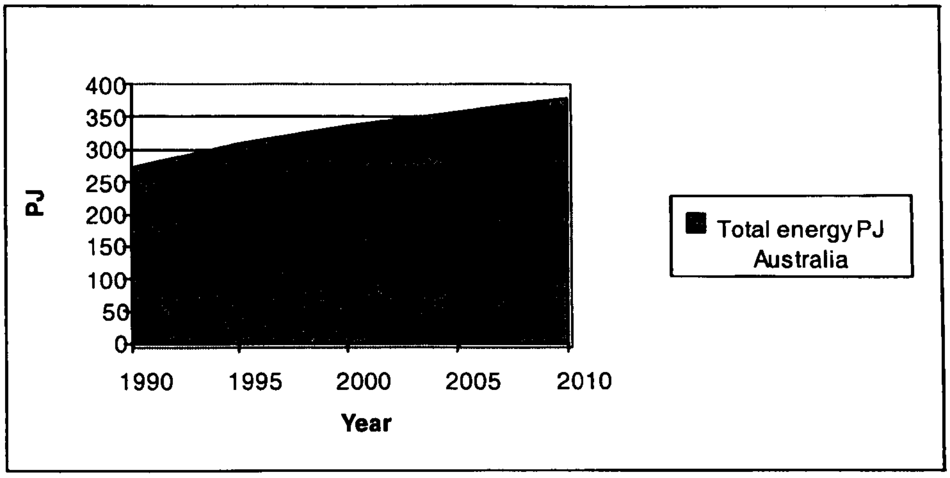


Figure 3.1 Total residential energy consumption in 1990 – 2010

Source: AGO, 1999, p. 10

As 91.14% of the electricity supply of Australia relies on fossil fuel, that is responsible for 41% of greenhouse gas emission (EmulateMe, 2003a, Bush et al., 1997) (see Figure 3.2), Australia has to put a considerable effort into stabilizing CO_2 emission. Australia signed the Kyoto Protocol to the UN Framework Convention on Climate Change on 29 April 1998 to limit its greenhouse gas emissions to 108% of its 1990 level. However, in June 2002 the Australian Government announced that it would not submit the protocol for ratification by the parliament and effectively withdrew from the Protocol. The Federal Minister for the Environment and Heritage, the Hon Dr. David Kemp said of Australia's position,

> The Prime Minister announced to the Australian Parliament that on current settings it was not in Australia's interests to ratify the Kyoto protocol. The Prime Minister announced that: "because the arrangements currently exclude - and are likely under present settings to continue to exclude - both developing countries and the United States, for us to ratify the protocol would cost us jobs and damage our industry." ... Nevertheless Australia remains committed to develop and invest funding in programs to meet the target it agreed at Kyoto. That target is on a par with the targets taken by other industrialized countries under Kyoto in terms of the economic adjustment required.
>
> (Kemp, 2002)

He went on to say that the key areas for practical actions that the Government would continue to support include:

- Science and monitoring - delivering scientific research to improve understanding of southern hemisphere climate systems and address key areas of climate change uncertainty.
- Engaging business - sharing knowledge on policies and approaches, and developing tools that will assist industry action to reduce emissions including common approaches to reporting and verifications of emissions reductions and possibilities for domestic crediting of these reductions.

- Technology development - providing for government and business to collaborate on renewable energy, advanced cleaner coal technologies and geological sequestration of carbon dioxide.
- Greenhouse accounting - strengthening capabilities for accounting for emissions from forestry and agriculture.
- Collaborating with developing countries - helping to build capacity in the Pacific.

(Kemp, 2002).

Besides this effort from the central government, greenhouse gas emission from electricity used in residential buildings is strongly growing (AGO, 1999, p. 11) and accounts for 82% of emissions (see Figure 3.3). This may relate to the increase in per capita energy consumption that has increased 10% over the last ten years (AGO, 1999, p. 10).

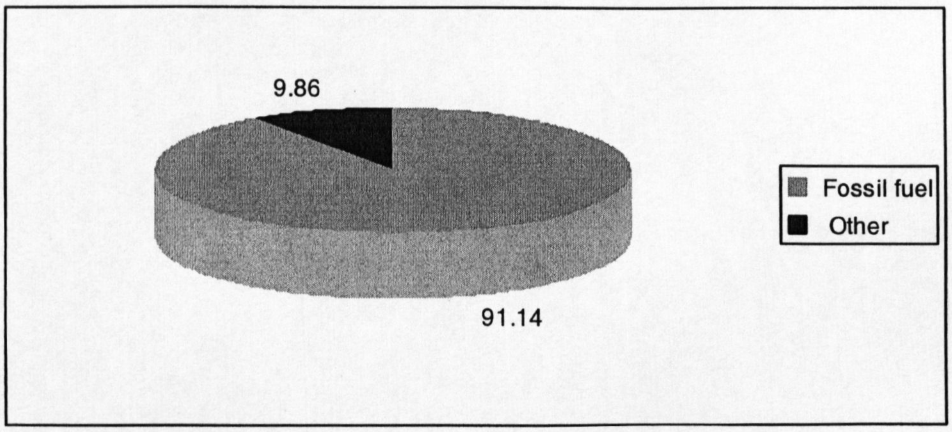


Figure 3.2 Electricity supply resources by fuels in 2010

Source: ABS (Bush et al., 1997)

Added to the unsustainability in the energy sector, the salinization of ground water in Australia is another problem that has not been taken care of by many Australians (Shearman & Sauer-Thomson, 1997). In media releases and advertising campaigns, the government has encouraged people to save water. However, the number of people buying bottled water has increased 10% from 1994 to 1998 (ABS, 2001, p. 2). This is because the conventional drinking water from main supply system in many areas (especially Adelaide) has often an unacceptable taste. The rate of using rainwater tanks has increased very little (about 1%) and the number of people using the water supply has remained the same. The extra energy consumption for transportation and purifying bottle water puts more negative impacts on the environment. The plastic containers for drinking water also create more waste.

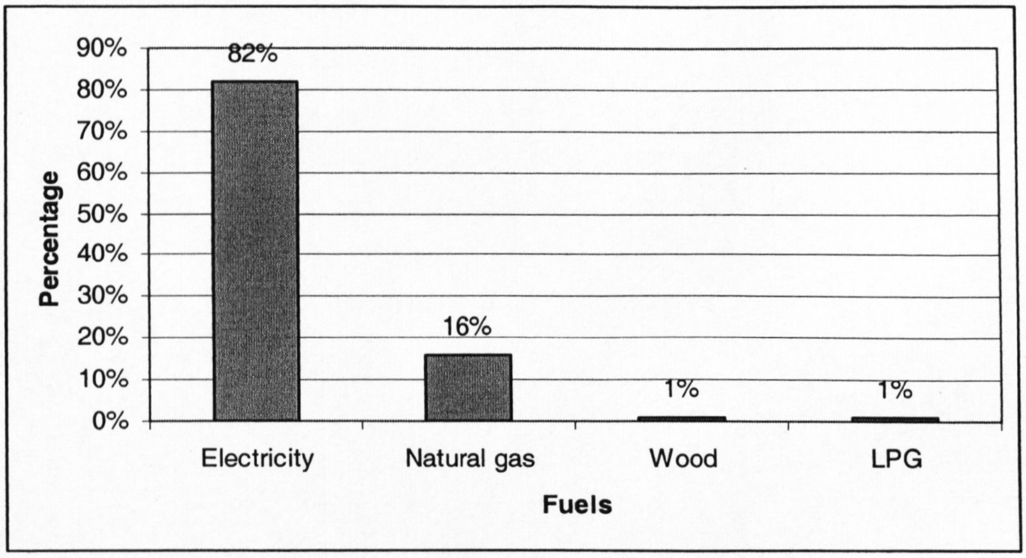


Figure 3.3 Greenhouse gas emission by fuels in 2010 in residential sector

Source: AGO, 1999, p. 15

The government has also encouraged the housing sector to adopt sustainable practices. The *Better Cities Program* introduced by the Keating Labour Commonwealth government in the early 1990s was a major initiative that funded a number of projects aimed at promoting improvements in the efficiency, equity, and sustainability of Australian cities (CDHRD, 1995b). Specific projects were directed at improving transport efficiencies and reducing land requirements that would result in benefits such as reduced energy consumption, improved air quality and resource conservation. Another initiative was the development of the Australian Model Code for Residential Development (AMCORD) as a national resource document for planning and development of residential areas (CDHRD, 1995a). Local government authorities are encouraged to adopt this Code as part of their development plan[12]. Many new housing projects, such as the Olympic Village in Sydney, New Haven Village and Mawson Lakes in Adelaide, have been developed with "environmentally friendly" principles in mind that incorporate energy, water, and sewage strategies to reduce their impact (SAHT, 1992).

3.3 The housing sector – Australia and Adelaide

The housing sector creates many negative impacts on the environment. The popular detached houses with big gardens brought housing in Australia to be "one of the highest standards of housing in the modern world" (Paris, 1993, p. ix). This together with the development of motorized road transport has caused urban sprawl (CDHRD, 1995c, p. 193; Paris, 1993, p. 112) that has many impacts on the environment. The decrease in average household size -

[12] The South Australian government planning department (Planning SA) released a modified version of AMCORD entitled "The Good Residential Design SA". This document has been adopted wholly or in part by a number of local Councils within the Adelaide metropolitan region.

from 2.6 persons per household in 1996 to 2.3 persons per household in 2021 (ABS, 2001, p. 52) - and the increase in dwelling size - from 206 m^2 in 1996 to 231m^2 in 2000 (ABS, 2001, p. 173) – result in continuing high resource use.

The decrease in the household size may relate to the high home ownership. Australia has a very high rate of housing ownership (70.1%), one of the highest in the world (ABS, 2001, p. 181). Housing stock has increased very fast. The number of occupied private dwelling increased from 6,173,000 in 1991 to 7,186,000 in 1999. By comparison, the stock of public rental dwellings increased at a much slower rate from 352,000 in 1990 to 363,000 in 2000 (ABS, 2001, p. 172)

The greater Adelaide metropolitan area has low density with an average of 1.5 people per km^2. The total population was 1,088,400 in 1998 (ABS, 1996) and inhabited an area of 984,377 km^2 (EmulateMe, 2003a). Housing stock in 1995 reached an average of 1.48 dwellings per household in South Australia[13] with 2.5 persons per three-bedroom dwelling (ABS, 1995, p. 133). There seems to be a surplus of dwellings and low occupancy. This suggests the construction of new dwellings may be not necessary at present.

In addition,

> Household growth in South Australia is projected to be the second slowest of all the States and Territories in Australia, increasing by between 16% and 28%, from 584,000 in 1996 to between 679,000 and 745,000 in 2021.
>
> In 1996, couple families **with** children were the most common family type in South Australia, accounting for 46% of families. This family type is projected to decline ... both in numbers and relative importance over the projection period.
>
> In contrast, by 2021 the most common family type in South Australia is projected to be the couple family **without** children which is expected to increase by between 32% and 47%. This growth is slower than the 53% to 70% projected nationally.
>
> (ABS, 1999b)

However, there were 647,606 dwellings counted in South Australia in 2001, an increase of 4.7% (28,929 dwellings) since 1996. Of these dwellings, 90.2% (584,042) were occupied private dwellings, 9.6% (61,902) were unoccupied private dwellings, and 0.3% (1,659) were non-private dwellings (ABS, 2002b).

Housing in Adelaide has the most affordable price in comparison to other capital cities in Australia (ABS, 2001, p.173). This enhances the increase in dwelling size and the decrease in household size. Yet despite this, a part of the population is homeless or living in inadequate housing conditions. The current development of housing has not ensured sustainability as they have applied some technological but few social or economic instruments. The following

[13]. There were 587,900 dwellings per 398,000 households in South Australia in 1994 (ABS, 1995, p. 27 & 131).

sections examine the present state of housing in Adelaide in terms of the application of the instruments of sustainable housing.

3.4 Instruments to sustainable housing in Adelaide

3.4.1 Technological instruments

Terrace and detached housing

Terrace and detached houses were traditional houses in Australia. "The first dwellings of the white settlers ...were modeled on British dwelling types, using local material ... There was a clear distinction between two kinds of houses, the town house and the country house" (Paris, p. 100-101). The terrace house has many advantages of efficient land use and saving building materials in addition to carrying a cultural heritage. However, at present they account for only a small proportion of total dwellings in the metropolitan Adelaide (see Table 3.1). Detached houses account for the major proportion of houses in Adelaide (except in the city centre). New houses in the suburbs of Novar Gardens and Coventry Gardens, used as case studies in this research, are mostly detached and only a few are attached houses (less than 10%).

Table 3.1 Housing types

Housing types	Percentage of total housing
Detached	74.1%
Terrace & Street house	13.6%
Flats, apartments	11.7%
Total	100.0%

Source: ABS, 1998, p. 57

Since there was abundant land available and a small population, detached houses have been developed since white settlement began in Australia (Paris, 1993). This dwelling type has many spiritual (including cultural) and practical values for Australian life, but the increase in the stock has caused urban sprawl (CDHRD, 1995c; King et al., 1996). The preference for and popular use of detached housing seem to be understandable as many Australians found this type of house suitable to their lifestyle and family needs. A house with garden provides vegetables and fruit (Paris, 1993), and an outdoor entertainment place for households such as barbecues in the back yard. Gardening is a leisure activity for many Australians. Front gardens were an important element of suburban housing in Australia as it contributes beauty and nature for the houses (Butler-Bowdon, 2001). It is obvious that a house with a surrounding garden creates a higher level of privacy for the resident compared with other types of houses. A suburb that has houses with gardens often has a lively natural atmosphere with lawn, trees, leaves, flowers, and singing birds. Besides this, houses with gardens have the opportunity to compost organic wastes to produce fertilizer for land in the garden, and could reduce the amount of waste needed to be transported and treated outside. A big garden also gives enough room for a tank to collect rainwater for daily use of the households. A granny flat[14] added into the allotment contributes warm and secure support for elderly parents and can reduce requirements for family members to travel to visit each other. Windows opening to four sides provide plentiful sunlight to light and heat the house in the winter, and to vent the house in the summer. These are undeniable values of a detached house with garden.

However, the increase in dwelling numbers and dwelling size require more resources use. Despite housing fewer people on average, dwellings are getting bigger. The average size of new private sector houses in South Australia has reached an area of 212 m^2 in the year of 2000 (ABS, 2001, p. 172). In addition, the current decline in the number of granny flats associated with detached houses contributes to a higher demand for elderly person accommodation in nursing homes and the like.

The increase in housing stock also creates a requirement for a higher consumption of furniture and furnishings, domestic appliances with associated energy consumption. With the high living standard of Australians, an increase of a small number of dwellings would create a huge increase in the consumption of energy and resources. Australia has the second highest ranking of households with colour TVs and the highest rank with VCRs in the world and the number of households having TVs, VCRs, CDs and PCs is increasing very fast (ABS, 1995, p. 166).

Moreover, the current use of detached houses with gardens seems to be inefficient. The popularity of houses with large size gardens is unnecessary as most people today are not farmers, and therefore do not have enough time for gardening. For many elderly people living by themselves, taking care of a big garden is sometimes problematic. Moreover, most houses have three to four bedrooms while the average household size is 2.5 (ABS, 1998, p. 52) and is decreasing. People sometimes buy a big house not because of their physical needs, but because of its economic benefit.

New housing

Technological instruments applied to achieve more sustainable housing in Adelaide include building more compact housing and infill within existing urban infrastructure (CDHRD, 1995b & 1995c), recycling water, and using renewable energy. These technologies have been used in many new housing projects that are then described as "city of the future" or offering an "ecologically sustainable lifestyle". The houses usually have smaller floor area, small front

[14] Granny flat is a small flat built within the allotment and next to the main dwelling to accommodate elderly in the household.

yards and often without side yards compared to the conventional houses. The small yards can reduce the need to water the gardens to save water.

Land subdivision

Land subdivision standards were set up in AMCORD for site planning that aims "[t]o achieve pleasant, attractive, manageable, resource-efficient and sustainable living environments" (CDHRD, 1995a, p. 149). In line with this *end* is the intention to "provide a range and mix of lot sizes to suit a variety of dwelling and household types, with areas and dimensions that meet user requirements; and to provide lots that are oriented where practicable to enable microclimate management, including the application of energy conservation principles" (p. 153). While lot sizes in the range 300 - 450 sq. m. are described as acceptable solutions (p. 153), no limitation is set for a lot size. This seems to run counter to the idea that drove the initial development of the Code, that is, "land for residential development is a scarce resource" (CDHRD, 1995a, p.152).

Housing design

Since the early 1980s, housing design guidelines and the regulatory environments, including planning and building regulations in Adelaide (and elsewhere in Australia) have been gradually adopting a 'performance-based' approach. These guidelines and regulations are primarily structured to describe the *ends* "leaving the means to achieve those performances to be chosen by the designers" (Williamson et al., 2003, p73-74). Many of the ends can have direct relevance to the issue of providing sustainable housing. The advantages of this approach are seen as,

a) giving clear information on what is trying to be achieved,

b) allowing for the use of alternative solutions,

c) allowing innovative designs,

d) giving designers flexibility in tailoring solutions to a particular context.

Nevertheless, in most cases these guidelines and regulations also describe some acceptable or deemed-to-satisfy solutions that can be seen as instruments for sustainable housing.

Guidelines for housing design often include issues such as lot layout and size, street setbacks, ensuring privacy, safety and security, the provision of communal open space, site facilities and landscaping, onsite-parking and access, design for climate, dwelling interior layout, acoustic protection in noisy environments and bushfire protection (CDRHD, 1995a, p. 147; Planning SA, 2000; Reardon, 2001a).

For architects and building designers, the *Environment Design Guide* that commenced publication in 1995 provides very detailed environmental design strategies (RAIA, 2001). The issues covered in these guidelines related to housing design include energy efficient design, climate response, windows design, thermal mass, thermal insulation, natural lighting and ventilation, perceived comfort, energy efficient artificial lighting, green building, construction, and ecologically sustainable design. On a bigger scale, it proposes retrofitting residential buildings to reduce greenhouse gas emissions, re-use/upgrading existing buildings, residential site analysis and development for energy efficiency and sustainability, sustainable transport in suburban areas, and guidelines for public spaces. It also introduces environmental impact assessment and suggests ways to minimize environmental impacts.

However, housing practices seem to not necessarily to comply with many aspects of these guidelines. For example, while guidelines often suggest that wide overhangs and verandahs represent an adaptation of housing design to the local climate by providing shade to ensure better summer thermal comfort (Reardon, 2001a, p. 37) and protection to walls during heavy rain, (Irvings, 1985b, in Paris, 1993, p. 102), the absence of these elements in new houses is common. Furthermore, in order to improve the thermal performance of houses it is usually recommended that East and West facing windows be kept to a minimum (Reardon, 2001a, p. 37). Many project builders and house designers seem however to ignore this advice and allow the windows distributed more or less equally on each direction without considering the issue of shading or solar access. Additionally, the popular open plan of the houses does not address energy saving ends as this type of dwelling requires higher energy consumption in heating and cooling because of their bigger volume compared to individual rooms. Open plan houses may provide a better thermal comfort in hot weather if the household uses fans and natural ventilation for cooling, however, as many houses are using reversed cycle air conditioners, the open plan does have negative effects. Finally, while the recent design guide *Your Home: Design for Lifestyle and the Future* (Reardon, 2001a, p. 15) suggests that garages should be incorporated into a house design in such a way that they don't dominate the streetscape, many new houses have double garages that dominate the front facade.

Building materials

In choosing materials for sustainable building, designers are generally recommended to consider issues such as minimizing waste, low maintenance, free of toxic emissions, long life, low embodied energy, and low life-cycle environmental impact (Reardon, 2001a, p. 23). Waste minimization is seen as a particularly important issue because,

> ... Australians generate approximately one ton of waste per person per year, which goes to landfill. Up to 40 percent of this is building waste. Minimizing and recycling this waste can have significant social, economic, and environmental benefits ...
>
> (Reardon, 2001b)

This objective can be achieved by adopting the following principles,

- Reducing consumption of resources by building smaller houses,
- Re-using existing buildings and materials. Don't demolish - deconstruct, give old buildings new lives,
- Recycling resources left over or have reached the end of their useful life,
- Using renewable resources like sustainable managed forests,

- Using materials with high recycled content to create a market for recycled resources.

Further, the RAIA *Environment Design Guide* (RAIA, 2001) gives guidance on the choice of building materials to reduce the operational energy use for heating and cooling a dwelling. Strategies such as using insulation materials in the exterior envelope and employing materials of high thermal mass (e.g. bricks, etc.) are suggested.

These instruments however do not consider the local availability or the social and economic acceptability of the materials. Considering these factors means that the choice of materials can be very limited. In 1998-99 around 90% of all houses built in Adelaide had brick veneer external walls, 95% had concrete slab-on-ground floors, and the roofs were either concrete tiles or corrugated steel sheets. One current trend that can be observed is an increasing use of lightweight external cladding on a timber framed structure. This type of construction is promoted as offering environmental and practical advantages over other forms of construction due to its low embodied energy and life cycle CO_2 production and not much difference in comparison to traditional brick veneer house in lifecycle energy totals (Bennetts & Williamson, 2000) (see Appendix C).

Water and energy systems

The application of technologies suggested in guidelines often includes water sensitive design, recycling storm water in the landscape, domestic waste water, and renewable resources (energy generation) (RAIA, 2001). Multiple water strategies, including reducing water demand, rainwater harvesting, reusing on-site waste water, waterless toilets, improved storm water management, have been recommended for sustainable development (Reardon, 2001b). Water harvesting and water recycling as instruments for sustainability, have been applied in some projects in Adelaide such as Mawson Lakes and New Haven Village. The water recycling system in these projects has been praised as a great solution to save water and to conserve a valuable resource because "no waste water leaves the site" (King et al., 1996, p. 86; Delfin Realty, 2000, p. 1). The AMCORD guidelines recommend storm water harvesting to "develop the resource potential of storm water to supply a range of second-quality water uses" (CDHRD, 1995a, p. 131). Using rainwater on gardens or for washing cars reduces the demand on the reticulated water supply. Storm water run-off into drainage systems can also be reduced by constructing on-site retention devices such as soakage trenches or wells. This has the dual advantage of reducing the infrastructure cost and the need to import water for gardens. Other water efficient methods including dual flush toilets, low water flow showerheads, planting native vegetation, and water drip systems for garden watering are now common in Adelaide. Rainwater tanks to capture and store rainwater run-off constructed of corrugated steel were a common feature of housing in Adelaide until around the 1970s. With increasing atmospheric pollution, the water stored in these tanks was considered unsafe to drink therefore the number of installed tanks declined.

Besides saving water, reducing fossil fuel energy use (and the associated greenhouse gas emissions) is identified as a major aspect of sustainable house design in most guidelines. Instruments for sustainable energy proposed in *Your Home: Design for Lifestyle and the Future* (Reardon, 2001a; b) include reducing demand by using passive design strategies, applying renewable energy technologies, choosing appropriate energy sources, for example, natural gas to reduce greenhouse gas emissions, and minimizing demand by efficient and careful operation. Efficient energy technologies such as ground source heat pump systems are recommended in some guidelines (RAIA, 2001) while renewable energy technologies including photovoltaic cells, solar hot water, wind systems, micro hydro systems, and wood from renewable sources are suggested in most design guide documents (Reardon, 2001b). Photovoltaic systems have been installed in some new housing projects, particularly where government subsidies are available (Delfin Realty, 2000; King et al., 1996). Although the cost of new technologies such as photovoltaic cells may be reduced in the future, it is likely to take some time before they are generally affordable. Moreover, the energy and resources used in the construction, operation, and maintenance of these recycling systems has rarely been reported, so the efficiency in energy, resources, and economy is not ensured.

Again, current housing practice seems to not comply with these sustainable guidelines and energy consumption in residential sector rather than reducing has experienced an increase of 10% in the last 10 years (see Section 3.2 above). Many guidelines are often ignored in practice. For example, house designers are encouraged to decide which rooms require frequent heating and cooling and to "make sure they can be closed off from the rest of the house and are well insulated" (Reardon, 2001a, p. 27) to reduce demand for energy, however open plan is popular in new houses.

In short, technological instruments seem to have little success in achieving their stated aims. While effort is put into applying these technological instruments, many social and environmental issues seem not to have been sufficiently considered in housing design. The "lifeless streets" in many newer suburbs (King et al., 1996, p. 85) is an example.

3.4.2 Social instruments

Household size and structure

The current decrease of household size in Australia from 3.0 in 1994 (ABS, 1995, p. 27) to 2.5 in 1997 (ABS, 1998, p. 52) and the increase of population (ABS, 1995, p. 13) create a higher housing demand, resulting in higher resources use and urban sprawl. The reduction of household size due to the increase of people living alone and the decrease of couples with children (ABS, 2001, p. 177) causes some social problems. Lone person households account for 24.6% of all households and the marriage rate was 5.9 per 1000 population in Australia, of which about half (2.6 per 1000 population) ended in divorce in 2001 (ABS, 2002a). This may have a long term effects because "divorces may impact on people's economic security in old age" (ABS, 2001, p. 54). The reduction of household size may be rooted in the individualism of Western culture where the individual benefit is given priority, and an individual can break a family if necessary to maintain individual benefits (Pham, 1999). The lifestyle of living alone and sole parenthood itself also has disadvantages. Half of sole-parent families have incomes below the poverty line and a higher poverty rate compared to other families (ABS, 2001). Sole parent families also face a higher crime risk rate in comparison to other types of family arrangement (see Figure 3.5).

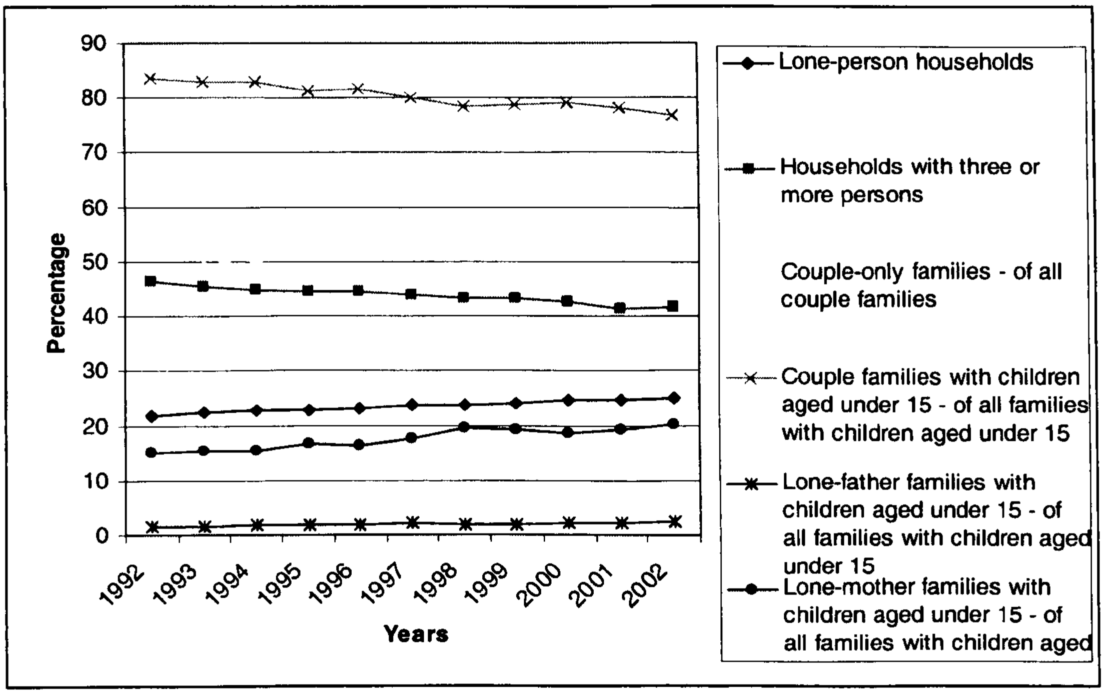


Figure 3.4 Living arrangement
(Percentage of households/families by types per total household/family types)
Source: ABS, 1995, p. 26

Saunders (CDHRD, 1995c, p. 36; 159) argued, "there may well be an inverse relationship between family size and well-being in families" when more than thirty percent of Australian children will spend some of their childhood in a one-parent family. About 52.7% of divorces involved children under the age of 18 (ABS, 2002a). In addition, a "high level of no-contact by non-custodial fathers with their children (40 - 50% in United State and Australia)" might not benefit the children (Cho & Yada, 1994, p. 25) and society as a whole.

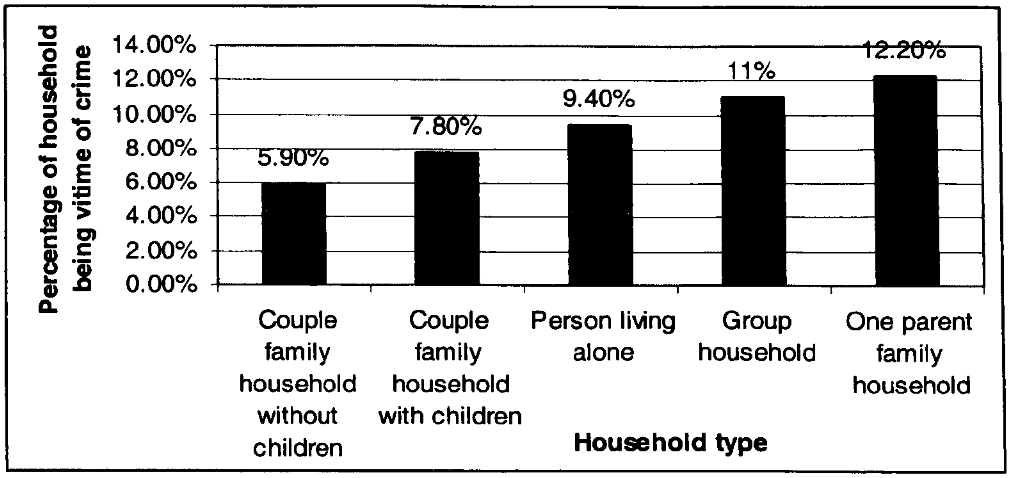


Figure 3.5 Victimization rate for household crime by household type in 1993
Source: ABS (1995, p. 137)

The current low and decreasing fertility rate - 1.7 children per women in 2002 (ABS, 2002a) - may lead to the ageing of the population resulting in a negative impact on economic growth in the long run. Adelaide has been labeled a city for the elderly due to its highest percentage of elderly in the population compared with other Australian cities. The effects of an ageing population are the possible reduction of innovation and flexibility that are needed for continuous economic growth, and a "rising burden of dependency, whereby a diminishing number of younger working people have to generate more and more income to support increasing number of pensioners" (Hall & Pfeiffer, 2000, p. 46-47). Added to this is the increasing high cost of health services and medication for the elderly.

Additionally, living alone and away from their grown up children may affect security for the elderly in emergency cases, and the elder parents cannot help the young family doing housework. Many young couples have to do all the housework by themselves to take care of children and go to work, therefore they have less time to relax. As the result, many women in Adelaide have to stay home as a 'housewife' to take care of their children while only the husband goes to work. This does not only affect economic growth due to the shortage of labour and high cost for social welfare, but also reduces the opportunity for women to participate fully in higher education, social activities, and careers. This also means that gender inequity may result.

Lifestyle of car dependence

The car dependent lifestyle of Australians also has implications for sustainability. About 89% of Australian households owned registered vehicles, with 48% owning two or more in 2000 (ABS, 2001). The high car ownership may cause high resource and energy consumption and create more environmental pollution as well as traffic congestion and accidents. Currently, many residents in Adelaide prefer houses with a double garage that require a larger and wider allotment size, causing a wasteful use of land.

Inequity in housing

Moreover, the affluent economy in Australia seems not to ensure a sustainable society, as there is an inequity in the provision of housing. While Australia has a distinctive housing system when compared with other Western societies, with a high level of owner occupation and home ownership rates among the highest in the developed urban industrial countries (Shearman & Sauer-Thomson, 1997), homelessness is still prevalent in Australia. "[O]ver one thousand people per day seek accommodation through the Special Accommodation Assistance Program (SAAP), but only a half can be accommodated" (CDHRD, 1995c, p. 165). In 2000, only 41,000 applicants were accommodated through public rental housing assistance while 213,000 other applicants were still on a housing waiting list (ABS, 2001). Although there is a "strong government support for the growth of owner-occupation" (Paris, 1993, p. 39), the problem of homelessness seems to come more or less from an unfair distribution when housing policies in Australia primarily benefit the wealthier classes (Paris, 1993). While many people have two houses, others are crowded into inappropriately small flats built in the 1960s, and pay a rent of up to 40 - 60% of their weekly income (ABS, 1995, p. 144).

> [For] the poorest Australians, few of whom have any hope of ever buying a home...struggle to meet rental payment... Homelessness is widespread, especially among the young and the best housing future facing many Australians today is a caravan or a secured place in a refuge.
>
> (Paris, 1993, p. 40)

Many Aborigines living in the poorest areas of cheap and run down rental housing is further evidence of the weakness of the social welfare system in Australia (CDHRD, 1995c). When social welfare systems do not support housing needs as a basic human right (UNDP, 1948), or the family structure does not operate to provide housing, social harmony seems not to be ensured.

3.4.3 Economic Instruments

Economic growth

Economic growth in Australia is successful in providing one of the highest GDP values in the world with a very low level of poverty. With the high income, housing prices seem to be affordable for many and the rate of home ownership is high. In 1999, about 70% of Australian households owned or were buying their homes (ABS, 2001, p, 177). In 1999, the average weekly housing cost was around 15% of average household weekly income (ABS, 2001, p. 158, 178).

The current rapid development of new housing areas around Adelaide seems to promote economic growth with little concern for environmental or social benefits. This development creates great benefit for housing investment and provides more housing for a growing population. The housing industry provides many jobs and economic benefits for the developers and city. The current government's subsidy (2002) for first home buyers aims at maintaining this industry, as the subsidy for purchasing new houses is higher than old houses. The vacancy chain effect should mean that the old houses could be expected to be available for the low-income people or homeless. However, it is likely that the low-income earners and homeless cannot afford these old houses as the price of housing, especially close to inner city areas, is increasing very fast (over 30% in the period 2000-2003) in Adelaide.

Fiscal instruments

The fiscal instrument of a full cost system is not applied to Adelaide housing. First, infrastructure costs in residential areas are generally either subsidized by the government (Paris, 1993), or aggregated across all uses of a facility. Secondly, costing of externalities (eg. landscape degradation) is not taken into account. Taken together this means there is no incentive for new urban developments to limit the urban sprawl and there is an economic barrier to the introduction of more sustainable technologies. Paris (1993) suggested two types of taxes for land use in the suburbs and city centres that could reduce urban sprawl in Australia, but these have not been applied. The current low price of electricity, which does not include the cost of environmental damages caused by burning fossil fuel, might not encourage people to save energy. Good and Service Tax (GST) has been applied in Australia for several years. The price of most products including electricity has increased, but seems to be still low compared to income.

Monetary instruments

Besides this, monetary instruments have recently created a low interest rate that has resulted in a high affordability for home purchasers. However, as many people can afford the bank interest, the housing demand is very high, causing the sharp increase in housing prices over the last few years. This in return may cause unaffordability in housing for many people.

Institutional instrument

Institutional instruments have encouraged home purchasing by providing some financial support for first home buyers and providing affordable home loans from banks.

3.5 Summary

Although Australia is a huge and developed country, it appears not yet to have developed the circumstances of sustainability. The country has environmental problems of land degradation, contamination of land and ground water, beach, river and air pollution, soil erosion, damage to the coastal ecosystem, limited fresh water, and water salinization. The increase in energy consumption in residential areas does not ensure sustainability since energy supply in

Australia relies mainly on burning fossil fuels. The urban sprawl due to low-density settlement, the lifestyle of being car dependent and the high energy and water consumption put burdens on the limited carrying capacity of the environment. The government has tried to set up many programs to protect the environment but they seem not to have been successful.

Some new housing practices have tried to promote sustainability but have not ensured sustainable outcomes. Detached housing has many spiritual and practical values in Australian culture, however, its increase in stock and the high consumption lifestyle of Australians continue to maintain high resource consumption.

When applying technological instruments, many new housing projects in Adelaide have addressed issues such as reducing urban sprawl, or incorporating new technologies such as recycling water, or using renewable energies, but seem to not have addressed adequately the full range of environmental factors or social and economic requirements. Housing design seems not to successfully provide indoor comfort conditions without air-conditioning, while recycling and renewable technologies may not ensure economic value when life-cycle costs are taken into account. Moreover, the current development of new housing projects in the outer suburbs may not be necessary if more efforts were put into urban consolidation and the renovation and rehabilitation of the older house stock.

Social instruments of family formation and lifestyles seem not to point towards long term sustainable outcomes. The simultaneous increase in the size of dwellings and the decrease in household size contribute to high resource consumption. The common living arrangement of lone people or single parent households not only causes high demand for housing but also seems not to always benefit people, especially children, economically and socially. Additionally, the lifestyle of high consumption and car dependence creates a further negative impact on the environment.

Although the economic instrument of economic growth in Australia seems to be successful, the fiscal instrument of a full cost system is generally not applied. The infrastructure and renewable energy technologies are generally subsidized in new housing developments and no tax put on new land use developments in order to discourage urban sprawl. The low cost of energy does not ensure the coverage of externalities and may not persuade people to save energy. Monetary and institutional instruments, however, have created a high affordability for house buyers.

Table 3.2 Opportunities and barriers to sustainable housing in Adelaide

	Opportunities	Barriers
Socio-economic and environmental situation	High GDP Economic growth fast (4-5% yearly) Small population Huge land with rich valuable minerals Have not much nature disaster High level of home ownership High living standard	Agricultural land degradation Contamination on land, ground water, beach and rivers Soil erosion Coastal ecosystem degradation Limited fresh water (Dry, little rain) Water salinization Energy based 91% on fossil fuels – greenhouse gas emission and consuming non-renewable resources High consumption lifestyle: car dependence, air-conditioners Low density settlements causes urban sprawls Ozone hole in the South pole Economic partly relies on extracting non-renewable resources
Housing technologies	**Traditional detached houses** Low density detached houses with big gardens provide economic and social/ spiritual benefits (vegetable supply, organic waste recycled, traditional heritage, close to nature, playground for children, enjoy gardening, green spaces) It also could provide good solar access	Low density detached houses with big gardens create urban sprawls causing agricultural land degradation, high transport demand: resources consumption and pollution. Also create garden wastes Inefficient in land and water use as people work outside Does not fit to single owners (small households) The average dwelling size increases
	Terrace houses Density, compact Traditional heritage Have garden	The number of terrace houses is very small compared to detached houses Have less solar access

	Opportunities	Barriers
Housing technologies	**New houses** Design smaller floor area and garden to reduce urban sprawls, save water and land Some are built inner city Use brown field in existing residential area (urban in-filled): Use light weight of construction to save resources (timber frame & brick cover) Use open plan to provide visual comfort & good ventilation Are socially preferred Recycle water to save valuable resources & reduce pollution Use solar hot water heaters Subsidies for renewable technological systems	Have poor indoor environment performance: windows not always face South/ North and lack of shade cause poor thermal comfort in summer and poor rain protection; Many are built far outskirts, resulting in high transportation demand Double garage requires wide allotment; concrete pavement, causing the lost of front garden (traditional heritage) and the large steel shutter affect aesthetic value Average dwelling size increases due to smaller households size Have some lifeless streets Lack children playgrounds Waste waster is not always recycled More use of air- conditioners Less composting and rain water collection Large glass wall sometimes face to West without overhang, causing poor indoor thermal comfort and requiring more air conditioners for heating and cooling Open plan requires more energy consumption for heating and cooling Many guidelines are not followed High initial costs Long-term payback investment Inapplicable in existing areas (major part)

	Opportunities	Barriers
	Introduce guidelines *Planning* Plan a pleasant, attractive, manageable, resource-efficient and sustainable living env. Provide a range and mix of lot sizes to suit a variety of dwelling and household types Provide lots that are oriented where practicable to enable microclimate management, including the application of energy conservation principles *Design* Design suitable lot layout and size & street setbacks Ensure privacy, safety, and security, Provide communal open space, site facilities and landscaping, on site-parking and access Design for climate, windows should face to north and south and keep the east and west facing windows to a minimum Apply energy efficient design, climate response, windows design, thermal mass, thermal insulation, natural lighting and ventilation, perceive comfort, energy efficient artificial lighting, green building, construction, and ecologically sustainable design Advise for dwelling interior layout, acoustic protection in noisy environments and bushfire protection. Reduce consumption of resources by building smaller houses Don't demolish - reconstruct, reuse give old buildings new lives *Materials* Recycle resources left over or have reached the end of their useful life Use renewable resources (sustainable forests) Use materials with high recycled content to create a market for recycled resources Use insulation in the exterior envelope Employ materials of high thermal mass	Guidelines are not always complied with in current housing practice
	Guidelines for Water and energy systems Use passive design strategies Apply renewable energy technologies (photovoltaic cells, solar hot water, wind systems, micro hydro systems, and wood from renewable sources) Choose appropriate energy sources Operate the systems efficiently and carefully Use efficient energy technologies such as ground source heat pump systems while renewable energy technologies Use water sensitive design Recycle storm water in the landscape and domestic waste water Reduce water demand Harvest rainwater Reuse on-site waste water Use waterless toilets Improve storm water management	No report on energy and resources consumption in building, operating and maintaining the recycling systems Energy consumption in residential sector has experienced an increase

	Opportunities	Barriers
Social instruments	**Individual lifestyle** Small households size ensures a more independent life Houses are affordable for many	Small household size with increasing in population requires high house need, causing urban sprawls and more resource consumption. Bigger dwelling size for smaller household causes inefficient used of resources. Living alone can be insecure in critical situations, have higher crime rate Divorce and living alone may not be beneficial collectively and individually, especially for children Aged population may cause a less innovative and flexible society, cost more for services and medications, and put impact on the national economy.
Economic instruments	**Housing distribution** Affluent have more than one luxury house High rate of home ownership	Inequity in housing distribution High rent compared to income
	Economic development Among the highest income in the world Housing is affordable, high rate of home ownership Housing industry creates economic growth and jobs Capitalist economy create wealth	More houses are built than current need, causing a waste of resources Market driven economic encourages consumption that may cause resources depletion Creates social inequity and exclusions
	Fiscal Subsidise for housing development, home ownership, renewable technologies, and efficient appliances Apply GST on consumption	Externalities are not applied Low energy price causes high consumption
	Monetary Introduce low interest rate to ensure affordability for housing	
	Institutional Banks provide home loan	

Chapter 4 The Hanoi context

4.1 Socio-economic and environmental situation in Vietnam

Vietnam is an economically poor country with a small land area (329,560 km^2) and densely populated. The population in 2001 was 79,939,014 (CIA, 2001b). Substantial economic development has been occurring over the past ten years after the ravages of war. GDP in Vietnam has increased two fold over the past decade with a growth rate of 5.5% per year and in 2001 was 1,950 USD per capita (CIA, 2001b). The main economic activity is agriculture that employs the majority of the population (70%) and makes Vietnam the third largest rice exporter in the world, but contributes only 25% to the GDP (EmulateMe, 2003b). The rest comprises 35% from industry of exporting crude oil, marine products, coffee, rubber, garments, shoes, and 40% from services (EmulateMe, 2003b). The rapid economic developments may help the country to increase economic growth to overcome poverty, but also cause a lot of environmental degradation.

Environmental degradation is caused principally by urban growth, industrialization, and population migration to cities. Current deforestation, soil degradation, poor management of forest logging, agriculture practices, over fishing, and surface and ground water contamination limit the sustainability of the environment and economy. In addition, natural hazards of occasional typhoons with extensive flooding put a heavy impact on the environment and economy.

> Logging and slash-and-burn agricultural practices contribute to deforestation and soil degradation; water pollution and over fishing threaten marine life populations; ground water contamination limits portable water supply; growing urban industrialization and population migration are rapidly degrading environment in Hanoi and Ho Chi Minh City.
>
> (EmulateMe, 2003b)

The ongoing environmental pollution seems to be the result of the overload on urban infrastructure systems and the lack of waste treatment. "The volume of urban and solid waste in Vietnam amounts to 9,100 m^3 per day, that only 400 m^3 is collected. Degradation of surface and sub-surface water supplies through industrial waste is increasing hazard" (Forsyth in Auty & Brown (1997, p. 521)).

The high population, together with increasing use of private motorcycles and motorcars, has caused serious pollution in cities of Vietnam. In 1996, the concentrations of CO, NOx, and dust particles in Hanoi were respectively 1.5, 2.5, and 43 times higher than permissible levels (Nguyen et al., 1996). Motorcycles account for 35% of all transportation modes now, but this is anticipated to increase to 45% in 2020. Cars accounted for only 1% of all transportation modes in 2000, but may increase to 5% in 2020 (HPC & Daewoo, 2000, p. 5-44). The introduction of low cost, low quality motorcycles imported from China in 2001 not only increased pollution, but also heavy traffic congestion and it endangered the safety of the passengers and the public. While the government has made efforts to solve this problem, none appear to have been very successful. The decision forbidding the importation of the motorcycles from China in 2002 seems to have had little effect because it was too late. The government's decision to switch from leaded petrol to lead replacement petrol in July 2001 may partly mitigate the pollution problem but the transition to the new fuel type will take time. Many roads and streets have been widened and built, however, with the rapid increase in private motor vehicle numbers, traffic congestion is still rife and "strikes people with a consternation" (Hanoi Moi, 2002).

Vietnam has tried to make a solid institutional start to environmental policy. In 1992, Vietnam formed the National Environment Agency within the new Ministry of Science Technology and Environment (MOSTE). In 1994, the National Law on Environment Protection (NLEP) became effective. With regard to industry, the law requires that all potential Foreigner Direct Investment (FDI) should submit an Environmental Impact Assessment (EIA). Forsyth (in Auty & Brown, 1997) argued, "Vietnam might achieve industrialization with considerably less pollution", but the chance seems to be small.

As Vietnam emerged from a period of isolation, it has become a party to many international agreements in an effort to improve its environmental situation. These agreements include the Convention of Biological Diversity, Climate Change Convention, Convention on Combating Desertification and the Effects of Drought, Convention on International Trade in Endangered Species of Wild Fauna and Flora, Environmental Modification Convention, International Hazardous Waste Convention, Oceans and Law of the Sea, Convention on Protecting the Ozone Layer, International Convention for Prevention of Pollution from Ships, International Wetland Convention, Climate Change-Kyoto Protocol, and the Nuclear Test Ban Treaty (CIA, 2001b).

The solutions to protect the environment seem to have been more in words but not much in action due to poor management. Environmental regulations protecting forest and valuable species have been published but barely complied with due to poor management. The government has a national program to grow five million hectares of forest but the implementation of this has been very slow. The media often calls for environmental protection in some limited issues such as keeping cities clean and green, however, there has not been any concrete plan, strategy or management to provide the facility and opportunity for people to carry out these tasks. At present, each city has an Architect-in-Chief to control building construction but many illegal constructions still appear due to corruption.

An essential problem is the lack of education in environmental issues. Environment subject has been introduced only in a few departments in some universities, but not widely introduced in the whole education system. It may be argued that the chance for sustainability is present but it needs a good management.

4.2 Energy sector

Coal provides 23% electricity supply in Vietnam, but has a poor quality. The old generators, such as the Ninh Binh[15] generator, create heavy environmental pollution to surrounding areas, and contribute to the greenhouse gas emission.

Since 1986, a large potential of natural gas has started to be exploited and used for electricity generation and may provide an energy supply for Vietnam while waiting for the development of renewable resources. Natural gas accounted for 19% electricity supply generated in 1998 and will be the major electricity supply resource in coming decades (Ha et al., 1999, p. 30) (see Figure 4.1). Although having a large potential, natural gas is non-renewable.

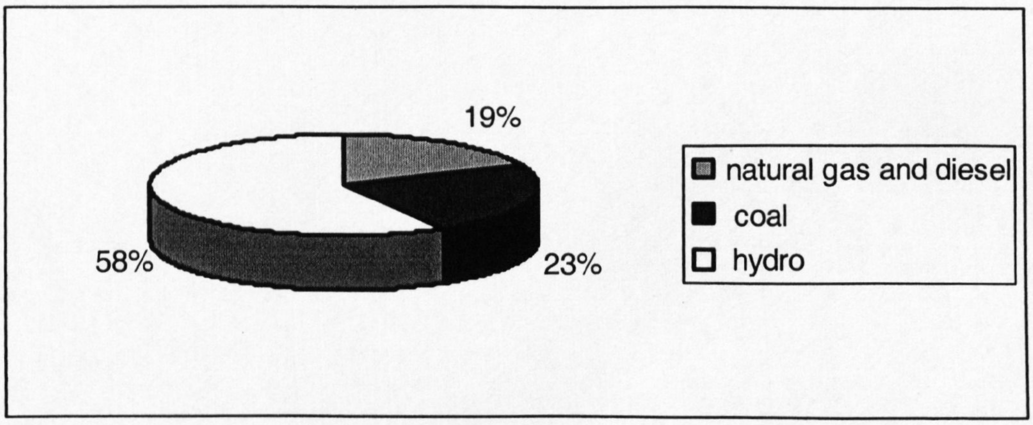


Figure 4.1 Electricity supply resources in 1999

Source: EI (2000, p. 1)

Although hydropower is renewable and at present provides 58.7% of the electricity supply (see Figure 3) and continues to be extended, the large scale hydro plants such as Hoa Binh, and Da Nhin[16] have caused serious environmental and social impacts such as a change in the local ecosystem, flooding, drought, and relocation of many ethnic groups around the

[15] Ninh Binh coal generator to the north of Hanoi was built in 1960s with the technical advises of Chinese experts. It has created heavy environmental pollution for Ninh Binh town due to its low quality technology and a wrong position in relation to wind direction. The whole town including people, houses, trees, roads are black as all particles and smoke from the generator are discharged into this town. It is said by Energy Institute sources that this generator will be closed soon.

[16] The Da Nhin hydropower station is built in middle of Vietnam (Khanh Hoa) with technical advice by Danish experts in 1998 – 2002 and loan from World Bank. To provide water for the reservoir, the Da Nhin hydropower station collects water from surrounding nine lakes. This caused a forced relocation of many ethnic groups that have been living on their land for thousand of years.

reservoir. In addition, hydropower is projected to be able to supply only 50% of energy demand in Vietnam in 2020 (EI, 2000).

While struggling with environmental management the energy sector in Vietnam has managed to explore some *renewable resources* but seems not to have been seriously concerned with sustainability. Although renewable energy has been used in Vietnam for decades (Hifab, 2000), and many big scale hydro power stations have been built, other renewable energies such as solar and wind powers have not been widely introduced.

Renewable energy such as solar, biogas, small hydro schemes, and wind power seem not to have been considered adequately for the future development of energy supply. Although having huge potential (EI, 2000, p. 17; EI, 1998, p. 9), renewable energies are only "considered as important resources for remote areas" (EI, 2000, p. 21), and are not indicated in the plan for energy resources in 2020 (see Figure 4.2) nor in any big scale energy program. Some small-scale biogas, solar, and wind power projects have been introduced in the countryside, but there is no Government policy to provide financial support for such projects. Support from foreign aid donors has funded several projects but the low quality of service from banks to obtain loans and the lack of maintenance and technical support services are barriers to the implementation of these schemes (Hifab, 2000). As organic waste is a high proportion (40%) of general household waste (Nguyen et al., 1996), it would be a sufficient resource for developing biogas projects. At present, two big waste treatment projects have been built in Hai Phong to treat the city's wastes and provide biogas. However, biogas was not included in the Government's future energy development plan released in 2000. Figure 4.2 shows the proposed energy resource mix in this plan.

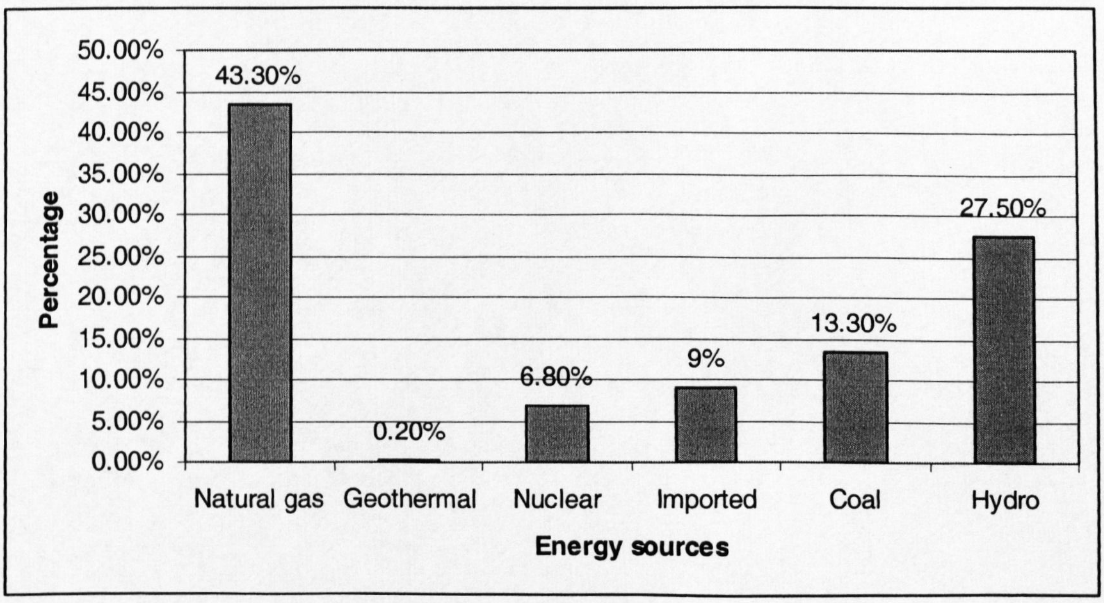


Figure 4.2 Energy resources for electricity supply in Vietnam in 2020

Source: EI, 2000

The current energy supply policy relies mainly on the non-renewable resources of coal and natural gas, and on the problematic energy resource of nuclear power. Due to the increasing demands for energy, the Energy Institute estimates that in the year of 2020, Vietnam will not have enough energy for its electricity supply (Figure 4.3) and therefore will have to import coal or electricity from Thailand and Laos. In this high consumption scenario, nuclear power reactors are being planned for energy supply (Ha et al., 1999, p. 28) (see Figure 4.2) and this obviously will have a high risk of environment damage. Vietnam has a low energy consumption per head per year (767.1 Kwh) (GSO, 1999) compared to other countries such as Thailand (1500 kWh) and Malaysia (2500 Kwh) (GSO, 1999; EI, 2000, p. 14). However, the increase in demand in the future seems not to ensure the sustainability of energy supply (see Figure 4.3). Demand Side Management (DSM) programs are currently being introduced at institutional levels (IE, 2000), but there has not been any practical implementation. The energy sector may need to reconsider its plans and take action to ensure sustainable development.

At present, an Energy Efficiency program has been introduced and applied in some public buildings in Vietnam's big cities (Hifab, 2000), but the household sector that currently accounts for 40% of electricity consumption (IE, 2000) has not been addressed in the program. Housing management therefore is an important issue in approaching sustainability since it causes many environmental impacts because of the huge consumption of energy and resources in construction and in daily life.

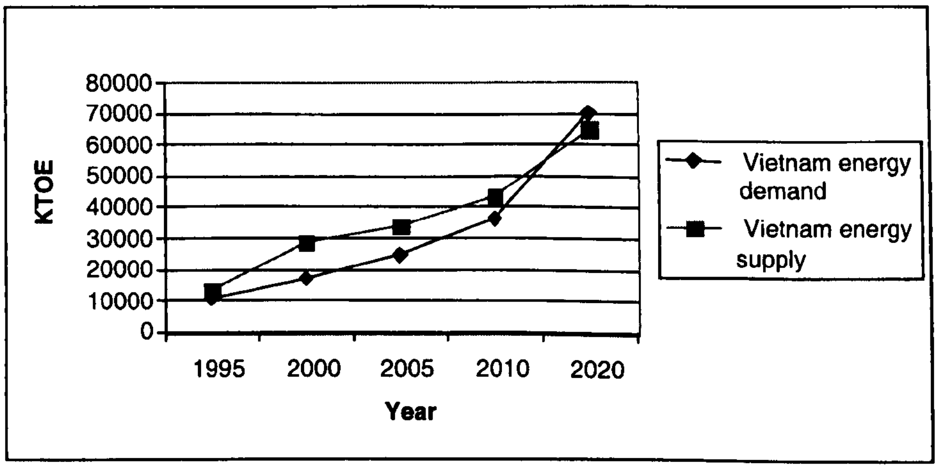


Figure 4.3 Energy supply and demand in Vietnam 1995-2020

Source: EI (2000)

4.3 The housing sector - Hanoi

Due to limited land, the rapid increase of population, and a poor economic situation, housing developments in Hanoi face many difficulties in approaching sustainability. Hanoi is much smaller than the Adelaide metropolitan region but has double the population. In 2000, the population density of Hanoi was 2,826 persons per km^2 in an area of 920 km^2 (HPC & Daewoo, 2000, p. 2-10). The high density is associated with the low housing area per capita. Currently, economic development has created the opportunity for Hanoi to supply the high housing demand, but housing supply is not sufficient. Over the last 40 years, the housing stock in Hanoi has doubled, but the population tripled (Nguyen et al., 1996, p. 5). In 1994, the average housing area per capita was 4.7 m^2 (Nguyen et al., 1996) but increased to 6 – 7 m^2 in 1998 and up to 8 – 9 m^2 in 2001. During this seven year period the population increased by about 500,000 (GSO, 1999; UNFPA, 2000). "Low income levels of the majority of the population have limited the development of residential projects" (HPC & Daewoo, 2000, p. 2-45). At present, "most of Hanoi's housing service facilities are at a low standard and in a bad condition" with 62% needing to be refurbished, of which 5% must be rebuilt (HPC & Daewoo, 2000, p. 3-2). A study of the demand for housing in Hanoi estimated 1,725,000 m^2 was required in 2000 but this will increase to 13,865,000 m^2 in 2020 including upgrading, renovating and newly constructed dwellings (HPC & Daewoo, 2000, p. 3-2). This shows that the housing sector will be under constant pressure in order to satisfy the demand for housing by all people in Hanoi.

With the aim of reducing the density of the city and providing adequate housing areas and standards for people, Hanoi plans to expand almost seven-fold its present size by 2020 (HPC & Daewoo, 2000). It shall add around 60 new urban projects to provide more housing for a population of up to 4,500,000 people in 2020 (HPC & Daewoo, 2000, p. 3-2). This master plan seems to be unfeasible because of lack of funding (HPC & Daewoo, 2000, p. 3-4).

Due to the current government policy that allows overseas Vietnamese and people from other provinces to buy houses in Hanoi, the population has expanded rapidly and housing prices increased up to five times from 1999 to 2001. Additionally there is a strong demand for investment in real estate with many of the rich now owning several houses, making it difficult for the poor and many middle-income earners to purchase a home.

There is therefore an urgent need to research carefully housing practices in multiple dimensions to avoid irreparable mistakes in the current rapid development. The slogan "Green, clean and beautiful Hanoi" seen daily in newspapers and on TV reveals the public concern in the ideology of sustainability. However, the notion of sustainability seems not to have been understood and pursued adequately by concrete actions.

4.4 Instruments to sustainable housing in Hanoi

4.4.1 Technological instruments

Hanoi was first settled around 1000 years ago. As Nguyen (1995) asserted, most traditional houses are well adapted to the local climate and socio-economic situation. Analyzing traditional technologies in designing and building housing shows that there are relationships between technological application and people's lifestyle or social issues.

Technological advice for building dwellings developed many years ago in Vietnamese culture. For example, Vietnamese folklore says for a good life, "marry a charming wife, and build your house facing to the South". A south oriented house would collect the cool wind during the hot summer, avoid direct sun into the house from West and East, and avoid the cold wind from the North during winter. In addition, this arrangement is believed to "better resist typhoons" (Phan, 1993, p. 17) that potentially cause great damage throughout Vietnam. Feng Shui theory also recommends South orientation as the best orientation for housing in Vietnam (Pham, 1998; Ngo, 1997; Vuong, 1996). In Feng Shui theory, the orientation, size, and interior of a house as well as its relationship to the surrounding environment are very important for the health, knowledge, and wealth of the owner (Vuong, 1996; Pham, 1998; Nguyen, 1996). Feng Shui is still applied in the design and arrangement of many houses in Hanoi.

There has been a succession of housing types developed according to the social, economic, and political situations. The following sections will examine technological instruments of different types of housing in Hanoi.

Tube houses

Tube houses[17] in the Old Quarter are valued in terms of their cultural, social, and economic attributes. They have represented the traditional urban house and lifestyle features of Hanoi's population for almost 1000 years (Rees, 1996; Hoang & Nishimura, 1990; Leonsson, 1995; Dang, 1996; HPC, 1996). The current environmental pollution that impacts negatively on the health of local people in the Old Quarter is related to the high density of the population, inadequate, over-loaded and degraded infrastructure and hygiene facilities (Rees, 1996). However, there are still a lot of values contained within the design and planning of this

[17] Tube houses in Old Quarter (Ancient Quarter) of Hanoi have been developed for almost a thousand year. The houses are narrow (2m to 6m wide) and deep (20 to 50 m length) and built attached to each other creating a dense living environment. Each house often has a shop or workshop in front. Living areas are located inside. There are dry and wet courtyards inside the houses used for different functions and provide natural lighting and ventilation for the house. Due to a lack of renovations or maintenance, the old toilet facilities do not suit to today lifestyle, the infrastructure systems are over loaded and damaged, and the houses are running down and having heavy environmental pollution and low living condition. There have been several research projects carried out to improve housing in this area but no actions have been taken, except a renovation of a house in Hang Buom street that is used as a museum.

housing area. Most current houses in Hanoi still follow the principle of land subdivision that developed in the Old Quarter.

This type of house and layout has an efficient way of using land, resources and energy. The long and narrow layout allows more houses and shops to be located on the streets compared to other forms of houses (e.g. detached houses), therefore reduces infrastructure requirements and transport distances. This efficient use of land not only reduces agricultural land degradation but also helps to maintain the valuable traditional-job villages[18] surrounding the urban area of Hanoi. The continuing construction of the tube house form along the new streets in Hanoi today is due to, first, the high cost of land and secondly, the economic value from the opportunity to open a shop in front of the house. The high density of this type of house has a compact urban pattern that seems to ensure efficient land use and contributes to energy and resources conservation.

Photograph 4.1 Streetscape in the Old Quarter of Hanoi in 1930

Source: Logan (2000, p. 107)

Tube house layout and design seem also to be an appropriate response to the local climate conditions. The climate of Hanoi is characterized as sub-tropical with high temperatures and humidity in summer accompanied by heavy monsoon rain, while the winter is relatively cold and dry. The high-density houses with yards shade the houses from the hot summer sun and the courtyards provide good natural lighting and ventilation for the house. The pitched roofs help speed up rainwater run off. The attached layout of the dwellings can also create good

[18] In Hanoi, there are many traditional villages where each village does a traditional job for hundreds years such as flowering, pottering, etc. The villages are often named by the products produced in the village such as Bat Trang for pottery village.

thermal insulation for the houses in periods of critical hot or cold weather. These techniques potentially create a comfortable indoor environment for people. The long and deep plan creates a quiet and peaceful place for living and the courtyards insulate the inside living zone from noisy business at front shop (Dang, 1996; Leonsson, 1995; & HPC, 1996).

The tube houses in the Old Quarter often have mix or multiple functions including trade, handicraft workshops, and living areas. This has created a rich cultural and social atmosphere and provided an opportunity to create income for the householders. The houses often have a shop or workshop in front for trading or producing handicraft goods while the inside area is mainly for living (Hoang & Nishimura, 1990). The current developing market economy in Vietnam is conducive to the development of small enterprises that can be arranged in a small shop or office at home. Hoang (2001) asserted its suitability to the socio-economic context of Hanoi. This is one reason for the preference of the Hanoi people for this house type (HPC & Daewoo, 2000, p. 3-1).

French house – an adaptation to local climate

French villas[19] (detached or semidetached) built during the French colonial times were suitable to the environmental conditions of Hanoi. The thick brick walls (330 mm) keep the houses well insulated from strong solar radiation during the summer and keep the houses warm during the winter. The windows have two layers with the shutter layer outside shading the windows from direct sun radiation while still enabling good ventilation for the house. A glass layer inside allows sun radiation to penetrate and heat the house in the winter. Most of the houses have pitched roofs that are suitable for the high rainfall in Hanoi. The elevation of the ground floor above a basement reduces the condensation effects caused by the humid climate. The building materials were mainly based on local resources such as bricks, timber, and tiles. Glass and concrete were used in a small proportion. Although the houses had two to three floors, these detached dwellings consumed a considerable amount of land, with allotments commonly in the range 500 – 600 m². This detached housing style, therefore, seems not to be suitable to the current high population and limited land supply of Hanoi today.

Post-colonial apartments

After the Independence in 1954, Vietnam started to build the country following a socialist system. A range of public housing was built by the government mainly for public servants. A very low nominal rent (sometimes no rent) was charged for these apartments. This housing

[19] During the colonial time (1850s – 1954), the French undertook substantial urban development in the city of Hanoi. The French extended and improved the roads in Old Quarter and built many new roads and buildings in French Quarter next to the Ancient Quarter. At this time, the infrastructure system including sewage, water supply, and electricity network were established for the first time. Many significant buildings such as museums, theatres, etc, and a large number of houses were built to provide facilities for the French officers and staff. This has contributed an important and beautiful part of Hanoi architecture. The buildings they constructed were based on French architecture of the time with some adaptation to local conditions.

was planned following a residential model adopted from Eastern Europe with each unit having apartments, small shop, kindergarten, and primary school. Most of the apartments were three to five floor walk-up style. Kim Lien was one of the first multi-floor apartments built in Hanoi in the 1960s. Some of the apartments in this area were built for single owners with shared kitchen, bathrooms, and toilets but now are used by families (Duffield, 1997). The apartments built later (from 1970s to 1980s) such as in the areas of Vinh Ho and Trung Tu have separated facilities but are of a low standard with an average floor area per apartment of 24 - 28 m^2 with a minimum standard for bathroom and toilet. North Thanh Xuan apartments built in the 1980s were the last apartments built following this model. The change from the planned economy to a market economy in 1990-1991 has meant that the government no longer provides housing.

Private self built houses

After the 1990s, most houses in Hanoi were self-built and can be seen to fall into two categories. One is a form of urban infill built on the unplanned land in villages in and around Hanoi and the other built on the government-planned land often on land reclaimed by filling lakes such as Thanh Cong and Dam Trau. These projects were aimed mainly at providing cheap land for Government workers. Within the past ten years, since 1990, the boom of self-built housing has contributed to a large housing area accounting for almost 75% of the total housing constructed in Hanoi (HPC & Daewoo, 2000, p. 3-1). This housing demonstrates a strong spirit of self-management believed somewhat impossible in the previous regimes.

The land subdivision arrangements in both these cases follow the tube house model but with generally a smaller allotment size of 30 to 50m^2 (HPC & Daewoo, 2000, p. 3-1). The houses are usually constructed three to four floors in order to provide the required space. King (personal meeting, 2001) suggests, these high-rise new houses show an adaptation of traditional housing to the new environmental situation. However, the lack of infrastructure in the unplanned areas and the filling of lakes have caused serious environmental problems such as local pollution and flooding.

With the multi-floor construction, the traditional pitched roof has often disappeared and been replaced with the concrete flat roof that causes a hot indoor climate and leaks due to its poor weatherproof resistance. Although there have been some steel roofing materials that are more durable and economic than tiles (for example, the Austnam products manufactured by the Australian company BHP) introduced into the industry, the application of pitched roof is still limited.

The walls are often constructed of 110 mm thick bricks, which are suitable for attached houses, but not for detached houses due to low insulation effect. The popular use of single glass layer in aluminium frame windows due to the low cost has negative impacts on ventilation and insulation for the indoor environment. Thick curtains may help to shade the house during the summer but ventilation is not ensured.

The courtyards that were a part of the traditional tube houses are often absent in these houses due to the small of allotment size. With windows on one side only (generally on the street frontage) and no courtyards, these houses have poor natural lighting and indoor ventilation (Nguyen, 1998). In addition, with the small allotment sizes, there is little chance for growing trees and shrubs in the house to promote environment quality or improve the beauty of the housing area.

While this type of housing is often initially designed by an architect and permission gained for their construction, many houses are also built illegally without building consent from the City chief architect. The lack of experience among the householders and the poor control of construction of self-built housing result a low housing quality with a mixture of different styles of architecture in a street. Many professional architects describe this as 'disorder' and has 'ruralized Hanoi's face' (Nguyen, 2000, p. 26; Dam, 2000, p. 33). While the diversity and mixture of many architectural styles might not be good in a professional architectural vision, others see that "the goals for the design or plan placed significant emphasis on users needs" (Cherulnik, 1993, p. 8). As such, the current self-build housing can be seen to respect the needs of users, and the symbol of freedom of the user in choosing their preferred housing. Nevertheless, the lack of knowledge of the householders in housing design has lead self-built houses to often have a poor quality indoor environment, inefficient use of space, inconvenient planning, and the use of unsuitable building materials.

New urban projects

Many new urban projects have been developed recently aimed at solving the 'disorder' of housing in Hanoi. About 25,000,000 m² of housing is planned for completion by the year 2005 in 65 urban projects in suburban Hanoi (HPC & Daewoo, 2000; Thuy Trang, 2002). These projects are expected to provide an adequate living standard for many people and build up a modern face for Hanoi. There are three types of houses including detached, street houses, and high rise apartments that will be built in these projects. In the urban projects Linh Dam Lakes and Dinh Cong, the number of high rise apartments is the highest, the street house the second, and the number of detached houses is very small. (See details in Chapter 6)

At present, these new urban projects have a good reputation among Hanoi people due to its good planning and service facilities, complete infrastructure system, big allotment and apartment size, and modern technologies (e.g. lifts in high-rise developments). These urban projects are often planned to provide all service facilities including supermarkets, kindergartens, primary schools, and recreational and sport centers. Allotment sizes in Linh Dam Lakes are around 200 m² for detached houses and 70 - 100 m² for street houses. The allotments have access to roads on two sides, front (main road) and back (path) (HUD, 1996) therefore windows and doors can be opened at least on two facades. High-rise apartments in these urban projects have a higher standard than the apartments built in the 1980s. The apartments have a floor area generally in a range 70 to 150 m^2 and big apartments often have two toilets and bathrooms.

However, a lack of concern for natural lighting, ventilation, and provision of a home garden still exists in these projects. Without courtyards, the rooms in the middle of many street houses do not have adequate access to natural lighting and ventilation. Most bathrooms, kitchens, and some guestrooms in high-rise apartments in Linh Dam Lakes also have poor access to natural lighting and ventilation. This causes a high reliance on the use of electric lighting and cooling appliances. The high density of the development compared to the green open area in a neighbourhood creates poor environmental and aesthetic conditions. The lack of trees and open spaces limits ventilation, shading, the provision of oxygen, and the absorption of carbonic and other polluting gases released from human activities and buildings. This also created a landscape with poor natural life that causes a bleak outlook in the neighbourhood. Under current regulations in this project, building area is limited up to 40% of allotment size for villas but the limit for new street houses is still very high (up to 90%).

Many new houses in Hanoi have four to five floors and have a floor area of up to 400 m^2. The trend of building a big house is likely due to social preference rather than the actual physical needs. There is a belief among many people in Hanoi that their house should not be lower than the next-door houses to gain more 'benefit from the God' (lộc trời). Hanoi society seems to highly appreciate wealth that is expressed in the current folklore "rich citizens, strong country". As a house is considered one of three major things in a man's life including "purchase a buffalo, marry a wife, and build a house"(tậu trâu, dựng vợ, làm nhà), in Vietnam building a big house is a symbol of social status.

By including a variety of types and standards, these new housing projects are aimed to supply homes for many income levels. However, the current high price of housing due to the high speculation (investment) means many low and middle-income earners have no chance to access these new houses.

Another problem is, as most of these projects are located in the outskirts of Hanoi, urban sprawl appears. The lack of provision of job opportunities around these urban projects may create a high transportation demand for the residents who work in the city centre.

Building materials

The common form of construction for all types of new housing is concrete frame and slab structure with mortar rendered brick infill walls. Practically no information is available in Hanoi to guide a designer in the use of sustainable materials. Some common sense therefore needs to be applied. The common building materials used in new housing including bricks, concrete (cement, sand and stone), glass, and steel are manufactured close to Hanoi from local materials. Brick is locally produced in both small enterprises and larger factories. Clay resources are plentiful around Hanoi. Kilns are generally coal fired and produce atmospheric pollution. Sand is exploited from the Red River in Hanoi. Cement is produced in Thanh Hoa and Hai Phong located about 50 km from Hanoi, and using local resources. Stone for concrete aggregate and limestone are also extracted from Thanh Hoa, Ninh Binh, and Hoa Binh (50 km from Hanoi). Steel is produced mainly in Thai Nguyen[20] (70 km from Hanoi). Glass is produced in Cau Duong factory in an outer suburb of Hanoi. As clay tile roofs cannot resist rainwater very well, are expensive and socially not preferable, flat concrete roofs are more popular. Austnam steel roofs introduced into the market around 1992 are now socially acceptable due to their good rainwater and heat resistance, ease of construction, good aesthetic appeal, and relative cost advantage.

Other commonly used materials such as timber (hardwood), chemical paints, and aluminium are obtained from sources that could be considered less sustainable. Timber used for windows and doors is often extracted from virgin forests in Vietnam, Laos, and Cambodia. The chemical wall paint imported from Japan has recently replaced lime wash. Aluminium is a new material introduced in Vietnam for making door and window frame.

Domestic technological systems

Domestic systems for waste treatment, water recycling, efficient appliances, and renewable energies have not been adopted in these new urban projects. Mixed solid waste is currently collected and discharged in dumping piles outside Hanoi. This causes serious environmental pollution for the area close to the dumping sites and for rainwater run-off and consequently for the ground water of Hanoi. Organic waste that accounts for around 50% of the total household waste in Hanoi (SIDA, 1994, cited in Nguyen et al., 1996, p. 11) could be a large resource for developing biogas. Biogas has been developed in some villages outside Hanoi but has not been utilized widely, especially in the city.

Waste recycling has been applied in Hanoi for hundreds of years on a small scale. A small proportion of waste including plastic, duck fur and down, paper, aluminium and iron are recycled in Hanoi. The recyclable waste is collected mainly by scavengers, who go around to buy and then sell this waste to recyclers. The recycling is generally conducted by small private enterprises that often have inefficient and polluting technologies, and are located in residential areas causing environmental pollution (Lindgård, 1995). A solid waste-recycling factory with a capacity of 150 tones has been built to produce organic fertilizer in Cau Dien, Hanoi (Ngoc Ha, 2002) but its capacity is still very small compared to the demands of Hanoi. Recycling human waste for fertilizing has been used in Vietnamese agriculture for a long time (Phan, 1993, p. 22) but the application of the modern flushing toilet and the introduction of

[20] A steel factory in Thai Nguyen was built with the help of Chinese government in the 1960s.

chemical fertilizer has over a period of time virtually removed this practice, especially in urban areas.

The sewage system is generally old and of poor quality (except in new projects), and water recycling has not been introduced in Hanoi. Sewage is mostly untreated and released directly into rivers and lakes in and around the city causing heavy pollution. Polluted water has caused food contamination through eating fresh-water fish and vegetables (through irrigation), causing negative impacts on the health of local people (Bellander, 1995). At present, a big project for water treatment in Westlake funded by the Netherlands will help in reducing environmental impacts in the area. However, many other rivers and lakes in Hanoi are not on the plan to be treated in the near future. Moreover, the old and overloaded sewage system in Hanoi causes flooding in many parts of the city in the rainy season, creating environmental and human health effects.

Energy end-use in the housing sector seems to be inefficient. As more energy-efficient appliances are often more expensive than others on the market, most households, especially the low-income earners, are not using high efficiency appliances. To reduce energy cost, many poor people limit the use and the number of appliances in their houses; for example, many households in Hanoi do not have a refrigerator, electric water heater, or space heater. This may cause social stress in their daily life. In contrast, the rich have many modern appliances and often do not care about energy cost, therefore, energy efficiency is not considered. Despite this, the current electricity consumption per capita is still relatively low because the number of the poor is high, but economic development is likely to increase the number of high-income people, and the demand for energy consumption.

The application of renewable energy resources such as solar hot water and electricity generation through photovoltaic cells is very limited in Hanoi. Although they have been introduced and produced in the Solar Lab in the Polytechnic University of Hanoi and Ho Chi Minh City for many years (Hifab, 2000), the implementation of these technologies is limited due to their relatively high price compared to the conventional options. Another point is that, with weak publicity, demonstration, and service, these appliances seem to be poorly accessible. The high humidity and cloudy sky especially in the winter mean Hanoi is not an ideal place for solar energy. However, solar hot water heaters have been used and gained acceptable quality in some households. Many households on an island in the middle of Red River where the national power network is not accessible are happily using photovoltaic cell technology for their lighting and powering televisions.

Transportation

The number of private motor vehicles has increased and public transport is not sufficient, causing an increase in pollution, traffic congestion, and traffic accidents in Hanoi. Since the subsidy of public transport in Hanoi has been cut in the 1990s, the proportion of all transport means attributed to buses has dropped in quantity from 80% in 1990 to 20% in 1996 (Reuterswärd, 1996). This has contributed to an increased trend in the use of private vehicles in the last 10 years. The latest master plan of urban transport for Hanoi expects to develop bus systems to provide up to 21% of traffic volume in 2020 (HPC & Daewoo, 2000) to serve people more frequently and on more routes. Due to the common habit of using motorcycles, combined with poor traffic management, and the high transport demand, traffic congestion and accidents occur everyday.

In short, housing in Hanoi has step-by-step improved in quality and quantity. However, there is a poor application of all valued traditional techniques in current housing practices. This often results in a common lack of natural lighting and ventilation, a waste of building material resources and energy due to the large size of some houses, the general use of inefficient appliances, poor management in the treatment of wastes and sewage and the application of renewable energy. By learning from traditional housing and by applying new available technologies, sustainable housing may contribute to remedying some of these problems. However, new solutions will not work if the users do not want to use them or cannot afford them. A study of the life style of Hanoi people would provide some basis for finding opportunities to apply technologies in housing.

4.4.2 Social instruments

Living arrangement

The Vietnamese extended family[21] provides people with a lifestyle that gives a secure social life and offers an opportunity for low energy and resource consumption. The traditional extended family was introduced in Vietnam through the influence of Confucianism from China (Pham, 1999, p. 1; Cho & Yada, 1994, p. 4) where "Confucius argued for a highly structured, hierarchical organization of society in which the family was the mainstay of social cohesion" (Whittaker, 1989, p. 15).

This living arrangement generally requires less material needs, saves energy and resources, because people can share a house, facilities, appliances, and housework. Morgan & Hiroshima's study in Japan 1983 asserted the benefit that is provided by grandparents who undertake most of the housework (Kurosu, in Cho & Yada, 1994, p. 182). In return, the young people will take care of the old people when they are ill and weak. As Anderson (1971, in Kurosu, in Cho & Yada, 1994, p. 181) points out, the extended family assists in critical life situations such as unemployment, illness, housing shortage, and old age as "[t]he family

[21] While the nuclear family is commonly defined as a family unit including only husband, wife, and their unmarried children, extended family includes not only the parents and their own children, but also married children and their spouses and offspring (Cho & Yada, 1994, p. 7). The extended family in Vietnam is different from China. In the extended family in China, all members of a big family including grandparents, all parent couples and theirs children live together in one house. The extended family in Vietnam includes only the parents, often the eldest son, his wife, and their offspring.

members would help one another in times of need" (Pham, 1999, p. 18). It also helps to teach people to behave with different generations in a society, to "adopt a united front to the outside world" (Pham, 1999, p. 18). This lifestyle also reduces energy used and cost of travel for communication between family members.

Beside these benefits, an extended family limits the independence of its individual members because a state of harmony of the extended family could only be achieved if everyone was aware of their responsibilities and carried out the duties appropriate to their position, and such sacrifices were a vital part of Confucius teaching (Whittaker, 1989, p. 15 –16). "[M]embers of a family were expected to subordinate their personal interests to those of the family as a whole", because "community was upheld and individualism as negated" (Pham, 1999, p. 18). This is in contrast to the supremacy of individualism in the Western discourse.

> The individual was not an independent entity, there was no individual in the western sense, and no free individual. Every facet of life was bound up with the family to which a person owned complete allegiance...while the reason of the Western family may be to produce and support the individual, whose maturity will signal the attainment of its objective, in the Vietnamese family the reason of each individual member was to continue, maintain and serve the family, and first of all people of the older generations.
>
> (Pham, 1999, p. 18)

The position of members in a family in Confucianism causes gender inequity especially for women. Izuhara (2000, p. 96) recorded a women's words in a field study in Japan "when you are a child, you should obey your parents; when you marry, obey your husband; then in your old age, obey your adult children". This sacrifice of individual needs for family needs in Confucianism (Pham, 1999) may conflict with the current Westernization of Vietnamese society. As the elderly are respected in Vietnamese society, they often decide all matters in the family including choosing their children's partner (husband/wife) and the younger have to obey them. This may have worked in the past when the elderly were more experienced and the changes in environment, society, and economy were slow. However, with the present rapid changes in lifestyle, the elderly may not be able to be up to date and therefore will not always be admired and obeyed by their children. The gap between generations on the perceptions of the issues of life may create conflicts when cohabitation occurs.

Due to Westernization and industrialization, Vietnamese society seems to be in a transition from this extended type to nuclear type families, but the change is still not rapid. At present, a study of the Hanoi People's Committee (HPC) has shown that the average household size in Hanoi declined from 4.97 in 1992 to 4.5 persons by 1996 and to 4 persons in 1998. It is projected to be 3.2 in 2020 (HPC & Daewoo, 2000, p. 5-6). The reduction in the household size relates to the two-child family policy that aims at slowing down the increase of the already high population and the transition from extended family to nuclear family. The industrialization and job distribution also force many people to move from home and to live alone to find a job. "[T]here is very clearly a more and more individual lifestyle being developed" in Hanoi (HPC & Daewoo, 2000, p. 2-31). However, a study of the transition of Japanese families has shown that although highly industrialized, and the availability of care centers for the elderly, extended families still exist. Many Japanese would feel shameful to send their old parents to the houses for elderly and they have built houses for extended family with two separated kitchens (Pham, 1999). This seems to be applicable to Vietnamese society too. Due to the influence of the traditional culture of living in extended families together with the lack of homes for the elderly, the extended family in Hanoi is unlikely to disappear in the near future.

Social relationship within neighbourhood

Vietnamese have highly valued emotional ties and attachment to relatives and the community (Tran, 1997). These provide a safe and secure social life for people in critical situations and a warm social relationship in the community. Vietnamese also tend to live close to their relatives and have close relationships within a community. This can be seen in the Vietnamese folklore '*sell far relatives buy nearby neighbours*'. The influence of Western lifestyle in promoting individual independence has however loosened the ties between neighbours. The social services of today also make these ties appear less necessary.

Westernisation in Vietnamese culture

Paul Mus affirmed that, "traditional Vietnamese society was not affected strongly by [French] colonialism" (cited in Pham, 1999, p. 7) in the early 20th century. However, the current open access to worldwide information through television, movies, the Internet, and trade contacts, means a degree of Westernization is unavoidable. Despite this, Vietnamese culture remains different from the West and the influence is eclectic. This can be seen in the contemporary Vietnamese saying '*eat Chinese food, live in a Western house, and marry a Japanese wife*'.

The influence of Western culture in Hanoi has caused an increase in the dependence on appliances and private vehicles and a high consumption lifestyle. Western conspicuous consumption is also evident with many people today wanting to show their wealth by displaying expensive things such as their big houses, or expensive motorcycles and motorcar.

Urban poor and inequity in housing

Although there is a general increase in income, the urban poor still exists in Hanoi, and accompanying this, slums exist. The job opportunities in the city attract many farmers from the countryside or other nearby provinces to come to Hanoi to work during the agricultural off-season. These people build shelters with any available material on unoccupied land and along rivers in the inner city. The shelters in these areas have no access to infrastructure such as electricity, water supply, or the sewage system and have a poor condition (Nguyen et al., 1996). These slums contribute to the inequity in housing. A study of '*Shelter for urban poor* *in Hanoi'* in 1996 (Nguyen et al., 1996) has investigated environmental impacts and proposed some solutions for improving these areas, but not much has been done since then. This does not only affect the aesthetics of the urban landscape but also creates a high criminal rate in the city as these slum areas also accommodate drug addicts and dealers.

Beside this, many people have not reached an adequate standard of living area per head. Many people are crowded into small houses in the Old Quarter with a space of less than 2 m² per person and share hygiene facilities with other households (see Table 4.1). The number of people living in a house with a standard of up to 6 m² per head is about 17.6% and up to 10 m² is 56.4%. The average housing floor area in Hanoi of about 9 m² per person (calculated from Table 4.1) is very low compared to about 50 m² in Sweden (Nguyen, 1998) and 60m² in Australia (calculated from average floor area per capita and household size in ABS (2002b)). In contrast, quite a few people live in big and some in luxurious houses.

Table 4.1 Housing area per person in Hanoi Census 1999

Housing area per person	< 2 m²	2 - 4 m²	5 - 6 m²	7 - 10 m²	> 10 m²
Number of people living in each housing standard	1,380	41,472	550, 913	1,310, 264	1,472,149

Source: UNFPA (2000, p. 37)

Housing distribution has never ensured equality in Hanoi. After the independence of Vietnam from French colonization in 1954, there were strong moves to redistribute housing and property from the rich (Tư sản – Capitalist/ Bourgeoisie) to the poor (Vô sản - Proletarian). At that time, under the policy of the Socialist government, many of the rich who had more than one house were forced to give up their houses or rooms in their houses to the poor to ensure a 'fair society'. This however is not applied any more. While many people today have more than one house and do not share with any one, many of the ex 'capitalists' who gave their own houses for others, now struggle to find accommodation for themselves or their children without any help from the government.

In short, the tradition of extended family and living in a close community relationship has provided an efficient lifestyle and safe society. However, the current Westernization and industrialization and the change in social values have created individualism and high consumption lifestyles. The market economy creates different income levels causing inequity in the distribution of housing.

4.4.3 Economic instruments

Economic growth

Although economic growth is relatively fast (5 – 6 % in 2002) the GDP per capita remains amongst the lowest in the world, with most Hanoi people still struggling to meet their basic daily needs. Therefore, it seems to be unrealistic to think of providing truly adequate housing for all people especially at the present, when housing prices are high. In Vietnam, there are no facilities to arrange loans to purchase a house (HPC & Daewoo, 2000, p. 2-31). All housing purchases are done on a cash basis. It is impossible therefore for many middle-income earners[22] (without capital assets via inheritance or similar), to afford an average standard two-bedroom 70 m^2 apartment that costs around 25,000 USD (market price in 2002). The prices are lower for old or small houses, but these houses often do not have adequate living standards. In addition, there is a lack of rental accommodation at affordable prices. There are two reasons for this. First, few surplus houses are available for the rental market, and secondly with few Government controls on landlord/tenant arrangements, renting is an insecure venture.

Poor financial resources also force people to care about quantity rather than quality, initial cost rather than long term running costs. In many cases, people would build their house with a better quality if they had more money. Many people are concerned about having a lot of space to secure the accommodation for their children's families, or to gain reputation in the society, but not much on the quality of the house due to limited finance. In many cases, the houses are built for an extended family including parents and their children's families to live in. However, very often children move out to gain employment far from home or to be independent; the houses become too big for its real use, causing wastefulness in building material, and running and maintenance costs.

The government also has little financial ability to subsidize housing. City policy makers have tried to build a variety of housing types and standards to attract different income earners including low cost housing for sale. Generally, low cost is often associated with low quality of construction and poor living standards, and therefore requires high maintenance costs that are not economically sustainable in the end.

Nevertheless, city managers have rebuilt some old multi-floor apartments in the city to provide better living standards for some people and still ensure economic benefit. Some five-floor apartments in Kim Lien built in the 1960s have been rebuilt to be ten floor modern apartments. The old occupants will remain in their former location while the upper floor apartments will be sold at a profit to pay back the construction cost of the rebuilt work. This has provided better housing for people with no cost and even some economic benefits. The rebuilding has alleviated the poor environmental quality of the old living condition where the residents had to share toilet, kitchen and live in cramped conditions. The city will expand this idea to most other old apartments in the city.

[22] A lack of comprehensive statistical data means making statements about the housing situation or personal income difficult. Experience of the author suggests the middle-income range is 2,000 – 2,500 USD per year in Hanoi.

As the number of these successful projects is small, the city still needs to budget to provide a subsidy new housing development. One way to create finance is through income taxation. Tax on income, on second home ownership, and on high consumption would help to create financial resources for building housing for disadvantaged groups in society to ensure a social equity.

Electricity and water price

Electricity consumption of each household is measured by a meter that is managed well by the City Electricity Company. A staff member from this company visits every house to give the bill to the householder and collect the payment each month. This way makes the payment convenient for the user as well as letting people knows their monthly energy use. Electricity is charged on a differential price system (Hifab, 2000) that encourages people to save energy as higher users pay a higher price. However, the relatively high electricity price does put stress on low-income earners. The expenditure on electricity accounts for around 7% of average family income (HPC & Daewoo, 2000, p. 2-11).

In contrast, water price is very cheap and water use is not well managed. Water meters have been applied only in some areas in Hanoi. The supply and distribution of water are subsidized with consumers paying about 13.5 US cents per 1000 litters (see Chapter 6). In some areas, water meters are not installed, and the fee is not calculated based on the real consumption but based on the number of persons in the household. The cost can be as low as 80 US cents per person per month. Tap water supply is not reliable, has poor quality, and is even not available in some areas in the city (Nguyen, 1996; HPC & Daewoo, 2000), while in other areas people use drinkable tap water for washing cars and motorcycles. As clean water is a rare resource in Hanoi, the poor management of this resource is an example of an unsustainable practice.

In short, although economic growth is relatively fast, most Hanoi people are still struggling to meet their basic daily needs and housing is unaffordable for many people. The limit of finance causes the general low quality of housing construction and inefficient appliances. The city of Hanoi is building many new dwellings with better quality in new urban projects but these dwellings are generally unaffordable for most people in Hanoi. The current solution of rebuilding old and run-down apartments in the inner city to provide homes for old and new residents seems to be sustainable. Beside this, the fiscal instrument of taxation has not been applied efficiently in Hanoi to promote sustainable actions and social welfare. Electricity has applied a differential price system to encourage people to save energy but puts pressure on low-income earners. Besides this, water is used wastefully as the price is too low. Monetary and institutional instruments are not effective in the housing sector, as no home loan system has been introduced in Hanoi.

4.5 Summary

Vietnam is an economically poor country with a small area and is densely populated. The economy is based on agriculture. Environmental problems include deforestation, soil degradation, over fishing, limited ground water, and ground water contamination, combined with the natural hazards of typhoons and flooding. Urbanization causes air and water pollution due to poor waste and sewage treatment and the high number of motor vehicles in the cities. The government has almost no concrete plan and strategies for approaching sustainability. Energy supply strategies in Vietnam also have not ensured sustainability. Energy supply is mainly from hydropower (58%), coal (23%), and natural gas and diesel (19%). Renewable energies have not been promoted but nuclear power is now on the plan.

Due to the limited land, the rapid increase of population, and the poor economic situation, housing development in Hanoi confronts many difficulties in approaching sustainability. The high density is associated with the low housing area per capita. Apart from some new built housing, most houses are old and of low quality. Although current economic development creates opportunities for Hanoi to supply the high housing demand, it is still a big challenge for the city to meet the housing demand of the high and increasing population. The city of Hanoi is building many new housing projects on the outskirts to supply a large number of homes for people and reduce the density of the inner city, but this will cause city expansion or urban sprawls. Instruments of sustainability have not been applied efficiently in the Hanoi housing sector.

In terms of technological instruments, although Hanoi has step-by-step improved housing quality and increased housing quantity, the poor application of all valued traditional techniques in current housing practices has often resulted in a common lack of natural lighting and ventilation, causing high energy demand for running the houses. A waste of building material resources and energy is due to the large size of some houses. While most building materials are locally available and have sustainable resources, imported tropical hard wood and chemical paints are not sustainable environmentally and economically. The general use of inefficient appliances and poor application of renewable energy have not promoted sustainability. The poor treatment of wastes and sewage causes environmental pollution that directly affects human health. Sustainable technologies for waste treatment, water recycling, efficient appliances, and renewable energies have not been adopted.

In terms of social instruments, the tradition of extended family and living in a close community relationship has provided an efficient lifestyle and safe society. However, the current Westernization and industrialization and the change in social values have reduced the number of extended families, created individualism and high consumption lifestyles. The market economy creating different income levels and the inequity in housing distribution caused inequity in housing.

Economic growth is relatively fast but the people's income in Hanoi is still low and housing is generally unaffordable. The limit of finance causes the general low quality of housing construction and inefficient appliances. Hanoi is building many urban projects to provide homes with better quality but due to the increase in real estate prices, these dwellings are generally unaffordable or unavailable for most people in Hanoi. The current solution of rebuilding old and run-down apartments in the inner city to provide homes for old and new residents seems to be sustainable. Beside this, fiscal instruments of taxation have not been applied efficiently in Hanoi to promote sustainable actions and social welfare. Electricity charged by the differential price system in Hanoi has encouraged people to save energy but can cause stress for very low-income people. Besides this, the water management is poor so that it causes wastefulness in use. Monetary and institutional instruments are not effective, as at present Hanoi does not have a home loan system. Table 4.2 summaries the opportunities and barriers to obtain sustainable housing in the Hanoi context analyzed in this chapter.

Table 4.2 Opportunities and barriers to sustainable housing in Hanoi

	Opportunities	**Barriers**
Socio-economic and environmental situation	High population creates rich labour force Economic growth is fairly fast Hydro power and natural gas are major energy sources	Small land, low GDP; high population Agriculture based economy Environmental problems: Air, water, soil pollution due to poor waste treatment, heavy traffic, and industries; Deforestation, over fishing, soil degradation Natural hazards very often (flood, typhoon) Energy demand is potentially higher than supply capacity
Technological instruments for housing	**Traditional tube house:** Cultural heritage Energy and resources efficiency Yards and pitched roof provided comfort indoor environment (ventilation, lighting, shading) A mix use of trade, living, and social life	The high density of housing and the old and degraded infrastructure cause air, water pollution, and cramped feeling
	Traditional building technique: South facing houses Feng Shui application ensures harmony between human, nature, and built environments.	
	French villas Well adapted to local climate: Thick wall, 2 layers windows (shutter and glass) provide shading, ventilation, and heat trap. Beautiful detached houses for Hanoi	Consume more land, urban sprawls, Expensive
	Post colonial multi-floor apartments (1960s – 1980s) Save land, resources in construction Provide more housing for people Convenient services as the houses were built by residential units (services available in the area)	Low standard of floor area per head, Poor quality of construction No maintenance causes a fast run-down

	Opportunities	Barriers
Technological instruments for housing (continue)	**Private self-built housing** *(Government planned housing and unplanned housing)* Developed from the tube shape houses Attached structure needs no insulation Save land and infrastructure Provide more housing for people Have diversity in style, size, and standard Present strong self-manage spirit Use local building skills and labours	Small allotment, especially in unplanned housing Low quality (indoor environment and construction) Inefficient and inconvenient plan due to a lack of knowledge in design Lack of infrastructure in unplanned housing Lack of construction management causing an disorder image in the streets
	New urban projects: Provide houses for many people Better quality houses, More green spaces and playgrounds Complete infrastructure, Services are provided Good planning	Unaffordable or unobtainable Located a bit far away from city centre
	Waste Some are recycled at local by small units (paper, glass, plastic, etc.)	Solid waste is mix collected and gathered in a dump site outside city Sewage is discharged to rivers inside and outside city. Recycling is very small and carried out in low quality manufacture units located in residential areas, causing pollution
	Energy Hanoi uses hydro energy	Solar energy (hot water and electricity generator) is rarely applied Most housing use inefficient appliances
	Transportation Some new buses were introduced to provide public transport inner city	Number of private motor vehicle increases, causing high pollution, traffic congestion, and accidents Poor public transport services
Social instruments	**Lifestyle of extended family** Extended family is common: help save energy and resources and ensure secure and warmness especially for elderly The change from extended family to nuclear family is not rapid Strong ties and attached to relative and community	Extended family limits the independence of individuals Potential change to nuclear family
	Westernisation: Westernisation with eclecticity	Westernisation and industrialisation create individualism and increase high consumption and the dependence on appliances
	Housing equity Provide better housing quality for some	Slums exist in the city Inequity in house and land distribution

	Opportunities	Barriers
Economic instruments	**Economic growth** Economic grows fast Variety types and standards of housing supply more variety of consumers Build low-cost housing for the poor City rebuilds run down apartments for old and new occupants	High housing price, low income, and no facility for home loan make housing affordability low People often care about quantity not quality, the initial cost, not long term benefit Low cost housing often has low quality that requires high cost for maintenance
	Fiscal Applied on electricity: differential electricity price encourages people saving VAT puts tax on consumption	Put pressure on low income user Subsidy in water: water is cheap and poorly managed causing waste of clean water use
	Monetary (Currently not supplied)	**Monetary** No home loan therefore no interest rate introduced for home loan Housing affordability is very low
	Institutional Woman unions sponsor some renewable energy projects	

Chapter 5 Field studies of housing projects in Adelaide and Hanoi

This Chapter introduces the work undertaken in the two case studies in Adelaide and Hanoi and describes the questionnaires administered to the principal stakeholders involved in housing including householders, planners, developers, and architects. The information collected in these questionnaires aimed to elucidate the elements of the multiple dimensions of sustainability in each local context.

5.1 Description of interviews to households

Housing projects selected for householder field surveys were the suburbs of Novar Gardens and Coventry Gardens, Adelaide (combined to form the Adelaide sample) and the Linh Dam Lake urban project in Hanoi. Each is a similar distance to the city centre (7 - 8 km). The dwellings in each area were all newly built within the past three years and are expected to represent the latest technological, economic, and social standards of housing developments of the two cities. The new housing project in Hanoi includes some multi-storey apartments, some street houses, and a few detached houses. This is typical in all new urban projects that have been developed in Hanoi recently. The housing projects in Adelaide include single or two-storey detached houses and some attached (row or terrace) houses, representing the typical new housing developments in the Adelaide metropolitan region.

The selection of sample households for interviews was random in each area with all the households having the same chance to be involved in the study. The sample number was limited to around 40 households due to many reasons such as the limit of time and budget, and the difficulty in getting householders who were willing to be involved in the study. Although the number of the sample was small, as the study used a long and detailed interview, it was sufficient to collect data about the housing practices and the residents' perception about housing and sustainability issues. As described below the household sample for interview was essentially achieved by knocking door by door in each location. While this has not achieved a random sample, it is believed the sample is essentially representative of the area. The interviews were conducted by the author on different days in a week and at different times in a day so most of the households were reached. The interview period was from January 2001 to the end of April 2001.

To be equal, this study did not choose green or sustainable housing projects although many were labeled so in Adelaide because sustainability has such a vague meaning and the majority of households (especially in Hanoi) would not know what it means. However, in addition to the main study areas in Adelaide a small number of households in the new suburb of Mawson Lakes were surveyed using mail questionnaires instead of direct interviews. Mawson Lakes is a new built housing area located about 12 km from Adelaide centre and was named, or more accurately, advertised as a 'sustainable housing' project with the application of recycled water and using renewable energies. The results of these surveys are not included in the main fieldwork analysis.

5.1.1 Novar Gardens and Coventry Gardens in Adelaide

Novar Gardens is located in the City of Marion and is about two kilometers from Coventry Gardens in the City of West Torrens (see Map Figure 6.1.1). They are both located in the South-west corner of the greater Adelaide metropolitan area. Each housing area has about 50-60 households. They are located very close to each other and were built at almost the same time on vacant land in existing living areas with service facilities. The prices of the houses in these areas are up to four to five hundred thousand Australian dollars at the time.

The solution of urban consolidation used in these areas has value by saving resources in infrastructure and service facilities and creates lively neighbourhoods. This principle has been claimed as being efficient in land use and resources consumption by CDHH (ADFAT, 2002). These housing areas are located in convenient locations, at about four kilometers from the beach, three kilometers from city airport, and a couple of kilometers from the biggest suburban shopping centre in South Australia (Marion shopping centre). The Novar Gardens land was previously 'a drive-in picture theatre', and Coventry Gardens was market garden land that had been abandoned for a long time. The surrounding area of these two housing areas includes older housing areas and recreation areas of horse riding and soccer fields. The local shops and primary schools are small but within five minutes walking distance. Bus stops are five minutes walk away but transport does not operate frequently during the weekends and is not available after nine o'clock in the evening to go to the city centre.

The interview process faced some difficulties in the beginning in gaining access to households, but finally achieved a successful result. A hundred letters written by the Head of the School of Architecture, Landscape Architecture and Urban Design, University of Adelaide were sent out to households by mail to ask for the acceptance of interviews at the end of March 2001. After one week, only four households called to make appointments for interviewing. Faced with this situation, the solution of door knocking was decided upon. Most interviews were conducted in an easy atmosphere when people seemed to be relaxed and interested. When they were told that the interview would take thirty to forty minutes, they were hesitant to take part, but when the interview had been completed, they thought that it was short.

5.1.2 Mawson Lakes

Mawson Lakes is a well-known new developing housing area that is expected to be a model of more sustainable housing in Adelaide. This area has planned to apply high technology such as water recycling and households are encouraged to use solar energy and there is a commitment for households to cut energy consumption by 35 to 40% of conventional housing (Delfin Realty, 2000). The area is located twelve kilometers from the city centre, next to Technology Park and the University of South Australia. There are not many existing houses in the surrounding area. Mawson Lakes is a new urban project, planned to provide accommodation and all service facilities such as school and shopping centers.

The author delivered the questionnaires to the local people at a community meeting after a short introduction about the study and a call for participation. After understanding the aims and content of the research, all the people agreed to participate. There were more than twenty people in the meeting. After several weeks, only seven questionnaires had been filled in roughly and returned by mail.

5.1.3 Linh Dam Lakes in Hanoi

A survey of current new housing practice in Hanoi was carried out in Linh Dam Lakes, a three-year old housing project (see Map Figure 6.1.1). This housing area has gained a high reputation among Hanoi people, developers, and city planners (interviewed in Hanoi). The market price of the houses in this area is increasing rapidly. While some houses have been occupied, other houses in the area are still under construction. Many apartments and houses were sold before they were built due to the preference of the local people. The area is supposed to house 5,800 people in a floor area of 138,190 m² (HUD, 1996). This project is one of fifteen big urban projects that are planned for development in Hanoi within the coming decade. There are three types of housing, which include flats, attached houses, and detached houses (named as villas) in the area. Among them, attached and high-rise apartments make up a large proportion.

Table 5.1 Land and construction area for each housing type in Linh Dam Lakes

Type of houses	Land area	Construction area
Attached houses	16,735 m² (60.6%)	51,697 m²
High-rise apartments	8,230 m² (29.8%)	78,501 m²
Detached houses	2,664 m² (9.6%)	7,992 m²
Total	27,629 m² (100%)	138,190 m²

Source: HUD (1996)

Only one nine-floor block that includes about 54 apartments, about thirty attached houses, and nine detached houses was completed and most of the dwellings were occupied at the time of interview. The research surveyed a high percentage of available dwellings including 20 attached houses (80%), 20 flats (45%), and three villas (30%).

The interview was reported to the housing management office of the area before commencing. The method used to get people involved was to knock at the householder's door and ask for their co-operation in the interview. Most people actively participated in the interview. The householders in the flats and attached houses were easier to get in contact with while it was rather difficult in the case of villas. It was more difficult to get people who lived in villas to be involved in the interview. Most of the interviews were conducted during the weekend because the occupants worked during the day. It took more than seven weekends to complete the whole series of interviews. The area is located about eight kilometers from city and it took some time to travel there by motorcycle, as there was no public transport available to reach this suburb.

5.2 Examination of the social characteristics of households surveyed

Age of residents

Table 5.2 shows the age breakdown of household residents surveyed in Adelaide (AD) and Hanoi (HN). The number of residents in the group aged from 0 to 6, from 7 to 17, and from 35 to 54 was similar while the number of respondents aged from 18 to 34, from 55 to 64, and over 65 were different in the two cases. The number of respondents in the age group from 18 to 34 and from 55 to 64 in Hanoi was higher than in Adelaide while the number of residents at age group of over 65 in Adelaide was higher than in Hanoi (Table 5.2). In general, the population in Hanoi was younger than in Adelaide.

Table 5.2 Number of household residents by age in the two cases

Age of residents	AD	HN
0-6	10	13
7-17	16	17
18-34	10	51
35-54	47	53
55-64	4	21
>65	24	7
Total	111	162

Gender

Other social characteristics of respondents and the residents such as gender were not significantly different between the two cases (Table 5.3). While 39% of respondents in

Adelaide were male, 55.8% of all respondents in Hanoi were male. While the interviews were being conducted in Hanoi, it became obvious that although the couples were home together, the men were to be considered as in charge of answering questions while the women were often busy working in the kitchen and therefore could not be involved in the interview. Even if the woman was not busy, she said she had no idea and trusted her partner. Sometimes, the females contributed some ideas that were different to the men, but in most cases, the couple agreed with each other in answering the questions in the interviews. The behaviour of respondents in Adelaide was slightly different, as the women and men seemed to have the same behaviour in taking the interview. In some cases, the women were involved in the interview while the men were doing housework or the other way around, the men involved in the interview while the women were doing housework. Some interviews in Adelaide were conducted in the presence of the couple and they often agreed on most points.

Due to the similarity in the age and gender structure of respondents between the two cases, and the random selection of samples, it is possible to compare the findings from the field survey with less bias.

Table 5.3 Gender distribution of the residents & respondents

		AD	HN
Respondents	Male	16 (39%)	24 (55.8%)
	Female	25 (61%)	19 (44.2%)
Residents	Male	52 (47%)	88 (54%)
	Female	59 (53%)	74 (46%)

The questions used in the field surveys followed the structure of instruments of sustainability as developed in the previous Chapters. It therefore included three main parts of technological, social, and economic instruments.

5.3 Questionnaires to households, purpose and scope

The questionnaires used to interview households include six parts and contain 58 questions about the knowledge, perception, attitudes, and actions of households in terms of housing, resources use, environmental concerns, and sustainability (see Appendix D). The questionnaires were the same for Adelaide and Hanoi; the Adelaide one was administered in English and the Hanoi one in Vietnamese.

The questionnaires include most facts about housing developments in the two cases to understand the local contexts in the two cases. In sociology, Hall and Pfeiffer (2000) pointed out "personal preference, individual lifestyle, local patterns of activities and inherited values all influence social behaviour and the social fabric", and "key features, which interact, are the role of family, the involvement of women in the labour force". So these issues were included in parts one and two of the questionnaires. In terms of environmental performance, Rudlin and Falk (1999, p. 84) asserted:

> ...efforts to improve the environmental performance of housing have gone down something of a blind alley. Most effort has gone into the thermal efficient of a small number of new housing and has largely ignored the existing stock as well as other forms of domestic energy use such as appliances and transport.

Domestic appliances and households' daily transport were investigated in part three of the questionnaire.

Part four investigates the reason for delay in applying technological instruments to promote sustainable environment in Adelaide and Hanoi. The investigation of perception, attitude in the willingness to apply these technologies is necessary. Beside this, as households often have limited knowledge about sustainability or sustainable environment (Becker, 1999), part five of the questionnaire investigates this to define the roots of the problems.

Most questions were constructed by the author following the purpose of the study. Some questions were modified from some questionnaires of previous relevant studies. The majority of categories in some questions were referred to, and modified from the standard questions such as in Census (1996) or Environmental Issues (ABS, 1994) and from studies of Australian Bureau of Statistic (ABS, 1995; 1996).

Part 1: General social issues

The first part investigates general social issues related to housing. Question 1 starting the interview collects data of the name, occupation, and education level. The category of ages of the household members followed the category in ABS (1995) with simplifications and modifications. It follows the different stages of human life from birth to starting school, finishing school, fertility age, middle age, and retirement. The questions of occupation and education are built with the purpose of defining the relationship between people's jobs, their education levels, and their attitude and behaviour to environmental issues. They are open questions, and the answers were coded as the standard categories in surveys of ABS (1977).

Questions 2 and 3 ask about age and the number of generations in households. These questions investigate the character of the household and their lifestyle. To study the social aspect of the family structure, Question 4 aims at identifying the living arrangements of households. The classification of living arrangements used the standard category of Australian Bureau of Statistics 1995 (ABS, 1995, p. 26) with an additional category for couples with independent children and extended families that exist in Vietnam. When studying the extended family, identifying the extended members would help to define the common form of the living arrangement in the households. Traditionally, the extended family members in Vietnam consist of grandparents. Questions 4c, 4d, and 4e study where and how their grandparents are living as well as their difficulties. Question 5 examines the satisfaction of respondents with their current living arrangement. Question 6 investigates why they do want or not want to live with their parents. These questions aim to identify the potential change, advantages and disadvantages of this type of living arrangement. These questions, put in Adelaide and Hanoi contexts would help to compare the social values of family in the two different cultures.

Part 2: Housing preferences

The second part of the questionnaire seeks information on housing preferences. Question 7 examines the type and source of finance the households used to pay for the house. This aims at defining ownership and affordability of the household - which are the major indicators of human needs in relation to housing. The investigation of important requirements when choosing or building a house in Question 8 aims at providing important elements of a householder's perceptions about sustainable housing. This would be a substantial basis for defining elements of sustainable housing frameworks. In order to identify the barriers for the households to meet their own choice, Question 9 examines the reason for the households to choose their current house. This will present the priority and trade-off solutions made by households. This is a very important suggestion for current housing policy to define the key issues that concern householders and orient solutions for sustainable housing. Besides this, Question 9b studies gender equity in making decisions in choosing the house of the occupants. The preferred space in a house was investigated in Question 10, which aims to define the priority of their daily social life. This would suggest designers and developers invest and focus more on users' preferred spaces to better meet the needs of users. It is important to note that kitchen and toilet were not considered as an important part of the house in traditional housing in Vietnam. This study would identify the change in social perspective in housing in Hanoi. It also helps to compare different values put on different places in a house of the two case studies in Adelaide and Hanoi. The comparison of the preferred places of different genders in a house may help to identify important places in different gender perspective.

Question 11 asks the households to compare the values they put on different aspects of housing including the preferred house, the relationship between neighbours, and the environmental quality of a housing area. These aspects represent three dimensions of sustainability in housing including the economy, society, and the environment. The ranks the households put on the importance of these three aspects will be used to define the priority and value that people put on different dimensions of sustainability. This also helps for a comparison of the values the respondents put on dimensions of sustainability between the two cases.

Questions 12 and 13 include some concrete questions about the satisfaction of the household with different social, environmental, and economical issues in housing. The issues include social, environmental, and economical aspects. This will double check the perceptions of respondents about their current housing situations, the problems they are bearing, and the priorities and values that they put on different issues in housing. The categories of the issues are referenced from the categories of Environmental Impact Assessment (Glasson, 1994).

Questions 14, 15 and 16 investigate the perception of respondents about indoor environmental conditions in terms of thermal performance and natural lighting and ventilation of the house. This will be used to assess the user perspective of the current indoor living environment. The answers will also define the successes and failures in current housing design in terms of the performance of indoor climate.

Question 17 investigates the perception of the respondents about indoor environment in extreme climatic conditions and their attitudes and actions in response to these conditions. These questions relate to people's concerns about energy conservation when achieving their thermal comfort. Question 18 seeks the willingness and actions to improve the living condition and energy saving of the households. In an indirect way, Question 19 defines the perception of a good house in the views of households through the advice they would give to their friends who want to buy a house. These questions were built based on the model of questions 21a, 21b and 26 of a previous study in the University of Adelaide (Olweny, 1996)

Questions 22 and 23 evaluate economic conditions and the affordability to purchase a house. This is one important indicator of the economic dimension of sustainability. Questions 24 and 25 identify the social dimension of sustainability through the householders' relationships within their neighbourhood and community. A relationship between income level and social life as well as environmental behaviour may be defined. The income levels may be related to domestic transport pattern, appliances, and energy and water consumption in housing.

Part 3: Domestic transport, appliances, energy and water concerns

The third part of the questionnaire examines the use of domestic transport, appliances in households, waste treatment, and the households' attitude to their energy and water use in housing. The aim here is to assess "resources and energy conservation in daily life activities" – important indicators of sustainability (Becker & Jahn, 1999, p. 223; Rudlin & Falk, 1999, p. 84).

Questions 20 and 21 study the usage of domestic transportation. It investigates daily travel patterns and respondents' attitude towards their use of transport and resources. The transportation means and the usage reported by households can show the current travel pattern. The efficiency of urban systems will be assessed by the convenience of public transport systems, and the distance to service and shopping centers. Asking households to assess their travel amount will help to identify the respondents' perception and attitude towards their use of resources and travel. A comparison between these assessments with their actual travel amounts will help to define the attitude of the respondents to their traveling lifestyles.

Questions 26 - 35 study energy and water use. Question 26 investigates the use of appliances in their houses. Question 27 studies factors the respondents considered when buying appliances. Question 28 examines the perception of respondents about their energy consumption. Questions 29 and 30 ask for a report of energy bills and the perception of respondents about energy prices. Question 31 investigates the perception of the households about their water use. Questions 32 and 33 ask about water bills and the perception of respondents about water price. Questions 34 and 35 investigate the current way of using water in the households, including for gardening.

Part 4: Technological application

This part of the questionnaire deals with technological systems that may be applied in the house including design and renewable technologies. Households were asked in Question 36 to indicate their methods of shading the house during hot weather. Question 37, 38, and 39 investigate the knowledge, the use, and the willingness of applying new or renewable technologies of water and energy. This part also studies the barriers to applying new or renewable technologies, and hence suggests solutions for future application.

Part 5: Attitude to environmental issues

A study of environmental attitudes is conducted in the fifth part in questions 40 and 41. Households were asked to indicate their priority order and the relationship within three issues: Environmental protection, economic growth, and increased human welfare. This was aimed at helping to understand the perception of the respondents about dimensions of sustainability. This may also relate to the knowledge of the respondents about the situation of the current environment that was investigated in Question 42 that asks about the link between global and local environmental problems.

Question 43 investigates respondent's attitudes towards environmental problems today to see if they worry about them or not. This may help identifying the reasons for taking action for environmental protection that is reported in response to Question 44. Question 45 studies if respondents see the impacts of environmental problems on their life. This may explain the reason for current delays in taking environmental protection actions. Question 46 examines households' perceptions about the reasons for current environmental problems that they had raised before to see if they could realize any of these reasons in their daily life activities. Question 47 asks what they could do to protect the environment to examine their knowledge and willingness to protect the environment.

Question 49 investigates the perceptions the respondents have about current environmental policies, technological applications, lifestyles, and economic instruments to promote sustainability to identify the barriers to the application of these instruments. The method of asking people to indicate their level of agreement or disagreements in a list of statements has adopted the method used in a study of the relationship between people and the residential environment conducted at the University of Melbourne (Robertson, Holley, & Downton, 1977).

Part 6: Housing design

The final part of the questionnaire collects information of housing design, size, the building materials, and the participation of a household in housing design and construction (Questions 50, 51, 52, 55, 56, 57, and 58). The examination of structure and land area aims to evaluate urban consolidation conditions that relate to resources and water use. Floor areas per head and material used in building housing will examine housing standards to evaluate resources and energy use. It is important to study the structure of windows, doors, walls, roof, and floor to examine the energy and resource conservation in housing construction. Question 53 asks households to indicate the disadvantages of different types of dwelling. The classification of housing types follows with a modification the classification in the dwelling type in Australian Social Trends (ABS, 1995, p. 140). Question 54 gathers general comments on new housing developments from people in general. Lastly, a collection of the designs of houses visited was made to provide evidence for analysis about the gaps between respondents' perception and actual housing design.

5.4 Questionnaires to planners, architects and developers

The aims of this part of the field studies were not only to understand the views of these stakeholders to current solutions to the new housing projects, but also to compare the perception of these different stakeholders about certain issues related to housing and sustainability. The questionnaires can be seen in Appendix D.and are described below.

5.4.1 Questionnaires to city planners

The questionnaires include four parts and contain 33 questions. Part one investigates general information about the respondents. Part two asks the perception of the respondents of housing issues. Part three examines knowledge and perceptions of respondents of technological systems application in housing. In addition, part four investigates the perception of respondents of environmental issues. Many questions are similar to those in the questionnaires to households.

Part one includes Questions 1, 2, 3, 4 and 5 investigating name, gender, age, office, and position in the office, and the length of service of the respondents.

Part two studies the perceptions of respondents of housing issues. Question 6a investigates the housing development plan and priorities factors in the two coming decades to see the current trend of housing development.

Question 7 asks the respondents to indicate their perception of a good housing project. This question is also used in household interviews to compare these stakeholders. Question 8 asks the respondents to indicate a good housing project in the city that they had been involved in over the last five years. Question 9 then investigates the main issues considered in this project. Questions 11, 12, 13, and 14 examine the consideration of factors of density, natural lighting, cross ventilation, and high-energy efficiency in this project.

Question 10 asks the respondents to give their understanding of the term 'sustainable housing' to compare the perception of the stakeholders between good housing and sustainable housing.

Part three studies the knowledge and perceptions of respondents about systems applied in housing. Questions 15, 16, and 17 investigate the knowledge and perception of the respondents about water, energy, and waste technologies.

Part four investigates the perception and knowledge of the respondents of environmental issues. Question 18 asks the respondents to identify effects that planning could cause on designing new housing estates in terms of the environment, economy, and society. Question 19 studies the current policies for new housing development in issues of land price, land use, housing regulations, as well as the preferred types and location of housing.

Question 20 examines the perception of the respondents of the important level of environment protection, economic growth, and increased human welfare. Question 21 asks the respondents to indicate environmental problems at global, national, and local levels. Question 22 asks the respondents to propose solutions to sustainable housing that can protect the environment while maintaining human welfare and economic growth.

Questions 23 and 24 study the role of economic factors in enabling environment protection and increase human welfare. Questions 25 and 26 study the role of regulations in promoting environment protection and increase human welfare. These questions aim to investigate the knowledge of respondents in understanding the relationship between the dimensions of sustainability. Question 27 asks the respondents to identify barriers the planners may meet when protecting the environment.

Question 28 examines the perception of respondents of types of housing. This question is also asked in the questionnaires to households to compare between stakeholders.

Questions 29, 30, 31, and 32 focus on energy issues such as energy price policy, solutions to saving energy that still maintain human welfare and economic growth, the role of economic factors and regulation in promoting energy efficiency in housing development.

Question 33 asks the respondents to indicate their agreement or disagreement to some statements related to current claimed solutions to sustainable housing. Question 34 asks for comments about housing development generally. These two questions are also asked in the questionnaires to households to compare.

5.4.2 Questionnaires to designers/ architects and developers

Questionnaires to architects/ designers and developers are similar. It includes four parts. Part one is also about general information, part two is about perception on housing, part three relates to technological application, and part four is about environmental issues.

Part one includes Questions 1,2,3, and 4 gathering general information about the architects such as name, gender, company, experience, and the projects they have done within the past five years.

Part two investigates the perception of the architects about housing issues. Questions 7 and 8 ask the respondents to give definitions of a good house and factors the respondents considered when design a house. Question 9 asks respondents to tell their understanding of the term 'sustainable housing'. These questions are asked in the questionnaires to households and planners to compare.

Question 10 investigates the most important issue in designing housing in the perception of the architects. This question is available in the question to households. The comparison is used to define the gaps between housing users and designers.

Question 11 asks the architects to indicate a preferable housing project they had done. Question 12 asks them to rank the satisfaction level they had with social, environmental, and economic aspects in this housing project. Question 13 studies their satisfaction level with indoor comfort at different times in a day of different seasons in the year. This aims to evaluate the success of the housing projects in the perception of the architects.

Part three includes questions about the application of systems in building housing. Questions 14, 15, and 16 respectively investigate structure, building materials, and the density of the housing project. Questions 17 - 22 examine the application of solar and light access, cross ventilation, high-energy efficiency, avoiding direct sunlight and shading in summer, and insulation in the houses.

Questions 23, 24 and 25 study the application of water, energy, and waste treatment systems in the house. Question 26 investigates the preinstalled appliances in the house.

Part four is about environmental issues. Question 27 studies the perception of architects in the important levels of environmental protection, economic growth, and increased human welfare. Question 28 investigates the knowledge of the architects about environmental problems in global, national, and local levels. These questions are asked in the questionnaires to households and planners for a comparison.

Question 29 asks architects to indicate solutions to sustainable housing that protect the environment while still maintaining human comfort and ensure an acceptable cost. Question 30 seeks the barriers to achieving these solutions. Question 31 asks the respondents to raise the effects that housing design can have on the environment, society, and the economy.

Questions 32 and 33 investigate the perception of architects of types of housing and about statements related to current solutions to sustainable housing. Question 34 draws general comments from the architects about current housing developments. These questions are also asked in the questionnaires to households and planners to compare.

5.5 Description of interviews to planners, developers, and architects

The aim of this part of the field study is to interview stakeholders involved in the design, development, and policy making for new housing. The stakeholders interviewed were chosen not based on their involvement in the housing projects chosen for field survey. In Adelaide, the selection of the architects was based on their known involvement or interest in sustainable housing issues.

In Adelaide

A sample list of fifteen architects was obtained from the Royal Australian Institute of Architects, South Australian office. Contacts for appointments of interviews then were made through telephone with only five architects available, who agreed to be interviewed. The interviews were conducted successfully within 2 weeks although most of the architects were very busy. The city planner was contacted through telephone and a staff member from Adelaide City Council was involved in the interview. Two developers were also contacted by telephone and the interviews were taken in their offices and in the housing area in Mawson Lakes.

In Hanoi

Some architects from Zamil Steel company, and some lecturers in architecture at Hanoi Architectural University (HAU) were asked for interviews and seven of them were involved in the interview. A planner who was also a lecturer in HAU met by chance also accepted an invitation to be interviewed. Three developers were involved in the survey, as they were building and developing new housing projects in Hanoi. The interviews were conducted at their offices.

5.6 Conclusion and discussion

The fieldwork was conducted aiming at understanding deeply the real context of housing practice in the two cases. Interviews to households provide the users' view of current housing condition and sustainable housing. Interviews to stakeholders including planners, architects, and developers give information of current practice in the housing industry as well as their perception of sustainable housing and the feasibility in future. Data collected at two cases also helps to compare sustainable housing between these cases to answer the research question 2 asking about the contextual dependence of sustainable housing, and creates basis for evaluation of housing practice. Interviewing different stakeholders involved in the in the housing industry helps defining gaps that need to be bridged to ensure good collaboration between different stakeholders in a community to enable sustainable housing.

The selected housing areas were new developments, reflecting the current trend of social and market preference as well as the level of environmental concern of a locality. The housing projects in Adelaide and Hanoi were built in around the year 2000, presenting the latest social and market preference and environmental consideration of each context at the time.

Most questionnaires were created for the purpose of the study based on standard questions with some monitoring. The number of interviews was not large but the interview was very detailed, therefore, information gathered is sufficient for this study.

The fieldwork has good results as most respondents participated actively in the research. This provides very valuable data for this study as it is based on reality and ensures the involvement of users and stakeholders (community).

Chapter 6 Results from the field studies

Using the data collected by observation and the questionnaires for householders in the case studies as described in the Chapter 5, this Chapter compares the application of instruments of sustainability in housing, and the perception, attitudes, and behaviour of the householders in the two contexts. Because the applications of instruments of sustainable housing relate to and influence each other, it is impossible and mistaken to assess the applicability of each instrument separately. This Chapter therefore studies the application of each instruments in an interrelation with the others instruments. Again, the Novar Gardens and Coventry Gardens are combined and described as Adelaide while the Linh Dam Lakes case study is called Hanoi.

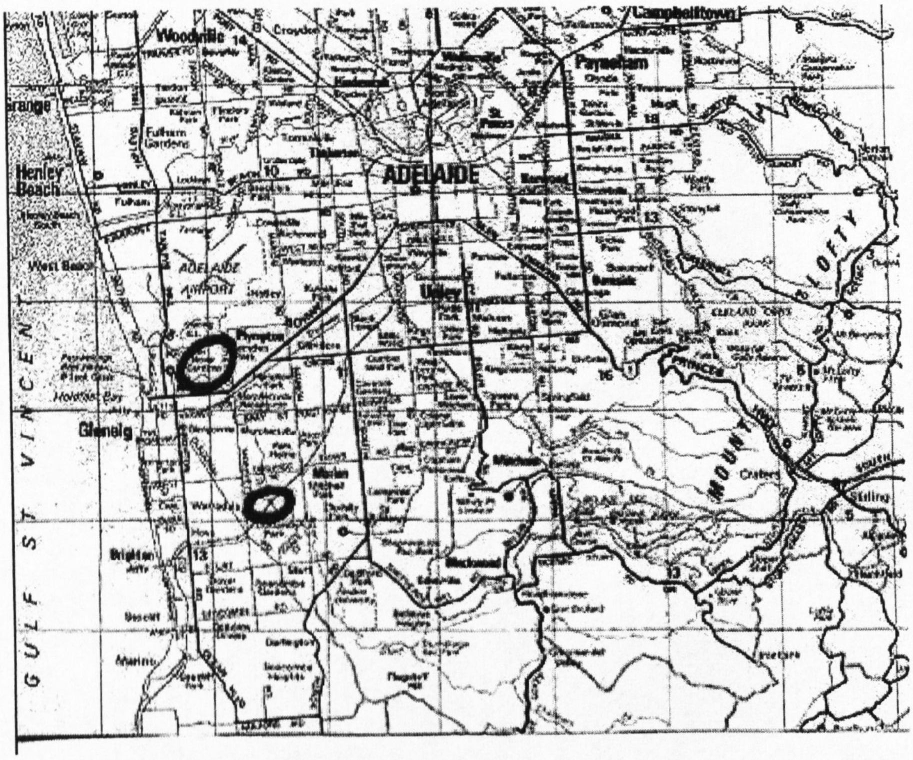
6.1 Technological instruments

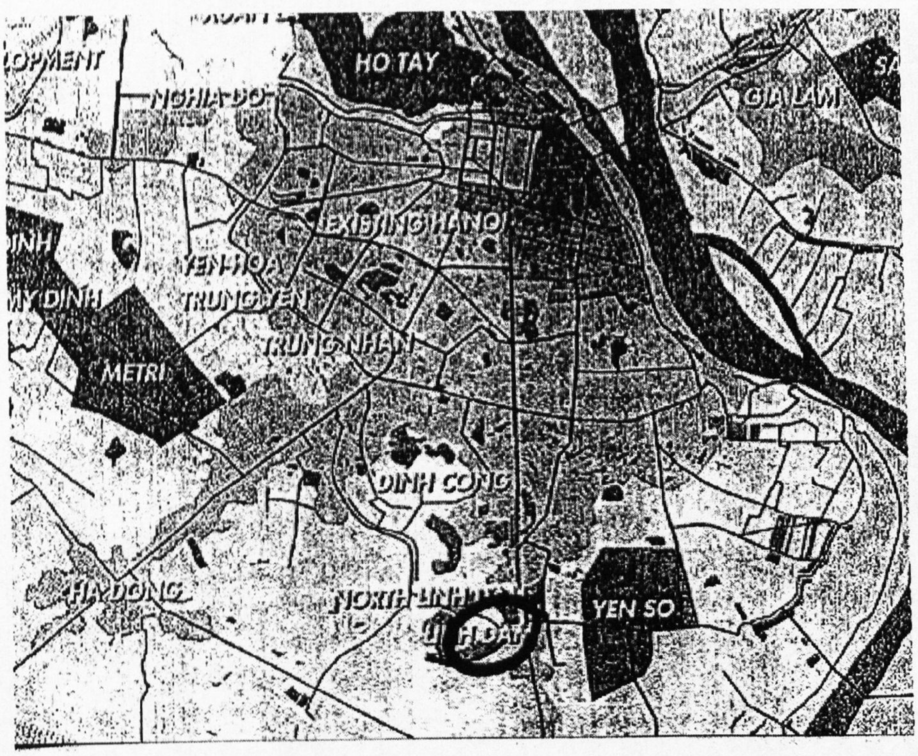
As outlined in Chapter 2, technological instruments of land subdivision, types and size of housing, and density have different impacts on environment, society, and the economics of housing practices in these two cases studies. The combination of these impacts has different implications on the sustainability of housing. This part examines technological instruments that are employed in building housing and their occupation from planning, design, building materials, to systems, and appliances.

6.1.1 Land use

Location and land subdivision

The housing projects in Adelaide are small and located in existing residential areas while the project in Hanoi is a new urban project in suburb. The housing projects in Adelaide use existing service facilities while the project in Hanoi has new service facilities and infrastructure. The housing projects in the two cases have a similar distance to the city centre (Figure 6.1.1).





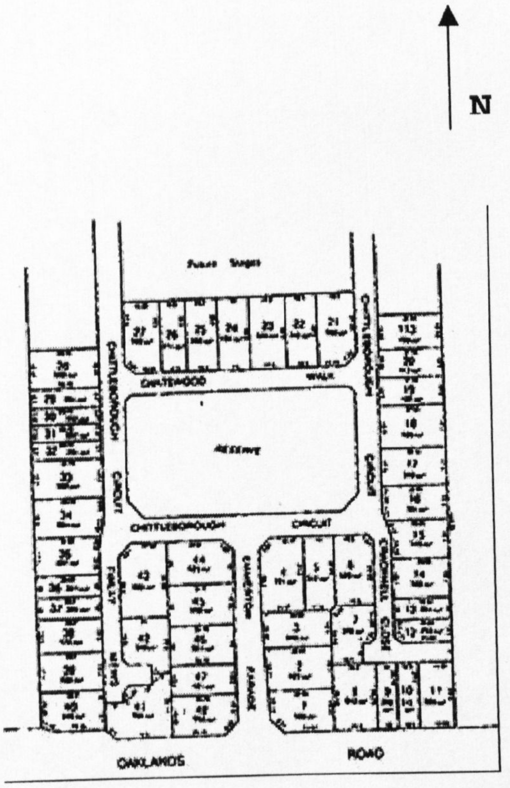
2.5 km 2.5 km 2.5 km

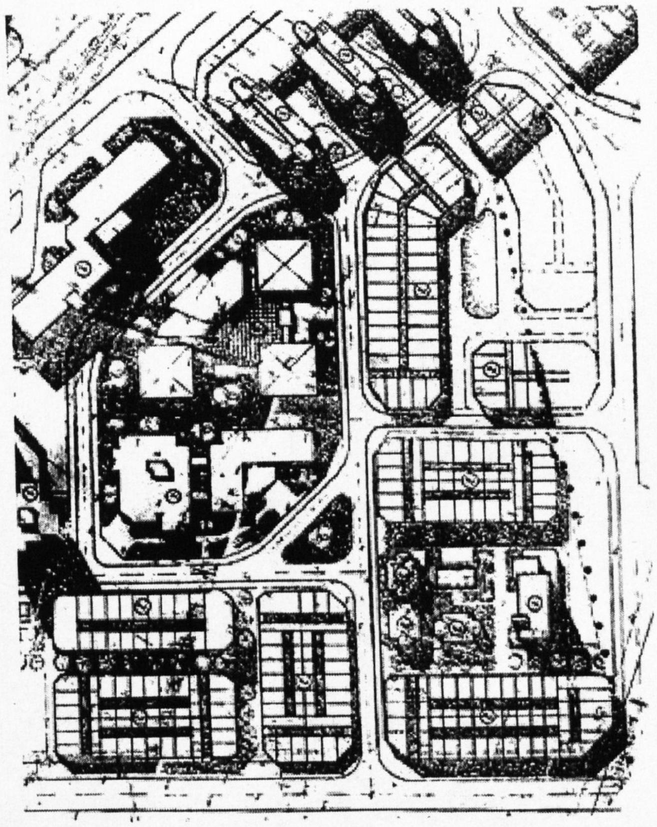
The maps are at the same scale: I---------I-----------I---------I

Figure 6.1.1 Location of survey sites

Note: The location of the sites are circled in the map of Adelaide (above) and Hanoi (under).

The land allotment sizes in Adelaide are much bigger than in Hanoi. Most houses in Adelaide are detached and have allotments ranging from 400m² to 750m². Only few houses in Adelaide are attached with allotment sizes from 210m² to 300m². In Hanoi, around 37% of land for housing construction is used for building attached houses with allotment sizes from 54m² to 143m². High-rise apartments take about 46% of all housing construction land in the project in Hanoi. Only about 10% of housing construction land in the area is used for building detached houses with allotment size of about 200m² (HUD, 1996 and see Table 5.1). The shape of allotments in Adelaide is wider and shorter than in Hanoi as most allotments in Hanoi are long and narrow (Figure 6.1.2).





0 20 40 60 m
I----I----I----I

Allotments' subdivision in Coventry Garden in Adelaide in the stage 1 (AV Jennings, 1999)

Allotments' subdivision in Linh Dam lakes in Hanoi (HUD, 1996)

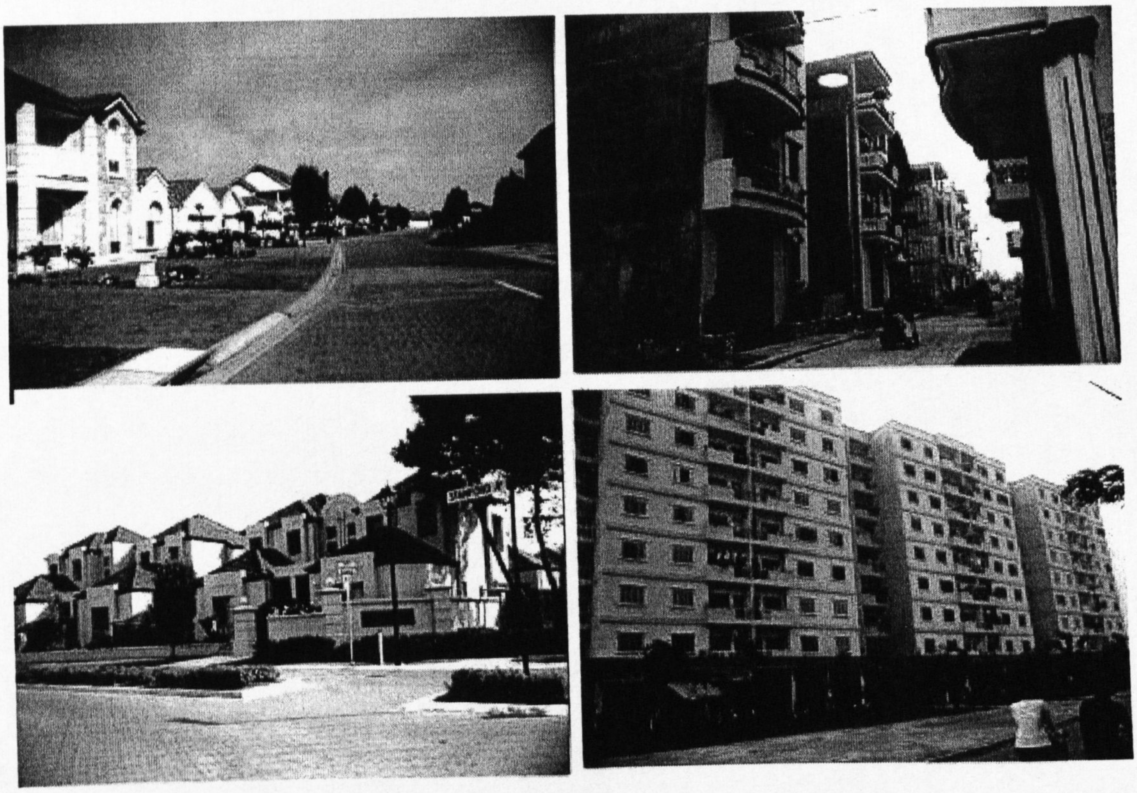
Figure 6.1.2 Land subdivisions of housing in Adelaide and Hanoi

Orientation

The wider allotments potentially allow better solar access to housing in Adelaide than in Hanoi. However, windows of many houses in Coventry Gardens face west and east. Only around half of windows of the houses in Hanoi face the preferred orientation of south and southeast. The nine-floor apartment building (marked as * in the top north-west corner of the Linh Dam lakes plan in Hanoi, Figure 6.1.2) has windows facing to southeast or north-west.

Streetscape

The streetscapes in Adelaide are spacious and green while in Hanoi they are narrow, dense, and 'dry' due to lack of green trees. All the houses in Adelaide have front gardens with green lawn and flowers while only few houses in Hanoi have this (Photograph 6.1). While the popular detached house type in Adelaide is dominant, the traditional street houses in Hanoi are developed accompanying new types of detached and high-rise apartments. This makes the landscape of this project in Hanoi different from existing areas. Overall, the difference in housing type, size, height, and density creates entirely different streetscapes for the two cases.



Adelaide Hanoi

Photographs 6.1 Streetscapes in Adelaide and Hanoi

6.1.2 Housing

Housing type, size and the density

The housing type, size, and the density in Adelaide are different from Hanoi. While most houses in Adelaide are detached, most houses in Hanoi are attached and apartments. Table 6.1.1 gives the breakdown of number of houses by type in the two cases.

Table 6.1.1 Number of houses by type

Type of house	AD	HN
Detached	38	3
Attached	3	22
Apartment		18
Total	41	43

Table 6.1.2 The average size of dwelling

Case	Average dwelling size	Average housing area/person
AD	266.2 m^2	106 m^2
HN	171 m^2	42 m^2
Significant difference (1)	Yes (df = 73, p = 0.00)	Yes (df = 73, p = 0.00)

(1) T-Test for Equality of Means

Although the housing area per head in this project in Hanoi is much higher than the average for Hanoi, it is very low in comparison to Adelaide. The dwelling size in Adelaide is 1.6 times larger than in Hanoi and housing area per person in Adelaide is 2.5 times higher than in Hanoi in average (Table 6.1.2). Measured by T-Test for equality of means, these differences are significant. It is necessary to note that the average dwelling size in the two housing areas in Adelaide (266 m^2) is slightly larger than the average dwelling size of new housing in metropolitan Adelaide (183 m^2) (ABS, 2001). This seems that the government's urban consolidation policy to save land and resources has not been fulfilled in these areas (SAHT, 1992). Moreover, average housing area per head in these areas in Adelaide (106 m^2) is higher than the average in Adelaide (92 m^2)[23]. The average housing area per head in the survey areas in Hanoi (42 m^2) is about four times higher than the average of Hanoi in general (9 m^2) (UNFPA, 1999).

The density of housing in Adelaide is lower than in Hanoi because the allotment size in Adelaide is bigger than in Hanoi and the household size in Adelaide is smaller than in Hanoi. The average allotment size in Adelaide (513.8 m^2) is five times larger than in Hanoi (60.4 m^2) and the household size in Adelaide was smaller than that of Hanoi. The land area per head in Adelaide (198 m^2) is almost nine times higher than in Hanoi (22.5 m^2), therefore, the density in Hanoi is about nine times higher than in Adelaide. Again, the T-test showed the differences in the two cases were significant (Table 6.1.3).

[23] Average household size in Adelaide is 2.3 in 2000 (ABS, 2001, p. 52) and the average dwelling size is 231m^2 in 2000 (ABS, 2001, p. 173)

Table 6.1.3 Land area

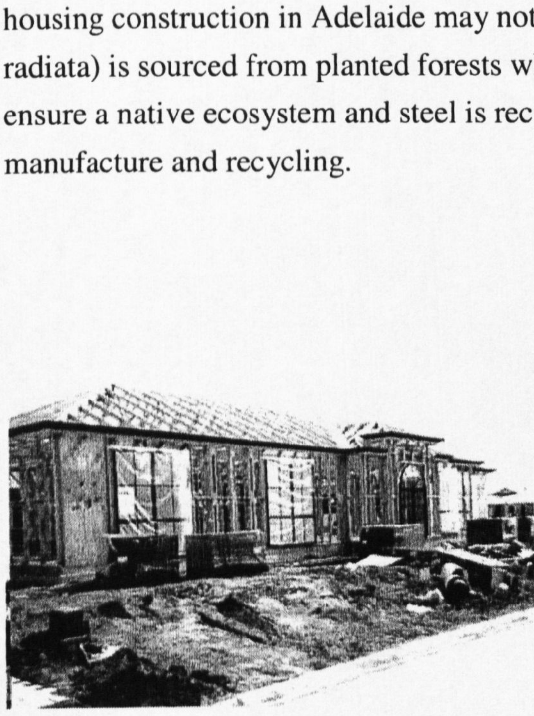
Case	Land area per person	Land area per dwelling
AD	198 m^2	513.8 m^2
HN	22.5 m^2	60.4 m^2
Significant difference (1)	Yes (df = 55, p = 0.000)	Yes (df = 73, p = 0.000)

(1) T-Test for Equality of Means

Building materials

Building materials used in housing in Adelaide are different from Hanoi. While the houses in Hanoi use more brick and concrete, housing in Adelaide uses plasterboard, timber, steel, and aluminium (Table 6.1.4). Thick brick walls (150 – 200 mm) are used for making external walls of most houses in Hanoi. Most houses in Adelaide have brick-veneer external walls made by timber frame, plasterboard and brick outer skin. While all indoor walls in Hanoi are brick (110 mm and 220 mm thick), nearly all houses in Adelaide have plasterboard on timber frame interior walls.

The difference of building materials used in housing in the two cases causes different impacts on the environment and economy. Bricks and concrete are durable and use local abundantly available resources, but have a high-embodied energy and cause environmental pollution in manufacture. Plasterboard uses a resource that is abundant in Australia (South Australia has the largest gypsum mine in the world), but plasterboard is potentially less durable than brick and is generally not reusable. The timber and steel used massively for framing in current housing construction in Adelaide may not ensure sustainability as timber (mainly pinus radiata) is sourced from planted forests where the plants are not native so the forest cannot ensure a native ecosystem and steel is recyclable but has a high embodied energy in manufacture and recycling.



Adelaide

Hanoi

Photographs 6.2 Building materials used in housing

The pitched roof has many advantages (as discussed in Chapter 4) and is in 100% of houses in Adelaide but only 23% in Hanoi. The ceilings are concrete in all houses in Hanoi as the houses have multi floors while the ceilings in Adelaide are usually plasterboard in the common single storey housing in Adelaide. Table 6.1.4 summarizes the building materials found in the two case studies.

Floor coverings of the houses are likely to fit more to cultural background than to the local climate. Floor coverings in Adelaide are suited more to a cold climate while the floor coverings in Hanoi are suited more to a hot climate, though both cases have a similar high average temperature in summer. While all houses in Hanoi have ceramic, tiles, or marble floor coverings, most houses in Adelaide have ceramic floor coverings in kitchens and wet area rooms and carpet in all other rooms. This seems to relate to the ethnic cultural background of most residents in Adelaide as most of them came from Europe where it is cold and carpet is popularly used.

The wide use of glass windows in Adelaide seems to fit more to cold climate, as it is good for trapping heat in winter but contributes to possible over heating in summer. All windows of the houses in Adelaide have single glazing installed with added external shading devices (blinds or roll down shutters) on critical windows while in Hanoi 42% of the houses have two layered windows (single glazing and timber shutter), 54% of the houses have only single glazing, and one house has a solid timber windows. The two layered window arrangement (glass and timber shutter) are not installed in any house in Adelaide. This may relate to housing design fashion.

While none of the windows in the houses in Adelaide has steel mesh for security, it is very popular in Hanoi to have this. Having security mesh in the windows seems not to relate to the security conditions but to cultural behaviour. Break-ins are also relatively high in Adelaide with "7.6% of the households were victims of either a break-in or an attempted break-in in the 12 months prior to the survey" in April 1998 (ABS, 2001). Most houses in Adelaide, however, have an alarm security system.

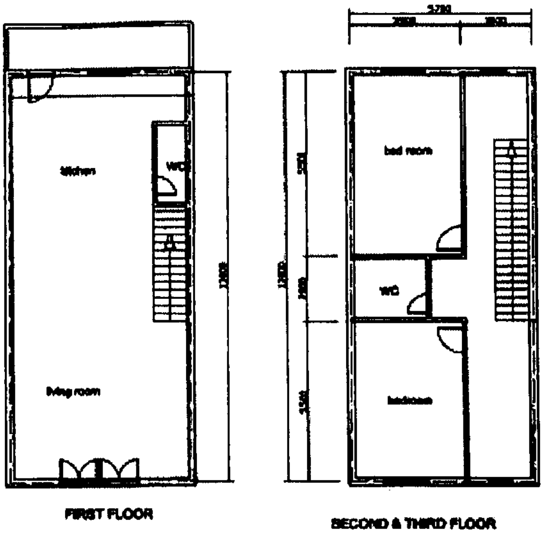
Most entrance doors in both cases have extra steel mesh aimed for security in Hanoi and for insect prevention and security in Adelaide. In Hanoi, 7% of the entrance doors have glass on the upper half for light and providing a view from inside. Most doors in Adelaide have opaque sidelights in frames on the sides of the door for decoration. Most internal doors of the houses in Adelaide are hollow core timber while in Hanoi these are solid timber.

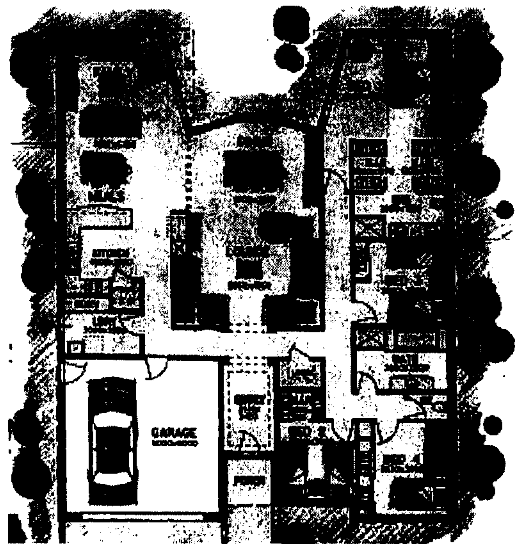
Table 6.1.4 Building materials used in the case studies - number of houses

Elements in a house	Material	Case	
		AD	HN
Outdoor walls	Brick 220 mm	5	41
	Brick 110 mm, timber frame & plaster boards	36	
	Brick 150 mm		2
Indoor walls	Brick 110 mm		36
	Brick 220 mm	1	7
	Plaster board	40	
Roof	Flat concrete		33
	Pitched steel or tiles	41	10
Ceiling	Concrete		43
	Plaster board	41	
Floor	Concrete	41	43
Floor cover	Ceramic or tiles		42
	Tiles and carpet	41	
	Marble		1
Windows	Glass in timber frame (1 layer)		23
	Glass and shutter timber (2 layer)		18
	Glass in aluminium frame (1 layer)	41	1
	Solid timber		1
Doors	Solid timber		40
	Hollow core timber	41	
	Glass in wood frame		3

Plan and structure of the house

The houses in Adelaide often have one to two floors while the houses in Hanoi often have three to four floors. Each floor of the houses in Hanoi often contains only a few rooms while the plan of the single storey houses in Adelaide has all the rooms to provide all living functions. Corridors are popular in the houses in Adelaide to ensure privacy and access for different functional zones in the house. Corridors are often applied in the second floor of the houses in Hanoi, as the ground floor often is open space for common family functions such as lounge (guestroom), kitchen, and dining room. Corridors take not only space in the house but are often dark as they have only indirect contact to windows and natural light. Some houses in Adelaide have skylights. Some rooms in some houses both in Adelaide and in Hanoi are dark during the day as having no access to natural lighting. The attached houses in Hanoi also have limited accessibility to natural lighting and ventilation in the rooms in the middle of the plan. The stairs in the houses in Hanoi also take some space in the already small allotment and cause access troubles for the elderly and children when going up and down.





A typical house plan (3 storey) in Hanoi A house plan in Adelaide

Note: The plans are at the same scale

Figure 6.1.3 Plan of the houses in Adelaide and Hanoi

The houses in Adelaide have rooms that are not available in the houses in Hanoi such as laundry and storage room. Laundry work is often carried out in the bathroom or kitchen in Hanoi. While it is common to have a walk in dressing room connected to the main bedroom to store clothes in Adelaide houses, people in Hanoi store clothes in wardrobes located in the bedrooms or the lounge.

The position of rooms in the houses in Adelaide is also different to Hanoi and it reflects the social lifestyles in the two cases. While the lounge is located in the front part the house and open to the main entrance in Hanoi because guests should not come deep into the house to ensure privacy, the lounge is often located in the middle of the house in Adelaide. As a family room is more often a place for welcoming informal guests and is often located in the back part of the house, guests therefore go through all the depth of the house to reach this room. While in Hanoi bedrooms are often located upstairs or in the end part of the house and considered as private areas, master bedrooms in Adelaide are often located in the front (facing the street) next to the main entrance. Some respondents in Adelaide were not satisfied with this, they said that "it is wrong to have bedrooms in front because they could not open windows freely to collect cool winds, and also they got light and noise disturbance from passing cars on the street at night".

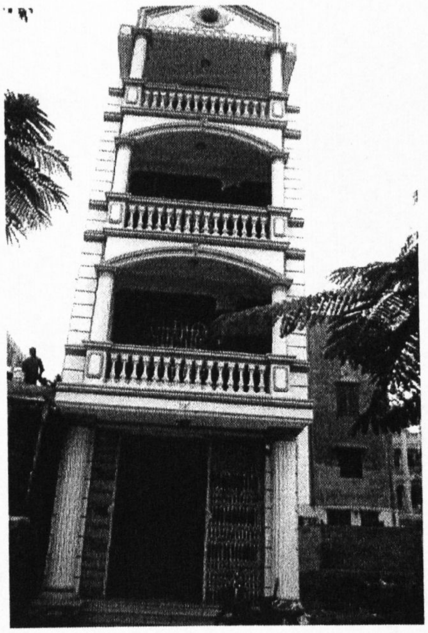
The current trend of owning two cars affects housing design in Adelaide. A double garage was preferred in Adelaide. This large garage takes quite a large proportion of the plan and facade of the house. The households in Hanoi kept one or two motorcycles in a corner of the kitchen, lounge or under the staircase. Few houses in Hanoi had a car, and the single garage did not take much space. The number of households having cars was actually very small and predicted not to increase at a fast rate in the future (HPC, 2000) due to the limited parking space, traffic congestion, and small dwelling size in Hanoi.

Appearance

Large garages also dominate the appearance of the houses in Adelaide. The double garage steel roller doors in Adelaide take up a large proportion of the façade. Accompanying this is a large proportion of concrete or brick pavement instead of the traditional lawn in the front garden in Adelaide. One household took the lawn away and paved the entire front garden to provide access and parking for their third vehicle (a caravan). The front gardens in suburban housing that have proudly represented cultural heritage in Adelaide (Butler-Bowdon, 2001) seem to have been ignored to give way for garages and vehicle driveways (ABS, 2001). Front gardens, when they exist in Adelaide, have provided high aesthetic values for the houses and streetscape, and benefited the environmental quality of the area. (See Photograph 6.3)

Houses in Hanoi often have large main entrance doors to provide accessibility for motorcycles (or a car in a few cases) into the house. The large doors often have steel concertina security shutters that cause a low aesthetic value to the facade of the houses in Hanoi.

The houses in Adelaide often have simple façades with decorative front gardens while the houses in Hanoi have decorative façade but only few (the detached houses) have front gardens. Balconies in the houses in Hanoi are often designed with details that are stylish and decorative. Due to the high density, the narrow streets, and the high-rise, the appearance of each house is not easily visible from the street and described by many critics as a jumbled view of disharmony in colours and details. The balconies in housing in Hanoi often shade and protect the doors and windows from rainwater. The common smallness or absence of overhangs and veranda in the houses in Adelaide not only cause the loss of the traditional Australian houses with veranda, but also impact negatively on the environmental performance of the house as letting direct sun radiation and rainwater penetrating into the house.



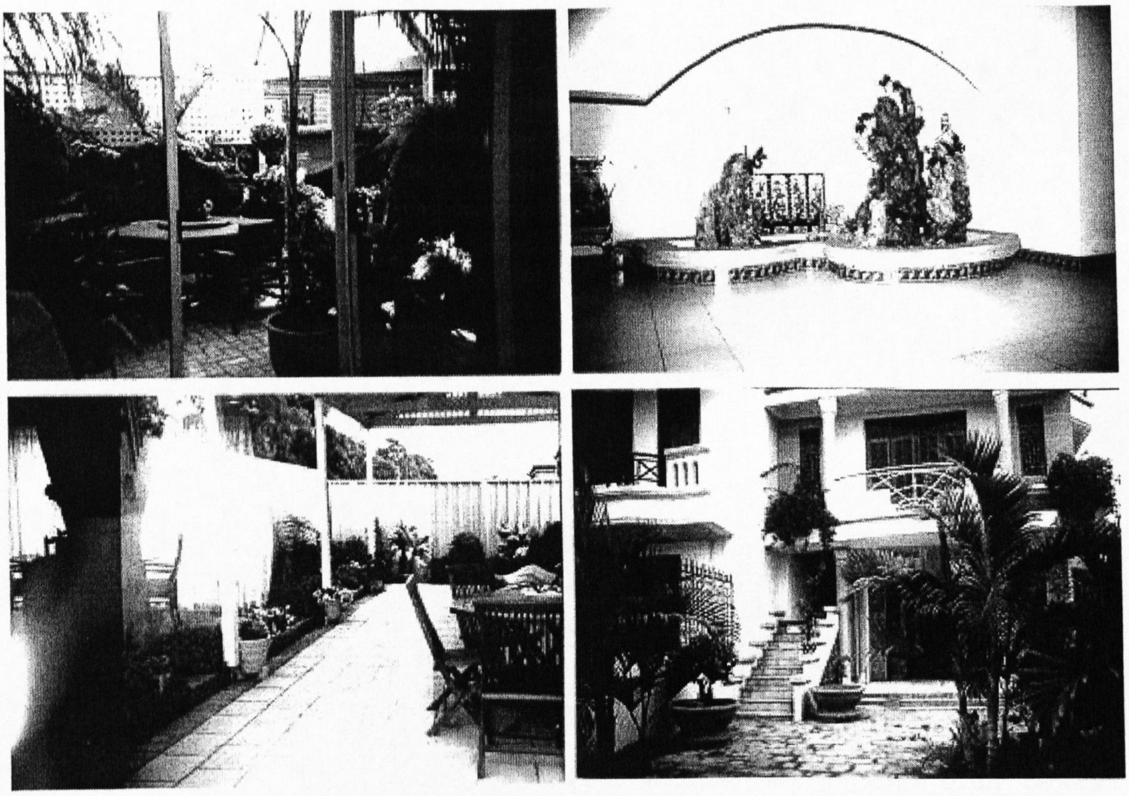
Housing in Hanoi

Housing in Adelaide

Photographs 6.3 Appearance of the houses in Adelaide and Hanoi

Garden and the taste of nature in housing

The residents in Hanoi expressed their love for nature differently from the residents in Adelaide. While the houses in Adelaide have nice front and back gardens, households in Hanoi because of the often small allotments without a garden area, have flowerpots on their balconies, a bonsai or fishpond in the house, or garden on the roof. (Photograph 6.4)



Adelaide Hanoi

Photographs 6.4 Nature brought into the houses

Interior decoration

Though both cases have similar high temperatures in summer, the furniture and finishing in Adelaide houses are suited to the colder winter climate while the interior in housing in Hanoi is adaptable to different climatic conditions. While soft and warm sofas were widely used in Adelaide, the residents in Hanoi preferred solid wooden furniture that is cool to sit on during hot weather. During the winter, residents in Hanoi often put a small piece of carpet on hard sofas to get warmth and comfort when sitting. While people in Adelaide sleep in soft beds all year around, most people in Hanoi changed the soft beds into hard beds during the summer to have more comfort. Residents in Hanoi were often using 'chiếu' (a traditional thin sleeping mat made from a kind of dried reed) and only use soft mattresses during cold weather. Some households in Hanoi covered the ceramic floor with carpet or chiếu during the winter. The colours used in the houses in Adelaide (mainly yellow or dark pink) often created a warm feeling while it was more popular to have blue, cream, or white colour paint in the houses in Hanoi to provide a cool feeling. The common lighter style of highly decorated furniture in Hanoi also creates a cool and airy feeling while the often heavy, fabric covered or solid furniture in Adelaide creates a warm feeling (Photographs 6.5). The warm furniture and furnishing in Adelaide seem to relate to the cultural background of the respondents in Adelaide, as most of them were immigrants from cold climate regions.

Adelaide Hanoi

Photographs 6.5 Interior of the houses

6.1.3 Daily transportation

Besides aspects of house design and construction, household daily travel means and use patterns also relate to technological instruments of sustainable housing. Question 20 of the questionnaire to householders collected data on modes and use of daily transport. This is a multiple response question. The daily transportation means the households used are shown in Figure 6.1.4. Cars were widely used in Adelaide (100%), but not in Hanoi (9%). Motorcycles were employed by 98% of households in Hanoi while no households in Adelaide used motorcycles for their daily travel. While only 7% households in Adelaide used bicycles, 60% of the households in Hanoi used them for their daily travel. Walking daily was also more common in Hanoi (40%) than in Adelaide (12%). Buses and trains had not been provided in this area in Hanoi.

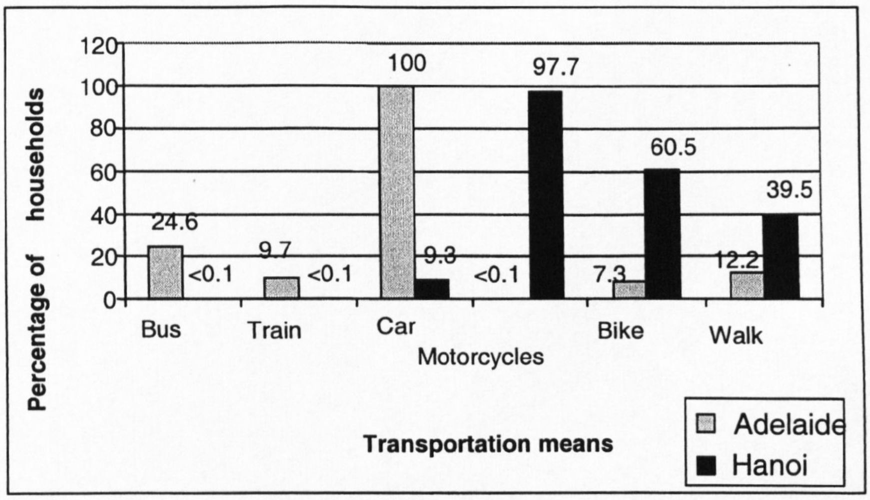


Figure 6.1.4 Percentage of households using transportation means daily

There were 1.9 cars per household in Adelaide and almost zero cars in Hanoi while 2.2 motorcycles per household in Hanoi and zero motorcycle in Adelaide (Figure 6.1.5). There were 1.05 bicycles per households in Hanoi while it was zero in Adelaide. Motorcycles were popular in Hanoi due to its lower cost compared to cars and the ease of parking and storage in the small size houses.

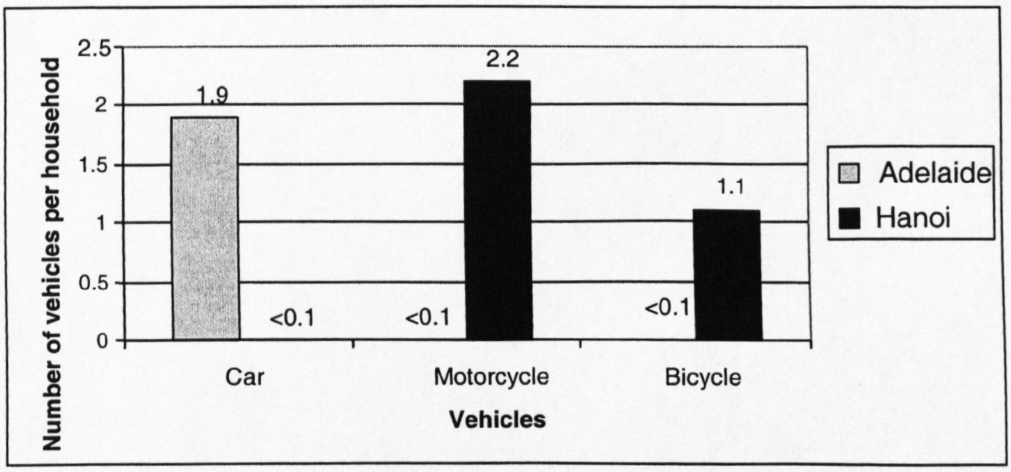


Figure 6.1.5 Average number of vehicles owned by the households

Note: N households = 41 (AD) & 43 (HN)

Question 21 asked the respondents to rank the amount of the household travel per week taken as a whole using a five-interval description (see Scale 3, Appendix D). The result is shown in Table 6.1.5. There was no significant difference in how the respondents in the two cases saw their daily travel levels, with the ranking in both cases on average being very similar at around the middle level (3.4 & 3.7).

Table 6.1.5 Mean rank of households travel per week

Case	The mean of rank of the households travel weekly
AD	3.4
HN	3.7
Significant difference (1)	No (df = 82, p = 0.950)

Note: (1) T-Test for Equality of Means, N respondents = 41 (AD) & 43 (HN)

There was also somewhat surprisingly no significant difference between the average kilometres travelled per week per household in Adelaide and Hanoi. However, the average kilometres travelled per person in Adelaide were higher than in Hanoi. (Table 6.1.6)

Table 6.1.6 Average Km household's travel per week

Cases	Average km households travel per week	Average km a person travel per week
AD	347.7	137.1
HN	300.7	72.6
Significant difference (1)	No (df = 76, p = 0.442)	Yes (df = 77, p = 0.003)

Note: (1) T-Test for Equality of Means, N respondents = 41 (AD) & 43 (HN)

Question 21b asked, "What are the main reasons for the most of travel?" with respondents permitted to make multiple responses. The results presented in Figure 6.1.6 show different reasons for the main travel of the households in the two cases.

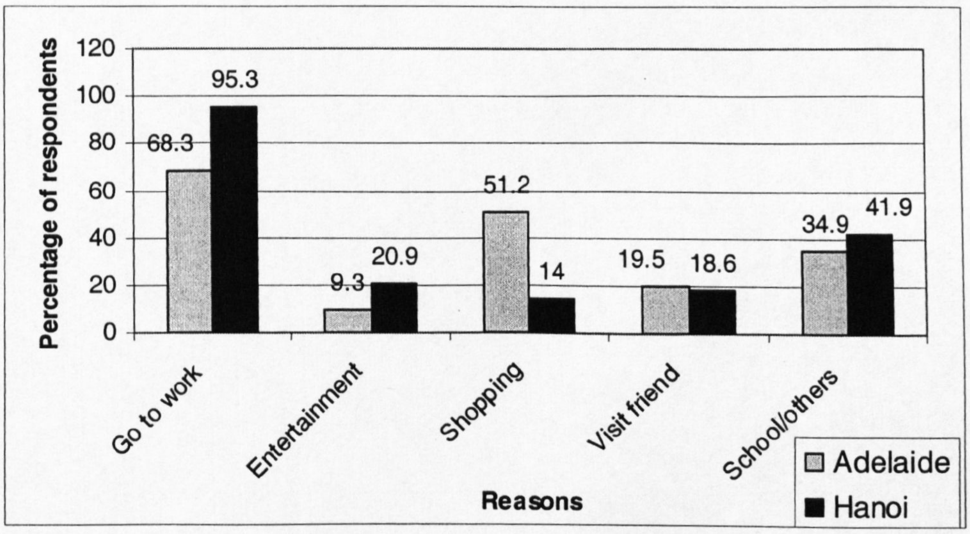


Figure 6.1.6 Main reasons for travel

Note: N respondents = 41 (AD) & 43 (HN). N responses = 75 (AD) & 82 (HN).

In Hanoi, the main reasons were for work, school, and entertainment but in Adelaide they were for work, shopping, and school. The percentage of respondents that indicated 'work' as a reason in Hanoi (95%) was higher than in Adelaide (68%). There was no significant difference between the two cases with the reasons of 'bringing children to school' (35% in Adelaide and 42% in Hanoi), and 'visiting friends' (20% in Adelaide and 19% in Hanoi).

However, the percentage of respondents giving the reason 'shopping' in Adelaide (51%) was higher than in Hanoi (14%) while the percentage of respondents suggesting the 'entertainment' reason in Hanoi (21%) was higher than in Adelaide (9%). Shopping reason was raised by second highest number of respondents in Adelaide but by the lowest number of respondents in Hanoi. Shopping seems to have an important role in the daily life in Adelaide. While daily travel seems to mainly support basic needs (work and school) in Hanoi, it supplied consumption lifestyle (shopping) in Adelaide.

6.1.4 Domestic appliances and their usage

Besides travel, the quantity and usage of domestic appliances will also have an influence on the overall sustainability of housing. To compare the two cases, domestic appliances are subdivided into three categories – cooling and heating, lighting and entertainment, housework supporting – and the average number and usage of these appliances are examined.

Cooling and heating

Question 26 examined number of appliances and their usage in the households. The result is recorded in Table 6.1.7. The average number of coolers and heaters per household in Adelaide (respectively 0.90 and 0.85) taken as a whole was higher than in Hanoi (respectively 0.55 and 0.26). These differences were statistically significant. The coolers and heaters in Adelaide were nearly all ducted reversed cycle air-conditioners that could supply heating and cooling for the whole house while the single electric air conditioner or heater in Hanoi could supply only to a single room. The number of portable fans per household in Hanoi (4.1) was much higher than in Adelaide (0.5) while the numbers of ceiling fans were similar in the two cases. While the households in Adelaide relied more on air-conditioners to provide summer thermal comfort, the households in Hanoi relied more on portable fans.

Table 6.1.7 Appliances for cooling and heating

Cases	Average coolers per household	Average heaters per household	Average portable fans per household	Average ceiling fans per household
AD	0.9	0.85	0.5	0.3
HN	0.6	0.3	4.1	0.6
Significant difference (1)	Yes (df = 82, p = 0.47)	Yes (df = 82, p = 0.000)	Yes (df = 80, p = 0.000)	No (df = 82, p = 0.150)

Note: (1) T-Test for Equality of Means, N respondents = 41 (AD) & 43 (HN)

Question 26 also examined the usage of these appliances. The result is shown in Table 6.1.8. The households in Adelaide used air-conditioners for a longer period than the households in Hanoi, while the households in Hanoi used fans for a longer time than the households in Adelaide did. The average number of hours using air-conditioners (main heater & cooler) per household per day in Adelaide (5.5 hours) was higher than in Hanoi (1.9 hours). There was no significant difference between two cases in the average time of using heaters and ceiling fans per day for households having these appliances. However, the number of hours using portable fans per day among the households that had portable fans in Hanoi (4.6 hours) was higher than in Adelaide (1.5 hours). As ducted reverse cycle air-conditioners consume more energy than portable fans, although the time using heaters and ceiling fans was similar in two cases and the time the households in Hanoi used portable fans was not much different to the time the households in Adelaide used air-conditioners, the households in Adelaide consumed more energy than the households in Hanoi. The relationship of this energy use with indoor environment satisfaction is discussed below.

Table 6.1.8 The usage of cooling and heating appliances

Case	Average hours using coolers	Average hours using heaters	Average hours using portable fans	Average hours using ceiling fans
AD	5.5	2.7	1.5	2.5
HN	1.9	2.5	4.6	3.2
Significant difference (1)	Yes (df = 47, p = 0.000)	No (df = 38, p = 0.729)	Yes (df = 55, p = 0.000)	No (df = 15, p = 0.633)

Note: (1) T-Test for Equality of Means, N respondents = 41 (AD) & 43 (HN)

Lighting and entertainment appliances

Table 6.1.9 Number of TV, video, computer and lamp per households

Case	TV	Video	Computer	Fluorescent light	Incandes-cent lamp	Halogen lamp	Efficient lamp
AD	2.4	1.3	1.0	0.8	14.7	0.9	2.9
HN	1.9	0.7	0.6	10.3	10.3	0.9	0.0
Significant difference (1)	Yes (df = 82, p = 0.035)	Yes (df = 82, p = 0.000)	Yes (df = 82, p = 0.008)	Yes (df = 82, p = 0.000)	No (df = 81, p = 0.174)	No (df = 80, p = 0.961)	Yes (df = 82, p = 0.023)

Note: (1) T-Test for Equality of Means, N respondents = 41 (AD) & 43 (HN)

Table 6.1.10 Number of appliances per person

Cases	TV	Video	Computer	Fluorescent lamp	Incandes-cent lamp	Halogen lamp	Efficient lamps
AD	0.9	0.5	0.4	0.4	5.9	0.3	1.0
HN	0.5	0.2	0.2	2.6	2.9	0.3	0.0
Significant difference (1)	Yes (df = 82, p = 0.000)	Yes (df = 82, p = 0.000)	Yes (df = 82, p = 0.001)	Yes (df = 82, p = 0.000)	Yes (df = 81, p = 0.010)	No (df = 80, p = 0.826)	Yes (df = 82, p = 0.019)

Note: (1) T-Test for Equality of Means, N respondents = 41 (AD) & 43 (HN)

As shown in Table 6.1.9, the number of televisions, video players, and computers per household in Adelaide was higher than in Hanoi though the household size in Adelaide was smaller than in Hanoi. Some households in Adelaide with two persons had four televisions and five video players. The number of incandescent and halogen lights in Adelaide and Hanoi was similar. The average number of fluorescent lights used in each household in Hanoi was higher than in Adelaide, but the number of energy-efficient lights in Adelaide was higher than in Hanoi. The average number of televisions, video players, and all types of lights except halogen lights per person in Adelaide was clearly higher than in Hanoi (Table 6.1.10). The average number of hours using TVs and video players per day for the households having these appliances was not significantly different between the two cases. The average time using computers and fluorescent per day in the households in Hanoi was higher than in Adelaide. The average time using incandescent lights in Hanoi was higher than in Adelaide. This may relate to the lack of natural lighting during the daytime in housing in Hanoi. The average time using fluorescent lights in Hanoi was higher than in Adelaide. The average time using halogen light among the households that had these lights was not significantly different between the two cases. (Table 6.1.11)

Table 6.1.11 Average hours using TV, video, computer, and lamps per household

Cases	TV	Video	Computer	Fluorescent lamp	Incandes-cent lamp	Halogen lamp	Efficient lamps
AD	3.8	0.9	1.8	2.4	3.6	3.9	3.8
HN	4.1	0.6	4.0	4.5	1.9	1.1	0.0
Significant difference (1)	No (df = 81, p = 0.594)	No (df = 65, p = 0.400)	Yes (df = 55, p = 0.002)	Yes (df = 54, p = 0.000)	Yes (df = 74, p = 0.000)	No (df = 6, p = 0.082)	Yes

Note: (1) T-Test for Equality of Means, N respondents = 41 (AD) & 43 (HN)

The overall differences in the time using these appliances between the two cases was not clear as the households in Hanoi used their computers and fluorescent light for a longer time while the households in Adelaide used incandescent and efficient lamps for a longer time. However, as the households in Adelaide had more appliances, energy consumption in Adelaide is potentially higher than in Hanoi.

Housework supporting appliances (called white goods)

Housework appliances include washing machines, refrigerators, dishwashers and cooking equipment. It is important to note that many of these appliances were popular in Adelaide but not available or realistic to many households in Hanoi because of their cost implications. As shown in Table 6.1.12, the average number of these appliances per household in Adelaide was higher than in Hanoi. Separate freezers, dishwashers, bread makers and a swimming pool with hot water were not available in Hanoi. Number of stoves per household was the same in two cases (one each). Rice cookers were more common in Hanoi (1.07) as rice is an every day food for Vietnamese people. On the other hand, the barbecue is popular in Adelaide (0.85) but not in Hanoi (0.0). The number of water pumps in Hanoi (0.67) was higher than in Adelaide (0.0) because the pressure of water supply was not enough to provide water to the high levels of the houses and water had to be pumped up to a tank on the roof to provide water pressure for the house. The households in Adelaide are connected to a mains pressure water supply and therefore did not need to pump water. The households in Hanoi used a small hot water boiler

(20-30 litters) for each bathroom instead of a big hot water tank (50-200 litters) for the whole house, as was the case in Adelaide. Therefore, although the number of hot water boilers in Hanoi was higher than in Adelaide, it does not mean households in Hanoi used more hot water. Since the household size in Adelaide was smaller than in Hanoi, the number of most appliances per person in Adelaide obviously was higher than in Hanoi.

Table 6.1.12 Number of appliances supporting housework per household

Appliances	**HN**	**AD**	**Significant difference (1)**
Fridge	1.00	1.34	Yes (df = 82, p = 0.001)
Freezer	0.00	0.36	Yes (df = 82, p = 0.000)
Dishwasher	0.00	0.80	Yes (df = 82, p = 0.000)
Washing machine	0.60	0.97	Yes (df = 82, p = 0.000)
Drier	0.00	0.59	Yes (df = 82, p = 0.000)
Oven	0.12	1.02	Yes (df = 82, p = 0.000)
Stove	1.07	1.00	No (df = 82, p = 0.087)
Toaster	0.00	0.98	Yes (df = 82, p = 0.000)
Rice cooker /barbecue	1.07	0.83	Yes (df = 82, p = 0.003)
Bread maker	0.00	0.32	Yes (df = 82, p = 0.000)
Microwave	0.14	1.02	Yes (df = 81, p = 0.000)
Hot water heater	1.49	1.00	Yes (df = 82, p = 0.009)
Water pump	0.67	0.00	Yes (df = 82, p = 0.000)
Pool	0.00	0.00	No (df = 82, p = 0.146)
Other (Kettle)	0.00	1.00	Yes (df = 82, p = 0.001)

Note: (1) T-Test for Equality of Means, N respondents = 41 (AD) & 43 (HN)

Although aware that the capacity and size of hot water boilers and refrigerators was larger in Adelaide than in Hanoi, to simplify, this research assumes that they were the same. This research also assumes that all refrigerators and separate freezers were connected to the power supply for 24 hours a day though this was not true in some cases in Hanoi. The usage of the appliances is shown in Table 6.1.13. The households having these appliances in Adelaide used them more often than in Hanoi. On average, dishwashers were used 0.78 times per day in the households in Adelaide while no household in Hanoi had one. On average, clothes washing machines were used in the households in Adelaide (4.8 times per week) more often than in Hanoi (3.5 times per week). The total number of clothes driers was only 2 in Hanoi and 26 in Adelaide, but these households in Hanoi used it 5 times per week while these households in Adelaide used it only once per week on average. While the households in Adelaide used ovens more often than in Hanoi, the households in Hanoi used stoves and rice cookers more often than in Adelaide. As bread is a common food in Adelaide, but not in Vietnam, the number of hours using toasters in the households in Adelaide was much higher than in Hanoi. Bread makers were not available in Hanoi but used 0.8 hours per week in Adelaide. The number of hours using microwaves per day in Adelaide (0.6 hours) was higher than Hanoi (0.3 hours). An off-peak electric hot water system that had an automatic system to let it heat the water during off peak times (at night) and kept the water warm all day for use was installed in most households in Adelaide. In Hanoi however, this technique is not available and most households only turned on their water heater for a few minutes before using it (for instance, before having a shower). In average, these appliances were turned on for 7.3 hours in summer and 8.1 hours in winter in Hanoi. It is difficult to compare energy consumed for water heaters between the two cases.

Table 6.1.13 The usage of appliances for supporting housework per household

The usage of appliances	**N of HHs having**		**Usage**		**Significant difference (1)**
	AD	**HN**	**AD**	**HN**	
Loads of dishwashing per day	33	0	0.8	0	Yes
Loads of washing per week	40	26	4.8	3.6	Yes (df = 64, p = 0.037)
Loads of drying per week	26	2	1.1	5.0	Yes (df = 26, p = 0.006)
Hours of using oven per week	40	7	0.5	0.2	No (df = 45, p = 0.234)
Hours of using stove per day	41	43	1.0	2.2	Yes (df = 82, p = 0.000)
Hours of using rice cookers/ barbecue per day	36	42	0.3	1.4	Yes (df = 76, p = 0.000)
Hours of using toaster per week	40	1	0.2	0.1	Yes (df = 39, p = 0.543)
Hours of using bead maker per week	14	0	0.8		Yes
Hours of using microwave per week	40	6	0.6	0.3	No (df = 44, p = 0.073)
Hours of turning on water heaters in summer	41	35	24.0	7.3	Yes (df = 74, p = 0.000)
Hours of turning on water heaters in winter	41	35	24.0	8.1	Yes (df = 74, p = 0.000)
Hours of using water pump during summer	2	22	3.5	4.7	No (df = 22, p = 0.807)
Hours of using water pump during winter	0	22	0.0	4.2	Yes
Hours of turning water heaters for pool	2	0	2.0	0	Yes
Hours of using others appliances weekly	40	0	0.5	0	Yes

Note: (1) T-Test for Equality of Means, N respondents = 41 (AD) & 43 (HN)

Based on the number of appliances and the usage of these appliances, it is sufficient to argue that potentially, households in Adelaide consumed more energy than in Hanoi. The actual energy consumption studied has also affirmed this conclusion (see below).

6.1.5 Energy and water use and the perceptions

Examining the use of energy and water in households together with household perception and attitude of their use is important in understanding the effectiveness of the technological instruments in achieving sustainable housing.

Energy consumption and cost

The amount of energy consumption in the households in Adelaide was much higher than in Hanoi. Energy consumption and cost in each household was determined by examining their energy accounts. The average annual energy bill of the households in Adelaide was more than seven times higher than in Hanoi. As the prices of electricity in the two cases were similar, on average, the households in Adelaide consume about seven times more energy than in Hanoi. (Table 6.1.14)

Table 6.1.14 Average annual energy bills and prices

Case	Annual Energy bill (AUD)	Annual Electricity bill (AUD)	Annual Gas bill (AUD)	Electricity price (2) (AUc/kwh)	Gas price (3) AUc/MJ
AD	1732.8	1352.4	308.4	12	1.4
HN (4)	222.8	208.8	90.0 (5)	10-12	
Significant difference (1)	Yes (df = 65 p = 0.000)	Yes	Yes	No	

Note: (1) T-Test for Equality of Means, N respondents = 20 (HN) & 24 (AD)
(2) Marginal electricity charge at January (Hanoi) and March (Adelaide) 2001
(3) Marginal gas price at January (Hanoi) and March (Adelaide) 2001
(4) Hanoi prices based on conversion rate of 7,900 VN Dong to $AU 1
(5) Gas is purchased in portable bottles

Attitude to energy efficiency

Question 27 asked, "Would you tell me what factors are more important when buying appliances?" Respondents were presented with a list of factors from which they could choose one or more. The Figure 6.1.7 reports the result of this multiple-response question. Energy efficiency was seen as important but was not the first priority. The percentage of respondents who were concerned with price and quality (respectively 78% and 78%) in Adelaide was higher than those who were concerned with energy-efficiency (68%). In Hanoi, the issues of price, appearance and quality (respectively 63%, 51%, and 91%) concerned more people than energy-efficiency (37%). The number of respondents considering energy efficiency as a factor in the choice of appliances in Adelaide (68%) was higher than in Hanoi (37%).

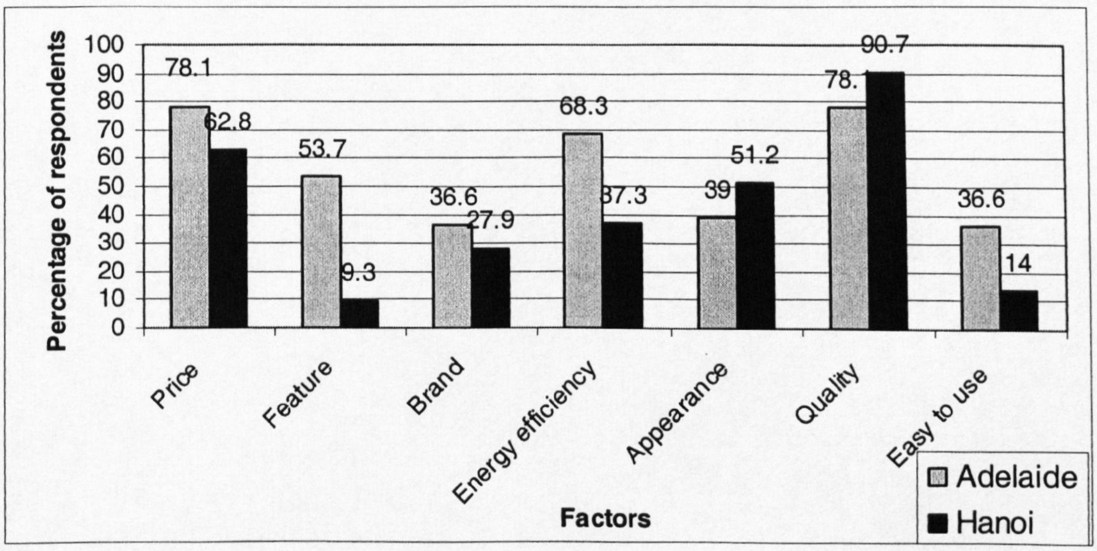


Figure 6.1.7 Factors considered when buying appliances
Note: N respondents = 41 (AD) & 43 (HN). N responses = 160 (AD) & 126 (HN).

The respondents in the two cases had different priorities when buying appliances. The differences seem to relate to the culture and background of the two cases. Though most households in Adelaide have higher income than in Hanoi, price concerned more respondents in Adelaide (78%) than in Hanoi (63%). The features or facilities of an appliance were more of a concern to respondents in Adelaide (54%) than in Hanoi (9%) while appearance was considered by a higher number of respondents in Hanoi (51%) than in Adelaide (39%). Quality (31%) concerned more respondents in Hanoi (91%) than in Adelaide (70%), this may relate to the common poor quality of appliances in Vietnam as many appliances are low quality and cheap to be affordable.

Perception about their energy use or attitude to saving energy

The respondents also had different attitudes to saving energy. Attitudes to saving energy often relate to the perception of the respondents about their energy use. The respondents may start to save energy or reduce their use only if they find their energy use is too much. Question 28 asked the respondents to rank their energy use on a five-point interval scale (see Scale 3 Appendix D). The result is shown in Table 6.1.15. There was no significant difference in ranks of energy use between the two cases. As the average rank was close to the middle of the scale, most households saw their use as not high and not low. Another point is that, though consuming seven times higher energy, the respondents in Adelaide did not find their consumption at a higher level than the households in Hanoi. This shows the respondents in the two cases had different perceptions about their energy use and needs. Finding reasons for their perception of the level of energy use is important.

When respondents were asked an open-ended question as to why they had given a particular rank to their energy use, the reasons were similar, but the explanations given to these reasons were sometimes different in the two cases. Each respondent could give multiple responses and the results are shown in Figure 6.1.8. More than 40% of the respondents in Adelaide and Hanoi indicated that they had been saving energy and only about 10% of the respondents in the two cases said their use followed the needs and not based on saving. The number of respondents raised the reason 'number of appliances in the house' in the two cases was similar (17% in AD and 14% in HN). However, while the households in Adelaide said they "have too many" the households in Hanoi said they "have too few". The number of the responses using bill to rank their energy use in Hanoi (21%) was higher than in Adelaide (10%). The number of the responses indicating 'character of the households' in Adelaide (32%) was higher than in Hanoi (16%). For example, householders in Adelaide suggested that "having children in the house", "it is impossible to control children's behaviour", or "having only one or two people living in the house" were the reason given for their ranks of energy use. While in Hanoi, it was "the absence of the family members during the day for going to work", "having newborn baby", or "having too many people in the house" were what determined their ranks. However, as the number of households having children was less and household size in Adelaide was smaller than of Hanoi, the requirement for energy use in

Adelaide should be lower than in Hanoi. So the actual main reasons for high-energy use in Adelaide is neither having children nor having a high number of occupants but is likely due to the high number and usage of appliances.

Table 6.1.15 The mean rank of energy use in the households

Cases	N households	Mean rank of energy use
AD	41	3.2
HN	43	3.0
Significant difference		No (df = 82, p = 0.144)

Note: (1) T-Test for Equality of Means

Moreover, some respondents in Adelaide blamed their high use of energy on the extreme hot weather, but no one in Hanoi said the same though the climatic conditions are fairly similar (see Appendix E). The perception of the respondents to climate is socially dependent and seems to affect high-energy use in Adelaide. Also, the number of respondents in Adelaide seeing their energy use related to housing design was higher than in Hanoi. Some respondents in Adelaide said "the high use of energy relates to the open plan of the house" or "this type of house is very hot during the summer".

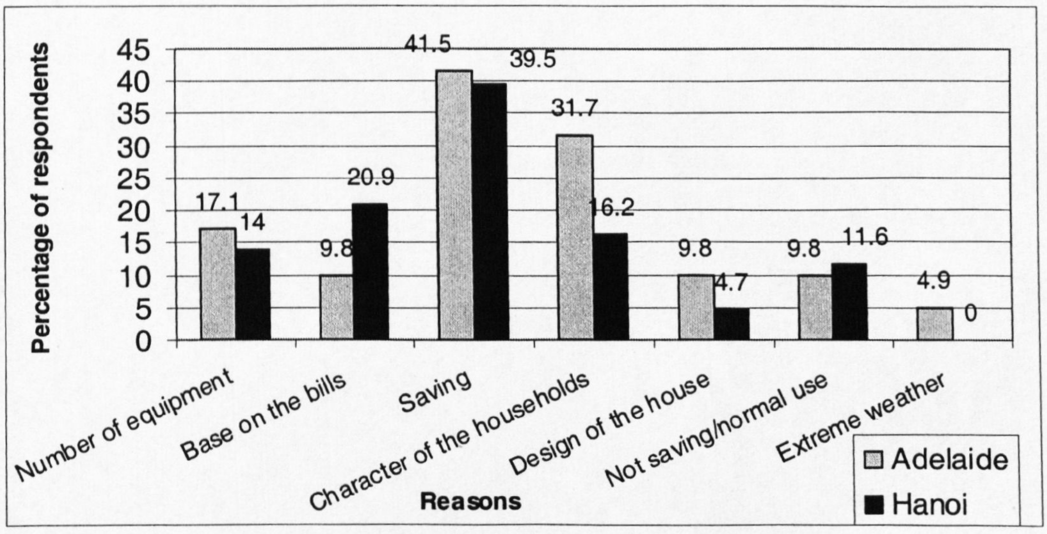


Figure 6.1.8 Reasons for the rank of energy use

Note: N respondents = 41 (AD) & 43 (HN). N responses = 51 (AD) & 46 (HN).

In summary, the high use of energy in Adelaide appears to be due to a large number and usage of appliances, a comparatively low tolerance to the local climatic conditions and housing design features (open plan and indoor climate performance). Energy consumption in Hanoi depends mainly on the number of household members and whether or not they have children.

Question 30 asked, "how do you consider the price of energy you use in your house?" The results are shown in Table 6.1.16. Though having an income level of 20 times different (Appendix C), and having similar energy prices, the perception of the respondents in the two cases to energy price was not significantly different.

Table 6.1.16 Mean rank of energy price

Case	Mean rank of energy price	N respondents
AD	3.9	41
HN	3.6	43
Significant difference (1)	No (df = 78, p = 0.750)	

Note: (1) T-Test for Equality of Means.
The ranks follow Scale 3 (Appendix D).

Energy expenses account for a higher proportion of daily life expenses of people in Hanoi (7%) than in Adelaide (4%) (HUD, 2000; ABS, 2001). This may cause the higher consumption and less concern with energy conservation amongst the householders in Adelaide.

The use and perception of water use

This research also studied water use in the households. Question 31 asked the respondents to rank their water consumption level on a five-point interval scale (see Scale 3, Appendix D). The result is shown in Table 6.1.17. The households in the two cases ranked their water consumption at a similar level, in the middle, which means they saw their use as reasonable, not too high and not too low.

Table 6.1.17 The mean rank of water use

Case	Mean rank of water consumption by the households	Number of HHs
AD	3.2	41
HN	3.0	43
Significant difference (1)	No (df = 82, p = 0.158)	

Note: (1): T-Test for Equality of Means

However, the reasons for the water consumption level (answer to Question 31b) were different between the two cases. Each respondent also can give more than one response (reason) and the result can be seen in the Figure 6.1.9. As many as 54% of the respondents in Adelaide saw they saved water because they considered their house and garden were small while only about 5% in Hanoi saw this (only few houses in Hanoi have gardens). Respondents in Adelaide said "the small size of garden and house is a key issue in helping them saving water" because "watering for gardens is very important especially during the dry summer in Adelaide". While 49% of respondents in Hanoi gave the reason of "save water" for their ranking level of water use, only 27% of respondents in Adelaide gave this reason. While 23% of responses in Hanoi saw their use of water related to 'household character' (for example, "having too many persons" or the "absence of people for work"), 17% of responses in Adelaide saw their level of water use related to the number of people living in the house. Some respondents in Hanoi said high 'water bills' concerned them while no one in Adelaide reported this concern. About 10% of households in Adelaide said their water use was efficient because they used modern technology to control the watering system by setting time. Only one respondent in Hanoi said they used rainwater to provide a part of their daily water needs.

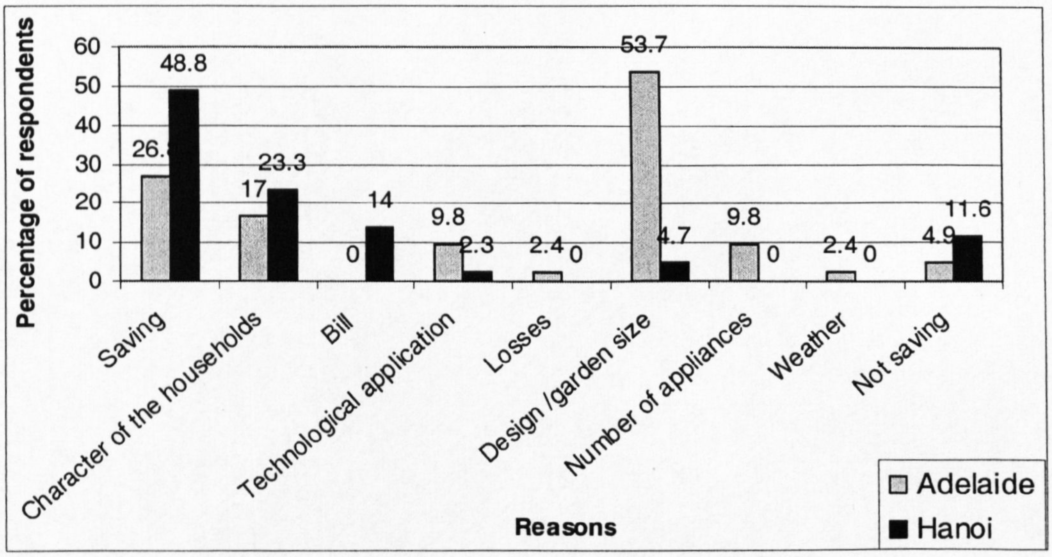


Figure 6.1.9 Reasons for the rank of water use

Note: N respondents = 41 (AD) & 43 (HN). N responses = 52 (AD) & 45 (HN).

When the respondents were asked, "how do you consider the price of water?" and to indicate their answer on a five point interval scale (see Scale 3, Appendix D), respondents in Hanoi ranked water price at a significantly higher level than in Adelaide (Table 6.1.18). The high price seems to influence the use of water among the households in Hanoi. Although water expenses in Adelaide were also about 5.4 times higher than of Hanoi (Table 6.1.19), because they had a higher income, the respondents in Adelaide ranked water price lower than in Hanoi (Table 6.1.18).

Table 6.1.18 Mean rank for water price

Case	Mean rank for water price	N respondents
AD	3.5	35
HN	4.4	43
Significant difference	Yes (df = 76, p = 0.000)	

Note: (1) T-Test for Equality of Means (rank on the Scale 3, Appendix 6.0)

Question 32 studied the method used for watering plants (gardens and flower pots) as this can have an important bearing on the amount of water used by a household. The results are shown in Table 6.1.19. Most households in Adelaide (69%) used fixed sprinklers to water their gardens. A drip watering system was used by only 6% of the households in Adelaide. Most households in Hanoi watered their gardens or flowerpots by hand using watering can or similar (49%) or moveable sprinklers (12%). In Hanoi, 40% of the respondents did not indicate any method, as they had neither garden nor plants.

Table 6.1.19 Method of watering

Watering method	**Number of responses**	
	AD	**HN**
By hand	14 (25.9%)	21 (48.8%)
Moveable sprinkler	0	5 (11.6%)
Fix sprinkler	37 (68.5%)	0
Drip	3 (5.6%)	0
Responses	41 (100%)	26 (60.5%)

Note: N respondents = 41 (AD) & 43 (HN). N responses = 41 (AD) & 26 (HN).

In summary, although the respondents in the two cases saw their use of water at similar levels (medium), the numbers of respondents in Hanoi saying they save water and use water saving methods for watering plants was higher than in Adelaide. Most households in Adelaide said they save water by having smaller size gardens.

Moreover, water charge in Adelaide depends mainly on the property value (Table 6.1.20), which does not reflect the actual use of water in households. This does not encourage householders to save water. Besides saving water and energy, application of green systems is important in sustainable housing.

Table 6.1.20 The cost of water – Adelaide & Hanoi

Case	**Water Cost/ Month**	**Water price average 2002**
AD	$ 54.2 AU	Fixed supply charge $31.25 + 38 cents for first 100 kL + 94 cents per kL of balance
HN	$ 10.1 AU	20 AU cents per kL
Significant difference (1)	Yes (df = 57, p = 0.00)	Yes

Note: (1) T-Test for Equality of Means for average water bill
Source: Case Study household water bills in Adelaide and Hanoi in 2002

6.1.6 Applying domestic systems

New or advanced technological systems may be applied as instruments to enable sustainability in housing. Such systems have been introduced widely in literature and in some housing projects. The possibility of introducing these systems and the success will depend on the householders' knowledge and perception of these systems. The following sections will examine this issue in relation to two case studies.

Knowing about domestic systems

Question 37 examined the respondents' knowledge, behaviour and attitude in applying domestic systems in their houses. The results are shown in Table 6.1.21.

Table 6.1.21 Attitude of respondents on the application of technologies

		Number/percentage of respondents							
Systems	**Yes/ No**	**Know**		**Using**		**Satisfied**		**Want to use (if not using)**	
		AD	HN	AD	HN	AD	HN	AD	HN
Grey water recycling	No	24	31	16	10		1	3	5
	Yes	17 (42%)	12 (28%)	1 (2%)	2 (5%)	1		12	6
Black water recycling	No	19	32	22	11			8	6
	Yes	22 (54%)	11(26%)					14	5
Bore water	No	15	6	26	26		5	17	25
	Yes	26 (63%)	37 (86%)		11(26%)		6	9	1
Tap water	No					6	20		1
	Yes	41 (100%)	43 (100%)	41	43	35 (85%)	22 (51%)		
Rain water tank	No	4	20	33	17		4	20	13
	Yes	37 (90%)	23 (54%)	4 (10%)	6 (14%)	4	2	13	6
Solar water heater	No	6	17	35	25			14	10
	Yes	35 (85%)	26 (61%)		1 (2%)		1	20	14
Photovol-taic	No	24	21	16	21			7	12
	Yes	17 (42%)	22 (51%)	2 (5%)	1 (2%)	1	1	9	8
Waste mix collection	No			41			12 (7.9%)	41(100%)	41(95%)
	Yes	41	43		43		31		
Waste separation	No		23		19	1 (2.4%)	1		
	Yes	41 (100%)	19 (44%)	41		40		1	19
Household composting	No	3	40	30	3			20	2
	Yes	38 (93%)	3 (7%)	8		8		9	1
Waste recycling	No		1	1	42			1	
	Yes	41 (100%)	42 (98%)	40		40			42
Waste reuse	No	23	31	18	12			18	1
	Yes	18 (44%)	12 (28%)						11

Note: Total N respondents = 41 (AD) & 43 (HN).

Knowing about these systems

The number of respondents knowing about the 'green' systems of grey water recycling, black water recycling, rainwater tanks, solar hot water, separated waste collection, household composting, waste recycling, and waste reuse in Adelaide was higher than in Hanoi. Many households in Hanoi did not know about 'households composting' because they had never lived in a house with large garden and composting was only used in rural areas. Waste separation has never been introduced in Hanoi. Some households in Hanoi only know it through popular media while the households in Adelaide were using it. New technologies, such as solar hot water heaters and photovoltaic cells for electricity generation, were expected to be known in Australia better than in Vietnam. As expected the number of respondents knowing about solar hot water in Adelaide (80%) was higher than in Hanoi (60%). Surprisingly however the number of respondents knowing about photovoltaic systems in Hanoi (51%) was higher than in Adelaide (42%). The number of respondents knowing about 'bore water' in Hanoi (86%) was higher than in Adelaide (63%) because this technique is common in Hanoi due to the lack of tap water.

Using these systems

Householders who had knowledge about some systems were then asked about their use of these systems. Though the number of households in Adelaide knowing about these systems was higher than in Hanoi, the number of households using them in Adelaide was not always higher than in Hanoi. The number of respondents using these systems was small in both cases. Only one household in Adelaide and two households in Hanoi recycled grey water. In both these cases, the recycling was performed 'manually' for example by using the wastewater after washing on the garden. No household in both cases recycled black water. While 26% of the households in Hanoi used bore water, no one in Adelaide used it. Only 14% of the households in Hanoi and 10% of the households in Adelaide harvested and used rainwater. One household in Hanoi and no one in Adelaide used a solar hot water heater system. Photovoltaic system was applied to one house in Hanoi and two houses in Adelaide.

The solid waste collection in Hanoi mixed all materials together but in Adelaide it was separated into recyclable, organic, and all other materials. Generally, the waste collection service in Adelaide was better and more reliable than in Hanoi. About 28% of households in Hanoi were dissatisfied with waste collection service because sometimes the collectors did not come while in Adelaide only one respondent in Adelaide was dissatisfied with it. All households in Adelaide said they separated waste while no one in Hanoi said so. In fact, the respondents in Hanoi were recycling some wastes by selling recyclable waste to scavengers who on-sell it to private recyclers. All the households doing composting in Adelaide were satisfied with it. In both cases no one said they reused waste.

Householders using these technologies were asked if they were satisfied with them. Overall, the number of respondents satisfied with using these technologies in Adelaide was slightly higher than in Hanoi. The household using grey water recycling in Adelaide was satisfied with it while one out of two households using it in Hanoi was not. Only six out of eleven respondents using bore water in Hanoi were satisfied with it. All the households in the two cases were using tap water but only 85% in Adelaide and 51% in Hanoi were satisfied with it. Many respondents complained of the smell (in Adelaide) and the quality (in Hanoi) of tap water. All four respondents in Adelaide and four out of six respondents in Hanoi using rainwater were dissatisfied with its quality. The households using solar hot water or photovoltaic in Hanoi were satisfied with these technologies while only one out of two in Adelaide was satisfied.

Wanted to use these systems

Households not using, but knowing about a particular system, were asked if they would want to use it. The percentage of respondents giving a positive answer to this question in Adelaide was generally higher than in Hanoi. For example, among the households not using grey water recycling, 75% in Adelaide and 60% in Hanoi wanted to use it. Also, for households not using black water recycling, 64% in Adelaide and 45% in Hanoi wanted it, and of the households not using rainwater, 40% in Adelaide and 35% in Hanoi expressed their interest in using it. However, households without a solar hot water heater, 57% in Adelaide and a similar, and 56% in Hanoi wanted it. Among households not using photovoltaic, 56% in Adelaide and 38% in Hanoi wanted it. Among the households not using household composting, 30% in Adelaide and 3% in Hanoi wanted it. Most respondents in two cases wanted separate waste collection. Among the households not reusing waste, 92% in Hanoi and 0% in Adelaide wanted it. Among the households not using, 35% in Adelaide and 4% in Hanoi did not want to use bore water. Most respondents in the two cases (100% in Adelaide and 95% in Hanoi) did not want to use mixed waste collection.

Reasons for not wanting new systems

Respondents who did not express an interest in using these technologies were asked for their reason. A summary of the reasons for not wanting these systems is included in Table 6.1.22. The respondents could give more than one reason. The reasons varied and covered issues of the need, health implications, cost, and administrative barriers. The number of respondents raising reasons for not wanting to use these technologies was generally similar in the two cases, however, some differences were noted. The number of respondents raising 'no need' for applying photovoltaic systems in Hanoi was higher than in Adelaide. People in Hanoi saw no reason to install a photovoltaic system when reticulated electricity was available, ignoring the possible advantages of a renewable source of energy. Cost was an issue of concern for respondents in both cases for not applying a particular system. Householders in Hanoi found the tap water (from a reticulated water supply system) was expensive and of a poor quality while no one in Adelaide gave these reasons. The reasons for not using bore water were found more as 'no need' in Hanoi and 'poor quality' in Adelaide. The technology of rainwater tank was seen complicated in Hanoi but not in Adelaide. In Adelaide, a number of households gave expense, as the reason for not using solar hot water heaters while householders in Hanoi did not see expense as a barrier. Expense was also more of a concern in Adelaide than in Hanoi for not using photovoltaic cells. The reasons for not wanting to use a particular waste treatment method are included in Table 6.1.23. All households in Adelaide wanted a separate waste collection method while only 9% in Hanoi wanted this over the mixed waste collection system. This result probably reflects the knowledge and experiences of such a method. One respondent in each case disliked the separated waste collection because of the existing bad service such as "the bin was too small" in Adelaide and "the waste chute door in their corridor (in high-rise apartment) was always left open so bad smells were emitted to the corridor" in Hanoi. Reasons for not wanting to compost household waste the respondents raised were, it was unnecessary (22% in Adelaide and 5% in Hanoi), their gardens were too small to make it possible, that it took too much time and energy, or it was not possible because they did not own the house. As many as 44% of the respondents in Adelaide found there is no need to reuse wastes but only 2% in Hanoi saw the same. However, no one in the both cases found any reason for not recycling wastes.

Table 6.1.22 Number of respondents raising reasons for not wanting to use the technologies

Reasons for not using water and energy systems	**Grey water recycling**		**Black water recycling**		**Bore water**		**Tap water**		**Rain-water tank**		**Solar water heater**		**Photovoltaic**	
	AD	HN	AD	HN	AD	HN	AD	HN	AD	HN	AD	HN	AD	HN
No need/ unnecessary	1	1	5	3	4	14			7	5	5	7	1	8
Hygiene		1	1	2					6	4				
Inconvenient	1	2												
Inapplicability (high-rise)		1			3	3								
No room/ small garden	1				3				6	5				
Expensive			2	2	2	1		8			8		5	2
Poor quality					13	3		13						
No permission					2									
Bad taste							6							
Complicated										3		1		1
Ownership									1		1			
Looks ugly												1		
Not reliable													1	2

Table 6.1.23 Number of respondents raising reasons for not wanting to use waste treatment methods

Waste treatment	**Mix collection**		**Separated collection**		**Households composting**		**Recycling**		**Reuse**	
	AD	HN	AD	NH	AD	HN	AD	HN	AD	HN
Wanted separate	41 (100%)	4 (9.3%)								
Bad service		12 (27.9%)	1	1						
No need					9 (22%)	2 (4.6%)			18 (43.9%)	1 (2.3%)
No room					9					
Ownership					1					
Too much work					1					

The reasons for not using these systems included all social, economic, and technical barriers. The application of these systems therefore needs to ensure a good quality service, convenience and an affordable cost for the users. As many respondents found these technologies unnecessary, providing education and information promoting the benefits of these technologies is important. Social instruments seem to play an important role in promoting the application of technological instruments.

6.2 Social instruments

Social instruments in housing include family structure, living arrangements, lifestyle, preferred housing, and the users' perception of, and behaviour in seeking comfort and satisfaction. Studying this helps to define the character of sustainable housing.

6.2.1 Living arrangements and perceptions

Household size and structure

Question 2 collected data on household size and structure. The results are shown in Table 6.2.1. The average household size of the case study areas in Adelaide (3.1) was smaller than in Hanoi (4.3). In fact, this household size in Adelaide was slightly bigger than on average in South Australia (2.9) (ABS, 2001) and the household size in Hanoi was slightly higher than on average in Vietnam (4) (HPC, 2000, p. 2-8). The average number of generations in a household in Adelaide (1.5) was also lower than in Hanoi (2.1). Most households in Adelaide had one to two generations while most households in Hanoi had two to three generations sharing a house.

Table 6.2.1 Household size and structure

Cases	Household size	N generations	N respondents
AD	3.1	1.5	41
HN	4.3	2.1	43
Significant difference (1)	Yes (df = 82, p = 0.001)	Yes (df = 82, p = 0.000)	

Living arrangements

Question 4a investigated living arrangements of the households in the two cases. The result is shown in Figure 6.2.1. The number of households having parents living with dependent children was similar and dominant in both cases (44% in Hanoi and 46% in Adelaide). The number of sole parent households was small in both cases (0% in Adelaide and 5% in Hanoi). This family type accounts for 9% of all families in South Australia (ABS, 1995, p. 27) and in Hanoi similar statistics are not available. The number of lone person households was also small in the both cases (5% in Adelaide and 0% in Hanoi).

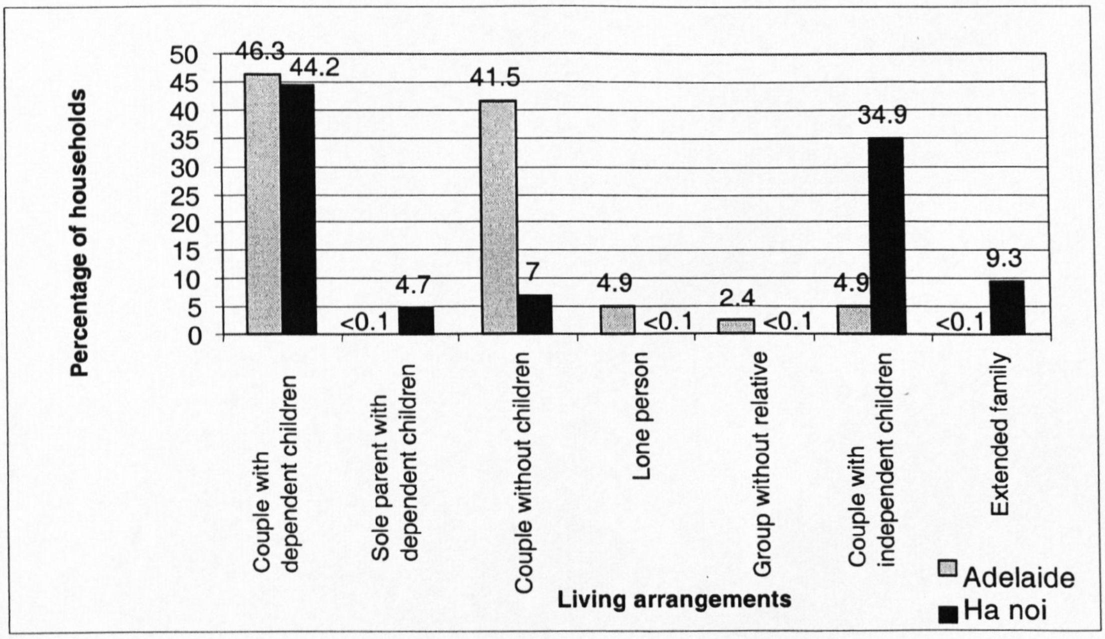


Figure 6.2.1 Current living arrangements in the two cases

Note: N respondents = 41 (AD) & 43 (HN).

Besides these similarities, the number of couples without children in Adelaide (42%) was much higher than in Hanoi (7%). Extended family was much more common in Hanoi (35%) than in Adelaide (5%). This was because most children in Adelaide move from home after the age of twenty-six (ABS, 2001) while most children in Hanoi often live with their parents until they can afford a house. Due to the low income, most people in Hanoi cannot afford to buy or rent a house. That is why the number of lone person household was low in Hanoi, and parents living with independent children were common in Hanoi (9%), but this is not the case in Adelaide (0%).

The extended family in Hanoi is believed to provide security for elderly (see Chapter 4) while nursing homes or couples without children in Adelaide may have different impacts on the life of elderly. Investigating advantages and disadvantages of different living arrangements could help to assess the sustainability of current living arrangements in the two cases.

Satisfaction with current living arrangement

Question 5a examined the satisfaction of the respondents with their current living arrangements include both the social and physical situation. The results are shown in Table 6.2.2. All households in Adelaide were satisfied with their current living arrangements while 14% of the households in Hanoi expressed some dissatisfaction. These households in Hanoi were couples with dependent children and extended family arrangements (Figure 6.2.2).

Table 6.2.2 Number of the respondents satisfied with current living arrangement

Satisfied with current living arrangement	AD	HN
No	0%	6 (14%)
Yes	41 (100%)	37 (86%)
N respondents	41	43

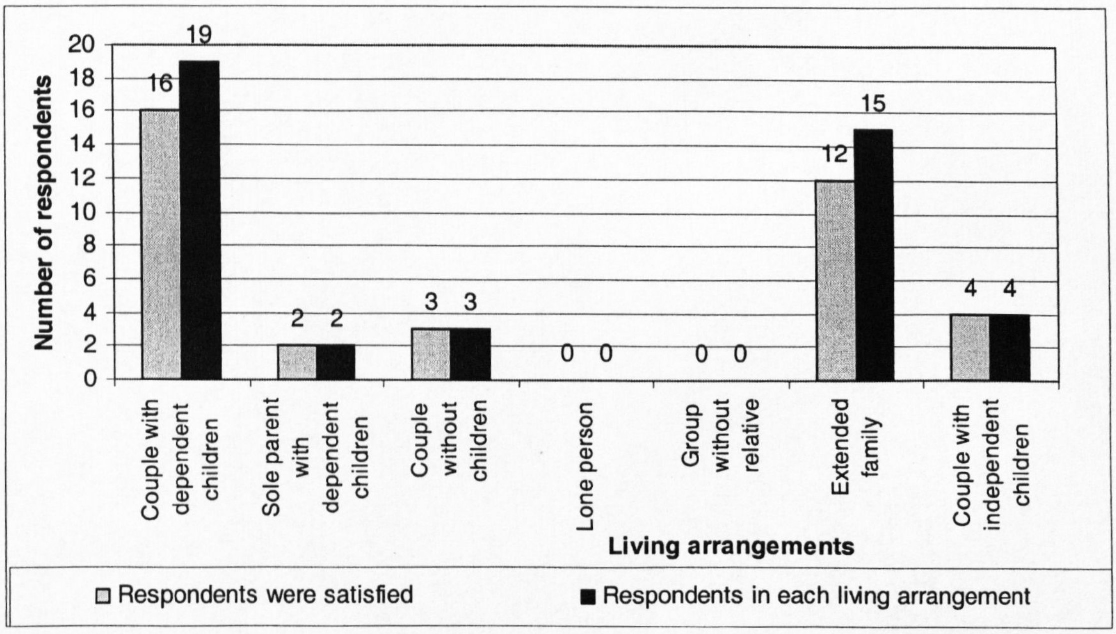


Figure 6.2.2 Number of respondents satisfied with current living arrangement in Hanoi
Note: N respondents = 43 (HN).

Question 5b studied what people wanted to change if they were not satisfied with their current living arrangements. Respondents often gave multiple responses and the results are shown in Table 6.2.3. Some respondents living in an extended family in Hanoi wanted to shift to a nuclear family situation. For example, a young woman said, "to be honest, no one wants to live with their parents-in-law". In contrast, an old couple said, "extended family living arrangement is good because old aged people are safe and the family members can take care of each other". This difference shows a generation gap.

While 35% of the respondents in Hanoi were living in extended families, only two households in Adelaide have this living arrangement (see Figure 6.2.1). This may relate not only to the lack of elderly care centres in Hanoi but also to the social and cultural perception of the respondents to this living arrangement.

Table 6.2.3 Changes people wanted to make in Hanoi

Changes wanted to make	Number of respondents
Complete the project	1
Having service facilities	1
Shift to nuclear family	2

Perception of the respondents about extended family

Question 6 asked the respondents who were not living with their parents "Would you want to live with your parents? Then if Yes, why? Why don't you [live with them]? And if No, Why?" The answers in the two cases were remarkably different (Table 6.2.4). Only 15% of the respondents in Adelaide wanted to live with their parents while 63% of respondents in Hanoi said this would be acceptable. However, 37% of respondents in Hanoi did not want to live with their parents, and this shows a potential change in social acceptance of the extended family and the preference for the nuclear family living arrangement in Hanoi.

Table 6.2.4 Percentage of respondents who were not living but would want to live with their parents

	AD	HN
N total respondents not living with their parents	39 (100%)	24 (100%)
N respondents would want to live with their parents	6 (15.4%)	15 (62.5%)
N respondents do not want to live with their parents	33	9

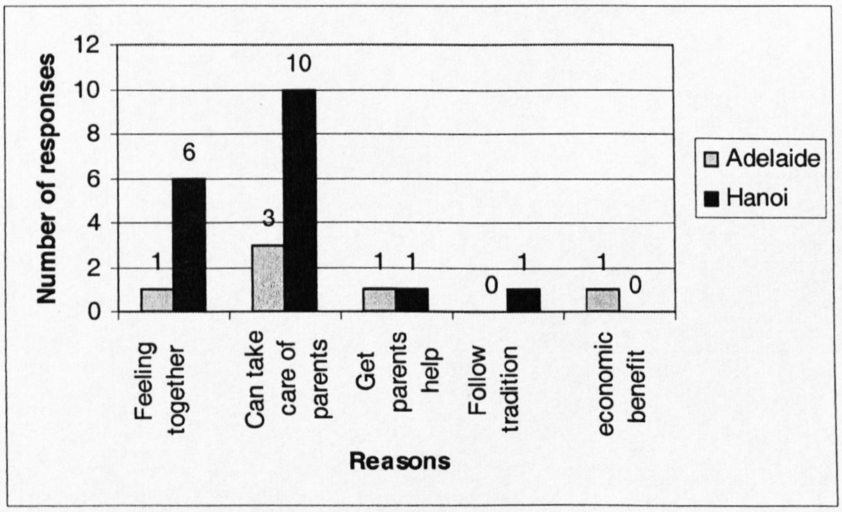


Figure 6.2.3 Reasons for wanting to live with parents

Note: N responses = 6 (AD) & 18 (HN).
N respondents would want to live with their parents = 6 (AD) & 15 (HN).

Question 6b investigated the reasons for the respondents wanting to live with their parents. With each respondent sometimes giving more than one reason, the results are reported in Figure 6.2.3. The reasons raised in the two cases were again different to each other. While ten respondents in Hanoi (24% of all respondents in Hanoi) found the convenience in taking care of their parents, only three in Adelaide found the same. Only a few respondents in both cases raised the benefit of the parents in supporting housework. Only one respondent in Adelaide saw economic benefit and no one in Hanoi did. A young man in Adelaide said: "it is good to live with parents because of free food and house". On the other hand, while six respondents in Hanoi raised emotional reasons such as "feeling together", only one respondent in Adelaide gave this reason for wanting to live with their parents. While one respondent in Hanoi wanted to live with his/her parents because of following tradition, no one in Adelaide raised this reason.

Question 6c explored the barriers to living with parents among those who were not living and wanted to live with their parents. The Figure 6.2.4 shows the multiple-response results for this question. The reasons such as ‘parents dislike city’ (many people in Hanoi came from a family in a rural area) and ‘parents live with the other child’ were raised in Hanoi only. The reasons ‘situation’ and ‘parents want independence’ were raised by a similar number of respondents in the two cases. ‘Situation’ included having small house or having small children. As the number of children in the both cases was similar (see Table 5.2), and the housing condition in Adelaide was generally better than in Hanoi, the perception of the respondents about their ‘situation’ seems not to be different. As the reason of ‘parents want independence’ was raised in Hanoi, this shows the potential for a change to a nuclear family living arrangement in Hanoi.

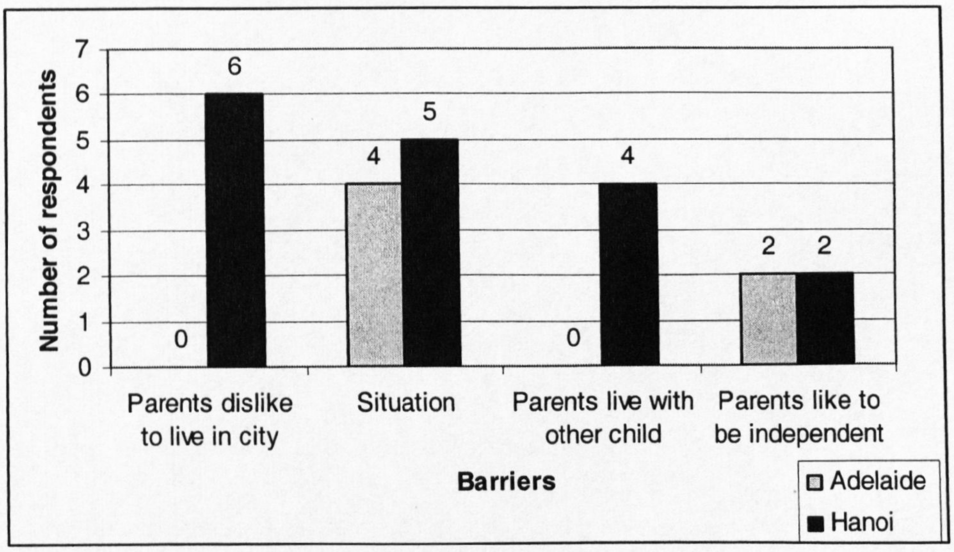


Figure 6.2.4 Barriers to living with parents

Note: N responses = 6 (AD) & 17 (HN).
N respondents who were not living and want to live with their parents = 6 (AD) & 15 (HN).

Question 6d investigated the reasons for respondents not wanting to live with their parents among those who were not living with their parents. The result shown in Figure 6.2.5 (sometimes recorded as multiple responses) revealed the major reason was that most respondents in the two cases liked to live independently (19 in Hanoi and 9 in Adelaide). Some respondents in Adelaide did not want to indicate any reason as they found this as a private issue. Beside this, some respondents in both cases indicated the reason of “housing condition” (generally means the house was too small) as a reason for their parents not living with them. This again can be explained only by the difference in social perception of the respondents about housing condition and requirements between the two cases.

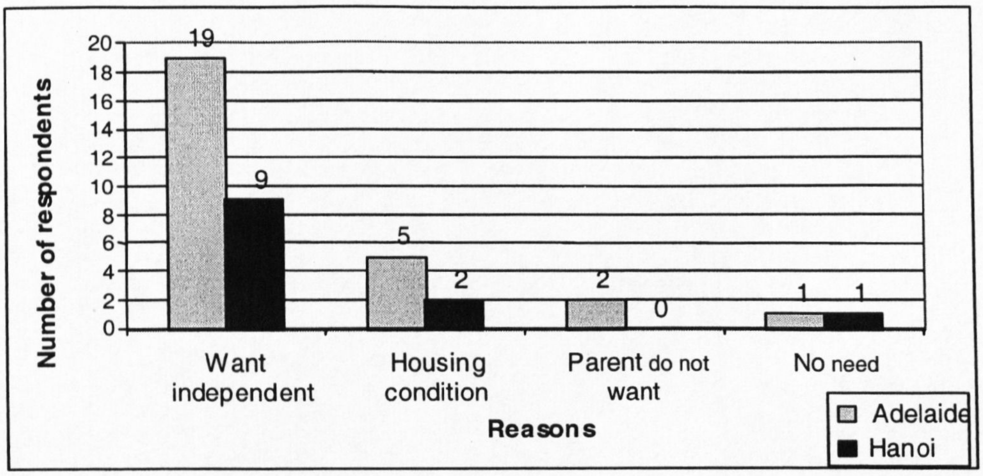


Figure 6.2.5 Reasons for not wanting to live with parents

Note: N responses = 27 (AD) & 12 (HN).
N respondents not living with and do not want to live with their parents = 33 (AD) & 9 (HN)

<u>Situation of old-age parents (not living with household)</u>

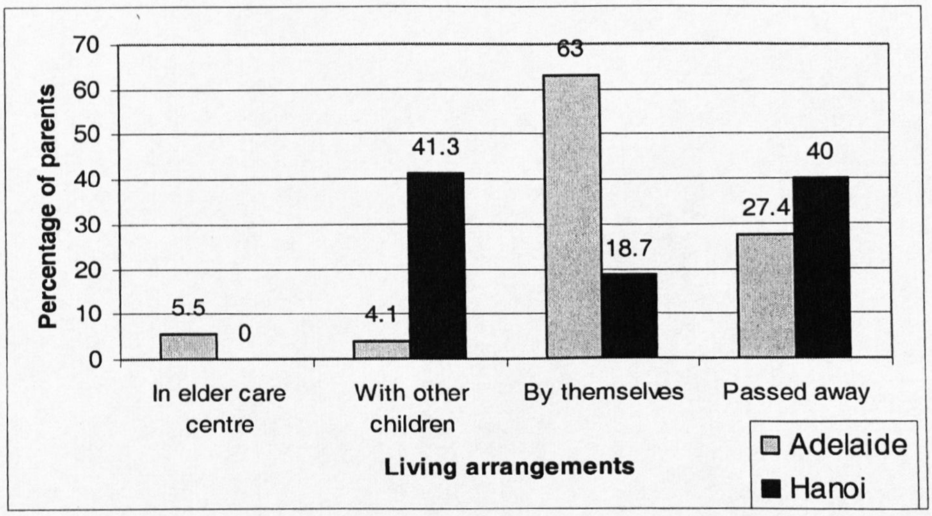


Figure 6.2.6 Living arrangement of the parents (% of parents)

Note: N elderly parents = 73 (AD) & 75 (HN)

As parents living by themselves are common in Adelaide and increasing in Hanoi, it is necessary to investigate the full situation of elderly parents. Question 4b investigated the current living arrangements of parents if not living in the respondent's household to understand how these people might be cared for. The result is shown in Figure 6.2.6. Of all parents (including those deceased) the number of parents living 'by themselves' in Adelaide (63%) was higher than in Hanoi (19%) (see Table 6.2.4)

To further investigate this situation Question 4c and 4d asked the respondents if their parents had any difficulties in their daily life such as health or mobility. The result shows that about

20% of the respondents in Adelaide and 12% of the respondents in Hanoi said their parents have some form of difficulties (see Table 6.2.5).

Table 6.2.5 Parents having difficulties

	AD	HN
Number of respondents reported their parents having difficulties	8 (20%)	5 (12%)
Number of respondents said their parents do not have any difficulties	22	36
Number of respondents did not answer this question (for reasons of privacy)	11	2
Total number of respondents	41 (100%)	43 (100%)
Number of old age parents having difficulties	15	4

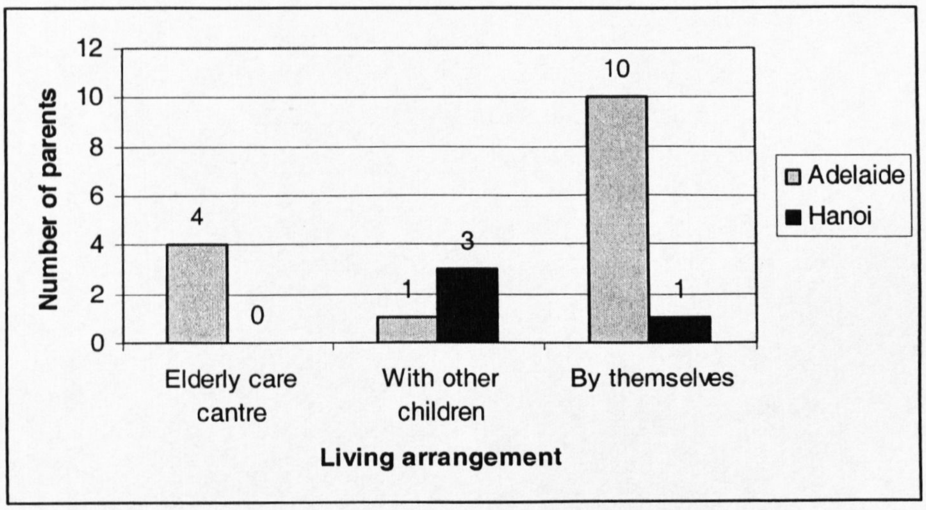


Figure 6.2.7 Number of parents having difficulties in different living arrangements (Percentage of parents having difficulties)

Note: N parents having difficulties = 15 (AD) & 4 (HN)

About 15 old age parents in Adelaide and four old age parents in Hanoi were reported to have difficulties in their daily life. Among these 15 respondents in Adelaide, the number of parents 'living by themselves' (67%) was higher than those living in other arrangements (26.7%) in elderly care centre and with other children (6.7%). Of the four old age parents in Hanoi, three were living with other children and one was living by her/himself (see Figure 6.2.7).

On the other hand, the respondents in the two cases seem to have different perceptions about difficulties their old-age parents were having in their daily life. The multiple-response Question 4e studied these difficulties and the result is shown in Figure 6.2.7. The respondents in Hanoi mainly identified social difficulties while the respondents in Adelaide saw physical difficulties (Figure 6.2.8). While 'living alone' and 'lack of social activities' for the elderly were raised in Hanoi, the respondents in Adelaide raised 'health/mobility'.

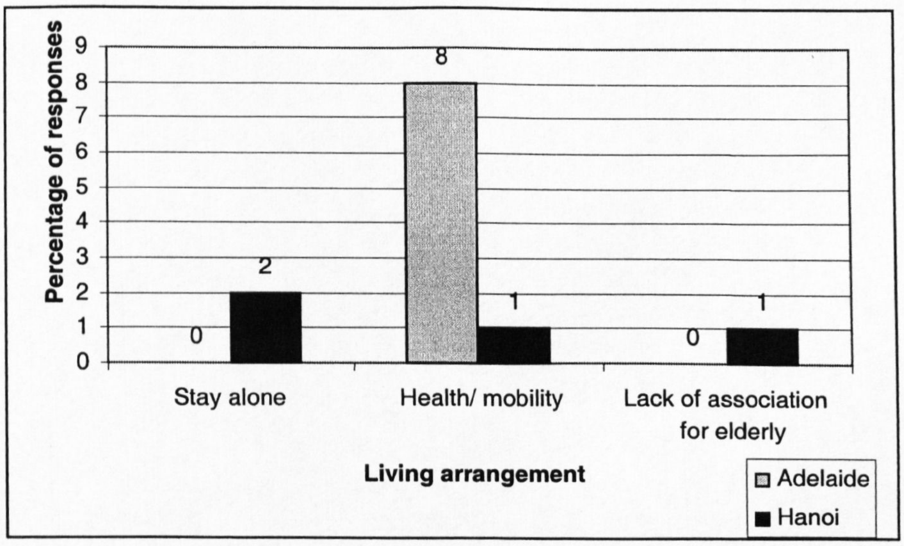


Figure 6.2.8 Difficulties the parents having (% of respondents)

Note: N respondents reported = 8 (AD) & 4 (HN).

6.2.2 Ownership, gender equity, and community involvement

Besides living arrangements, house ownership, the neighbourhood, involvement in housing design and construction, and the age and gender equity in housing are social issues related to sustainable housing (Rudlin & Falk, 1999). These issues are investigated in the following sections.

Ownership

Question 7a investigated the house ownership situation. The result is shown in Table 6.2.6. Most residents in both cases owned their house. Rental houses were more popular in Adelaide than in Hanoi. Only one household rented a house in Hanoi to live temporarily while they were building their own house. Three households in Adelaide rented their houses for living.

Table 6.2.6 Ownership of housing

	AD	HN
N respondents renting the house	3	1
N respondents owning the house	38	42
N respondents	41	43

Involvement in design and construction

Potentially high ownership could imply a high involvement of the user in designing and constructing the house. Question 51a studied the involvement of the users in designing and constructing their house. The result is shown in Table 6.2.7. Though the ownership was high in both cases, the number of owners involved in housing design and construction in Hanoi (respectively 58% and 49%) was higher than in Adelaide (respectively 27% and 22%). The correlation of these figures with their satisfaction with their current house is investigated below.

Table 6.2.7 Number of households involved in design and construction of their house

Cases	Design	Construction	N respondents
AD	11 (26.8%)	9 (22%)	41
HN	25 (58.1%)	21 (48.8%)	43

Gender equity in involvement in housing

Question 9b studied the involvement of the different genders in housing choice. The result is shown in Table 6.2.8. The number of households having both genders making housing choices was high in both cases and higher in Adelaide (81%) than in Hanoi (72%). The number of households having the male making housing choice alone was higher in Hanoi (26%) than in Adelaide (12%) while the number of households having just the female making housing choice was low in both cases (7% in Adelaide and 2% in Hanoi).

Table 6.2.8 Who made housing choice?

	AD	HN
Male	5 (12.2%)	11 (25.6%)
Female	3 (7.3%)	1 (2.3%)
Both	33 (80.5%)	31 (72.1%)
N respondents	41	43

Question 51b studied gender equity in the involvement in design and construction of the house among the households involved in designing and constructing their house. The result is shown in the Table 6.2.9. All eleven households involved in designing and constructing their house in Adelaide included both male and female. Among households involved in designing and constructing their own house in Hanoi, only 64% of the households have both genders involved in designing and 33% of the households having both gender involved in constructing their house. Males were more dominant in Hanoi about matters of design or construction of housing while it was equal in Adelaide.

Table 6.2.9 Number of male and female involved in design and construction of their house

Who involved	Design		Construction	
	AD	HN	AD	HN
Male		8		12
Female				1
Other		1		1
Both	11 (100%)	16 (64%)	9 (100%)	7 (33%)
Total N	11	25	9	21

Question 17d studied gender equity in making decisions in changes in the house with the result shown in Table 6.2.10. The number of households having both genders making the decision in Adelaide (92%) was also higher than in Hanoi (67%). Though the number of households having one gender making the decision was low in both cases, the number of households having male making the decision was higher than number of households having female making decision alone in both cases. Households in Hanoi sometimes have a son making the decision as old age parents in Hanoi often listen to their mature children. Generally, it seems that children have little right to make decisions about their parents' house in both cases.

Table 6.2.10 Number of male and female decided the change

	AD	HN
Male	1 (7.7%)	2 (16.6%)
Female		1 (8%)
Son		1 (8%)
Both	12 (92.3%)	8 (66.7%)
Total N	13	12

Question 17e investigated budget contribution for the changes. The result is shown in Table 6.2.11. The equity in budget contribution in Adelaide was higher than in Hanoi. The number of households having both genders contributed budget for the changes in Adelaide (100%) was higher than in Hanoi (75%). About 17% of the households in Hanoi had the male householder alone paying for the changes while no households had women paying alone. This inequity in financial contribution in Hanoi may relate to inequity in the income and job opportunities for women in Hanoi. There is little employment equality with most jobs advertised in newspapers in Hanoi clearly indicating the preference for a male employee.

Table 6.2.11 Number of male and female paid for the changes?

	AD	HN
Male		7 (17%)
Female		4 (8%)
Both	41 (100%)	32 (75%)
Total N	41	43

To further examine social equity Question 20c studied gender differences driving motor vehicles. Result is shown in Table 6.2.12. The percentage of the households having both genders driving motor vehicles in Adelaide (85%) was higher than in Hanoi (65%). The number of households having only males driving in Hanoi (35%) was higher than in Adelaide (12%). One household in Adelaide and no household in Hanoi had only a female driving motor vehicles. This may indirectly affect the female accessing jobs and other social services.

In short, the male was more dominant in Hanoi while gender equity is fairly ensured in Adelaide in making decision and contributing budget to the house. This seems to relate to gender equity in the society, culture, and economic conditions (income, job opportunity).

Table 6.2.12 Number of male and female drives motor vehicles?

	AD	HN
Male	5 (12.2%)	15 (34.9%)
Female	1	
Both	35 (85.4%)	28 (65%)
Total N	41	43

Community

While, as seen above, there is obvious gender inequity for individual household decision making, promoting involvement for all in community decisions may ensure that the interests of all are taken into account.

Question 25a studied community involvement in two cases. The result is shown in Table 6.2.13. The percentage of the households involved in community activities in Hanoi (5%) was much lower than in Adelaide (43%). Many respondents in Hanoi said they would like to join community activities but the area was too new to have any community activities. Many people just moved in and many houses were still vacant. They said they had been involved in community activities in previous housing areas.

Table 6.2.13 Number of respondents participated in community activities

Participate in community activities	**AD**	**HN**
No	23	41
Yes	18 (43.9%)	2 (4.7%)
Total N	41	43

Table 6.2.14 Community activities

Activities	**Number of respondents**	
	AD	**HN**
Clean the street		1
Community meeting	1	1
Joins in associations	17	
Total	18	2

When asked what community activities did they actually take part in, householders in Adelaide mainly reported joining in associations and attending community meetings. One respondent in Hanoi said they, with their neighbours, cleaned the street as a community activity (Table 6.2.14). On the other hand, the higher involvement in community activities in Adelaide seems to relate to the higher number of retired people or the people staying at home doing home chores who have more spare time to participate in community activities (see Table 6.2.15).

Table 6.2.15 Occupation of the residents

Occupation	Number of residents	
	AD	HN
Professional, technical	20 (29%)	41 (48.2%)
Administrative	9 (13%)	12 (14.1%)
Sale workers	2 (2.9%)	1 (1.2%)
Trade man, production	3 (4.3%)	0
Service, sport	1 (1.5%)	5 (5.9%)
Member of armed force	0	3 (3.5%)
Retired	20 (29%)	19 (22.4%)
Student	3 (4.3%)	3 (3.5%)
Home duty	11 (15.9%)	1 (1.2%)
Total N	69 (100%)	85 (100%)

Neighbourhood relationships

Question 7 investigated the number of neighbours visiting and the number of visits per month to the households. The result is shown in Table 6.2.16. The number of neighbours visiting was not significantly different between the two cases but the number of visits per month in Hanoi was higher than in Adelaide. Interestingly, while as reported above, 'travel to visit friends' was very similar in the two cases, observation shows people in Hanoi are much more likely to drop in for a chat or to ask for assistance from their neighbours.

Table 6.2.16 Neighbours visiting

Neighbour visit	Case	Mean	N	Significant difference (1)
Number of neighbour visiting	AD	2.0	41	No (df = 82, p = 0.118)
	HN	2.7	43	
Number of visits per month	AD	3.7	31	Yes (df = 66, p = 0.003)
	HN	10.2	37	

Note: (1) T-Test for Equality of Means

6.2.3 Preferred house

Besides studying living arrangements and social relationships between residents in a household and within a community, determining housing preferences from a user's perspective is necessary to formulate sustainable housing solutions. The following sections analyse the survey questions aimed at elucidating householders' views about their preferred house and how this compares to their actual house.

Question 8 asked, "Would you tell me what are the most important requirements when choosing or building a house?" The results for the two cases are shown in Figure 6.2.9 where each respondent could give more than one requirement (response). There were similarities but also differences in the perception of the respondents in the two cases about a good house. The highest number of the respondents in the two cases raised design and location (respectively 63%, 78% in Adelaide and 72%, 60% in Hanoi) as the most important requirements. Other issues such as quality of a house, social suitability, type of house, affordability, business opportunity, and neighbour relationships were raised by only a few respondents in both cases. Beside these similarities, there were a few differences that concentrated on social, traditional, economic, and physical issues. Some requirements were raised as issues in Hanoi but not in Adelaide such as infrastructure (23%) and administrative custom for ownership (7%). The requirement of the application of Feng Shui principles was raised in Hanoi (7%), as some Hanoi people still strongly believe in Feng Shui application in designing housing for a more fortunate life. On the other hand, the requirement to have appliances (such as air conditioners) was raised in Adelaide (2%) but not in Hanoi. The requirement of 'business opportunity' raised in Adelaide (7%) was higher than in Hanoi (2%) but the meaning was different. Business opportunity was related to financial investment in Adelaide while in Hanoi, it was related to the opportunity to open a shop or business in the house. For example, one respondent in Adelaide who lives alone in a three-bedroom house said, "I prefer this house because it would be easier to sell compared to a smaller house that might suit my needs better".

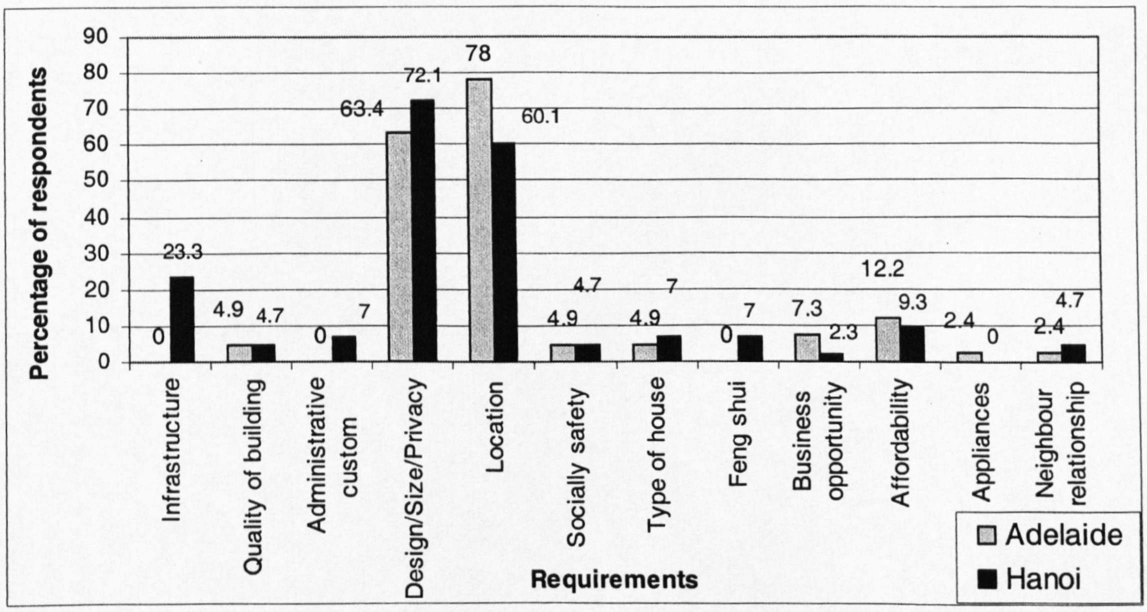


Figure 6.2.9 Requirements for a good house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 74 (AD) & 87 (HN)

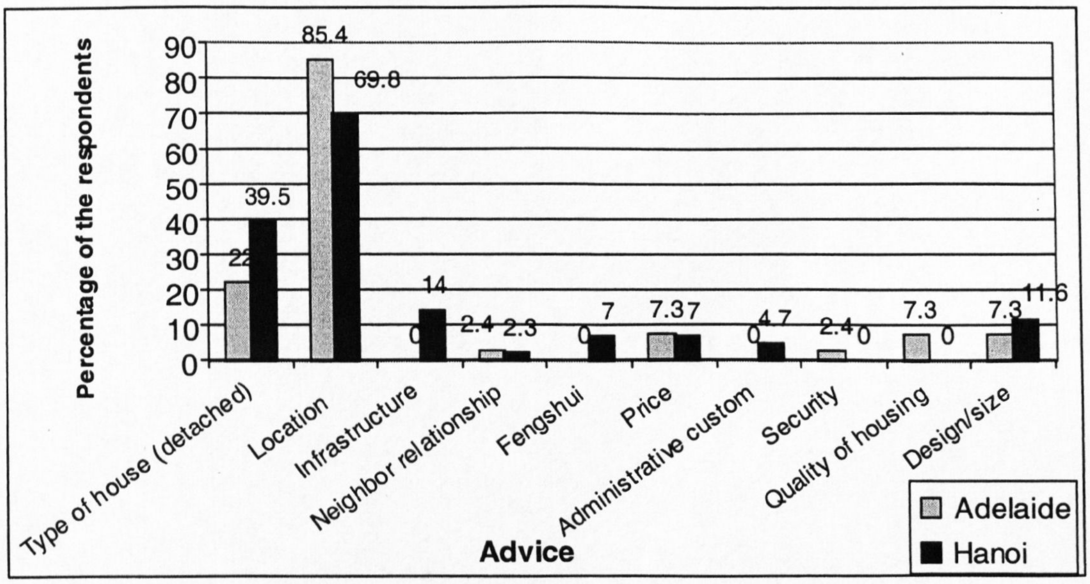


Figure 6.2.10 Advice for a friend who wants to buy or build a house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 55 (AD) & 67 (HN)

Question 19 investigated the issue of housing preferences in a different (and much more indirect) way. In this case, the respondents were asked "If you were to give advice to friends from interstate (from country) or overseas, who were intending to buy or build a house in Adelaide (Hanoi), what would you tell them?" The respondents often offered more than one piece of advice (response) and the results are shown in Figure 6.2.10. Location was again raised as a key issue in both Adelaide and Hanoi. However, for this question the type of house (detached, apartment, etc) figured in both locations as the next most important requirement. Only few respondents in the two cases raised design (7% in Adelaide and 12% in Hanoi) as an issue of concern yet in answer to Question 8 concerning their own choices it was one of the main important factors. Some issues such as infrastructure, Feng Shui, and administrative custom were raised in Hanoi only (respectively 14%, 7%, and 4%), not in Adelaide while quality of housing was raised in Adelaide only (7%). The issues raised were related to socio-economic conditions in each case.

Most important issues

Question 12d asked the respondents to indicate on a five-point interval scale (see Scale 1, Appendix D) the level of importance they attach to several factors related to their house including appearance, housing area, convenient plan, the cost and natural lighting. The results are shown in Table 6.2.17.

Table 6.2.17 Mean rank of the importance level of different issues

Case	Appearance	Housing area	Convenient plan	Cost of the house	Natural lighting and ventilation
AD	4.1	4.3	4.4	4.3	4.4
HN	4.0	4.2	4.5	3.8	4.6
Significant difference (1)	No (df = 82, p = 0.766)	No (df = 82, p = 0.815)	No (df = 82, p = 0.769)	Yes (df = 82, p = 0.023)	No (df = 82, p = 0.166)

Note: (1) T-Test for Equality of Means

The respondents in the two cases had the same perception about the important level of appearance, area, convenient plan and natural lighting. Somewhat counter intuitively, the cost of buying or renting the house was indicated in Adelaide at a higher level of importance than in Hanoi though the respondents in Adelaide have a higher income than in Hanoi. This may relate to the perception mentioned above; housing is seen as financial investment in Adelaide. Housing is seen more as a home in Hanoi and the respondents had already bought the house, so it's not so much of an issue for them. Since the level of all these issues was ranked highly at the 'very important' end of the scale, all these issues were relatively important to the respondents in the both cases.

<u>The most and least important places in a house</u>

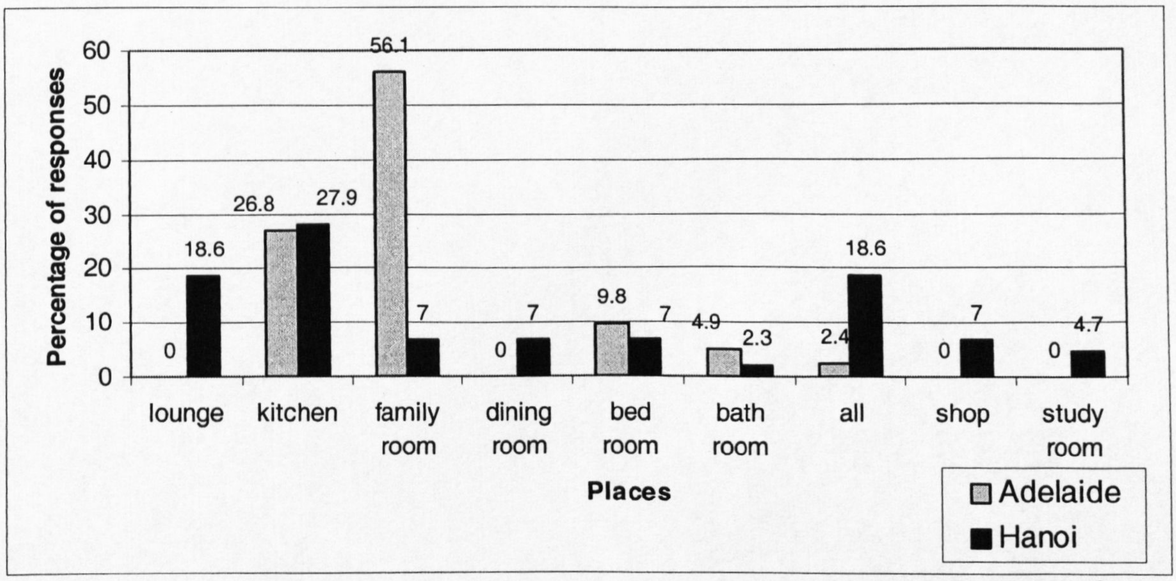


Figure 6.2.11 The most important place in a house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 41 (AD) & 43 (HN).

Question 10 asked householders to "name the most important place in your house" from a given list. The results are shown in Figure 6.2.11. The respondents in Adelaide and Hanoi had different perceptions about the most important place in their house. The respondents in Hanoi indicated a greater range of places than the respondents in Adelaide.

The most important place in a house in the perception of the respondents seems to be associated with the lifestyle of the respondents and the design of the house. The number of respondents seeing the family room as the most important place in Adelaide (56%) was higher than in Hanoi (7%). New houses in Adelaide often have an open plan where the family room adjoins the kitchen and dining room. The friends or informal guests are often welcomed in this place. Most houses in Hanoi have no family room, so the family members and guests often gather in the lounge while 'lounge' in Adelaide is more often used for welcoming formal guests. Many respondents in Hanoi considered lounge (19%) and dining room (7%) as most important places while many respondents in Adelaide asserted they never use the lounge. The total number of the respondents in Hanoi raising lounge, dining room, kitchen, and family room (59%) was similar to the number of respondents raising family room in Adelaide (56%). In addition, while some respondents in Hanoi (19%) found all places in their house equally important, only one respondent in Adelaide saw the same. Having a shop at home is popular and considered as important in Hanoi (7%) while no houses in Adelaide included a shop. The study room was considered as the most important place by 7% of the respondents in Adelaide but by no one in Hanoi though the numbers of children at the studying age (from seven to seventeen) in two cases were similar (11% in Adelaide and 14% in Hanoi) (Table 6.2.18). It is necessary to note that most houses in Hanoi did not have a study room and children often used a table in their bedroom for study while it was popular in Adelaide to have a separate study room. The rooms in the houses in Hanoi were used more efficiently than in Adelaide. This may relate to the bigger household size, smaller dwelling size, and smaller number of rooms in houses in Hanoi than in Adelaide.

Table 6.2.18 Age of residents

Age	Number of residents	
	AD	HN
Children age from 0 to 6	10	13
Children age from 7 to 17	16 (14%)	17 (11%)
Person age from 18 to 34	10	51
Person age from 35 to 54	47	53
Person age from 55-64	4	21
Person age >65	24	7
Total N	111	162

In contrast, Question 10b asked respondents to nominate what they saw as the least important place in their house. The results are shown in Figure 6.2.12. The respondents in Adelaide saw more places as least important than the respondents in Hanoi. While 72% of the respondents in Hanoi said no place in their house was least important, only 24% of the respondents in Adelaide said so. Many respondents in Adelaide saw lounge (22%), studying room (20%), and bathroom (15%) as the least important places while only 5% of the respondents in Hanoi said lounge is the least important. While 12% of the respondents in Hanoi saw the balcony as the least important place, no one in Adelaide mentioned the balcony because most houses in Adelaide being single storey had no balconies. Although balconies in Hanoi often are too small for any activities except for drying clothes and storing some flowerpots, it provides shade and protects the house from rainwater entering the house.

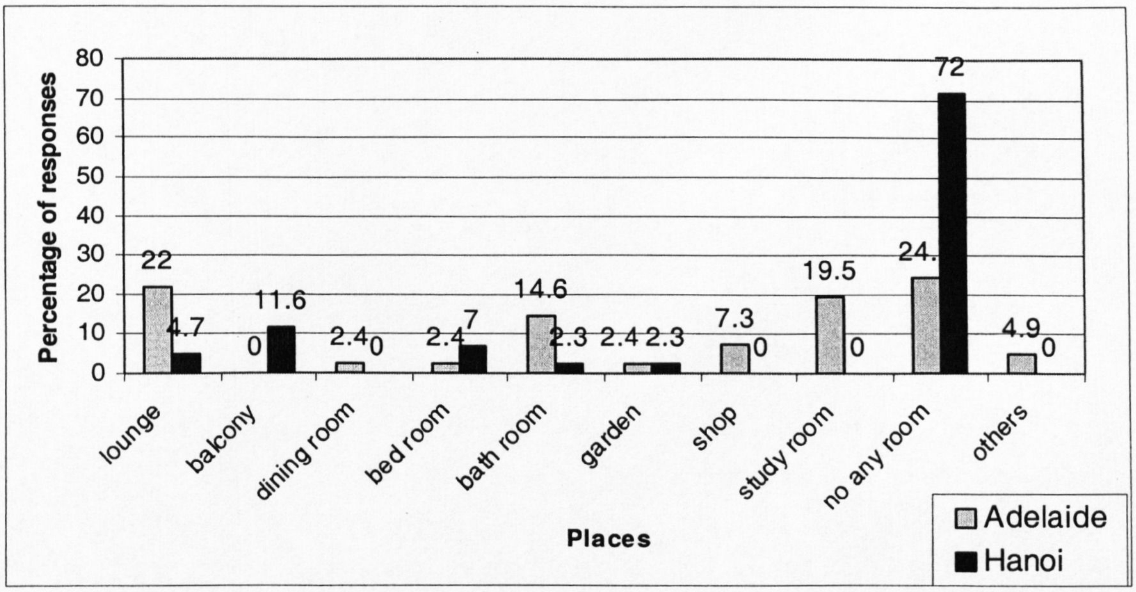


Figure 6.2.12 The least important place in a house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 41 (AD) & 43 (HN)

Things the respondents liked and disliked the most in their houses

Question 12b sought opinions about the things the respondents liked the most about their house. The results of this multiple response question displayed in Figure 6.2.13, show that the major things respondents in both cases liked the most about their house were the location and design. Many respondents in Hanoi said this new housing area had a good plan, good infrastructure and was located not too close to the city centre, which they saw as too noisy and crowded. The respondents in Adelaide said the location of their houses was 'great' because it was near a major shopping centre, the beach, and the city centre. The number of respondents liking the location of the house in Hanoi (51%) was higher than in Adelaide (27%) while the number of respondents liking the design of the house in Adelaide (66%) was similar to Hanoi (65%). Some other things were raised by only few respondents and different between the two cases. Appearance, social relationship, price, and infrastructure were the things that were liked the most in Hanoi but were not mentioned in Adelaide. While some respondents in Adelaide said they like their brand new house and modern appliances, no one in Hanoi mentioned these aspects.

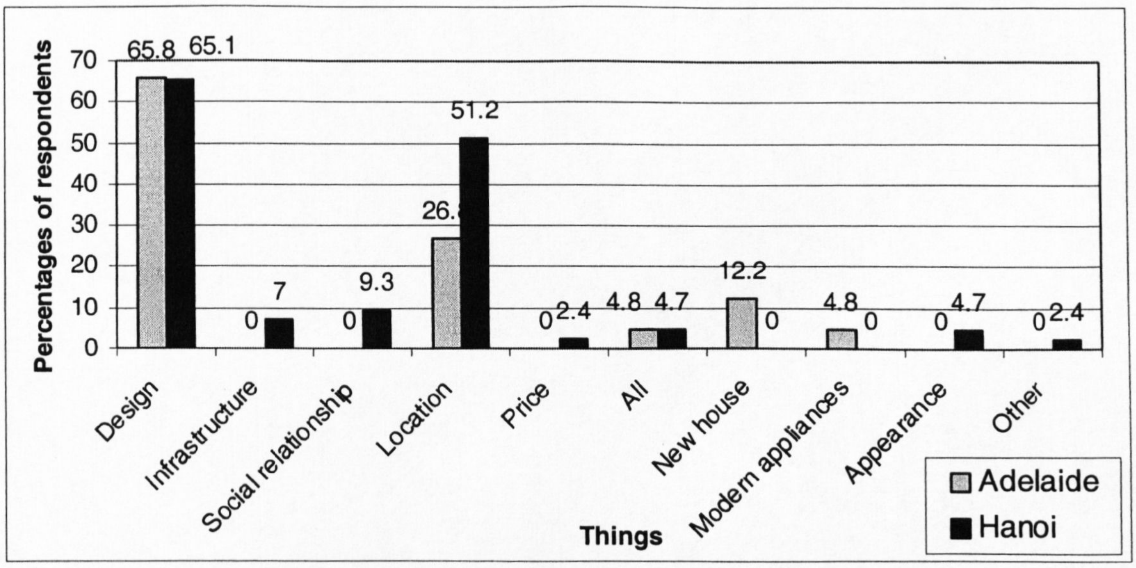


Figure 6.2.13 Things the respondents liked the most about their house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 47 (AD) & 63 (HN)

As the number of respondents living in detached houses in Hanoi was lower than in Adelaide, this may be the reason for the lower number of the respondents in Hanoi liking their house design compared with Adelaide. As shown in Table 6.2.19, there is a significantly higher number of respondents living in a detached house that are satisfied with the design compared with the other forms of housing.

Table 6.2.19 Number of respondents satisfied with design of their house

Type of house they living in	Detached	Apartment	Attached
Number of respondents liked design	30	11	14

Note: N respondents mentioned design in AD & HN = 55

To identify the failures of current housing practice in the resident's perception, Question 12c (multiple response) investigated things the respondents disliked the most about their current house. The results are shown in Figure 2.6.14. While overall the houses seem to fulfil users' needs in Adelaide better than in Hanoi, the respondents in the two cases were dissatisfied with many issues and the percentage of respondents disliking these issues was different between the two cases. The percentage of respondents saying there was nothing they disliked about their house in Adelaide (44%) was higher than in Hanoi (15%). The number of respondents disliking the design of the house in Hanoi (42%) was higher than in Adelaide (26%). The number of respondents disliking social relationship, location, appearance, and time spent on cleaning was small and similar in the two cases.

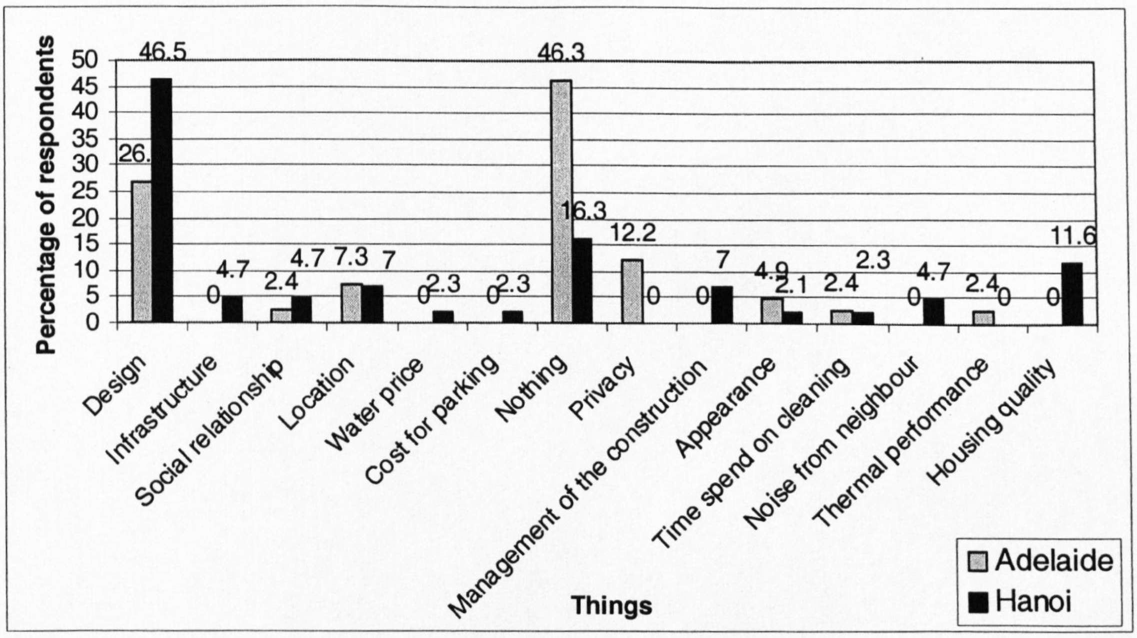


Figure 6.2.14 Things respondents disliked the most in their house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 43 (AD) & 48 (HN)

Besides this, while some respondents in Hanoi disliked housing quality (10%), the management of the housing area (6%), noise from neighbours (4%), infrastructure (4%), the high price of water (2%), and cost of keeping vehicles (2%), the respondents in Adelaide did not raise any of these but raised privacy (12%) and thermal performance of the house (2%). Many respondents living in apartments in Hanoi complained of the low quality of the construction and the delay in completing the infrastructure system and service centres in the area. Though housing in Adelaide uses more insulation materials and has a high standard, some respondents in Adelaide still complained that their houses "are very hot during the summer" because the house "has no overhang or eaves".

Reasons for choosing current house

Question 9, a multiple response question, asked respondents to indicate: "Why did you choose this house?" The respondents in two cases (see Figure 6.2.15) found similar but also different reasons for choosing their house and the reasons seem to reflect the situation of housing and the cultural background of the respondents in each case. Most respondents in both cases saw location and design as the main reasons for choosing their current house and the number of responses that suggested these factors in Adelaide (respectively 41% and 40%) was higher than in Hanoi (respectively 26% and 26%). The number of respondents that suggested 'social suitability' in Hanoi (11%) was higher than in Adelaide (3%). Affordability concerned a similar number of respondents in the two cases (10% in Adelaide and 13% in Hanoi). Besides this, the respondents in Hanoi raised many issues that were not considered in Adelaide such as good infrastructure (19%), Feng Shui (16%), and economic benefit (9%). On the other hand, the 'newness' concerned more households in Adelaide (10%) than Hanoi (2%).

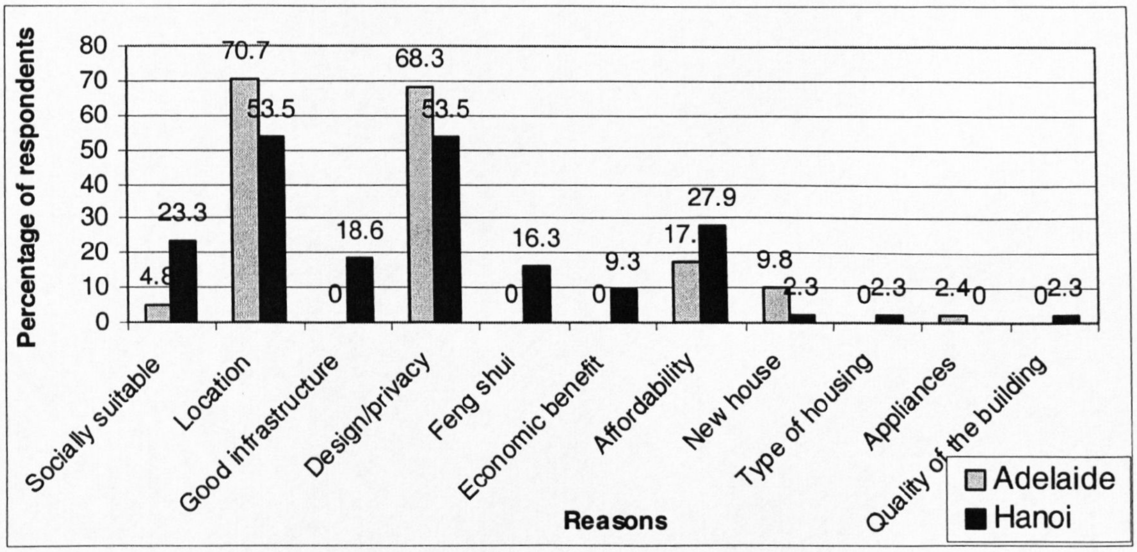


Figure 6.2.15 Reasons for choosing current house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 71 (AD) & 90 (HN)

Comparing the reasons for choosing the house with the requirements of a good house given in answer to Question 8 (see above) shows a strong correlation. However, some reasons for choosing the house were not raised in the requirements of a good house such as the newness and appliances (in Adelaide). These aspects may be not important but are necessary to consider when developing sustainable housing, especially in Adelaide.

<u>Satisfaction with current house and issues in the house</u>

In Question 12 respondents were asked "would you tell me how satisfied you are with this house?" and to indicate their answer on a five point interval scale (completely dissatisfied to completely satisfied, see Scale 2, Appendix D). T-Test for Equality of Means showed that the mean satisfaction level of the respondents with their current house in Adelaide (4.2) was higher than in Hanoi (3.9) (df = 82, p = 0.024). (See Table 6.2.20)

Question 13 asked the respondents to rank their satisfaction level on the same five point scale for a number of aspects related to their house. The results are shown in Table 6.2.21. The respondents in Adelaide had a significantly higher satisfaction level than the respondents in Hanoi with many physical issues and some social issues including appearance of the house, the harmony of neighbourhood, security, location, area of the house (space), number of rooms in the house, plan of the house, garden, environmental quality in the area, public transport, safety of road system, infrastructure, benefit from garden, benefit in housing investment. Beside this, there was no significant difference between the two cases in the satisfaction level of the respondents with privacy, time spent on housework, suitable to social life, disturbance from neighbours, neighbour relationship, quietness, playground, cost for buying or renting the house, and the cost of running the house.

Table 6.2.20 Mean rank of satisfaction levels with issues in the current house

Issues	**AD**	**HN**	**Significant difference** (1)
Appearance	4.4	3.7	Yes (df = 82, p = 0,000)
Harmony of neighbourhood	4.5	4.0	Yes (df = 82, p = 0.000)
Security	4.3	3.8	Yes (df = 82, p = 0.004)
Privacy	4.1	4.2	No (df = 82, p = 0.832)
Time on housework	3.9	3.6	No (df = 82, p = 0.179)
Suitable to social life	4.2	4.2	No (df = 82, p = 0.827)
Disturbance from neighbour	4.2	4.2	No (df = 82, p = 0.087)
Neighbour relation	4.4	4.3	No (df = 81, p = 0.575)
Location	4.6	3.7	Yes (df = 82, p = 0.000)
Space	4.7	4.0	Yes (df = 82, p = 0.000)
Number of rooms	4.6	4.0	Yes (df = 82, p = 0.000)
Plan	4.6	4.1	Yes (df = 82, p = 0.004)
Garden	4.2	2.7	Yes (df = 81, p = 0.000)
Environmental quality	4.2	3.8	Yes (df = 82, p = 0.017)
Quietness	4.1	3.8	No (df = 82, p = 0.144)
Public transport	4.1	3.2	Yes (df = 76, p = 0.000)
Distance to shop	4.2	2.9	Yes (df = 82, p = 0.000)
Safety of roads	4.0	3.3	Yes (df = 82, p = 0.000)
Infrastructure	4.2	3.4	Yes (df = 81, p = 0.000)
Playground	4.2	4.0	No (df = 82, p = 0.242)
Benefit from shop		3.3	Yes
Benefit from garden	4.1	2.0	Yes (df = 41, p = 0.003)
Benefit in housing investment	4.5	3.8	Yes (f = 80, p = 0.001)
Cost for buying or renting house	4.2	4.1	No (df = 82, p = 0.270)
Cost for running the house	3.8	3.5	No (df = 80, p = 0.212)

Note: (1) T-Test for Equality of Means
The ranks followed the Scale 2 (Appendix D)

Table 6.2.21 Issues for which respondents were dissatisfied or completely dissatisfied with issues by number of respondents, Adelaide and Hanoi

Issues in housing		Appearance of house	Harmony of neighbourhood	Security	Privacy	Time on housework	Suitable to social life	Disturbance from neighbour	Neighbour relation	Location	Space	Number of rooms	Plan of the house	Garden	Environment quality	Quietness	Public transport	Distance to shop	Safety of roads	Infrastructure	Playgrounds	Benefit from shop	Benefit from garden	Benefit from housing	Cost for buying or renting	Cost for running the house
N of respondents	**AD**	0	0	2	3	2	2	1	0	0	0	0		2	1	1	2	2	2	0	3		2	0	1	4
	HN	1	2	4	1	4	1	5	1	6	1	2		23	3	5	13	18	8	7	2	4	1	4	2	7

The number of issues with which the respondents were dissatisfied or completely dissatisfied in Hanoi was higher than in Adelaide and the number of respondents dissatisfied or completely dissatisfied with these issues in Hanoi was often higher than in Adelaide.

Adelaide

While no major reason was identified by a number of respondents, a few respondents identified a number of issues they were not satisfied with as follows. Two respondents were not satisfied with security because having recently purchased their house they had not yet set up the security system. Two respondents were dissatisfied with privacy because, they said, "the houses are too close to each other". It is important to note that though this housing area has a higher density than the other existing areas in Adelaide, it is still a low-density housing area (see Chapter 3). The reason for the dissatisfaction seems to relate to the unfamiliarity of the respondents to a higher density living environment. Two households in Adelaide were dissatisfied with time spent on housework because the house is 'too big to take care of'. Two households in Adelaide were not satisfied with the suitability of the house to their social life. They said this house did not fit their family situation of having children. They believed that children need a larger garden and one storey housing. Two respondents were also dissatisfied with the small size of their garden and the benefit derived from the garden. One respondent was dissatisfied with the disturbance from neighbours as the "neighbour has naughty boys that sometimes make noise". One respondent was dissatisfied with noise from traffic as their house was located next to a main road. One respondent was dissatisfied with the environmental quality of the area due to the dust released from construction sites nearby. Two respondents were dissatisfied with public transport because of the low frequency and no buses to the city in the evening and late at night. Two other respondents complained of the long distances to shops and "the local shop is small and less diverse". Two respondents were not happy with the safety of the local roads. They said, "there was no speed limit and this endangers children playing in the streets". Three respondents complained of the lack of children's playgrounds as the public garden in the centre of the housing area only had a small space for children to play. One respondent was dissatisfied with the high cost of buying their houses and said, "cheap quality, and runs down very fast, requiring repair and replacement costs". Four respondents were dissatisfied with the cost of running the house. They said, "the cost of electricity and water in their present house was higher than the previous house though their current house and garden are smaller than the previous house".

Hanoi

In comparison to Adelaide, in Hanoi the respondents identified three main issues as the area of dissatisfaction. These included the lack of gardens, the distance to shopping facilities, and the accessibility to public transport service. A number of other issues were also identified.

One respondent was dissatisfied with the appearance of their house while two respondents were dissatisfied with the harmony of the neighbourhood as they described some of their neighbours' houses as ugly. The dissatisfaction with the harmony of neighbourhood related to the disorder and contrasting styles of the houses in the streets because the residents were left free to design their houses. Four respondents in Hanoi living in detached houses were not satisfied with security. They said, "local people living in the village nearby sometimes come to steal small things". The sense of security was also seen in the nature of the detached house itself because the "detached houses provide less social ties within the neighbourhood" and reduce communication. Though having higher density, the number of respondents dissatisfied with privacy in Hanoi was smaller than in Adelaide, suggesting that the notion of privacy is culturally defined. Four respondents in Hanoi complained of time spent on housework. This was especially the case in some large detached houses despite these households having some helpers. One respondent found their house did not suit their social lifestyle and one was not satisfied with the relationship between neighbours, as there was a conflict between next-door neighbours.

One respondent was dissatisfied with the space in the house and two respondents were dissatisfied with the number of rooms in their houses, as they wanted to have more rooms. It is necessary to note that one of them has the biggest house in the area (a detached three-storey house with only four people living in it). The perception about space and number of rooms seems to depend on personal perception.

Beside this, many problems will be solved when the project is completed. Five respondents were dissatisfied with disturbances from the construction works at the neighbours' houses. The construction works on the site also caused many disturbances to local residents such as noise, dust and traffic disturbance by building materials and trucks on the roads. Six respondents in Hanoi were dissatisfied with the location of the house as "it is too far away from the city and other service centres" because it is located eight kilometres from the city centre and local service facilities had not been built. Three respondents complained about the environmental quality and five respondents were dissatisfied with the quietness in the area due to the construction sites nearby. Some complained, "the construction sites do not have any toilets for workers so the workers released their wastes everywhere in the site within the housing area and this affects the quality of the environment in the area". Due to the newness, public transportation was not provided in the area and thirteen respondents were dissatisfied with it. However, if buses were provided, it was not sure if the people would use them because of the common habit of using motorcycles and the general poor service quality of buses. Eight respondents in Hanoi were dissatisfied with the safety of the road system. The main road connecting this area to Giai Phong Highway had no transport signs and signals, and was not complete therefore had caused many accidents. A woman complained of the incomplete sewage system which caused flooding in front of her house as wastes from the construction site nearby often filled the sewage lines. Two respondents also found the delay in providing children playgrounds affected their family life having children. The delay in the completion of the area also affects the viability of their shops, as some said "there were too few customers in the area".

Though land and house price increased, four respondents complained that, "housing investment achieved negative impact". They found they had to spend too much in renovating and repairing the apartments due to their poor quality. The respondents were dissatisfied with the cost of buying the houses. Seven households in Hanoi were dissatisfied with the high cost of running the house that seems to relate not only to the number of appliances and energy usage but also to the condition of the indoor environment in the house.

Satisfaction with the indoor environment

Question 14 examined the satisfaction of the respondents with the indoor environment of their houses. Respondents were asked to raise their opinion on a five-point semantic interval scale (see Appendix D) for daytime and night time in both winter and summer seasons. The results are shown in Table 6.2.22. The satisfaction of the respondents with indoor environment quality in Adelaide was higher than in Hanoi in the daytime in the winter but was not significantly different from Hanoi at night-time in the winter and all day in the summer.

Table 6.2.22 Mean rank of satisfaction with indoor environment by city

	Case	**N**	**Mean**	**Significant difference (1)**
Day time in the winter	AD	39	4.3	Yes (df = 80, p = 0.028)
	HN	43	4.0	
Night time in the winter	AD	39	4.2	No (df = 80, p = 0.102)
	HN	43	3.9	
Day time in the summer	AD	40	3.8	No (df = 81, p = 0.117)
	HN	43	4.1	
Night time in the summer	AD	40	3.9	No (df = 81, p = 0.196)
	HN	43	4.1	

Note: (1) T-Test for Equality of Means

Questions 14b, 14d, 14f, and 14h (multiple response questions) studied the reasons for these satisfaction levels. The results are shown in Figure 6.2.16. Analysis of the responses shows that the reasons for the level of satisfaction they gave could be categorised into four groups corresponding to climate, design, use of appliances, and location of the house. The number of responses indicating design and location as the reasons for their satisfaction levels was not significantly different between the two cases. Besides this, while many respondents in Adelaide saw using appliances as the reason for their current satisfaction with the indoor environment, no one in Hanoi saw the same. Instead, while many respondents in Hanoi saw climate condition as the reason for the current satisfaction level, only a few respondents in Adelaide saw the same. The lower satisfaction of the respondents in Hanoi during the winter may be related to the lower number of the households using heaters or that as some respondents said, "their houses were not sealed tightly".

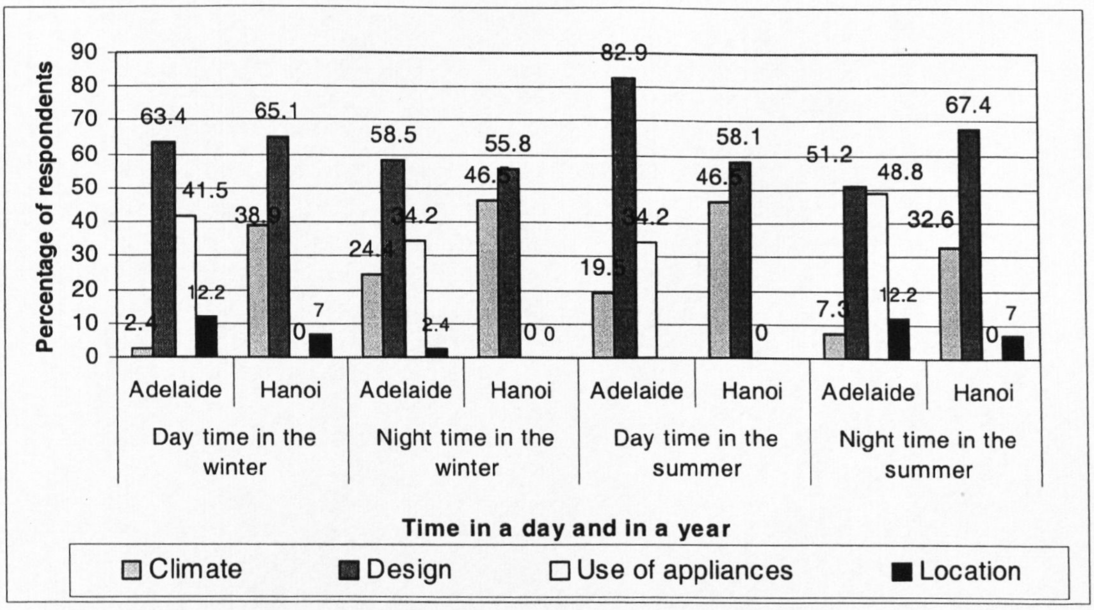


Figure 6.2.16 Reasons for the level of satisfaction with indoor environment

Note: N respondents = 41 (AD) & 43 (HN). N responses = 202 (AD) & 183 (HN)

As indoor environment includes lighting and ventilation, Questions 16a, 16c, and 16e (multiple response questions) investigated the respondents' perception about the darkness, glare and ventilation conditions in their houses. As shown in Figure 6.2.17, the number of respondents seeing glare during the summer days in the house in Adelaide (60%) was higher than in Hanoi (51%) while darkness during the day was seen by more respondents in Hanoi (44%) than in Adelaide (22%). A small number of households in Adelaide (5%) reported that their house did not have good ventilation while all respondents in Hanoi indicated that their house had good ventilation.

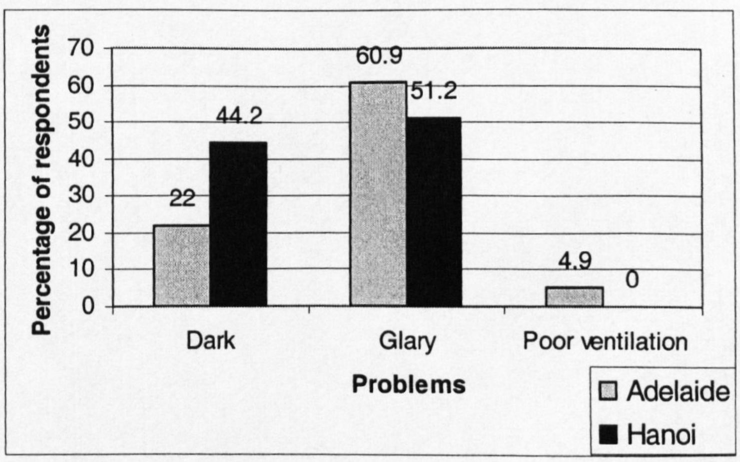


Figure 6.2.17 Lighting and ventilation in the house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 36 (AD) & 41 (HN)

The glare and darkness seem to relate to the type of house and the density of the housing area. The long and narrow attached houses and apartments in Hanoi had less accessibility to natural lighting because the houses could open windows in front and back of the house while detached houses in Adelaide could open windows on four sides. However, opening windows on four sides can cause glare during the summer.

Responses to inside conditions

Question 15 investigated the householders' responses to different indoor conditions such as being hot or cold, their house being dark or glary inside, or not having good ventilation. The respondents could give more than one response and the results are shown in Table 6.2.23.

Table 6.2.23 Response to different indoor conditions

Responses to indoor conditions	**Number of responses**	
Being hot inside	**AD**	**HN**
Monitor windows, doors or curtains, etc.	10 (24.4%)	30 (69.8%)
Use appliances	35 (85.4%)	25 (51.1%)
Do nothing	0	1 (2.3%)
Adjust clothes or take a shower	4 (9.8%)	0
Shade the house	1 (2.4%)	0
Being cold inside		
Monitor windows, doors or curtains, etc.	3 (7.3%)	41 (95.4%)
Use appliances	36 (87.8%)	5 (11.6%)
Adjust clothes or take a shower	7 (17.1%)	2 (4.7%)
Being dark inside during the day		
Monitor windows, doors or curtains, etc.	4 (9.8%)	4 (9.5%)
Use appliances	6 (14.6%)	19 (44.2%)
Being glary in summer days		
Monitor windows, doors or curtains, etc.	21 (51.2%)	21 (48.8%)
Shade the house from outside (pergola)	8 (19.5%)	3 (7%)
Do nothing	1 (2.4%)	0
Not good ventilation in the house		
Use appliances	1 (2.4%)	0

Note: N respondents = 41 (AD) & 43 (HN). N responses = 137 (AD) & 151 (HN)

Though having similar satisfaction levels with the indoor environment, the respondents in the two cases had different attitudes and behaviour in response to being hot or cold inside. While the number of respondents who relied on appliances to relieve hot and cold conditions in Adelaide (85% and 89%) was higher than in Hanoi (51% and 12%), the number of respondents who altered the setting of their house in response to being hot and cold inside in Hanoi (70% and 95%) was higher than in Adelaide (24% and 7%). The number of respondents adjusting their clothes in response to being hot and cold inside in Adelaide (10% and 17%) was higher than in Hanoi (0% and 5%). On the other hand, as expected due to the higher number of houses being dark inside, the number of respondents using appliances for lighting in Hanoi (44%) was higher than in Adelaide (15%). In response to glary conditions, a higher number of respondents in Adelaide (20%) than in Hanoi (7%) reported that they shade their house on the outside. Respondents in Adelaide said that building a pergola in the backyard for shading also created an outdoor entertainment place.

Changes made in the house

The households have made changes in their house to make it more suitable to their life. The open-ended Question 17 allowing multiple responses asked "Have you made any major changes to this house?" The results shown in Table 6.2.24 indicate the number of respondents in both cases making changes to their house was not low and similar in the two cases (32% in Adelaide and 28% in Hanoi). Changing the inside was more common in Hanoi (92%) than in Adelaide (31%) as upgrading new built apartments is common in Hanoi. Some respondents in Adelaide complained about housing quality and three households had made some improvements. A woman said, "The quality of the doors and windows is cheap and they are going to deteriorate very fast". Changing the outside was dominant in Adelaide only (46%) where common improvements included erecting a pergola in the backyard, or building extra garage space. The major changes in Hanoi included improving *beauty and convenience* (58%), and *quality* (33%), while improving the indoor environment (53%) was the major concern in Adelaide. Installing appliances and improving quality were more common in Hanoi (20% and 33%) than in Adelaide (11% and 16%).

The relatively large number of changes made shows that in the perception of the householders, the design of the houses in Hanoi have not ensured beauty and convenience while the houses in Adelaide have not ensured a good indoor environment.

Table 6.2.24 Changes the respondents have made to their house

	Number of respondents	
	AD	**HN**
N of HHs made major changes	13 (31.7%)	12 (27.9%)
Location of change		
Inside	4 (30.8%)	11 (91.7%)
Outside	6 (46.2%)	0 (0%)
Both inside and out side	3 (23.1%)	1 (8.3%)
Changes made in the house		
Design for beauty and convenient plan	4 (21.1%)	7 (46.7%)
Design for better indoor environment	10 (52.6%)	0 (0%)
Improve quality	3 (15.8%)	5 (33.3%)
Install appliances	2 (10.5%)	3 (20%)

Note: N respondents = 41 (AD) & 43 (HN)

There were also changes the respondents would like to make but did not due to factors such as difficulties with time, budget, or applicability. Question 18a sought what the respondents wanted to change further in their house by asking, "Are there any changes you would like to make to your house?" and "Why?" and further "Why haven't you made these changes yet?" The results shown in Table 6.2.25 indicate that 51% of respondents in Adelaide and 49% of respondents in Hanoi wanted to make changes and respondents sometimes gave more than one reason (response) for the changes. The numbers of responses indicating *decorate, improve quality*, and *change design* inside their house in Hanoi was the largest (each at 29%) and higher than in Adelaide (respectively 4%, 8%, and 24%). In Adelaide, the number of responses indicating *change outside* the house was the largest (48%), *change inside* (24%) the second, and *install more appliances* (12%) the last. The number of households wanting to improve security in Hanoi (8%) was higher than in Adelaide (4%). However, the number of households wanting to install more appliances in Adelaide (12%) was higher than in Hanoi (4%).

Table 6.2.25 Percentage of responses indicating changes wanted to be done

N respondents wanted to make more changes	**AD (21)**	**HN (21)**
Changes wanted		
Decorate	1 (4%)	7 (29.2%)
Improve quality	2 (8%)	7 (29.2%)
Improve security	1 (4%)	2 (8.3%)
Change design inside	6 (24%)	7 (29.2%)
Change design outside	12 (48%)	0
Install appliances	3 (12%)	1 (4.2%)
N responses	25 (100%)	24 (100%)
N respondents	41	43
Why want to change?		
Aesthetic	1 (3.9%)	4 (17.4%)
Quality	1 (3.9%)	5 (21.7%)
Security	1 (3.9%)	2 (8.7%)
Convenience	10 (38.5%)	9 (39.1%)
Better indoor environment	14 (68.6%)	3 (13.0%)
N responses	27 (100%)	23 (100%)
N respondents	41	43

Adding the number of the respondents who had already made changes to their house and the number of respondents wanting to make more changes showed more clearly the weak points of housing in Adelaide and Hanoi. This overall result shown in Table 6.2.26 is that housing in Adelaide could be improved to provide better indoor environment and enhanced convenience while housing in Hanoi could be improved to ensure a better aesthetic outcome, a more convenient plan, and higher quality.

Many of the complaints expressed by respondents appeared to be relatively trivial and could easily be avoided with more concern with design and construction supervision. For example, one woman in Hanoi complained of what she saw as an ugly floor in her lounge that consisted of ceramic tiles that did not look the same because of bad colour matching of different batches from the manufacturer. Another said the quality of the plaster was so low that it could fall down from the ceiling and the households, therefore, had to replaster the whole house. Another woman in Hanoi said that she wants to have an exit from the lounge to the balcony of her apartment because "it is dark in the lounge as it has no window, and that she has to pass her son's bedroom to reach the balcony." She also did not like the design of the apartment because "the toilet door faces the main entrance" which does not look nice and is not recommended in Feng Shui.

Table 6.2.26 Changes done and wanted to be done

Changes done and wanted	Number of responses	
Change out side	18 (43.9%)	
Change inside	10 (24.4%)	18 (41.9%)
Improve indoor environment	24 (58.5%)	
Improve convenience	14 (34.2%)	
Improve beauty and convenience		16 (37.2%)
Improve quality		12 (27.9%)
N responses	66 (100%)	46 (100%)

Note: N respondents = 41 (AD) & 43 (HN)

While the problems in Hanoi reflected perhaps carelessness, the issues in Adelaide related more to a mismatch between the house facilities and the householders' lifestyle expectations, especially the inside/outside relationship. Most of the respondents in Adelaide wanted to put up a pergola in the backyard to improve indoor environment (shade the house) and make the outdoor place more convenient. Many respondents in Adelaide said "this house is very hot in the summer" and "you can not survive without air conditioners" and they used air-conditioners twenty-four hours a day on extremely hot days. Some others commented, "the overhangs (eaves) of the house are too narrow to provide any shade". A couple complained that their garage was not insulated so heat came into the house through the garage therefore they wanted to insulate the garage. Some respondents in the both cases wanted to put an extra steel mesh doors for security.

Comments on housing

The open-ended Question 54 asked the respondents in the two cases for their general comments on "housing design, housing construction, environmental management, and the cost of housing and other technical appliances". Some respondents offered no comment while others gave more than one comment. The results shown in Figure 6.2.18 reinforce the findings above that the housing projects have not ensured good quality in many aspects. As the price of water and land in the survey area in Hanoi was relatively higher than other areas in the city, 30% of respondents in Hanoi wanted to reduce water and land price. Only one respondent in Adelaide mentioned this. The number of the respondents in Adelaide (32%) giving comments on housing design was higher than in Hanoi (12%). The comments on housing design in Adelaide included:

> "some neighbors' houses are too big and not nice"; "some allotments should be bigger"; "too many similar houses"; "housing styles should be more diverse"; "the

> orientation of the house was not considered"; "many windows face west", "overhang should be bigger to protect the house from rain and sun radiation coming into the house"; "overhang should be bigger but it may cost more than I can afford" or "houses should use natural energy".

When asked to expand on these issues the respondents explained the problems of the trade-off between improving indoor environment or applying renewable technologies and the cost.

The respondents in Hanoi were concerned with styles, plan, and the size of the houses. The comments on design and size included "each house should have different architectural styles", "housing design should fit to the lifestyle of the household", and "the houses should not be too big to avoid wastefulness". There were also some 'unexpected' comments on infrastructure planning such as, "the main street's sewage pipe (line) should be located in the back of the allotment, not in front, because Vietnamese kitchen is often located at the back of a house". Concerning saving land, a sentiment expressed by a number of respondents in Hanoi argued:

> "We should have more high-rise housing for sale and rent. This type of house should develop continuously. We should limit the development of villas but develop street houses and high-rise apartments to suit the economic condition of the majority of people, and at the same time, to save land in Hanoi".

In contrast, only one respondent in Adelaide had a positive attitude to the development of high-rise apartments. This respondent said, "high-rise apartments are good economic solution for the young and single people" but implied it was not for him.

While 9% of the respondents in Hanoi had comments on the planning of the housing area, only 5% of the respondents in Adelaide did. The respondents in Hanoi argued, "high-rise housing should be located behind low-rise housing in relation to the street so as not to block the view from low-rise housing to street". This is against the conventional way of urban planning in Linh Dam where high-rise housing is located close to the highways and low-rise housing is located behind. Other comments opposed the current separated grouping of different types of housing in Hanoi such as, "all types of houses should comprise mix, not separated to ensure no segregation or classification between the rich and the poor in an area" because detached houses are very expensive and occupied by the rich while most street houses are occupied by middle-income earners. The respondents in Adelaide did not have any concrete comments on planning. They only said "the planning should be better" and "do not like urban sprawl".

A small number of respondents in the both cases had general comments on infrastructure. In Hanoi, the complaints related mainly to the incompletion of the infrastructure systems, while in Adelaide the main complaints were of the narrowness of the street and lack of safety for children of the road system. Some respondents said the 60 km limit speed in the residential area should be reduced to 40 km.

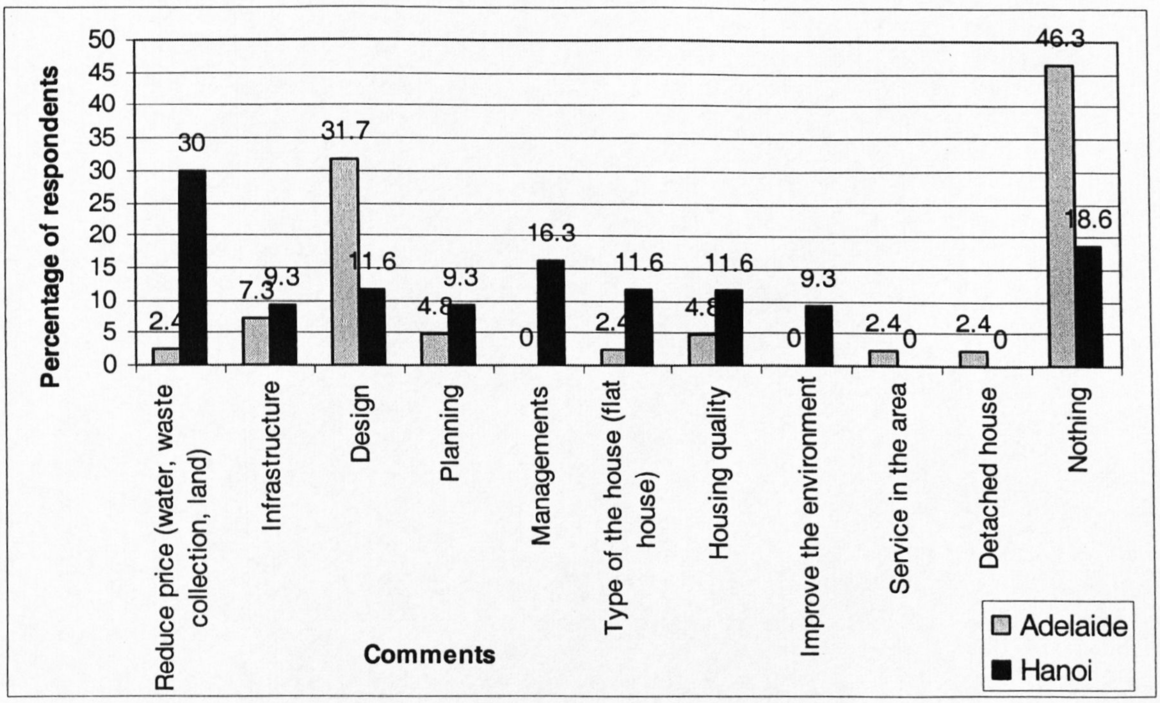


Figure 6.2.18 Comments on housing

Note: N respondents = 41 (AD) & 43 (HN). N responses = 44 (AD) & 45 (HN)

Both in Adelaide and Hanoi respondents also commented on the overall management of house construction. In Adelaide these comments related to particular bad experiences and included,

> "There was a lack of quality in everything that the builders did, no care and no value. Everything they do is cheap and nasty!" "It is a nightmare to build your house by yourself."

> "I wish we did not let the builders push us around so much and I wish they had finished off better than they did. Their follow-up service was very poor. My advice to any person wanting to build a house in the future would be to get an independent inspector in during building and before payments are handed over. Australian builders can be quite lazy and slack."

> "Builders are not concerned with the environment. When the construction of housing was conducted, wastes were everywhere on the site, was blown into the streets and the neighbours doors".

In Hanoi, as explained above, much dissatisfaction related to the incomplete nature of the Linh Dam Lakes project. The individual allotments had been sold three years previously (in 1997) and some people had built their houses and moved in, while the others were constructing their houses, and some had still not even started to build their house. Many service buildings such as supermarket, school and childcare centres had not been built so the residents have to travel long distances to the city centre to obtain these services.

> "Housing construction should be completed in a limited time to avoid disturbances to households who have settled earlier from construction work of the neighbours' houses which happens for a long time."... "New urban projects have to complete service centres urgently to provide services for the residents as indicated in the plan and the construction schedule."

Perception about types of housing

To understand the perception of the respondents about different housing types, Question 53 asked the respondents to raise the disadvantages of several types of housing including multi floor apartments, terrace houses (translated as street house for the Hanoi interviews), and separated houses. The respondents in the two cases had different perceptions about these types of housing.

Disadvantages expressed by the householders about apartments are shown in Figure 6.2.19. The inconvenience of living in multi-story apartments relates to lifestyle in Adelaide while it relates to technical issues in Hanoi. Though there were a similar and highest number of the respondents in both cases (42% in Adelaide and 42% in Hanoi) who saw the inconvenience of using stairs or an elevator when living in this type of house, the reasons given were different. While the respondents in Adelaide said they "hate stairs", the respondents in Hanoi said, "it is inconvenient and unsafe to leave their vehicles on ground floor" and "it may be trouble if the elevator is damaged".

Some respondents in both cases had a similar view about lack of privacy (24% in Adelaide and 26% in Hanoi), bad design (17% in Adelaide and 14% in Hanoi), low quality (2% in Adelaide and 2% in Hanoi), and noise (15% in Adelaide and 16% in Hanoi) of apartments. Besides this, the lack of outdoor area concerned more respondents in Adelaide (42%) than in Hanoi (5%). This seems to relate to the habit of living in spacious garden houses in Adelaide. Poor hygiene and infrastructure concerned only the respondents in Hanoi (26%). A few respondents in Adelaide found that it is hot when living at high altitude, and they cannot do recycling but no one in Hanoi saw this.

The perception of the respondents in two cases about social life in multi-story apartments was different. Loneliness and less security were raised by a few respondents in Adelaide but by no one in Hanoi. The reason for being suspicious of feeling lonely or insecure in Adelaide may be related to being unfamiliar with living in this type of housing.

The respondents in Adelaide seemed to see more disadvantages in multi-story apartments than the respondents in Hanoi. While many disadvantages seen by the respondents in Adelaide related to social and lifestyle, the respondents in Hanoi saw technical disadvantages.

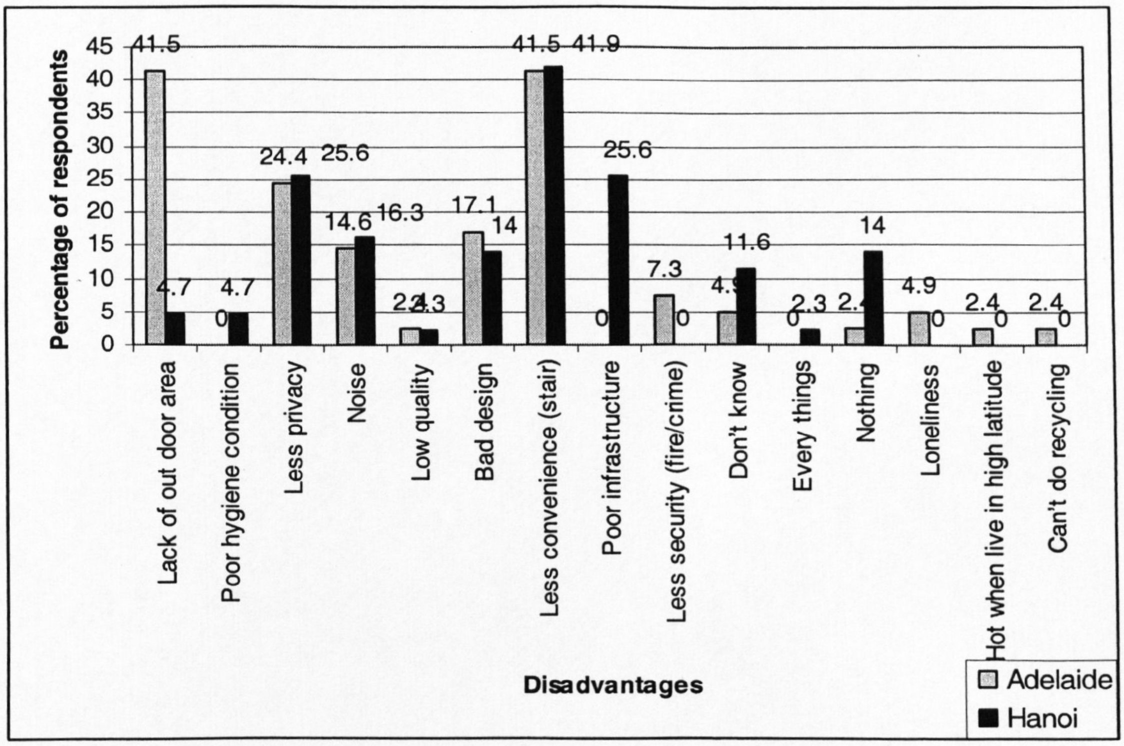


Figure 6.2.19a Disadvantages of high-rise apartments

Note: N respondents = 41 (AD) & 43 (HN). N respondents = 68 (AD) & 70 (HN)

Terrace houses (street houses) are more common in Hanoi than in Adelaide, and the respondents in Hanoi saw more disadvantages than the respondents in Adelaide. The disadvantages seen for terrace housing are shown in Figure 6.2.19b. The number of the respondents seeing no disadvantages in a terrace house in Adelaide (44%) was higher than in Hanoi (36%). Lack of privacy was seen by a number of respondents in Adelaide (34%) but by only a few in Hanoi (10%). The 'position of the house beside the street' was raised by the second highest percentage of respondents in Hanoi (24%) but no one in Adelaide mentioned this. The respondents in Hanoi said that, "street houses are on streets, so it is noisy and dusty". The shop in front of the house, which is common in ancient houses in Old Quarter of Hanoi, protects the living environment inside from the noise and dust from the streets. The absence of this arrangement in many new houses seems to not ensure noise and dust protection. On the other hand, although traffic and activities on the streets in Adelaide are not as much as in Hanoi, the number of respondents raising 'noise' in Adelaide (12%) was higher than in Hanoi (5%); the noise disadvantage seems to be socially dependent. So, the perception about disadvantages of dust and noise seems to, first, relate to the design and environmental quality of the house rather than the position of the house next to the street, and secondly, depends on social perception of the respondents.

Poor infrastructure and less security were seen as disadvantages of terrace housing in Hanoi but not in Adelaide, as these are common issues of concern in Hanoi, but not in Adelaide. This disadvantage seems not to relate to the house type.

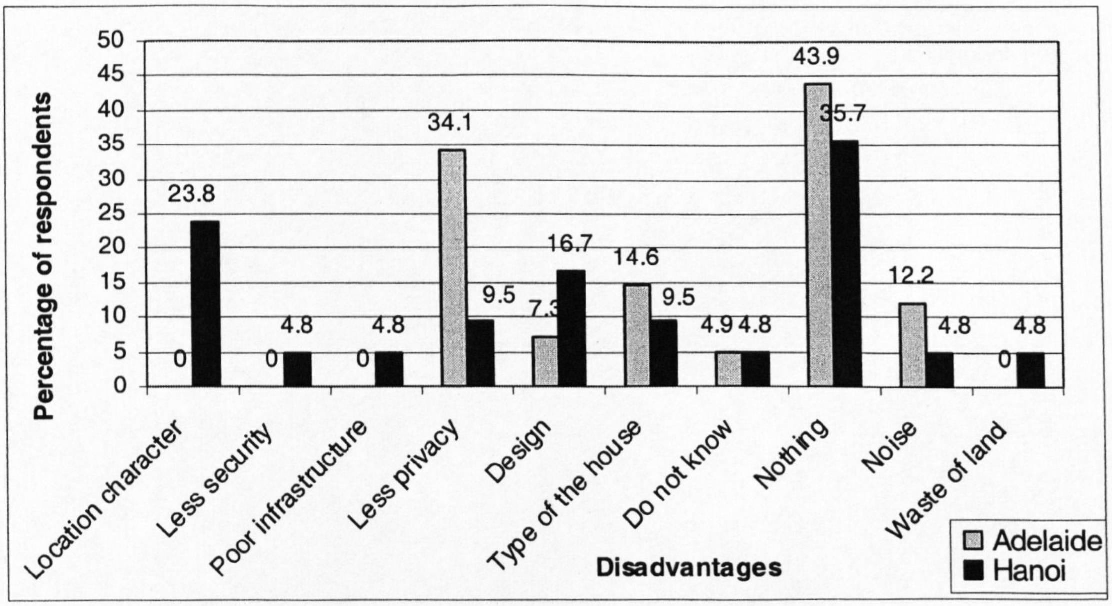


Figure 6.2.19b Disadvantages of street house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 48 (AD) & 51 (HN)

Many respondents saw disadvantages of multi floor terrace houses. Some respondents in Adelaide said they hate stairs, especially when residents are old or for families with children. Some respondents in Hanoi said it is tiring and inconvenient to go up and down. Most respondents in Adelaide said the attached structure of terrace houses meant they were so close to each other that they could hear the neighbour. One respondent in Hanoi said this house type creates conflict between neighbours, as the houses were too close to each other. One respondent in Adelaide said this type of house created poor neighbour relationships. So, social relationships between neighbours seem to relate to this type of housing.

While 12% of the respondents in Hanoi saw disadvantages in the design of terrace houses, only 5% of the respondents in Adelaide saw this. The respondents in Hanoi saw the disadvantages of the size of the house, "it is difficult to design, build or repair this type of house as the house is too narrow, or sometimes is so small that it causes inconvenience in daily life". The respondents in Adelaide saw a number of design related disadvantages such as "north and west orientation causes difficulties in designing the house"; "a lack of parking places for visitors", "the backyard is too small" that causes "lack of out door area", and "not much garden". A few respondents in Hanoi saw the waste of land in this house type compared to high-rise apartments while no one in Adelaide saw this as an issue.

Disadvantages of detached houses in the perception of the respondents are shown in Figure 6.2.19c. While 85% of respondents in Adelaide saw no disadvantage in detached houses, only 37% of respondents in Hanoi saw the same. About 23% of respondents in Hanoi found less security as the houses were isolated from neighbouring houses so neighbours cannot take care of each other while no one in Adelaide saw lack of security as a problem. As a related issue, 21% of the respondents in Hanoi said this type of house created "poor neighbour relationships" as it set up barriers for communication. Again, no one in Adelaide said this was a problem. This difference seems to relate to the local culture and the expectations of the respondents about social relationships between neighbours. In Vietnam, people are willing to develop relationships with neighbours. In Adelaide, the expectation of relationships with the neighbours seems not to be the case. In Hanoi, this also relates to the habit of living in street houses, and not in detached house while detached houses are very common in Adelaide.

The high cost of detached houses, however, was recognised in both cases (14% in Hanoi and 7% in Adelaide). The number of respondents raising this in Hanoi was higher than in Adelaide because detached houses are very exclusive in Hanoi, but are 'normal' Adelaide.

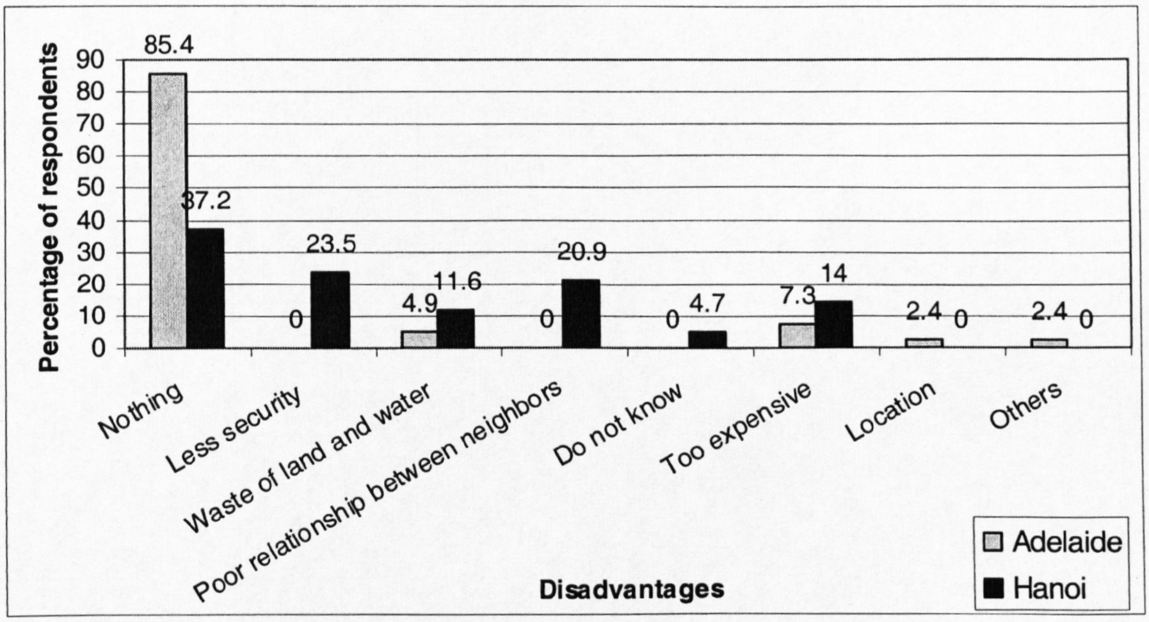


Figure 6.2.19c Disadvantages of detached house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 42 (AD) & 48 (HN)

There were 12% of the respondents in Hanoi seeing this type of house as a waste of land and water while only 5% of the respondents in Adelaide saw the same. This relates to the obvious limited land in the inner city of Hanoi while land in Adelaide is relatively available. There were 5% of the respondents in Hanoi also said they do not know of any disadvantages of detached houses because they had never lived in one while no one in Adelaide said so.

The respondents have different perceptions about social aspects in housing. Sustainable housing must fulfil all social requirements of the residents. Since these requirements are different, sustainable housing should be different in different social contexts.

6.3 Economic instruments

A number of questions in the questionnaires were aimed at eliciting respondents' perception of economic instruments in housing. Questions addressed issues of housing affordability, financing, cost of energy and water, and benefit from housing investment.

6.3.1 Affordability

Question 22 asked the respondents to rank their household income level in an interval scale (see Scale 3, Appendix D). The distribution of responses is shown in Figure 6.3.1 and the mean ranks are shown in Table 6.3.1. Though the real average income of the respondents in Adelaide was about 20 times higher than in Hanoi (see Appendix C) the rank of income levels of the respondents in Adelaide (3.3) was only slightly higher than in Hanoi (3.0) and both were at a medium level. The difference of the means is however significant.

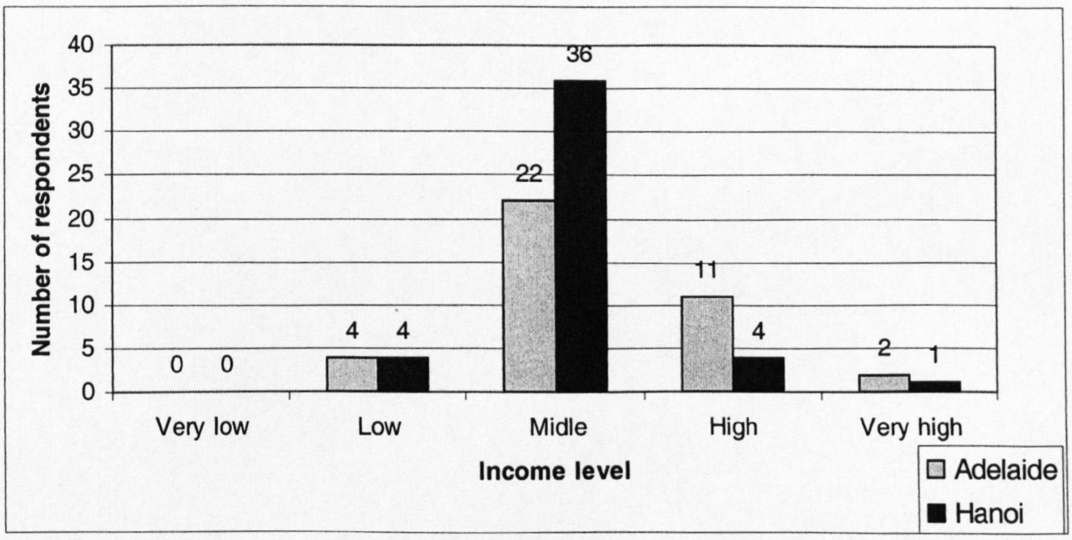


Figure 6.3.1 Distribution of responses

Note: N respondents = 39 (AD) & 43 (HN) (2 respondents in AD refused to answer this question)

Table 6.3.1 Mean rank of income level by households

Case	Mean rank of income level
AD	3.3
HN	3.0
Significant difference (1)	Yes (df = 80, p = 0.040)

Note: (1) T-Test for Equality of Means, N = 39 (AD) & 43 (HN)
Ranks follow Scale 4 (Appendix D)

Respondents were next asked, "taking into account your household income, would you assess the overall affordability of your house". The results were obtained on a five-point interval scale ranging from very unaffordable to very affordable (see Appendix D). Though the rank of income levels perceived by the respondents in Adelaide was only slightly higher than in Hanoi, the perception of the householders about affordability in purchasing or renting a house in Adelaide was very much higher than in Hanoi (see Table 6.3.2).

Table 6.3.2 Mean rank of affordability for purchasing a house

Case	Affordable levels	N respondents
AD	3.8	41
HN	2.9	43
Significant difference (1)	Yes (df = 82, p = 0.000)	

Note: (1) T-Test for Equality of Means

This perception of housing affordability appears to be borne out by housing cost statistics. In fact, the actual affordability of a house does not only relate to income but also to the proportion of that income devoted to housing costs, including purchase cost and operating costs. While household income was around 20 times higher in Adelaide than Hanoi, the cost of houses in Adelaide was only about two times higher than in Hanoi (see Table 6.3.3). To purchase a house, most households in Adelaide could borrow money from the bank and pay interest, adding costs to housing, while most households in Hanoi pay cash (see below). The operating costs in Adelaide also seem to be higher than in Hanoi (this will be studied below).

Table 6.3.3 Price range of houses (including land) in study areas - Adelaide and Hanoi

Case	Detached houses	Attached houses	Apartments
AD	AUD 250,000- 400,000	AUD 180,000- 200,000	Not applicable
HN	AUD 140,000 - 200,000	AUD 70,000 - 100,000	AUD 18,000 – 20,000

Source: HUD (2000); Real Estate Institute of South Australia & Services (2002)

6.3.2 Finance sources for purchasing housing

Question 7 asked respondents to indicate the financial sources for buying their house. The results are shown in Figure 6.3.2. Respondents in Adelaide gave a single source of finance while many respondents in Hanoi said their finance came from several sources. In Adelaide, houses were generally purchased with finance from a bank loan or by using savings (often from selling a previous home). Houses in Hanoi were purchased using a combination of financial sources, principally savings, or borrowing from relatives.

While 46% of the respondents in Adelaide took out loans from the banks for purchasing their houses, only one respondent in Hanoi did so. The home loan system supporting first homebuyers in Adelaide was used while this system was not available in Hanoi. Besides relying on income, 44% of respondents in Hanoi had to borrow and 12% of respondents in Hanoi inherited from relatives to be able to purchase a house. No one in Adelaide borrowed from a relative and only one household in Adelaide inherited their house from a relative. For people wishing to buy a house, sources of finance other than their own savings are unreliable in Hanoi, because not everyone can inherit or borrow from a relative. This 'need to save' to buy a house, coupled with low income, puts housing purchase beyond the reach of most people in Hanoi.

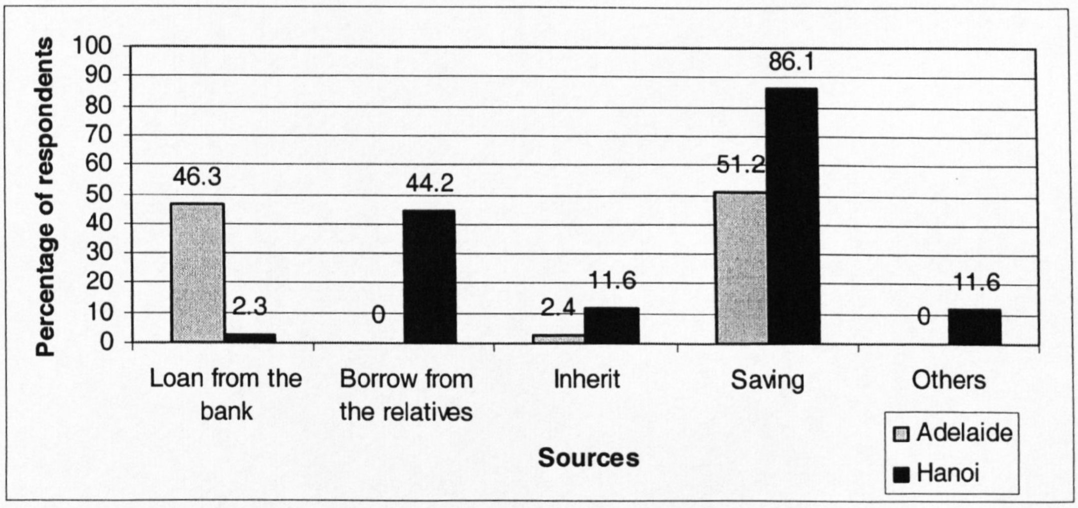


Figure 6.3.2 Financial sources used in paying for the house

Note: N respondents = 41 (AD) & 43 (HN). N responses = 41 (AD) & 66 (HN)

6.3.3 Economic benefits and costs

The economic benefit and costs of housing are important economic instruments to ensure a sustainability of housing development. Question 13 investigated the householders' satisfaction with various issues, including the economic benefits that could be derived from a shop, garden, housing as an investment, and the cost of buying and running the house. The results are shown in Table 6.3.4. The satisfaction level of the households having a shop with the benefit from shop in Hanoi was at the middle level (3.3) while shops were not part of the Adelaide houses. The respondents in Adelaide ranked benefit from garden higher than in Hanoi as not many houses in Hanoi have a garden. Benefit from housing investment was ranked higher in Adelaide than in Hanoi because purchasing houses was often seen as investment in Adelaide but as obtaining an accommodation in Hanoi. Housing prices have increased very fast in both Adelaide and Hanoi in the last three to four years (Real Estate Institute of South Australia, 2002 & Vietnam Investment Review, 2003). However, the satisfaction of the respondents with the cost of buying and running houses was not significantly different in the two cases though as discussed above the affordability of housing in Adelaide is around double that for Hanoi.

Table 6.3.4 Mean rank of satisfaction levels with some issues in the current house

Issues	AD	HN	Significant difference (1)
Benefit from shop		3.3	Yes
Benefit from garden	4.1	2.0	Yes (df = 41, p = 0.003)
Benefit in housing investment	4.5	3.8	Yes (f = 80, p = 0.001)
Cost for buying or renting house	4.2	4.1	No (df = 82, p = 0.270)
Cost for running the house	3.8	3.5	No (df = 80, p = 0.212)

Note: (1) T-Test for Equality of Means
The ranks followed the Scale 2 (Appendix D)

6.3.4 Conclusion

The affordability of the respondents in purchasing home, energy, and water consumption depends on relative income levels but also relates to consumption levels. The higher income in Adelaide seems to lead to high consumption as the users can afford reverse cycle air-conditioners and detached houses. Low income in Hanoi leads most of the respondents to end up with apartments or street houses without air-conditioners and heaters. This indicates that economic development overall can provide higher incomes for people in a society, but at the same time can encourage high consumption which could cause waste of resources, and environmental pollution. On the other hand, higher consumption does not always ensure the higher satisfaction of the residents with their house and the indoor environment of the house (see Table 6.2.23). A good house depends not only on economic benefit but also on the satisfaction of the user with social and environmental issues. Economic development may be necessary to provide access to housing by improving affordability, but it may also create side effects and does not ensure higher satisfaction of the user with their house socially and environmentally.

6.4 Values, knowledge and attitudes

The study of application of technological, social, and economic instruments of sustainable housing above shows there are limitations and barriers for the housing sector in Adelaide and Hanoi in approaching sustainability. An overall study of people's perception, knowledge, and attitude to general issues of sustainability and about their values may be important to predict the potential change and the willingness to pay for that change in approaching sustainability.

This section will study the perceptions of the respondents about sustainable housing; knowledge of the respondents about the environment and its relationship with human well-being; attitude of the respondents to current environmental situations, their perceptions about causes of today's environmental problems, and actions to protect the environment. Attitude of the respondents to statements about actions to enhance sustainability will be examined to investigate the willingness to act and pay for achieving more sustainable outcomes. This also will help to understand to what extend the trade-off level respondents can have when

Question 40 asked the respondents how they saw the importance of environmental protection, economic growth, and increased human welfare. The results can be seen in Table 6.4.2. The importance of environmental protection was ranked at similar importance level in both cases while the importance level of economic growth and increased human welfare was ranked in Hanoi higher than in Adelaide.

Table 6.4.2 Mean rank of important levels of three dimensions (Scale 1, Appendix D)

Cases	**N**	**Environment protection**	**Economic growth**	**Increased Human welfare**	**Significant difference (1)**
AD	41	4.6	4.0	4.2	Yes (df = 2, p = 0,001)
HN	43	4.8	4.7	4.7	No (df = 2, p = 0.591)
Significant difference (1)		No (df = 82, p = 0,215)	Yes (df = 82, p = 0,000)	Yes (df = 82, p = 0,007)	

Note: (1) T-Test for Equality of Means

Comparing these three issues, the respondents in Adelaide ranked them at different levels while these were ranked similarly in Hanoi (using Non Parametric Test, K-related Samples, Compare means Paired samples T-Test was used). The respondents in Adelaide ranked the importance of environment protection higher than economic growth (df = 40, p = 0,000) while these were ranked similarly in Hanoi (df = 42, p = 0.229). The respondents in Adelaide ranked environmental protection more important than increased human welfare (df = 40, p =0,020) while these were ranked similarly in Hanoi. These may be because economic growth and human welfare systems in Hanoi are still low in comparison to Adelaide. Nevertheless, increase human welfare and economic growth were seen as having similar levels of importance in the both cases (df = 40, p = 115 in Adelaide and df = 42, p = 0,785 in Hanoi).

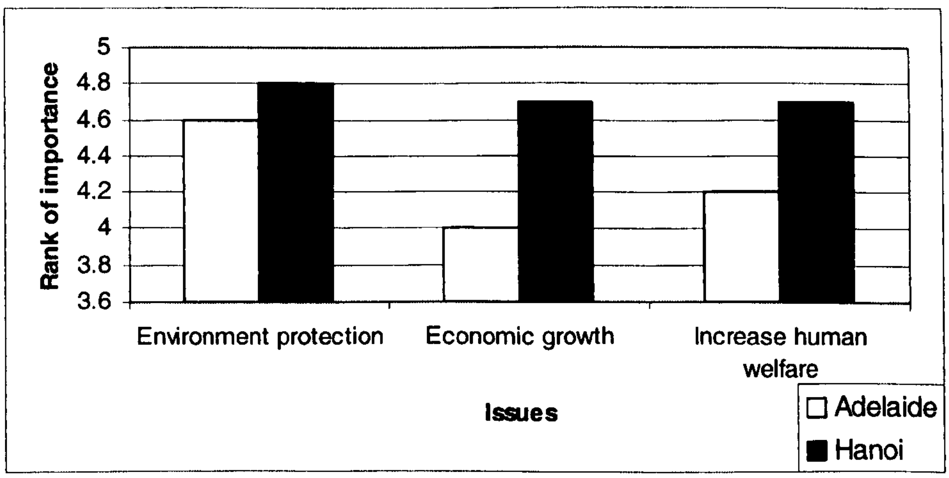


Figure 6.4.2 Important levels of dimensions of sustainability

Though the importance of these three dimensions was highly ranked, the relationship between these issues was seen in a vague way in the perception of the respondents in both cases. As a follow up, Question 41 asked the respondents "Do you see any relationships between these issues?" Table 6.4.3 shows the results. Most respondents in Adelaide and in Hanoi saw relationships between these issues. While some respondents in Adelaide did not see any relationship between these three issues, no one in Hanoi indicated this.

Table 6.4.3 Number of respondents saw relationships between these three dimensions

Saw relationships between three dimensions	AD	HN
No	6 (14.6%)	0
Yes	34 (82.9%)	42 (97.7%)
Don't know	1	1
N respondents	41	43

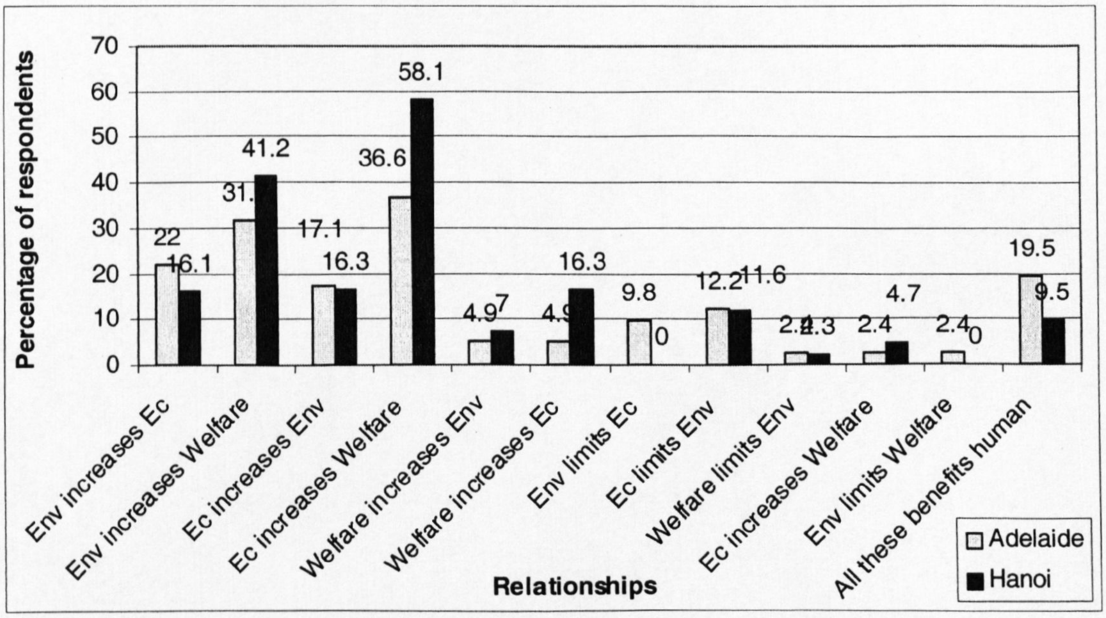


Figure 6.4.3 Relationships between three dimensions

Note: N respondents = 41 (AD) & 43 (HN). N responses = 68 (AD) & 79 (HN)
Env: Environmental protection; Ec: Economic growth; Welfare: Human welfare

When asked what was the relationship they saw, the relationships raised by the respondents were very diverse, in contrast, and different between the two cases (Figure 6.4.3). While respectively 44% and 58% of respondents in Hanoi and 32% and 37% in Adelaide saw 'environmental protection would enhance human welfare' and 'economic growth would support human welfare', a few respondents in Hanoi and Adelaide raised the opposite; 'economic growth limits human welfare' and 'environmental protection limits human welfare'. While 22% of respondents in Adelaide and 12% in Hanoi saw 'environmental protection enhances economic growth', 10% of respondents in Adelaide and no one in Hanoi saw that 'environmental protection limits economic growth'. While 12% of respondents in

Adelaide and in Hanoi said, 'economic growth limits environmental protection', 17% of respondents in Adelaide and a similar number of respondents in Hanoi saw 'economic growth supports environmental protection'. While 5% of respondents in Adelaide saw the relationship of 'increased human welfare enhances economic growth', 16% of respondents in Hanoi saw this. In addition, at the same time, one respondent in each case took an opposing view and said, 'increased human welfare limits economic growth'.

Moreover, among the relationships raised, environmental protection and economic growth were seen as important but only as the 'means' to provide benefit for the human welfare 'end'. For example, the relationships 'environmental protection would enhance human welfare' and 'economic growth would support human welfare' were raised by the highest percentage of respondents in the two cases. This observation can be seen even more clearly when 20% of the respondents in Adelaide and 10% of the respondents in Hanoi said that all these issues are related as they all benefit humans.

6.4.2 Knowledge about the environment and its relationship with human well-being

The vague perception of the respondents about the relationships between dimensions of housing sustainability may relate to the knowledge of the respondents about the environment. Question 42 asked the respondents "What do you see as the current environmental problems?" and to relate these to global, national, and local levels. The respondents could give multiple responses. The results are shown in Table 6.4.4 and Figure 6.4.4.

Global

When identifying problems at a global scale the respondents in Adelaide seem to have more knowledge of issues known to go beyond national or local boundaries, while respondents in Hanoi extended issues they were familiar with in their daily life. The number of respondents raising Ozone depletion, global warming, the degradation of ecosystems, water pollution, nuclear waste, resource depletion, over populated, and ocean pollution in Adelaide was higher than in Hanoi, whereas the number of respondents raising solid waste and chemical contamination in food was higher in Hanoi than in Adelaide. The number of respondents raising air pollution as global problem in the two cases was similar. Beside this, 14% respondents in Hanoi do not know about any global problems while only 5% of respondents in Adelaide said the same. This may relate to better accessibility to environmental information in Adelaide than in Hanoi.

National

Similarly, when identifying problems at a national scale the respondents in Adelaide also seem to have more knowledge of wider issues while respondents in Hanoi again reported issues that they faced everyday. The number of respondents raising Ozone depletion, global warming, water pollution, ecosystem degradation, nuclear waste, and resources depletion in Adelaide was higher than in Hanoi. The number of respondents raising solid waste, air pollution, and chemical contamination in food in Hanoi was higher than in Adelaide. While 10% of the respondents in Adelaide said they do not know of any environmental problems in Australia, all respondents in Hanoi suggested there were environmental problems at national scale. Two respondents in Adelaide insisted that Australia has no environmental problems.

Table 6.4.4 Environmental problems globally, nationally and locally

Environmental problems	**Percentage of respondents raising environmental problems at different levels**					
	Globally		**Nationally**		**Local**	
	AD	HN	AD	HN	AD	HN
Ozone depletion	24.4%	9.9%	9.8%		2.5%	
Global warming	43.9%	7%	19.5%		2.5%	
Solid waste	12.2%	37.2%	12.2%	60.5%	7.5%	20.9%
Air pollution	36.6%	44.2%	36.6%	53.5%	15%	39.5%
Water pollution	41.5%	27.9%	65.9%	51.2%	17.5%	11.6%
Ecosystem degradation	36.6%	11.6%	29.3%	18.6%		
Chemical contamination in food	2.4%	9.3%	2.4%	9.3%	7.5%	
Don't know	4.9%	14%	9.8%			
Wars	2.4%					
Nuclear waste	7.3%		4.9%		2.5%	
Resource depletion	9.8%		4.9%		2.5%	
Over populated	9.8%					
Ocean pollution	7.3%	2.3%				
Noise		4.7%			2.5%	16.3%
No thing			4.9%		62.5%	34.9%
Others				2.3%		
Lack of playgrounds					2.5%	
Safety of road system					2.5%	
Privacy (houses too close)					2.5%	
N responses	98	72	82	84	53	53
N respondents	41	43	41	43	41	43

Local

The respondents in Adelaide again raised more big problems while the respondents in Hanoi only raised small problems at local level. The number of respondents raising Ozone depletion, global warming, water pollution, chemical contamination in food, nuclear waste, resources depletion, lack of playgrounds, safety of road system, and privacy (the houses were too close) in Adelaide was higher than in Hanoi. However, the number of respondents seeing no environmental problems in Adelaide (63%) was higher than in Hanoi (35%). Generally, the respondents in the both cases did not see a link between global, national and local levels, as many global environmental problems were not recognised at national and local levels. For example, while 24% of respondents in Adelaide and 10% respondents in Hanoi saw Ozone depletion as a global problem, only 10% in Adelaide and no one in Hanoi saw this problem at a national level. A similar study of the environmental quality at local community, nation, and the world by Dunlap et al. (1993, p. 12) has been explained by Lomborg (2001, p. 34-35) in two contrasting ways. First, he suggests, this shows that people believe that the environment is worse 'somewhere elsewhere' than in their own country and where they themselves live. On the other hand, he suggests another possible explanation of this is "[i]t is not unthinkable that the environmental problems we experience at a national and international level either are not localised or occur in sparsely populated areas". Further, he argued:

> But it still points to the fact that our knowledge of things close to us, which is derived from our own experiences, is not the primary source of our fears for the environment. On the contrary we seem more worried about conditions the further away from us they are both physically and mentally.
>
> Lomborg (2001, p. 34-35)

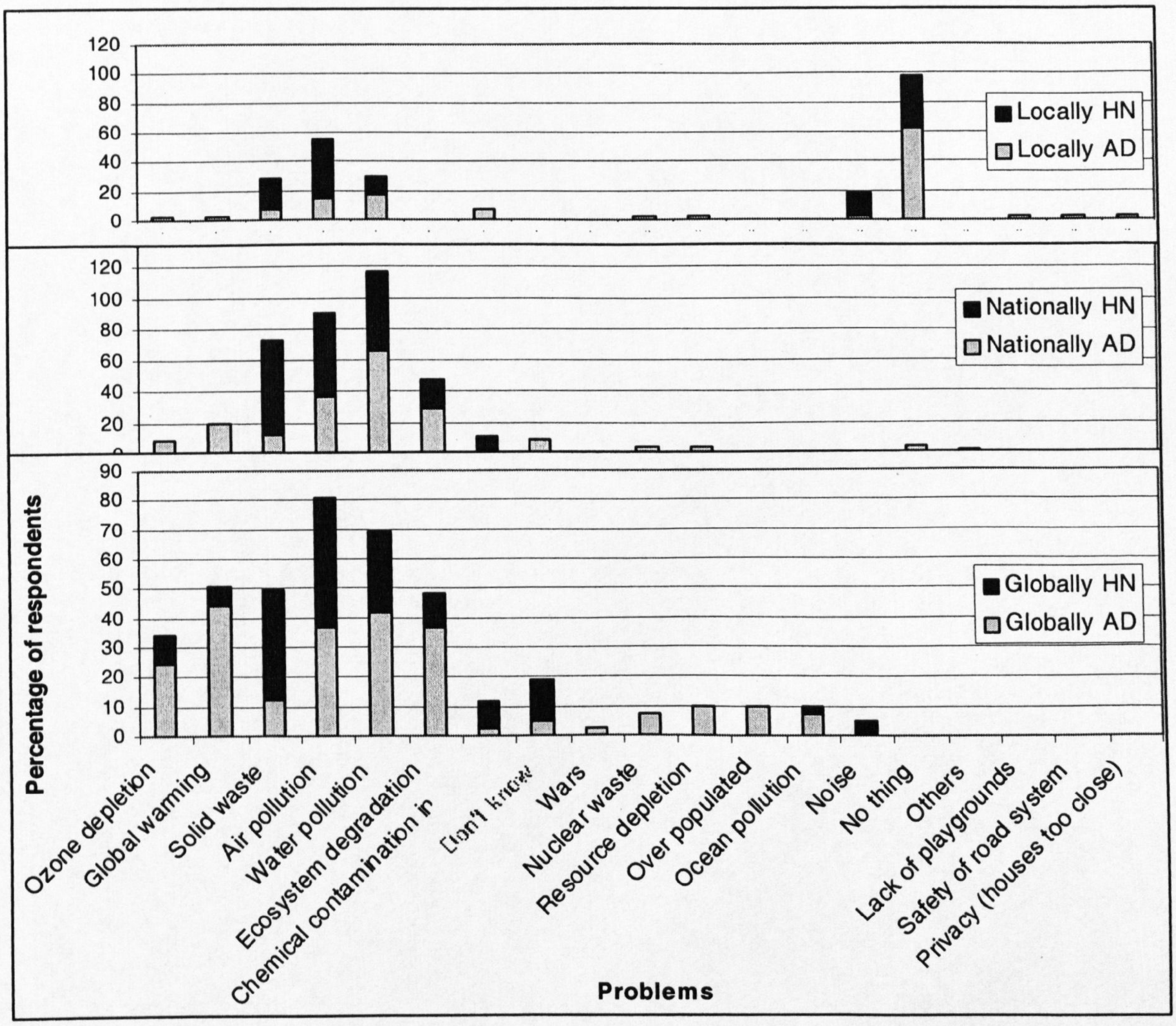


Figure 6.4.4 Environmental problems at global, national and local levels reported by respondents – Adelaide & Hanoi

To examine again the perception of the respondents about different environmental concerns, another Question (45) asked the respondents to raise the environmental issues that could affect their family's health. Each respondent could raise multiple responses. The results are shown in Table 6.4.5. Most respondents in both cases mainly saw some local environmental issues that could affect their family's health. Only a few respondents in Adelaide saw impacts of specific regional and global environmental issues on their health while no one in Hanoi saw this. Only about 12% of the respondents in Adelaide and 7% of the respondents in Hanoi saw that all environmental issues could affect their family's health. On the other hand, 17% of respondents in Adelaide and 9% of respondents in Hanoi saw that no environmental issues (global, national, or local) could affect them.

Table 6.4.5 Issues that could affect your family's health

	Number of respondents	
Issues	**AD**	**HN**
Chemical pesticide contamination in food	2 (4.9%)	6 (14%)
Solid wastes	1 (2.4%)	8 (18.6%)
Water pollution	11 (26.8%)	10 (23.3%)
Air pollution /dust	18 (43.9%)	29 (67.4%)
Noise	1 (2.4%)	6 (14%)
Lack of recreational places (land)	1 (2.4%)	0
Radiation from electricity	2 (4.9%)	0
Resource depletion	1 (2.4%)	0
Nuclear wastes	1 (2.4%)	0
Global warming	4 (9.8%)	0
Ozone depletion	4 (9.8%)	0
All environmental problems	5 (12.2)	3 (7%)
Nothing	7 (17.1%)	4 (9.3%)
Don't know	2 (4.9%)	0
N respondents	41 (100%)	43 (100%)
N responses	58 (141%)	66 (153%)

The dominant issues in both cases were that air pollution and water quality could affect their family's heath and the number of the respondents seeing air pollution in Hanoi (67%) was higher than in Adelaide (44%) while the number of respondents seeing water pollution in the two cases was not significantly different (27% in Adelaide and 23% in Hanoi). This relates to poor air condition in Hanoi and water supply and salinity issues in Adelaide. Besides these dominant concerns, the respondents in Hanoi saw more effects from local problems to their family's health while the respondents in Adelaide saw more effects from global problems. The number of respondents seeing solid waste in Hanoi (19%) was higher than in Adelaide (2%) due to the poor solid waste management in Hanoi. The number of respondents seeing noise and chemical contamination on food in Hanoi (14%, 14%) was higher than in Adelaide (5%, 2.4%) as the lack of control in the use of chemical pesticides and noise pollution existed in Hanoi. Some respondents in Adelaide saw the negative impacts from global warming (10%) and ozone depletion (10%) on their family's health while no one in Hanoi saw these. Few respondents in Adelaide saw the effect of national and local problems including the lack of playgrounds, nuclear waste, and radiation from electricity lines on their family's health while no one in Hanoi saw these. Only one respondent in Adelaide suggested a link between resources depletion and possible detriment to his/her family; no one in Hanoi suggested this link.

Because they did not see the impact of global environmental issues on their family's health, nor many environmental problems at the local level, many respondents in both cases were not worried about the current environmental situation. Response to Question 43 examining whether the respondents worried about the current environmental situation is displayed in Table 6.4.6. The number of the respondents indicating worry about the environmental situation in Hanoi (77%) was higher than in Adelaide (68%).

Table 6.4.6 Number of respondents worry for the current environmental situation

Worry	AD	HN
No	13 (31.7%)	10 (23.3%)
Yes	28 (68.3%)	33 (76.7%)
N respondents	41 (100%)	43 (100%)

Because they did not see a link between global, national, and local environmental problems, the respondents did not see the impact of global or national environmental problems on their health. This may be the reason for the delay in environmental action today.

Question 44 studied environmental actions taken by the respondents in the two cases. The results are shown in Figure 6.4.1. While the total number of respondents involved in all environmental actions in HN (25) was higher than in Adelaide (7), the actions taken in Hanoi were limited to cleaning street, planting trees, and taking part in community meetings. Recycling waste was raised in Adelaide as it was introduced in Adelaide, not in Hanoi. Only a small part of waste is recycled in Hanoi by the private sector. However, though the respondents in Adelaide separated the wastes for recycling it was not certain that all the wastes were recycled properly as most waste in Australia was of disposed at landfill sites (ABS, 2000, p. 1).

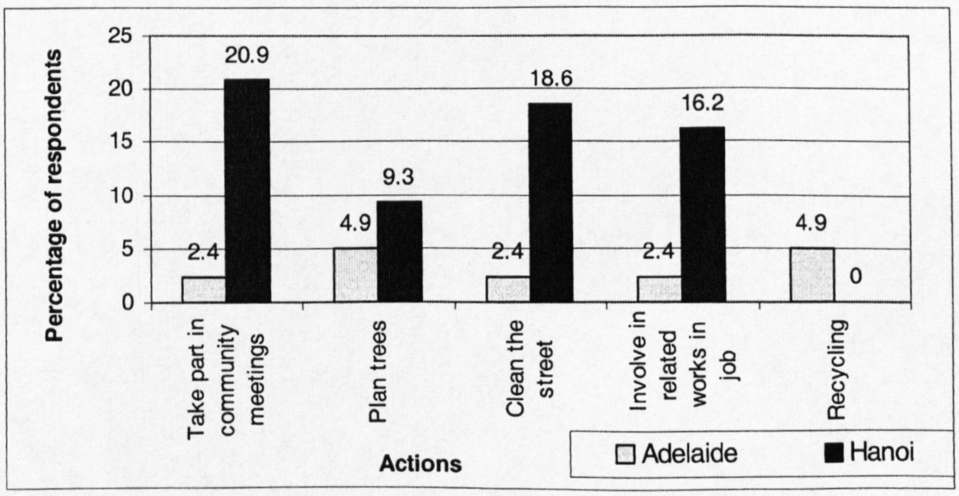


Figure 6.4.5 Actions taken to protect the environment
Note: N respondents taken actions = 7 (AD) & 25 (HN).

The lack of concern and actions on environmental protection may relate to the lack of knowledge about the impact of environment problems on human health. The application of many other environmental actions such as recycling organic wastes and water, using energy and water efficient technologies, collecting rain water, households composting, and using public transport were not listed in both cases.

6.4.3 Causes of today's environmental problems

The open ended Question 46 asked the respondents to define the main reasons for the present environmental problems. The respondents gave more than one reason (response) and the results are shown in Figure 6.4.6.

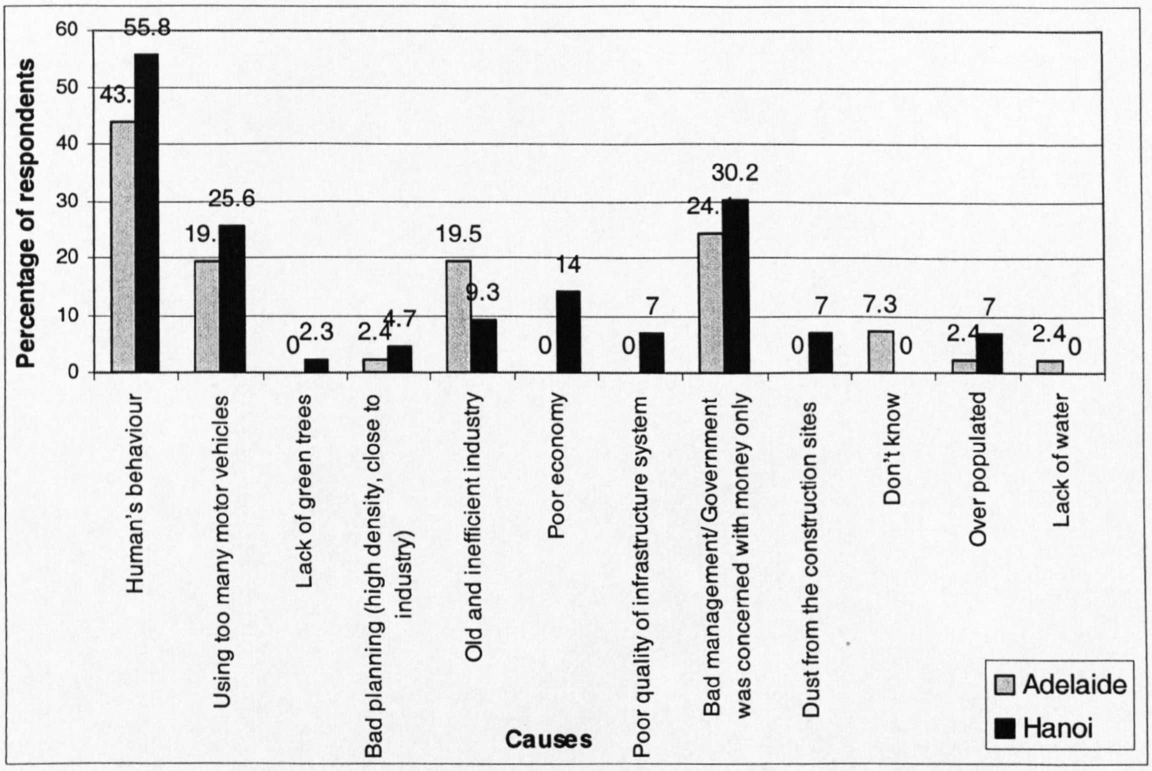


Figure 6.4.6 Causes of today's environmental problems

Note: N respondents = 41 (AD) & 43 (HN). N responses = 50 (AD) & 70 (HN)

There was a degree of consistency between the two cases with most respondents suggesting the main reasons for the current environmental problems lie in human behaviour, the over-use of motor vehicles, and the bad management of the government. The number of the respondents raising these in Hanoi (respectively 56%, 26%, & 30%) was slightly higher than in Adelaide (respectively 46%, 20%, & 26%). A few respondents in both cases also saw bad planning, high density, housing located close to industrial areas, and over population. Beside this, there were case-specific reasons such as poor economic conditions (14%), poor quality of infrastructure systems (7%), dust from construction sites (7%), the lack of green trees (2%)

in Hanoi, and lack of water (2%) in Adelaide. In Adelaide, 7% of the respondents could not identify any causes of current environmental problems.

6.4.4 Actions to protect the environment

Question 47 asked the respondents in the two cases, "If there is one thing that you can do to protect the environment, what would it be?" The results shown in Table 6.4.7 indicate that the respondents believed there are very few things they can do to protect the environment. Most respondents saw only what they were doing such as separating waste (46% in Adelaide) and cleaning the houses and streets (51% in Hanoi and 10% in Adelaide). Some respondents did not raise concrete actions but rather suggested changing the way of thinking such as having a good attitude to the environment and protecting trees (28% and 21% in Hanoi and 9.8% and 10% in Adelaide), or changing their behaviour such as controlling air pollution (13% in Adelaide and 5% in Hanoi). Besides this, 16% of the respondents in Adelaide did not know what they could do to protect the environment while no one in Hanoi said the same.

Only some respondents raised concrete actions such as using public transport (7% in Adelaide and 2% in Hanoi) and saving energy and resources (24% in Adelaide). In Hanoi, this relates more to the unavailability of public transport and low consumption level of energy and resources. Only 5% of respondents in Adelaide and 7% of respondents in Hanoi raised using efficient and less polluting technologies.

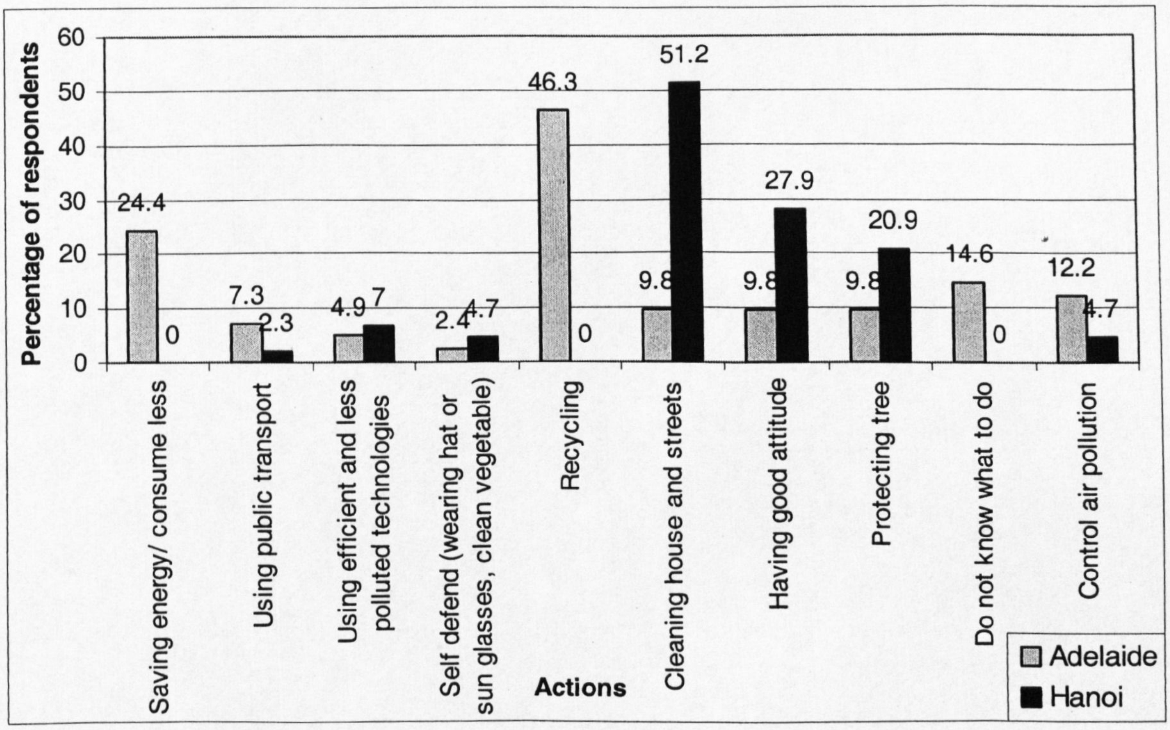


Figure 6.4.7 What you can do to protect the environment

Note: N respondents = 41 (AD) & 43 (HN). N responses = 49 (AD) & 49 (HN)

A few respondents in both cases even said they defend themselves from environmental pollution. For example, a woman in Adelaide said, it is better to stay inside the house, or wearing hats and sunglasses to avoid skin cancer and sunburn caused by ozone depletion. Two respondents in Hanoi said they clean vegetables very carefully to reduce chemical contamination. These responses, rather than actions to protect the environment, can be seen as responses to protecting the individuals from the present environmental problems.

Not many environmental friendly actions that have been introduced in many documents such as 'Better living cities' (CDHRD, 1995b), AMCORD (CDHRD, 1995a), and the sustainable urban neighbourhood (Rudlin & Falk, 1999) have been carried out. The weakness of environmental protection actions could lie in the lack of access to information, poor environmental management, and lack of environmental service facilities.

6.4.5 Attitudes of the respondents to statements of actions to protect the environment

The attitude of the respondents to environmental solutions also plays an important role in realising actions. Question 49 examined the perception and attitude of the respondents in the two cases about some avenues to sustainable housing. Respondents were asked to indicate a level of agreement on an interval scale between disagree strongly and agree strongly to a number of statements. Table 6.4.7 shows the average rank of the agreement levels of the respondents with these statements.

There was no significant difference in the agreement levels of the respondents in the two cases with many statements including advantages of living in an extended family, separate house with garden, using public transport, energy efficient appliances, renewable energy, environmental law, water resources, recycling water, resources consumption, waste recycling, the relationship between the environment and human health, and the willingness to pay for the consumption of resources. On the other hand, the agreement levels of the respondents in the two cases with the statements about the size of a house, the multi floor apartment house type, use of fans instead of air conditioners, and individual responsibility to environment protection were significantly different.

Moreover, there is a difference between belief and actions of the respondents. The following part will compare the agreement levels between the two cases and relate them to the practices in the two cases. Though having similar agreement to these statements, in reality, the common living arrangement, the popular housing types, the consumption of energy water and resources of the households in the two cases were very different from one another. The mean response of the respondents in the two cases indicates a tendency to agree to the statement "living in an extended family has more advantages than disadvantages". However, extended family was popular in Hanoi, while it was very rare in Adelaide. Extended family is more acceptable in Hanoi than in Adelaide.

Table 6.4.7 Agreement with statements of sustainability

Statements	Means rank		Significant difference (1)
	AD	HN	
Living in an extended family has more advantages than disadvantages.	3.5	3.5	No (df = 82, p = 0.815)
Separate house with garden causes urban sprawls and should be discouraged.	2.5	2.8	No (df = 82, p = 0.281)
A house should have just enough room for the essential daily needs of a family.	3.0	3.9	Yes (df = 82, p = 0.000)
A high standard and well-designed multi-floor apartment is as good as any other type of a house.	2.8	3.4	Yes (df = 82, p = 0.004)
Using public transport is good idea to reduce pollution and save resources.	4.4	4.3	No (df = 82, p = 0.643)
Energy efficient appliances would save money.	4.4	4.1	No (df = 82, p = 0.059)
Renewable energy such as solar energy and wind energy is cheap.	3.6	3.8	No (df = 82, p = 0.299)
It is better to use fans for cooling instead of air-conditioners.	3.2	4.3	Yes (df = 82, p = 0.000)
It is the responsibility of individuals to protect the environment.	4.1	4.4	Yes (df = 82, p = 0.014)
The government should make laws to protect the environment.	4.2	4.5	No (df = 82, p = 0.054)
Water is not a scare resource.	2.0	2.1	No (df = 82, p = 0.461)
It is good idea to recycle the grey water for toilet flushing.	3.9	4.1	No (df = 82, p = 0.526)
If we consume too many resources today, there might be nothing left for our grand children.	4.1	4.3	No (df = 82, p = 0.482)
All household waste should be recycled.	4.3	4.2	No (df = 82, p = 0.710)
It is the practical idea to recycle household wastewater for other uses.	4.1	4.1	No (df = 82, p = 0.863)
Environment pollution directly affects your health.	4.3	4.5	No (df = 82, p = 0.123)
You should pay more for resources (land, petrol and water) the more you use them.	3.7	4.0	No (df = 81, p = 0.147)
N respondents	41	43	

Note: (1) T-Test for Equality of Means.
The rank is on Scale 5 (Appendix D)

Although the respondents in both cases had the same neutral agreement level to the statement "separate houses with garden causes urban sprawls and should be discouraged", detached houses were more preferred in Adelaide than in Hanoi.

The agreement of the respondents with the statement, "a house should have just enough rooms for the essential daily needs of a family" in Hanoi was higher than in Adelaide. It was slightly positive in Hanoi (3.9) and neutral in Adelaide (3.0). The respondents in Adelaide said "a house should have spare rooms for guests and friends to stay when visiting", and most houses in Adelaide had spare bedrooms though these visits may occur only one or two times a year. Having spare rooms for guests was rare in Hanoi. When having guests staying overnight, the guest and owners are happy to share rooms and may talk all night. This shows that the social lifestyle decides the apparent necessity to have spare rooms.

The attitude of the respondents to the statement "a high standard and well-designed multi-floor apartment is as good as any other type of a house" was different between the two cases, with positive tendency in Hanoi (3.4) and a negative neutral tendency in Adelaide (2.8). The respondents living in different types of houses had no significant difference in their perceptions about this statement in the both cases as shown in Table 6.4.8.

Table 6.4.8 Attitude of the respondents to statements about apartments

Type of house living in	**Mean rank**		**N**		**Significant difference (2)**
	AD	HN	AD	HN	
Detached	2.7	3.6	38	3	No (df = 39, p = 0.117)
Attached	3.7	3.1	3	22	No (df = 23, p = 0.367)
Apartment		3.9		18	
Significant difference (1)	No (df = 1 p = 0.87)	No (df = 2 p = 0.57)	41	43	

Note: (1) T-Test for Equality of Means (Non parametric Test K- Independent Samples)
(2) T-Test for Equality of Means (Independent-Samples T-test)

However, using T-Test for Equality of Means with Independent-Samples T-test to compare between groups of households living in different dwelling types shows the respondents living in different types of housing in Adelaide had similar perception about this statement. However, the respondents living in apartments in Hanoi had a similar perception to those living in detached houses but had a higher agreement level to this statement than the respondents living in attached houses.

The respondents in the two cases had similar agreement with the statement "using public transport is good idea to reduce pollution and save resources". They both positively agreed with this statement (4.4 in Adelaide and 4.3 in Hanoi). However, though bus services were generally good, only a few respondents in Adelaide used buses for daily travel. This shows once more the difference between perceptions and action.

The respondents in both cases had the same agreement with the statement "energy efficient appliances would save money". They both positively agreed with this statement (4.4 in Adelaide and 4.1 in Hanoi). The respondents in Hanoi though agreeing with this statement, said they could not afford any extra initial cost for such appliances. The investment cost was seriously considered especially for renewable energy appliances. This may be the cause for the respondents in the two cases giving only a slightly positive neutral rank to the statement "renewable energy such as solar energy and wind energy is cheap" (3.6 in Adelaide and 3.8 in Hanoi).

While the respondents in Adelaide were neither agreed nor disagreed (3.2) with the statement "it is better to use fans for cooling instead of air-conditioners", the respondents in Hanoi positively agreed (4.3) with this statement. Most respondents in Adelaide were using ducted reversed cycle air-conditioners while most respondents in Hanoi were using fans for cooling.

Many respondents in Adelaide agreed it is better for the environment to use fans for cooling, but they "could not stand the hot weather without air-conditioning". Technological developments may provide higher comfort for users, but at the same time it seems to reduce the ability of people to tolerate the more severe environmental conditions. So the common use of air-conditioners in Adelaide can be considered to relate not necessarily to weather conditions but more to the cultural background of the users and the habit of relying on and being able to afford appliances of modern lifestyle. This suggests air-conditioners may be common used in Hanoi in future.

The respondents in the two cases agreed with the statement "it is the responsibility of individuals to protect the environment" and the mean agreement level in Hanoi (4.4) was higher than in Adelaide (4.1). They all realised the individual's role in environmental protection. The respondents in both cases also realised the role of government in environmental protection. They all agreed strongly with the statement, "the government should make laws to protect the environment" (4.2 in Adelaide and 4.5 in Hanoi).

The agreement of the respondents in the two cases with the statement "water is not a scarce resource" was similar and low in both cases (2.0 in Adelaide and 2.1 in Hanoi). The respondents in the two cases also agreed with the statements "it is good idea to recycle the grey water for toilet flushing", "it is the practical idea to recycle household waste water for other uses", and "all household waste should be recycled" (respectively 3.9, 4.1, and 4.3 in Adelaide and 4.1, 4.1, and 4.2 in Hanoi). It could be argued that the respondents in both cases would support the application of water and waste recycling systems if introduced.

However, the willingness to pay for environmental actions was not high in both cases. The agreement level with the statement "you should pay more for resources (land, petrol and water) the more you use them" of the respondents in the two cases was above neutral but not strong (3.7 in Adelaide and 4.0 in Hanoi). On the other hand, the agreement with the statement "environment pollution directly affects your health" and "if we consume too many resources today, there might be nothing left for our grandchildren" was similar and strongly positive in the two cases (respectively 4.3 and 4.1 in Adelaide and 4.5 and 4.3 in Hanoi). This means though understanding the adverse effect of environmental hazards and resource depletion, to their life, this is not reflected in willingness to pay to offset these negative effects. This may relate to the low-income situation in Hanoi, but to the ignorance of the respondents in Adelaide because as studied above they know the importance of the environment.

Generally, the respondents in both cases overall show a remarkable degree of similarity with each other to most of the statements. The slight differences, where they occurred, usually relate to the socio-economic and environmental background of the two cases. Although aware of the need to protect the environment, respondents in Adelaide seemed reluctant to pay for the environment at their expenses.

6.4.6 Making sense of value, knowledge and actions

The respondents in the both cases saw living in a healthy environmental as more important than other issues of living in a house of choice and having a good neighbourhood relationship. Generally environmental protection was seen as important as economic growth and increased human welfare. However, the link between environmental protection, economic growth and increased human welfare was seen in a vague way in both cases. The respondents mainly saw environment protection and economic growth as the means to provide benefit for human species.

The respondents in the two cases had a different knowledge of environmental issues. While the respondents in Adelaide knew more about global issues, the respondents in Hanoi mainly recognised local issues. This seems to relate to the availability of environmental information in each city. The respondents in both cases, especially in Adelaide did not perceive a link between environmental problems at global, national and local levels therefore most of them did not relate the impact of global problems on their locality or family's health.

Actions to environmental protection depend on available information and provided facilities (such as recycling system). As information and facilities are limited, most respondents in both cases, especially in Hanoi, did not know what can they do to protect the environment except what they were doing daily.

The respondents in both cases generally agreed with most solutions proposed to approach sustainable housing except for a few differences, where they occurred, which usually relate to socio-economic and environmental background of the two cases. However, though understanding the importance of environment protection, willingness to pay for environmental actions is not strong in the two cases.

6.5 Summary and discussions

The above examination of the perception of the households about preferable housing, lifestyles, and environmental actions shows similarities and differences between Adelaide and Hanoi in many aspects.

Technological application of housing in Adelaide and Hanoi was different. Housing in Hanoi was denser than in Adelaide. While one-storey detached houses were typical in the Adelaide metropolitan area, high-rise street house and apartments were more common in Hanoi. While all the houses in Adelaide had gardens, this was not the case in Hanoi. Although having a similar climate condition, the interior in Adelaide houses appeared to fit more to colder climate conditions while the interior of Hanoi housing was flexible and suited to the temperate climate condition. The interior arrangement in Adelaide perhaps owed more to the historical and cultural background of the residents rather than a conscious response to the local climate.

The households in Adelaide mainly travelled by car while motorcycle was the main means of transport in Hanoi. Though having a bigger household size, and having a similar distance to city centre, the amount of household travel was the same in the two cases. Beside this, households in Adelaide owned more domestic appliances and consumed more energy than the households in Hanoi. Energy efficiency was not the first concern of the respondents in the two cases. Though energy consumption in Adelaide was seven times higher than in Hanoi, the respondents in both cases saw their energy use at a similar level, as normal and reasonable. The respondents in the two cases also saw their water use as reasonable. These findings indicate that respondents in the two cases consider the "green-ness of the behaviour at about the same level. This perception appears to lead many respondents to find the use of environmental friendly systems as not necessary. This may also partly relate to the limited knowledge about these technologies, the high initial cost, and social acceptance.

The difference in social perception between the two cases was shown in the different family living arrangements, neighbourhood relationships, and preferred houses. The household size in Hanoi was bigger than in Adelaide because extended family and parents living with adult independent children were more common in Hanoi than in Adelaide. However, the number of respondents satisfied with their living arrangement was not much different between the two cases. While the extended family was popular and considered as a secure place for old age parents in Hanoi, most elderly people in Adelaide lived by themselves. The elderly living in this arrangement seemed to have more difficulties in daily life than in other arrangements.

Beside this, home ownership was high in both cases. Though the involvement of the households in design and construction of the house in Hanoi was higher than in Adelaide, the gender equity in involvement in the design and construction of housing in Adelaide was higher than in Hanoi. This relates to higher gender.equity in Adelaide than in Hanoi. Community activities were weak in the both cases due to the newness of the areas. However, the tie between neighbours in Hanoi seemed stronger than in Adelaide.

The perception of respondents in the two cases about their preferred house was mainly similar, but there were also differences. Beside both seeing location and design as major issues, the respondents in Hanoi were concerned with infrastructure and Feng Shui application while the respondents in Adelaide were concerned with appliances. Though technological systems applied in the two cases were different, the satisfaction of the respondents in the two cases was similar. To improve their house, the households in Adelaide often added a pergola in the backyard while renovating inside the house was common in

Hanoi due to low quality and standard. While relying on appliances was the main response to being cold and hot in Adelaide, the respondents in Hanoi accepted the climate and adapted their house suitably to different climate conditions. High-rise housing was more acceptable in Hanoi than in Adelaide.

Having lower GDP, housing affordability in Hanoi was lower than in Adelaide and the financial resource is different between the two cases. In addition, while home loans support home ownership in Adelaide, this was not available in Hanoi. Beside income, the respondents in Hanoi had to rely on borrowing from relatives to purchase a house. While housing investment was seen as exchanging goods for benefit in Adelaide, it was seen mainly as accommodation in Hanoi. Though having a higher income, the electricity and water price in Adelaide was not much higher than in Hanoi. This causes social stress for low-income earners in Hanoi but a high consumption of energy and water in Adelaide.

The respondents in the two cases also had different perceptions about dimensions of sustainability. Although the value of dimensions of sustainability was seen as equally important, the knowledge of and attitude to acting were different between the two cases. Generally, the respondents in Adelaide often saw global problems while the respondents in Hanoi often saw only daily local problems. The respondents in the both cases did not see any link between global and local problems therefore the respondents often did not see the impact of global environmental problems on their family health. Moreover, the respondents in the both cases saw the environment and economy only as 'means' to achieve human well-being 'end'. This leads to reluctance in willingness to pay and act for environmental benefit. Economy was seen closely related to human well being in Hanoi while it was seen as an independent factor in Adelaide. Response to the statements about sustainable housing in the two cases was similar in many issues except to the statements of rooms in a house, type of housing, use of appliances, and individual responsibility to protect the environment was different between the two cases.

Discussions

The survey data have shown that the application of the technological instruments was different in the two cases. Housing construction and design are identified as depending on land availability, local climate condition, local available building materials and technologies, and culture. As these factors are different in the two cases, housing construction and design are different. Household travel mode and energy and water consumption were different due to the difference in lifestyle and urban form of the two cases. Adelaide respondents in general appear to adopt a higher consumption lifestyle compared to Hanoi but with little difference in satisfaction with housing and indoor environmental condition. This suggests that for Hanoi people, the ambition to adopt a high consumption lifestyle will not necessarily increase their overall satisfaction level with their housing. Conversely, Adelaide people could alter their high consumption lifestyle without necessarily reducing the satisfaction level with their house. In addition, the application of green technological systems was limited in both cases due to limited knowledge, high initial cost, and mainly, the social acceptance of users of these systems. Therefore providing information and education to change social perception about the long-term benefit of these systems would be very important to promote the application of these technologies.

The social practice and perception of the respondents about living arrangement, neighbour relationship, and preferred houses and issues in housing are different between the two cases. The efficient living arrangement of an extended family sharing a house is accepted in Hanoi. However, this arrangement is not widely practised and is generally not accepted in Adelaide. The demand for communication between neighbours in Hanoi was higher than in Adelaide therefore detached houses were seen as too isolated and street houses were more acceptable than detached houses in Hanoi. This is not the case of Adelaide, where detached houses are preferred. Moreover, although having similar perceptions about the most important issues in housing (location and design of the house), respondents in each case have specific desires in housing such as Feng Shui application (in Hanoi) and newness (in Adelaide). These examples show that the social instruments to sustainable housing in the two cases are different and depend on the cultural and social preference of users in each context.

The application of economic instruments was also observed to be different in Adelaide and Hanoi. Having lower income levels, and without a home loan, housing access and affordability in Hanoi were lower than in Adelaide. People in Hanoi often have to rely on informal financial support from relatives and friends while this is not the case in Adelaide.

To improve accessibility to home ownership in Hanoi, it is necessary to increase housing supply, affordability and access to finance. Hanoi needs to continue to build more housing, especially affordable housing, to increase supply and to reduce the market price of housing. Increased affordability can be achieved by a combination of increasing incomes, reducing the price of housing and the cost of finance. These need an improvement of economic situation, providing more housing, and minimising the cost of running the house and interest paid for loans. In contrast, the high-income levels in Adelaide appear to create high consumption that leads to a waste of resources, environmental pollution that does not always equate to the higher satisfaction of the residents with their house and the indoor environment of the house. In this case, the economic instruments of taxation and charges on high consumption could be introduced in Adelaide. These economic instruments are not currently suitable in Hanoi where most people already have a low income and relatively low consumption levels. This suggests that different economic instruments are required in Adelaide and Hanoi.

Overall, the respondents in the two cases had different perceptions about the relationship between environmental protection, economic growth and increased human welfare. This does not relate only to the limitation of information but also relates to the local political-economic system. The economic dimension was seen as an independent factor in Adelaide while it was only seen as a factor related to the social dimension in Hanoi. This asserts the need to consider multi aspects in a context to develop sustainable housing for each locality.

Nevertheless, as technology, economy and even culture are changing over time, sustainable housing has to consider not only the local context at the time but also in the future. Flexible housing solutions would be sustainable for housing development in the long run.

Chapter 7 Sustainable housing and the professional stakeholders

A comparative study between different stakeholder groups including planners, designers, developers, and householders about sustainable housing can define gaps between their perceptions about the application of instruments of sustainable housing. Understanding and bridging these gaps is likely to be important for making sustainable housing happen. Although the number of professionals is less than of householders, it is possible to compare between these groups. First, because the planners, developers, and architects are professionals in the field, they are believed to know better than householders about sustainable housing. Secondly, these individual professionals often make big decisions for a whole community while the householders have less opportunity to affect housing developments.

Le Corbusier is reported once to have remarked, "[l]ife is right, and the architect is wrong" (Wines, 2000, p. 16), and a comparison between householder views and attitudes of professionals could be instructive in highlighting differences. As seen in the previous chapter, housing, as expressed by householders' views and perceptions, has many dimensions. However, professional stakeholder groups, such as architects and builders, may deal with only a few aspects of these dimensions.

Whereas the previous chapter attempted to construct a multi-dimensional image of sustainable housing from the householders view, this chapter will investigate and compare the perceptions and actions of housing professional stakeholder groups and will compare these with householders' views. A comparison between two cases aims to show different perceptions of these stakeholder groups about sustainable housing. This suggests that solutions to sustainable housing can be seen differently in each context.

As described in Chapter 5, in order to collect data for this study, a questionnaire was administered to key professional stakeholders, but modified to suit each of the key stakeholders including planners, architects, and developers in Adelaide and Hanoi. The stakeholders were selected randomly by chance. The following section will investigate perceptions, priorities, actions, and barriers to the approach of these stakeholders to sustainable housing.

As the number of professional stakeholders interviewed is small, this part relies mainly on the use of qualitative information derived from the interviews. It is appreciated that the quantitative results presented, while interesting, cannot necessarily be generalised. The data collected from interviewing the stakeholders will be sorted by professional groups such as architects, developers, and planners for comparison. Responses to open-ended questions are coded into themes or topics for comparison.

7.1 Perception about a good house/good housing development

Question 7 to the architects and developers asked, “In your opinion, what is a good house?” The responses are displayed in the Table 7.1. The architects in both cases raised some similar issues of ‘affordability’, ‘comfort for users’, and ‘fulfilling client’s requirements’. Besides this, while the architects in Hanoi raised many environmental, social, and economic issues, the architects in Adelaide raised mainly social issues and only one environmental issue of ‘energy saving’ and one economic issue of ‘affordability’. While the developers in Adelaide raised environmental and economic but no social issues, the developers in Hanoi raised more environmental and social issues. Comparing the architect and developer groups in each case, the perceptions of these groups about a good house were similar in Hanoi but different in Adelaide. In Adelaide, the developers concentrated more on environmental and economic issues while the architects were concerned more with social issues.

Question 7 to planners asked, “In your opinion, what is a good housing development?” The planners in the both cases raised some environmental and few social but no economic issues. The planners in Adelaide raised more environmental issues while the planners in Hanoi raised more social issues. These results are also shown in Table 7.1.

Some issues were raised in one case only as they related to the socio-economic and environmental condition of each context. All stakeholder groups in Hanoi were concerned about ‘infrastructure’ while no one in Adelaide raised this as an issue. This relates to the common poor infrastructure in Hanoi. The architects in Hanoi mentioned that a good house should ensure adequate ‘environmental features’ as an environmental end while the planners in Adelaide tended to focus on environmental means in describing a good house. ‘Energy saving’ and ‘water saving’ were raised in Adelaide but not in Hanoi, as these issues were well established in Australia. ‘Durability’ was raised in Hanoi only. ‘Technologies’ were mentioned in Adelaide only as the technologies are not popular and unaffordable for most Vietnamese. ‘Attractive to market’ was raised in Adelaide, as the housing industry in Adelaide is a market base one while it is not quite the same in Hanoi. ‘Ownership’ was raised in Hanoi only because obtaining clear title for home ownership is often difficult. ‘Community’, ‘indoor and outdoor relationship’, and ‘structurally sound’ concerned the stakeholder groups in Adelaide only while ‘services/ transportation’ concerned the planners and developers in Hanoi. Good passive design was raised by the architects in Adelaide only.

The stakeholder groups in each case (Adelaide or Hanoi) and the same stakeholder groups in the two cases had different perceptions about a good house/housing development. Many issues of concern were related to local conditions or the profession of the stakeholder groups.

Table 7.1 Perception of stakeholders about a good house/ housing development

Benefit	Issues	A good housing development		A good house			
		Planners		Developers		Architects	
		AD	HN	AD	HN	AD	HN
En	Density/ allotment size	■			■		
En	Planning	■					
En	Shading/sunlight access/ ventilation	■					■
En	Environment (tree)				■		■
En	Environmental feature						■
En	Infrastructure		■		■		■
En+Ec	Energy saving			■		■	
En+Ec	Water saving			■			
En+Ec	Flexible use			■	■		■
En+Ec	Durability						■
En+Ec	Technologies			■			
En +S	Location						■
Ec	Affordability			■		■	■
Ec	Benefit of economic/ business			■			
Ec	Attractive to market			■			
S	Beautiful	■			■		■
S	Good passive design					■	
S	Comfortable for user				■	■	■
S	Convenient plan						■
S	Fulfil all clients requirements					■	■
S	Ownership/ administration		■				
S	House size		■				
S	Type (Detached/Street house)	■					
S	Community					■	
S	Indoor and outdoor relationship					■	
S	Structural sound					■	
S	Services/ transportation		■		■		
S	Privacy						■

Note: En = Environmental Ec = Economical S = Social
■ = Indicates that the issue was mentioned

7.2 Factors considered when designing, building, and developing housing

Responses of the stakeholder groups to Question 8 "What factors do you consider when designing a house?" (to architects), "What factors do you consider when developing a new housing area?" (to developers), "What were the main issues that you considered in planning these new housing developments in the city? (to planners), and "Would you tell me what are the most important requirements when choosing or building a house?" (to householders) are included in the Table 7.2.

Table 7.2 Factors considered when designing a house

Benefit	Factors considered	**Planning these new housing development**		**Developing a new housing area**		**Designing a house**		**Choosing or building a house**	
		Planners		Developers		Architects		Householders	
		AD	HN	AD	HN	AD	HN	AD	HN
En	Density				■				
En	Site, allotment size and shape					■	■	■	■
En	Orientation					■	■		
En	Building materials					■			
En	Thermal performance					■			
En	Zoning/planning	■			■				
En	Environmental feature			■	■		■		
En	Infrastructure		■		■				■
En+S	Streetscape					■	■		
En+S	Amenity of locality / location	■					■	■	■
En+Ec	Energy saving					■			
En+Ec	Durability/ quality				■				■
En+Ec	Flexibility				■				
Ec	Public transport			■					
Ec	Affordable price			■		■	■	■	■
Ec	Economic benefit						■		■
S	Fulfil all user requirements			■	■	■	■		
S	Beautiful				■		■		
S	Good design	■		■				■	■
S	Convenience for user				■		■		
S	Attract to customer, clients		■	■					
S	New house							■	■
S	Type of house (Detached)								■
S	Neighbour relationship							■	■
S	Appliances							■	
S	Feng Shui application								■
S	Design concept, idea						■		

Note: En = Environmental Ec = Economical S = Social
■ = Indicates that the issue was mentioned

In general, the architects in the two cases had similar perceptions about factors considered when designing a house as they both considered environmental, economic, and social issues. The developers in the two cases considered environmental, social, and economic factors when developing a new housing area but while the developers in Adelaide raised more economic issues, the developers in Hanoi raised more environmental issues. The planners in the two cases had different factors of interest when planning a housing project. While the planners in Adelaide took into consideration zoning, amenity of locality, and good design, the planners in Hanoi were concerned with infrastructure and attraction to clients. As described in Chapter 6, the householders in Hanoi and Adelaide raised similar requirements when choosing or building a house and they both were concerned little with environmental issues.

Besides some shared issues, all stakeholder groups in the two cases considered local specific factors. 'Building material', 'thermal performance', 'public transport', 'appliances', and ‘energy saving’ were raised in Adelaide, while ‘density’ and ‘infrastructure’, ‘beauty’, ‘convenience for user’, ‘Feng Shui’, ‘design concept’, and ‘type of house’ concerned the stakeholder groups in Hanoi.

In short, the architects and householders in the two cases considered several similar factors when designing a house. The architects and householders in each case also had quite a few common concerned issues. However, there was very little consensus between the planners and developers and between these two stakeholder groups in the two cases. The architects and householders in the two cases considered many factors while the planners and developers were concerned with only a few issues.

7.3 Sustainable housing

Table 7.3 Perception of the stakeholder groups about sustainable housing

Benefit		**Sustainable housing**						**Advise for buying a house**	
		Planners		Developers		Architects		Householders	
		AD	HN	AD	HN	AD	HN	AD	HN
En	Harmony with the environment				■		■		
En	Environmental protection	■				■			
En	Infrastructure								■
En + Ec	Energy saving	■	■	■		■			
En + Ec	Long-term/flexibility/durability	■		■	■		■	■	■
En + Ec	Resource conservation	■		■		■			
Ec	Affordability							■	■
Ec	Business opportunity							■	■
Ec	Fulfil all economic requirements		■						
S	Beauty				■		■		
S	Good design	■				■		■	
S	Convenience for user		■		■		■		■
S	Fulfil all social requirements		■				■		
S	Ownership/ administration		■						■
S	Type of house (Detached)							■	■
S	Neighbour relationship							■	■
S	Appliances							■	
S	Safety							■	■
S	Feng Shui application								■
En + S	Location	■						■	■

Note: En = Environmental Ec = Economical S = Social
■ = Indicates that the issue was mentioned

Responses to Question 9 asking the architects, developers, and planners “What do you understand by the term ‘sustainable housing’?” are included in the Table 7.3. Question 19 to householders is also included for comparison, and this is discussed below. Although all the professional stakeholder groups in the two cases had included multi dimensions when indicating the meaning of sustainable housing, the stakeholder groups had different perceptions about sustainable housing.

Comparing stakeholders groups in Adelaide, there was a similarity between the responses. All the stakeholder groups raised 'energy saving' and 'resource conservation'. However, while the planners and architects raised 'environmental protection' and 'good design', the developers did not raise these, and while the planners and developers raised the issues of 'long-term suitability/ flexibility' and 'location', the architects did not raise these.

In Hanoi, there was a similarity between the responses of the developers and architects while the responses of the planners were slightly different. While the developers and architects were concerned more with environmental and economic issues, the planners were concerned more with social issues.

Comparing the same stakeholder groups in Adelaide and Hanoi, the perception of these groups was also different. The planners in Adelaide were concerned more with environmental issues while the planners in Hanoi were concerned more with social aspects. Moreover, the meaning of sustainable housing seems to be seen in more concrete terms among the planners in Hanoi than in Adelaide. The planners in Adelaide raised a general and well-known definition of sustainability 'energy and environmentally efficient housing which meets the need of the present without compromising the ability of the future to meet own need'. One planner in Adelaide even said that sustainability is a 'meaningless term' and he did not believe in it. Differently, the planners in Hanoi raised a range of more tangible issues such as 'saving energy', 'ensuring ownership', 'fulfilling social requirements', 'convenience for users', and 'fulfilling economic requirements'.

The developers in Adelaide focused more on environmental and economic issues while the developers in Hanoi were concerned more with social issues. Whereas both raised 'flexibility for long-term use of owners', the developers in Adelaide raised only 'energy and water management', while the developers in Hanoi raised many issues such as 'physical durability', 'human live harmonically with the environment', 'long-term suitability of the house to society', 'convenience for users', 'flexibility', and 'beauty'. The developers in Adelaide were concerned more with resources conservation while the developers in Hanoi were concerned with environmental harmony and social issues.

Although the architects in the two cases considered three dimensions of sustainability, the issues concerned were different. The architects in Adelaide raised 'no negative impacts on the environment', 'low embodied energy', 'solar access', 'reduce waste', and 'sensitivity design' while the architects in Hanoi raised 'physical stability', 'long-term suitability to functions and appearances'.

It is possible to compare the perception of these professional stakeholder groups about sustainable housing with aspects concerning householders when giving advice to friends who were intending to buy or build a house (Question 19). The result shows the planners, developers, and architects were concerned more with environmental and economic issues while the householders were concerned more with social and economic issues but very little with environmental issues. The householders raised issues that were not raised by any actors such as 'Feng Shui', 'safety', 'neighbourhood relationships', 'infrastructure', 'appliances', and 'type of the house'. There were similarities between the stakeholder groups in each case in the perception of sustainable housing. However, the similarity between the same stakeholder groups in the two cases was very rare. The stakeholders often referred to their own local context.

Generally, the householders in the two cases raised more requirements for sustainable housing than the professional stakeholder groups. The professional stakeholder groups have not necessarily understood the need of users (householders) while the householders had little concerns to environmental issues.

7.4 Actions perceived to achieve sustainable housing

To investigate the actions perceived to achieve sustainable housing among the stakeholder groups, similar, but profession-specific questions were asked to the stakeholders to suggest solutions to housing that fulfil the three dimensions of sustainability. Question 29a asked the architects, "What a designer can do in designing new housing projects to protect the environment while still maintaining human comfort and ensuring an acceptable cost?" Question 27b asked the developers, "In your opinion, what would you do in developing new housing projects to protect the environment while still maintaining human welfare and ensuring an acceptable cost?" Question 22 asked the planners, "In your opinion, what could you do in planning new housing developments to protect the environment, while maintaining human welfare and economic growth". The responses from these questions can be compared to each other and to the responses to Question 8 asking the householders about the most important requirements when choosing or building a house. The responses to these open ended questions were grouped into topics and the results are shown in Table 7.4.

Comparing the stakeholder groups in Adelaide shows, generally, the stakeholder groups were concerned with different aspects. Only a few issues concerned more than one group. For example, 'affordability' concerned the planners, architects, and householders; 'economic benefit' concerned developers and householders; 'good design' concerned developers and householders; and 'social effects' concerned developers and householders. While the planners and architects were concerned more with environmental and economic issues but little with social issues, the developers and householders were concerned more with social issues and little with environmental issues.

The stakeholder groups in Hanoi also were concerned with different issues. Only a few issues were raised by two groups including 'sewage treatment' and 'waste separate'(developers and architects), 'economic benefit' (developers and householders), and 'apartments' (planners and householders). While the planners and householders were concerned more with social issues, the developers and architects were concerned more with environmental and economic issues.

Table 7.4 Actions perceived for sustainable housing

Benefit	Actions perceived	Actions for sustainable housing						Requirements	
		Planners		Developers		Architects		Householders	
		AD	HN	AD	HN	AD	HN	AD	HN
En	Density						■		
En	Environmental protection			■		■			
En	Respect to nature/ site				■	■			
En	Good infrastructure								■
En	Provide green area						■		
En	Select material					■			
En	Recycle commercial buildings to housing	■							
En	Good insulation/ double glazing					■			
En	Passive design, orientation					■	■		
En	Review every 3-5 years	■							
En	Guidelines	■							
En	Sewage treatment, waste separation				■		■		
En + S	Location							■	■
En + Ec	Not using air conditioners					■			
En + Ec	Energy saving					■			
Ec	Affordability	■				■		■	■
Ec	Economic benefit			■	■			■	■
En + S	Inner city	■							
En + S	Suburb		■						
Ec + S	New urban areas		■						
S	Good design			■				■	■
S	Convenience for user								
S	Social suitability			■				■	■
S	Safety							■	■
S	Apartments/ Housing type		■					■	■
S	Appliances							■	
S	New housing							■	
S	Education			■					
S	Feng Shui application								■
En + Ec + S	Balance all demands				■				
En + Ec + S	Management				■				

Note: En = Environmental Ec = Economical S = Social

■ = Indicates that the issue was mentioned

Comparing the same stakeholder groups in the two cases, except for the householders, the actions perceived to achieve sustainable housing by the professional stakeholders were different. While the planners in Adelaide were concerned more with environmental and economic issues, the planners in Hanoi focused more on social and some environmental issues. While the planners in Adelaide focussed on developing new inner city housing and reversing old office buildings to housing, the planners in Hanoi preferred developing high-rise apartments in new urban projects in suburbs. The projects in Adelaide aimed to reduce urban sprawl (environmental concerns) while the projects in Hanoi aimed to reduce the overcrowding in the inner city and provide homes for thousands of people (environmental and social concerns).

The developers in the two cases both were concerned with all environmental, social, and economic dimensions but the issues raised were different except that both were concerned with 'economic benefit' (see Table 7.4). The architects in both cases focused mainly on environmental issues while the architects in Adelaide also were concerned with some economic issues. The environmental issues raised by the architects in the two cases were different except for the application of 'passive design or orientation'. The householders in Adelaide and Hanoi had similar perception about actions for sustainable housing. However, some issues were raised in one case only as they reflect the housing condition and people's belief in each context. The householders in Adelaide raised 'new house', 'appliances', 'profit' while the householders in Hanoi did not raise these but raised 'infrastructure' and 'Feng Shui' application that were not mentioned in Adelaide.

Generally, the stakeholder groups in each case have indicated different actions to achieve sustainable housing. Comparing the two cases, the same professional stakeholder groups proposed different actions. However, though raising some specific local issues, the householders in the two cases raised similar actions.

7.5 Importance of issues in housing

The perceptions about the importance of issues in housing between the stakeholder groups and cases were different. Question 10 asked architects (in relation to designing housing) and developers (in relation to developing housing) to rank the level of importance in a five-point interval scale the issues of Appearance (society); Space (physical quantity); House plan (physical quality); Cost (economy); and Natural lighting and ventilation (environment). This is compared with householder (Question 12(d)) that asked the same question in relation to their house. The mean ranks of the level of importance raised by the stakeholder groups are shown in the Table 7.5.

In Adelaide, except for the developers who found natural lighting and ventilation in the middle (between important and not important), all the other stakeholder groups in Adelaide saw these as issues important, though they gave priority (that is the mean rank greater than 4) for different issues. The developers gave priority for appearance and cost (social and economic) while the architects gave priority for house plan and cost (social and economic) and householders gave fairly equal priority for all these issues (social, economic, and environmental), with slightly lower importance on appearance.

Table 7.5 Mean rank of the level of importance of issues in housing

Issues	Developers (in developing housing)		Architects (in designing housing)		Householders (in housing)	
Case	AD	HN	AD	HN	AD	HN
Appearance (society)	5.0	3.7	4.0	4.1	4.0	4.0
Space (physical quantity)	4.0	3.3	4.0	3.1	4.3	4.2
House plan (physical quality)	4.0	5.0	4.8	4.3	4.4	4.5
Cost (economy)	5.0	3.7	4.6	3.7	4.3	3.8
Natural lighting and ventilation (environment)	3.0	4.3	4.2	4.2	4.4	4.6

Note: The ranks given follow Scale 1, Appendix D.

In Hanoi, except for the developers and architects who could not decide whether 'space' is important or not, all stakeholder groups in Hanoi seem to have similar perceptions about these issues in housing. All the stakeholder groups gave priority for 'house plan' and 'natural lighting and ventilation' (social and environmental) though at different levels.

There were similarities between the same stakeholder groups in the two cases about the importance of 'house plan', between architect groups about 'appearance' and 'natural lighting and ventilation', and between the householder groups about all issues except for 'cost'. Beside this, there were also differences. The developers in Adelaide ranked 'appearance' at a higher importance level than the developers in Hanoi. The developer and architect groups in Adelaide ranked space at a higher level of importance than these groups in Hanoi. All three stakeholder groups including developers, architects, and householders in Adelaide saw cost as more important than these stakeholder groups in Hanoi and this economic dimension was only seen as potentially important (at level 3.7, not clearly indicated as important) in Hanoi.

7.6 Importance levels of dimensions of sustainability

Question 20 (to the planners), Question 40 (to the householders), Question 27 (to the architects), and Question 28 (to the developers) asked the stakeholders to rank the level of importance of three dimensions of sustainability including 'environmental protection', 'economic growth', and 'increase human welfare' in a five-point interval scale (see Scale 1, Appendix D). The mean ranks of the level of importance raised by the stakeholder groups are shown in the Table 7.6 for comparison.

In Adelaide, the importance of 'environmental protection' was ranked at the highest level by the architects, the second by the householders and the third by the planners and developers. Differently, the importance of 'economic growth' was ranked at the highest level by the developers, the second highest by the architects and the last by the planners and the householders. The importance of 'increase human welfare' was ranked at the highest level by the architects, the householders the second, the developers the third, and the planners the last. The planners in Adelaide ranked the importance of 'environmental protection' and 'economic growth' at the same level and higher than the importance of 'increased human welfare'. However, the developers ranked the importance of 'economic growth' at the highest level and higher than the other two dimensions. In contrast, the architects ranked 'economic growth' at the lowest level among these three dimensions, and ranked the importance of 'environmental protection' and 'increase human welfare' at the highest levels. The householders ranked the importance of 'environmental protection' at the highest level, higher than 'increased human welfare' and 'economic growth'.

Table 7.6 Mean rank of the level of importance of dimensions of sustainability

Dimensions of sustainability	Planners		Developers		Architects		Householders	
	AD	HN	AD	HN	AD	HN	AD	HN
Environmental protection	4	4	4	3.7	5	4.7	4.6	4.8
Economic growth	4	4.5	5	3.7	4.4	4.1	4	4.7
Increased human welfare	3.5	4.5	4	4.3	5	4.6	4.2	4.7

Note: The ranks given follow the interval Scale 1, Appendix D.

In Hanoi, all the dimensions were seen as important but at different levels. The importance of 'environmental protection' and 'increased human welfare' were ranked at the highest level by the householders, the second by the architects, the third by the planners and the last by the developers. The importance of 'economic growth' was ranked at the highest level by the householders, the second by the planners, third by the architects, and last by the developers. On the other hand, while the planners ranked 'economic growth' and 'increased human welfare' at the same levels and higher than 'environmental protection', the developers saw 'increased human welfare' as the most important dimension, above 'environmental protection' and 'economic growth'. The architects saw the importance of 'environmental protection' and 'increased human welfare' as the most important dimensions, and higher than 'economic growth'. The householders saw the importance of 'environmental protection' almost the same as 'economic growth' and 'increased human welfare'.

Although all the dimensions were seen as important, the importance levels were slightly different between the two cases. The planners in the two cases ranked 'environmental protection' at the same level. However, the planners in Hanoi ranked the importance of 'economic growth' and 'increased human welfare' higher than the planners in Adelaide. On the other hand, the importance of 'environmental protection' and 'economic growth' was ranked by the developers in Adelaide higher than by the developers in Hanoi. The importance level of 'increased human welfare' was ranked by the developers in Hanoi higher than the developers in Adelaide. The importance of these three dimensions was ranked by the architects in Adelaide slightly higher than by this group in Hanoi while these were ranked by the householders in Hanoi higher than by the householders in Adelaide.

7.7 Satisfaction with issues in preferable housing projects

After asking the stakeholders to select a preferred housing project, Question 12 asked the architects and developers to indicate their satisfaction levels in a five-point interval scale (see Scale 2, Appendix D) with different issues in this project. The result is compared to the response to Question 13 asking householders to raise their satisfaction level to issues in their house. It is necessary to note that the housing project proposed by some architects and developers in Hanoi was the housing area that was occupied by the surveyed householders, but this was not the case in Adelaide. The average levels of satisfaction raised by stakeholder groups are presented in Table 7.7 for comparison.

Table 7.7 The mean rank of satisfaction with issues in preferred housing projects

Issues	Developers		Architects		Householders	
	AD	HN	AD	HN	AD	HN
Appearance	3.0	3.0	4.2	3.1	4.4	3.7
Harmonious neighbourhood	4.0	3.0	4.4	3.4	4.5	4.0
Privacy	4.0	3.0	4.2	4.0	4.2	4.2
Social suitability	4.0	4.0	4.6	4.0	4.2	4.2
Location	3.0	1.0	4.8	3.6	4.6	3.7
House area (space)	4.0	4.0	4.4	4.1	4.7	4.0
Number of rooms	3.0	4.0	4.4	4.1	4.6	4.0
Convenient plan	5.0	3.0	4.6	4.1	4.7	4.1
Benefit from garden	4.0	1.0	4.8	1.5	4.2	2.7
Environmental quality	4.0	4.0	4.4	3.7	4.2	3.8
The indoor environment	4.0	2.0	4.4	4.0		
Road safety	5.0	3.0	4.0	3.9	4.0	3.3
Infrastructure	5.0	3.0	3.6	3.3	4.2	3.4
Public area (playground)	5.0	4.0	4.2	3.1	4.2	4.0
Energy efficiency	5.0		4.4	3.4	3.8	3.5
Construction efficiency	4.0	4.0	3.8	4.1		
Cost of the houses	3.0	4.0	4.2	3.7	4.2	4.1

Note: The ranks given follow five-point interval Scale 2 (Appendix D)

The stakeholder groups in Adelaide were satisfied with most issues in housing but were dissatisfied with different issues. The developers were dissatisfied with appearance, location, number of rooms in a house, and cost of the house. The architects were dissatisfied with infrastructure. The stakeholder groups in Hanoi were dissatisfied with more issues than in Adelaide. The architects were not satisfied with appearance, harmonious neighbourhood, privacy, location, convenient plan, and benefit from garden, indoor environment, road safety, and infrastructure. The developers were dissatisfied with appearance, harmonious neighbourhood, location, benefit from garden, and environmental quality. The householders were dissatisfied with benefit from garden, road safety, energy efficiency, and infrastructure.

Moreover, as no stakeholder group in the both cases was satisfied with all issues, the preferred projects could all potentially be done better.

7.8 Satisfaction with thermal performance

Question 13 asked the architects and the householders to rank their satisfaction level with the thermal performance of their preferred houses (to architects) and of their house (to householders) in a five-point interval scale (Scale 2, Appendix D). The mean of satisfaction level of the stakeholder groups is shown in the Table 7.8 for comparison.

Table 7.8 Mean rank of satisfaction levels with thermal performance

Times	Architects		Householders	
	AD	HN	AD	HN
Daytime in the winter	4.6	4.0	4.3	4.0
Night time in the winter	4.2	4.0	4.2	3.9
Daytime in the summer	4.2	4.0	3.8	4.1
Night time in the summer	4.4	4.0	3.9	4.1

Note: The ranks given follow the five-point interval Scale 2 (Appendix D)

Comparing architects and householders in Adelaide, the satisfaction with thermal performance of the house was similar during the winter but different during the summer. The satisfaction level of the householders with thermal performance of the house in the summers was lower than of architects. This may explain the high use of air conditioners among the householders as described in Chapter 6. Many householders also asserted that this type of housing structure is hot. In Hanoi, the satisfaction with thermal performance in the houses indicated by the architects and the householders was similar at different times and in different seasons.

Comparing the same stakeholder groups in the two cases, the thermal performance in the preferred projects evaluated by the architects and householders in the two cases generally was at a satisfied level (level 4). The satisfaction with thermal performance of these houses evaluated by the architects in Adelaide was slightly higher than in Hanoi especially in the winter. However, while the householders in Adelaide evaluated the satisfaction with thermal performance of their houses in winter higher than in Hanoi, the householders in Hanoi evaluated their satisfaction with the thermal performance of their houses in summer higher than in Adelaide. Based on users' perception, new houses in Hanoi seem to be cooler in summer but colder in winter than new housing in Adelaide. New houses in Adelaide may need to improve design to provide a cooler temperature in the house in summer while the new houses in Hanoi may need to improve design to provide a warmer indoor temperature in winter.

Another point is that, although the housing projects are very different in plan, type, and building materials, the satisfaction of the stakeholder groups with the thermal performance was not significantly different between the two cases. Good thermal performance housing in one region may not need to have the same design and techniques as another region.

7.9 Solutions to natural lighting and ventilation and energy efficiency

Questions 17, 18, 19, and 20 respectively asked the architects and developers if any provisions had been made to 'maintain solar and light access to all houses', 'cross ventilation to all houses', 'require high energy efficiency of the houses', and 'consider avoiding direct sun in to the house in summer'? Why and how? Questions 12, 13, and 14 respectively asked the planners if any provisions had been made to 'maintain solar and light access', 'cross ventilation to all houses', and to 'require high energy efficiency of the houses'? Why and how? The responses in Adelaide and Hanoi are shown in Table 7.9.

In order to provide natural lighting and ventilation, 'orientation' was mentioned by the architects in both cases (north and south facing windows in Adelaide and south facing housing in Hanoi). While the developers in Adelaide mentioned 'orientation', the developers in Hanoi raised 'the suitable position of windows' as a means for ensuring natural lighting and ventilation.

The planners in Adelaide took 'setback' and 'shading' into account while 'courtyard' was raised in Hanoi as solutions to natural lighting and ventilation. The architects in Adelaide proposed 'large glass windows' while the architects in Hanoi suggested 'having windows on four sides of houses' and 'reducing density'. The planners in Adelaide considered 'sunlight penetrating into living zones in houses' while 'indirect sunlight' was proposed in Hanoi as the means of improving natural lighting and energy efficiency.

To avoid direct sun into the house in summer, the architects in Adelaide raised 'overhangs', 'orientation of windows', 'shading', and 'veranda', while the architects in Hanoi raised 'orientation', 'balcony', 'logia', 'shading', 'curtains', and 'tree' as the solutions. Due to the difference in density and housing type, 'overhang' and 'verandas' on houses were more popular in Adelaide, while 'balcony' and 'logia' were more popular in Hanoi.

Table 7.9 Solutions to maintain solar and light access, cross ventilation to all houses, require high-energy efficiency, and avoid direct sun in to the house in summer.

Solutions	**Planners**		**Developers**		**Architects**	
Solar and light access to all houses	AD	HN	AD	HN	AD	HN
Avoid shade impacts adjoining	■					
Low density/ detached houses with garden						■
Orientation			■		■	■
Large glass windows and doors					■	
Transparent veranda					■	
Don't know	■					
Courtyards		■				■
Good design				■		
Suitable windows and doors				■		■
Cross ventilation to all houses						
Nothing						■
Court yards		■				■
Low density/ detached houses with garden						■
Reasonable size of allotments						■
Good design				■		
Suitable windows and doors				■		
Orientation					■	■
Large glass windows and doors					■	■
Shutter doors and windows					■	
Location					■	
Require high energy efficiency						
Orientation of windows	■				■	
Open large windows and doors						■
Courtyards		■				
Set back position	■					
Encumbrance control			■			
Nothing			■		■	■
Insulation					■	
Thermal mass floor					■	
Light walls					■	
Select materials					■	
Solar hot water heater					■	
Design / Ceiling height/ Room size/ WC and garage in the bad orientation					■	■
Detached house with garden						■
Avoid sun penetrate in the house in summer						
Orientation of windows					■	■
Shading					■	■
Overhang					■	
Veranda					■	
Pergola						■
Balcony/logia						■
Curtain						■
Nothing						■
Tree						■

Note: En = Environmental Ec = Economical S = Social ■ = Indicates that the issue was mentioned

The same stakeholder groups in the two cases raised different solutions to high-energy efficiency. The planners in Adelaide suggested 'orientation of windows to the north' while the planners in Hanoi suggested 'courtyard' as a solution. The developers in both cases did not suggest any solution. The architects in Adelaide proposed 'insulation', 'high thermal mass floor', 'light wall', 'low energy material', 'use solar hot water heaters', and 'solar access design' while the architects in Hanoi raised 'large windows and doors to south and east', 'detached house with garden', 'low density', 'room size', 'high ceiling', 'toilet and garage in the West'. Comparing the two cases, the stakeholder groups in Adelaide considered maintaining heat while the stakeholder groups in Hanoi were concerned more with cooling in the houses.

Besides this, some architects in Hanoi appreciated a detached house with garden that is very luxurious and seems not to suit the context of high density in Hanoi. Though detached houses with gardens can provide better natural lighting and ventilation that can help saving operating energy in housing, they could create urban sprawl that causes high-energy consumption.

Comparing the stakeholder groups, the architects in both cases seemed to have better knowledge than the other stakeholder groups about solutions to natural lighting and ventilation, and energy efficiency.

7.10 Knowledge about environmental problems

To investigate the knowledge of the stakeholder groups about the current environment problems, Question 28 asked the architects and Question 26 asked the developers "What are the environmental problems? Globally? in Australia/Vietnam? and in this housing area?". Similarly, Question 21 asked the planners and Question 42 asked the householders "What do you see as current environmental problems? Globally?, in Australia/Vietnam?, and in this housing area?". Table 7.10a, b, and c list environmental problems raised by the stakeholder groups in the two cases.

Global level

The stakeholder groups in Adelaide raised different environmental problems at global level except some stakeholder groups raised the same problems of 'pollution' (planners and developers), 'global warming' (planners and householders), 'ecosystem degradation' and 'toxic chemical contamination' (architects and householders), resource depletion (developers, architects, and householders), and 'over populated' (planners and householders). The stakeholder groups in Hanoi also raised different environmental problems at global level except some stakeholder groups raised the same problems of 'ozone depletion' and 'global warming' (planners and householders), 'solid waste', 'air pollution', 'water pollution', and 'ecosystem degradation' (architects, developers, and householders), and noise (developers and householders).

The same stakeholder groups in the two cases raised some different and similar environmental problems at the global level (Table 7.10a). The problems raised by the planners in the two cases were very few and different (except both raising 'global warming'). The planners in Adelaide raised 'pollution', 'over populated', and 'agricultural land degradation' while this group in Hanoi raised 'ozone depletion' or 'don't know'. The developers in the two cases raised different problems. While the developers in Adelaide raised only three problems of 'natural resources depletion', 'pollution', and 'cultural environment destruction', the developers in Hanoi raised many local environmental problems such as 'air and water pollution', 'solid waste disposal', 'noise', 'and ecosystem degradation'. The architects in the two cases raised only one shared problem of 'resource depletion'. Besides this, while the architects in Adelaide raised big problems such as climate change or ecosystem degradation, this group in Hanoi raised daily issues such as 'air and water pollution'. The householders in both cases raised similar problems and they included most known environmental problems. Nevertheless, the householders in Adelaide raised more environmental problems than the householders in Hanoi.

Table 7.10a Environmental problems at global level

Environmental problems globally	Planners		Developers		Architects		Householders	
	AD	HN	AD	HN	AD	HN	AD	HN
Ozone depletion		■					■	■
Climate change					■			
Global warming	■	■					■	■
Solid waste/ sewage				■		■	■	■
Pollution	■		■			■		
Air pollution				■		■	■	■
Water pollution				■		■	■	■
Ecosystem degradation				■	■		■	■
Toxic chemical contamination					■		■	■
Don't know		■					■	■
Noise				■				■
Wars							■	
Nuclear waste/radiation						■	■	
Resource depletion (fuel/land/water)			■		■	■	■	
Over population	■						■	
Ocean pollution							■	■
Agriculture land degradation	■							
Cultural destruction			■					
Third world					■			

Note: ■ = indicates that the issue was mentioned

National level

Environmental problems raised by the stakeholder groups in the two cases at national level were different and focused on the problems of their own country (Table 7.10b). The stakeholder groups in Adelaide raised many similar problems. Some groups raised the same issues such as 'pollution' (planners and developers), 'resource depletion' (planners, architects, and householders), 'agriculture land degradation' (planners and architects), 'water pollution' and 'toxic chemical contamination in food' (architects and householders). In general, the planners and developers raised similar environmental problems. This also applied to the architects and householders.

In Hanoi, there were also similarities between the planners and developers, and between architects and householders when raising environmental problems at a national level. The issues that raised by more than one group included 'pollution' (by planners, developers, and architects), 'air' and 'water pollution' (planners, architects, and householders), 'ecosystem degradation' (developers and householders), 'resource depletion' (developers and architects).

Table 7.10b Environmental problems at national level

Environmental problems nationally	Planners		Developers		Architects		Householders	
	AD	HN	AD	HN	AD	HN	AD	HN
Ozone depletion							■	
Climate destruction					■			
Global warming							■	
Solid waste, sewage				■		■	■	■
Pollution (poor infrastructure)	■	■	■	■		■		
Air pollution		■				■	■	■
Water pollution		■			■	■	■	■
Salinity					■			
Ecosystem/habitat degradation	■			■			■	■
Toxic chemical contamination					■		■	■
Don't know							■	
Noise				■				
Wars								
Forest clearance/lack of green tree		■		■				
Nuclear waste/ radiation						■	■	
Resource depletion (fossil fuels/land /energy/water)	■		■	■	■	■	■	
Over population	■							
Nothing							■	
Agriculture land degradation	■				■			
Cultural destruction			■					
Urban sprawls	■							

Note: ■ = indicates that the issue was mentioned

Comparing the same stakeholder groups in the two cases, the planners in the two cases raised different problems except only one shared problem of 'pollution'. Again while the planners in Adelaide raised general big issues such as 'resource depletion' and 'over population', the stakeholder group in Hanoi raised daily problems of 'air and water pollution' except the issue of forest clearance/lack of green tree that is common in Vietnam. The developer and architect groups in Adelaide and Hanoi also raised different problems except two shared problems of 'pollution' (or similarly 'water pollution') and 'resource depletion'. Some architects in

Adelaide raised the global environmental problem of 'climate destruction' at a national level while the architects in Hanoi did not. The householder groups in Hanoi and Adelaide raised many similar problems except that while the householders in Hanoi raised global problems of 'Ozone depletion' and 'global warming' at national level while the householders in Adelaide did not.

Generally, the stakeholder groups in Adelaide raised more environmental problems, especially the global problems, than the stakeholder groups in Hanoi. However, some householders in Adelaide said "there is not an environmental problem in Australia" while no one in Hanoi said so.

Local level

There were similarities between planners and developers as well as between architects and householders in raising environmental problems at a local level (see Table 7.10c). Many issues were raised by more than one stakeholder group such 'pollution' (planners and developers), 'water pollution' and 'toxic chemical contamination' (architects and householders), 'resource depletion' (all stakeholder groups), and 'agriculture land degradation' (architects and planners).

The similarities between environmental problems raised by these groups at the local level also generally applied to the Hanoi case. The shared issues that were raised by stakeholder groups in Hanoi included 'solid waste' and 'air pollution' (architects and householders), 'water pollution' (all stakeholder groups), 'noise' and 'nothing' (developers and householders).

The same professional stakeholder groups in the two cases raised different issues at local level. Only the architect groups in the both two cases raised 'water pollution' and 'resource depletion'. Although there were some similarities, the householders in Adelaide raised more environmental problems than the householders in Hanoi. Some stakeholders in the both cases did not see any problems at local level. Again, some global problems were raised at local level by some stakeholders in Adelaide only.

In general, there were similarities in the perception about environmental problems between architects and householders in the two cases. Architects and householders tended to raise more environmental problems than the developers and planners. Comparing global, national, and local levels most professional stakeholder groups in the two cases raised different environmental problems. Like the householders, they generally did not see a link between global, national, and local environmental problems. Only some architects and households in Adelaide raised some global environmental problems at national and local level.

Table 7.10c Environmental problems at local level

Environmental problems locally	Planners		Developers		Architects		Householders	
	AD	HN	AD	HN	AD	HN	AD	HN
High density		■						
Social classification				■				
Ozone depletion							■	
Climate destruction					■			
Global warming							■	
Solid waste/ sewage		■	■			■	■	■
Pollution	■		■					
Air pollution						■	■	■
Water pollution		■		■	■	■	■	■
Salinity					■			
Ecosystem/habitat degradation	■						■	
Toxic chemical contamination					■		■	
Don't know							■	
Nuclear waste							■	
Noise				■				■
Resource depletion (land /energy/water	■		■		■	■	■	
Over population	■							
Nothing				■			■	■
Agriculture land degradation	■				■			
Cultural destruction			■					
Urban sprawls	■							

Note: En = Environmental Ec = Economical S = Social

■ = Indicates that the issue was mentioned

7.11 Barriers to environmental protection

To investigate the possible barriers to environmental protection, Questions 27 and 28 asked the planners and developers " What are the barriers to planners/developers in achieving environmental protection? Technical, financial, legal, or other?" Similarly, Question 30 asked the architects "What are the barriers: technical, financial, legal, or others?" The responses of these stakeholder groups can be compared in Table 7.11.

Table 7.11 Number of respondent identifying barriers to environmental protection

Barriers	Planners		Developers		Architects	
	AD	HN	AD	HN	AD	HN
Technical	■				■	■
Finance	■	■	■	■	■	■
Regulation	■			■		■
Others	■	■ 'People view points'	■ 'Community acceptance'		■ 'Client attitude'	■

All the stakeholder groups in the two cases saw the same 'financial' barrier but also different barriers to environmental protection. Finance seems to be perceived as the essential barrier to achieving environmental protection. The shared expression of barriers was not only finance but also 'community/ client attitude' in Adelaide and 'regulation' in Hanoi. This points out that, possibly, poor 'community acceptance' in Adelaide and 'ineffective environmental regulations' in Hanoi were major barriers in achieving sustainable housing. On the other hand, though Adelaide has a higher technological development, technology is still perceived by housing professionals as an important barrier to achieving environmental protection.

7.12 Disadvantages of different types of houses

Question 32 asked the architects and developers, Question 28 asked the planners and Question 53 asked the householders, "What are the advantages and disadvantages of detached, terrace houses (attached), and apartments?" The disadvantages of each housing type can be seen in the Table 7.12a, b, and c.

Table 7.12a Disadvantages of detached houses

Impacts	Disadvantages	Planners		Developers		Architects		Householders	
		AD	HN	AD	HN	AD	HN	AD	HN
En	Waste of land / water	■	■	■	■		■	■	
En	Waste of material & infrastructure					■	■		
Ec	Expensive/ high investment cost	■			■	■	■	■	
S	Locate in suburb/ not healthy place					■		■	
S	Isolated					■	■		
S	Less security								■
	No thing						■	■	■

Note: En = Environmental Ec = Economical S = Social
■ = Indicates that the issue was mentioned

The perceived disadvantages of detached houses can be seen in Table 7.12a. In Adelaide, the main disadvantages of this house type indicated by most stakeholder groups were 'waste of land' and 'expensive'. The planners and developers saw only this while the architects and householders saw more issues such as 'waste of material', 'suburb location', and 'isolated'. Some householders however said they saw no disadvantages.

In Hanoi, 'waste of land' and 'expensive' were raised by most stakeholder groups. Although some architects saw no disadvantages, the architects in Hanoi raised many more disadvantages than other stakeholders. The householders in Hanoi raised very few issues and some even said they saw no disadvantages.

Except for some local specific problems, the same professional stakeholder groups in Adelaide and Hanoi had similar perceptions about the disadvantages of detached houses. The householders in the two cases however had a totally different perception about disadvantages of detached houses. The householders in Adelaide raised quite a few problems while the householders in Hanoi raised only one problem of 'less security' that was not raised in Adelaide.

Disadvantages of attached houses perceived by stakeholder groups are shown in Table 7.12b. The disadvantages seen by all groups except the planners in Adelaide were 'noise' and 'lack of privacy'. The planners raised only 'impact of local amenity/ appearance' while the architects raised more practical issues such as 'difficult for large family' and 'poor natural lighting'. Although some saw 'nothing' or did not know of any disadvantages, the householders saw more social disadvantages than the professional stakeholders groups.

Table 7.12b Disadvantages of attached houses

Impacts	Disadvantages of attached houses	Planners		Developers		Architects		Householders	
		AD	HN	AD	HN	AD	HN	AD	HN
En	Waste of land		■				■		■
En	Locate next to street/ road								■
En	Poor natural lighting/ ventilation			■			■		
En	Noise			■		■	■	■	■
S + En	Does not fit family with children			■					
S	Less security								■
S	Impact of local amenity/ appearance	■	■		■		■		
S	Lack of privacy			■		■	■	■	■
S	Poor design/ monotone						■	■	■
S	Type of house							■	■
	No thing							■	■
	Don't know							■	■

Note: En = Environmental Ec = Economical S = Social
■ = Indicates that the issue was mentioned

In Hanoi, the disadvantages of attached house (street houses) raised by most stakeholder groups were 'waste of land' and 'impact of local amenity/ appearance'. Beside this, while the planners and developers saw only these issues, the architects and householders raised much more issues (see Table 7.12b). Beside some householders who said they saw 'nothing' or 'do not know', issues raised by the architects and householders were similar.

Comparing the same stakeholder groups in the two cases, there were similarities among the planners and householders but differences among the architects and developers. The architects in Hanoi raised many more issues than the architects in Adelaide while the developers in Adelaide raised many more issues than the developers in Hanoi. As studied in Chapter 6, the householders in the two cases had similar perceptions about the disadvantages of attached houses. All the disadvantages raised by the householders in Adelaide were also raised by the householders in Hanoi but the disadvantages of 'waste of land', 'location', and less security' were seen by the householders in Hanoi only. The waste of land in Hanoi street houses is due partly because they do not share boundary walls as in Adelaide but rather have separate walls and foundations. Perceptions of the stakeholder groups about the disadvantages of attached houses in two cases seem to depend on the context of local housing practices.

It is obvious that many disadvantages of this type of house arise not from housing type, but rather from poor housing design, construction, and from people's perceptions about it. For instance, 'noise' and 'privacy' can be reduced by a good design. Also evidence for the social dependence of appropriate housing type is that, while the stakeholders in Adelaide said "this type of house does not fit families with children", the stakeholders in Hanoi did not see this.

Table 7.12c Disadvantages of apartments

Impacts	**Disadvantages of apartments**	**Planners**		**Developers**		**Architects**		**Householders**	
		AD	**HN**	**AD**	**HN**	**AD**	**HN**	**AD**	**HN**
En	Waste of land						■		
En	Poor infrastructure & high density causes pollution			■			■		■
En	Noise from neighbours					■	■	■	■
En	Poor natural lighting								
En	Lack of ventilation						■		
En	Low quality							■	■
En	Hot							■	
En	Cannot do recycling								
Ec	Cost of construction and services		■		■				
Ec	Cost of maintenance & managements						■		
S	Accessibility	■							
S	Impact of local amenity	■							
S	Lack of privacy		■		■	■	■	■	■
S	Poor private ownership						■		
S	Does not suit to many lifestyles			■					
S	Poor design						■	■	■
S	Type of house								
S	Social impacts					■			
S	Lack convenience for users						■	■	■
S	Lack security							■	
S	Loneliness							■	
En + S	Lack of out door area							■	■
All	Every thing/ all								■
	No thing						■	■	■
	Don't know							■	■

Note: En = Environmental Ec = Economical S = Social

■: Indicates that the issue was mentioned

The perception of the stakeholder groups in Adelaide and Hanoi about apartments is shown in Table 7.12c. In Adelaide, the professional stakeholder groups raised different disadvantages. Only the architects raised the issues suggested by the householders such as 'noise' and 'lack of privacy'. Beside this, while all the professional stakeholder groups raised a few issues, the householders raised a long list of disadvantages (see Table 7.12c). Again, many disadvantages raised are also embedded not in the housing type but in the inadequacies of designers, developers, and planners in designing and planning the housing projects.

In Hanoi, all stakeholders raised the 'lack of privacy' as a disadvantage of apartments. The planners and developers as well as the architects and householders had the same perception about disadvantages of apartments. The planners and developers raised only two disadvantages while the architects and householders raised a range of disadvantages (see Table 7.12c).

Comparing the same stakeholder groups in the two cases, the planner and developer groups in the two cases saw different disadvantages of apartments. Besides seeing the same disadvantages of 'noise' and 'lack of privacy', the architects in Hanoi raised more issues than the architects in Adelaide. Householders in the two cases had similar perceptions about disadvantages of apartments except a few local specific problems such as 'infrastructure' in Hanoi and 'loneliness' in Adelaide.

In short, in the both cases, and for the three types of houses, the planners and developers often raised only a few disadvantages while the architects and householders often raised many disadvantages. The view of the developers and planners was similar in both cases. A similarity also applied to the architects and householders. Comparing the same stakeholder groups in the two cases, beside some similarities, some differences were applied to householder groups about detached houses, and between developer groups about attached houses. With apartments, the differences were applied to both developer and planner groups in the two cases. Many disadvantages of these types of housing were not embedded in the type itself, but in the mistakes from the housing industry or specific local problems.

7.13 Attitude to statements related to sustainable housing

Question 33 (to architects and planners), Question 30 (to developers), and Question 49 (to householders) asked the stakeholders to indicate their agreement level on a five point scale (Scale 5, Appendix D) to a list of statements suggesting solutions to sustainable housing. The mean ranks of agreement level of the stakeholder groups with statements from A to Q are shown in the Table 7.16.

No stakeholder group agreed with statement A and there were differences in the agreement levels between stakeholder groups. However, except that the architects in Adelaide had a higher agreement level than the architects in Hanoi, the same stakeholder groups in the two cases had similar agreement levels to this statement. This result also shows, as extended living arrangements are common in Vietnam and not in Adelaide, although not liking it, many people in Vietnam still have to live this way.

The architects and householders in the both cases disagreed with statement B discouraging a big house with gardens. However, while the planners and developers in Adelaide disagreed with it, the planners and developers in Hanoi completely agreed with it. This suggests most groups disagree with it except for the planners and developers in Hanoi, who were promoting high-density high-rise housing for Hanoi.

Table 7.13 Mean rank of agreement with statements of sustainable housing

Statements	Planners		Developers		Architects		Householders	
	AD	HN	AD	HN	AD	HN	AD	HN
A: Living in an extended family has more advantages than disadvantages.	3	3	2	1	3.6	2.4	3.5	3.5
B: Separate house with garden causes urban sprawls and should be discouraged.	2	5	2	5	3.8	3	2.5	2.8
C: A house should have just enough room for the essential daily needs of a family.	1	4	1	4	2.8	4.1	3	3.9
D: A high standard and well-designed multi-floor apartment is as good as any other type of a house.	4	4	2	4	3	3.6	2.8	3.4
E: Using public transport is good idea to reduce pollution and save resources.	4	3	5	5	4.4	3.9	4.4	4.3
F: Energy efficient appliances would save money.	4	5	5	5	4	3.7	4.4	4.1
G: Renewable energy such as solar energy and wind energy is cheap.	3	4	4	3	2.8	3.6	3.6	3.8
H: It is better to use fans for cooling instead of air-conditioners.	2	3	4	2	3.8	3.6	3.2	4.3
I: It is the responsibility of individuals to protect the environment.	4	5	4	5	4.8	4.6	4.1	4.4
J: The government should make laws to protect the environment.		5	5	5	4.4	4.4	4.2	4.5
K: Water is not a scare resource.	1	1	1	1	1	1.4	2.0	2.1
L: It is good idea to recycle the grey water for toilet flushing.	5	4	5	3	4.2	4.1	3.9	4.1
M: If we consume too many resources today, there might be nothing left for our grand children.	2	5	5	5	4.6	4.6	4.1	4.3
N: All household waste should be recycled.	1	3	4	5	4.6	4.3	4.3	4.2
O: It is the practical idea to recycle household waste water for other uses.	1	4	5	2	3.8	4.4	4.1	4.1
P: Environment pollution directly affects your health.	2	5	5	5	4.4	4.6	4.3	4.5
Q: You should pay more for resources (land, petrol and water) the more you use them.	3	3	5	5	4.4	3.7	3.7	4.0

Note: The ranks given follow Scale 5 (Appendix D)

All the stakeholder groups in Adelaide disagreed with statement C discouraging big houses with more rooms than necessary for daily needs, while all the stakeholder groups in Hanoi agreed with it. This reflects the fact of common big houses with many rooms in Adelaide while this is not the case of Hanoi.

All the stakeholder groups in the both cases, except for the planners in the both cases and for the developers in Hanoi, did not agree with statement D saying well designed apartments are as good as other type of houses. So there were more stakeholders who agreed with this statement in Hanoi than in Adelaide. The acceptance of apartments of the stakeholders in Hanoi seems to be higher than in Adelaide.

All stakeholder groups in the both cases agreed with statement E about using public transports except for the planners in Hanoi. The planners in Hanoi could not decide whether to agree or not. Using public transports was generally supported in both cases. The agreement with this statement in Adelaide was generally higher than in Hanoi.

All stakeholder groups in both cases agreed and strongly agreed with statement F that energy efficient appliances would save money while only the architects in Hanoi were not sure about their agreement. The stakeholders in Adelaide generally had a higher agreement level than the stakeholders in Hanoi with this statement.

All the stakeholder groups in Adelaide and Hanoi disagreed with statement G, "Renewable energy such as solar energy and wind energy is cheap", while the planners and householders in Hanoi and the developers in Adelaide potentially agreed with it. The number of stakeholder groups who agreed with this statement in Hanoi was slightly higher than in Adelaide. Though having lower incomes, and renewable energy that often requires high investment and maintenance costs, the stakeholder groups in Hanoi seemed to see more benefit from renewable energy than the stakeholder groups in Adelaide. This suggests the willingness to pay in Hanoi may be a little higher than in Adelaide.

All the stakeholder groups disagreed with statement H, "It is better to use fans for cooling instead of air-conditioners" except the developers and architects in Adelaide and the householders in Hanoi who agreed with it. Some professional stakeholders in Adelaide seem to see more advantages of using fans than using air-conditioners. However, as the householders in Adelaide did not agreed with this statement, this seems to relate to the current high use of air-conditioners, and the agreement among the householders in Hanoi relates to the low use of air-conditioners and high use of fans in Hanoi.

All stakeholder groups in the both cases agreed with statement I, "It is the responsibility of individuals to protect the environment" as they realised their individual responsibility to protect the environment. However, the agreement level of the planners and developers in Hanoi was slightly higher than of these groups in Adelaide.

All stakeholder groups in the both cases agreed with statement J as they realised the importance of government's law to protect the environment. The level of agreement between all stakeholder groups in the two cases was similar with a slightly higher agreement level among planners and developers than the architects and householders.

All stakeholder groups in the two cases had a strong opinion and completely disagreed with statement K, "Water is not a scare resource". They all saw water as a scare resource.

All stakeholder groups in the two cases disagreed with statement L, "It is good idea to recycle the grey water for toilet flushing" except for the developers in Hanoi, who were neutral. Most stakeholders saw recycling water for toilet flushing as a good idea while the developers in Hanoi doubted it.

All stakeholder groups in the two cases disagreed with statement M, "If we consume too many resources today, there might be nothing left for our grand children" except the planners in Adelaide. Most stakeholders in both cases saw the limitation of resources on earth. However, the planners in Adelaide did not believe this.

All stakeholder groups in the two cases disagreed with statement N "All household waste should be recycled" except the planners in Adelaide and Hanoi. While the planners in Hanoi could not decide to agree or disagree, the planners in Adelaide completely disagreed with the idea of recycling all household waste.

All stakeholder groups in Adelaide agreed with statement O, "It is the practical idea to recycle household waste water for other uses" except the planners who strongly disagreed. Differently, all stakeholder groups except the developers in Hanoi agreed with this statement. Most stakeholder groups in both cases except the planners in Adelaide and the developers in Hanoi saw the practicality of recycling waste-water for other uses.

All stakeholder groups in the two cases agreed with statement P, "Environment pollution directly affects your health" except the planners in Adelaide who disagreed with it. Most stakeholder groups, especially the developers in both cases and the planners in Hanoi saw the relationship between health of the environment and of humankind while the planners in Adelaide did not.

All stakeholder groups in the two cases agreed or potentially agreed with statement Q, "Environment pollution directly affects your health", except the planners in the two cases, who could not decide to agree or not. Generally, most stakeholder groups in the two cases were willing to pay for the environmental cost created by their resource consumption.

In conclusion, the stakeholder groups in the two cases had similar perceptions to most statements indicated. The significant differences were only on statements B, G, and H related to separate houses with gardens causing urban sprawl, renewable energy is cheap, and using fans is better than using air-conditioners. Another point is that, though having similar agreement levels to a number of statements, the real practice can be very different. This is because practice does not alway reflect what people prefer, but depends on the socio-economic and environmental conditions of a context.

7.14 Comments on housing development

Question 34 (to architects and planners), Question 31 (to developers), and Question 54 asked the stakeholders to give comments on housing development. The results are shown in Table 7.14. The stakeholder groups gave different comments about current housing development. Each stakeholder group mainly showed their concerns for their own field.

Table 7.14 Comments on housing developments

Issues	Comments	Planners		Developers		Architects		Householders	
		AD	HN	AD	HN	AD	HN	AD	HN
En	Need building codes				■				
En	Need intensive for energy efficient houses					■			
En	Reduce water and waste collection price								■
En	Respect to nature				■				
En	Need good solutions/design				■				■
En	Improve infrastructure								■
En	Building apartments inner city						■		■
En	Need waste treatment						■		
En	Improve the environment								
En	Provides more green area				■				
En + S	Reduce economic competition				■				
S + En	Improve housing quality								■
Ec	High cost of sustainability is a barrier			■					
Ec	Energy is cheap			■					
Ec	Poor economic limits sustainability						■		
S	Low involvement of architects in design					■			
S	Lack of advice/ legal from governments		■		■	■			■
S	Building detached houses in suburb						■		
S	Need harmonised housing area						■		
S	People want to get more space	■							
S	The stakeholders aims to different goals	■							
S	Lack of belief in environmental problems	■							
All	Financial, social & environmental cost must be counted					■			
All	Evaluate projects				■				

Note: En = Environmental Ec = Economical S = Social
■ = Indicates that the issue was mentioned

The planners in Adelaide talked about land, the gaps between the perception of the stakeholder groups, and their doubtfulness of human beliefs about the seriousness of environmental problems. The developers focused their comments on the cost issues. The architects in Adelaide complained about the poor involvement of architects in housing design and the weak control of the government's environmental regulations. The householders in Adelaide raised a range of issues from the type of houses to infrastructure and planning, from cost of energy and land to design and services.

In Hanoi, the planners gave comments on the government policy in urban development, finance investment, and regulations. The developers suggested changing design and construction codes to be responsible to the environment, such as having more green areas in housing, respecting the environment, and reducing economic competition that harms human ethics. The architects in Hanoi seem to have a wide perspective. Besides suggesting designing housing in harmony with its neighbours, the architects in Hanoi also considered building waste treatment factories and the barrier of current economic conditions to sustainability. Some of them had opposite comments. For example, while some architects suggested stopping terrace houses (street houses) but developing inner city apartments, others suggested low-density one-floor detached housing in suburbs. The householders in Hanoi had a variety of comments on different topics.

The same stakeholder groups in the two cases raised different comments. While the planners in Adelaide gave comments on barriers of high consumption lifestyles, different goals of the stakeholder groups and the doubtfulness of environmental problems, the planners in Hanoi suggested solutions to manage sustainable housing with government laws or regulation and investment. In Adelaide where regulations exist, the planners found barriers in current lifestyle, the perception of stakeholder groups in housing practices, and human belief as barriers. The major issues seen by the planners in Hanoi were regulation and finance sources.

The developers in the two cases were concerned with different issues. The developers in Adelaide were concerned with cost issues. They found the low price of conventional energy and high cost of energy-efficient appliances as barriers to approaching sustainable housing. The developers in Hanoi suggested the need to develop design and construction codes, bringing more green areas into housing, respecting nature and reduce economic competition. The architects in Adelaide and Hanoi also gave different comments. The architects in Adelaide found less involvement of architects in housing practices, and a lack of consideration with finance, society, and the environment in the current projects, as well as poor involvement of the government in approaching sustainable housing. The architects in Hanoi saw poor economic conditions limiting sustainable housing. They also suggested apartments in the city, more harmonious housing areas, and waste treatment. Some architects wanted to apply the detached house type of Australia to Hanoi. Besides all these differences, the householders in both cases had very similar comments. Most of the comments raised by the householders in Hanoi were also raised in Adelaide. The only comment that was raised in Hanoi but not Adelaide was 'improve the environment' and the one that was raised in Adelaide but not in Hanoi was 'service in the area'. This relates to poor environmental quality in Hanoi and likely inconvenient services in the housing suburbs in Adelaide.

The stakeholder groups in both cases gave different comments on current housing developments. They all contributed many ideas to improve current housing practices. Another point is that one stakeholder may not be sufficient to improve housing quality but all could.

7.15 Systems application (among architects)

Questions 23, 24, 25 asked the architects in the two cases to indicate their knowledge, application, and willingness to use technological systems in their preferred housing projects. The results are shown in Table 7.15. While all architects in Adelaide knew all these systems, many architects in Hanoi did not know some of these systems. While all architects in Hanoi knew of tap water, bore water, and mixed waste collection, only some knew of rain water tanks, solar hot water heater, photovoltaic, waste separated collection, bore water, waste recycling, waste reuse, and only a few knew of grey water recycling, black water recycling, and household composting. Accessibility to information of technological systems seems to be weak in Hanoi.

Table 7.15 Technologies applied in these housing projects

Technologies	Yes / no	Number of architects							
		Know		Using		Satisfied		Want to use	
		AD	HN	AD	HN	AD	HN	AD	HN
Grey water recycling	No	0	6	3	1				1
	Yes	5	1	2	0	2		3	2
Black water recycling	No	0	6	4	1				1
	Yes	5	1	1	0	1		4	3
Bored water	No	0	2	5	2				3
	Yes	5	5	0	3	1		4	1
Tap water	No	0	0	2	0		3	1	
	Yes	5	7	3	7			4	
Rain water tank	No	0	0	2	7				2
	Yes	5	7	3	0	3		2	2
Solar hot water heater	No	0	2	3	5				1
	Yes	5	5	2	2	2		3	5
Photovoltaic	No	0	3	5	6				1
	Yes	5	4	0	1			5	5
Waste mix collection	No	0	0	4	0				4
	Yes	5	7	1	7			0	2
Waste separated collection	No	0	4	3	7				4
	Yes	5	3	2	0			3	2
Household composting	No	0	5	2	7				4
	Yes	5	2	3	0			2	2
Waste recycling	No	0	3	2	3				4
	Yes	5	4	3	4			2	2
Waste reuse	No	0	3	2	3				4
	Yes	5	4	3	4			2	2

Source: Interview architects

Due to the lack of knowledge and technical supports, the architects in Hanoi used very few systems in their preferred projects. Among the preferred projects, no one had grey or black water recycling, rain water tanks, photovoltaic, waste separated collection, or household composting. Three projects had bore water but the quality is not guaranteed, two had solar hot water heaters, and four had waste recycling and reuse.

However, though knowing of these technical systems, many architects in Adelaide did not apply these systems into their preferred housing projects (not in the study cases). Among the preferred projects in Adelaide, only two had grey water recycling, one had black water recycling, three had rain water tanks, two had solar hot water heaters, no one had photovoltaic, two had separate waste collection, three had household composting, and three had waste recycling and reuse. The architects in Adelaide used more new systems such as water recycling than the architects in Hanoi did but the architects in Hanoi used more traditional systems than the architects in Adelaide did. Although having low access to new technologies, the number of projects using solar hot water, recycling and reuse of waste in Hanoi was not significantly different from Adelaide. On the other hand, as one architect in Hanoi said, "it is a waste of time to think about these systems" the significance of application of green systems seems not to have been explored properly in Hanoi.

Information accessibility and education are also needed for other stakeholder groups such as planners and developers in both cases. A similar survey has been done with some developers and planners in the two cases and the result shows that only a few knew of these systems. While one planner in Hanoi knew of these technologies the planners in Adelaide did not know these. While one developer in Adelaide knew these technologies, no developer in Hanoi knew of them.

Besides education, technical service provision, and economic instruments are needed in making the application of these green systems happen. The number of architects who wanted to apply these systems in housing design was high in both cases and the architects seem to be concerned with the environment. The barriers raised in Hanoi were services or technology availability while in Adelaide the barrier was seen as the high cost of these green systems.

In general, the architects in Adelaide had a better knowledge about these systems than in Hanoi, but the application and willingness to use them were not much different. This suggests accessibility to information is crucially important but may not be enough. There is a need for education for the architects to include more environmentally responsible technologies into their design. Beside this, making technologies economically beneficial is also important to reduce barriers in applying sustainable technologies.

Summary

The stakeholder groups in each case (Adelaide or Hanoi) and the same stakeholder groups in the two cases had different perceptions about a good house/housing development. Many issues concerned were related to local conditions or to the profession of the stakeholder groups. The architects and householders in the two cases had considered several similar factors when designing a house or a housing development. The architects and householders in each case also had quite a few common concerns. However, there was very little agreement between the planners and developers and between these two stakeholder groups in each case. The architects and householders in the two cases considered many factors while the planners and developers were concerned with only a few issues.

The stakeholder groups in each case had similar perceptions about sustainable housing. In contrast, similarity between the same stakeholder groups in the two cases was very rare. The stakeholders often referred to their own local context. Generally, the householders in the two cases raised more requirements for sustainable housing than professional stakeholder groups. This suggests the professional stakeholder groups have not necessarily understood the needs of householders. On the other hand, the householders had very little concern for environmental issues. Moreover, the stakeholder groups in each case indicated different perceived actions to achieve sustainable housing. Comparing the two cases, the same professional stakeholder groups also proposed different actions. However, besides raising some specific local issues, the householders in the two cases indicated similar actions.

There were similarities but also differences between the stakeholder groups and between the two cases about important aspects in housing. For example, 'housing plan' was seen as important by most stakeholders (developers, architects, and householders) while 'cost' was only seen as important in Adelaide, not in Hanoi. Generally, most stakeholders in the two cases saw three dimensions of sustainability including 'environmental protection', 'economic growth', and 'increased human welfare' as important and at similar levels. Beside this, the planners in Adelaide saw 'increased human welfare' and developers in Hanoi saw 'environmental protection' and 'economic growth' as slightly less important.

The stakeholder groups in Hanoi were dissatisfied with more issues in the preferred housing project than in Adelaide, and no stakeholder group was satisfied with all issues. This suggests the preferred projects could all be done better. Based on the satisfaction level of the architects and householders with indoor environment conditions, it is possible to suggest that new housing in Adelaide needs to improve design to provide a cooler indoor temperature in summer while in Hanoi, housing needs to be improved to provide a warmer indoor temperature in winter. Although the housing projects were very different in plan, type, and building materials, the satisfaction of the stakeholder groups with the thermal performance was not significantly different between the two cases. This suggests good thermal performance housing in one region may not need to have the same design and building techniques as another region. Different solutions to improve natural lighting, ventilation, and energy efficiency were proposed by stakeholder groups. The architects in both cases seem to have better knowledge about solutions to natural lighting, ventilation, and energy efficiency than the other stakeholder groups.

Except for some similarities between a few stakeholder groups, the stakeholder groups knew different environmental problems. The architects and householders knew about more environmental problems than the developers and planners. Like the householders, in general, the professional stakeholder groups also did not see global and national issues at a local level. The stakeholders also saw different barriers to protect the environment beside the common barrier of financial limit.

The stakeholder groups raised different disadvantages for different types of houses. Comparing the two cases, beside some similarities between the perception of stakeholders and between the two cases, there were differences between householder groups about detached houses and between developer groups about attached houses. With apartments, the differences applied to both developer groups and planner groups in the two cases. Many disadvantages of these types of house are not embedded in the type itself, but inappropriate offerings from the housing industry or from the specific local context.

In general, the architects in Adelaide had a better knowledge about green systems than in Hanoi, but the application and willingness to use them were not much different between the two cases. This suggests accessibility to information is needed and education for the architects to include more environmentally responsible technologies into their design is important. Beside this, making systems economically beneficial is also necessary.

Although the stakeholder groups had similar agreement levels with statements about sustainable housing, the housing practices and lifestyles are different in the two contexts. The stakeholders proposed different ideas related to their local context on housing developments.

Discussion

In investigating the nature and the context dependence of sustainable housing, understanding the attitudes and practices of the professional stakeholders is important. This chapter compares the professional groups then compares them with the householders to define gaps between them. Bridging these gaps can help to achieve sustainable housing.

As data in this chapter show, the lack of consensus among stakeholder groups in each case about sustainable housing aspects suggests a need for co-operation between the stakeholder groups. This does not only ensure embodying of the multi-dimensions in sustainable housing projects, but also contributes to raising awareness and education for the whole community in understanding and then acting for sustainable housing. The professional stakeholder groups have to necessarily understand the need of users (householders) while the householders have to learn more about environmental issues. This will help increase the willingness to change people's lifestyles into more sustainable lifestyles. The lack of knowledge about environmental problems at different levels of most stakeholders suggests information and education for environmental issues need to be improved.

As many disadvantages of different types of housing inherent the inappropriate quality of professional work and in the perception about social and cultural issues, improving the quality of housing and ensuring the suitability of the houses for users are important.

The application of green systems in housing, information, education, and services needs to be promoted in Hanoi while education and economic instruments are important issues in Adelaide.

The practice of housing development does not always reflect what people prefer because it depends on socio-economic and environmental conditions of a specific context. Sustainable housing therefore has to consider multi dimensions, not only people's preferences but also the socio-economic conditions of a context. The different perceptions about sustainable housing and actions perceived in achieving it in the two cases suggest sustainable housing and its solutions can be defined and achieved contextually.

At this stage this work has answered the research question 2. In order to answer the research question 3, this thesis will build a comprehensive multi-dimensional framework based on the basic framework built at the end of Chapter 2, with adding elements gathered from Chapters 3, 4, 5, 6 and 7. This framework can be used any where for evaluating housing and developing guidelines for sustainable housing. Later, this thesis will apply this developed framework to propose guidelines for housing in Hanoi as a demonstration of how to use this framework. The season to choose Hanoi and not Adelaide is because the author is from Hanoi, where she has lived and therefore known about it very well.

Chapter 8: Framework of sustainable housing and guidelines for sustainable housing in Hanoi

This chapter consists of two parts. The first part (8.1) introduces a multiple dimensional framework to evaluate sustainable housing projects drawn from this study. The second part (8.2) proposes guidelines for sustainable housing in Hanoi based on this framework.

8.1 Framework of sustainable housing

8.1.1 Introduction

The framework of sustainable housing presents a comprehensive picture including all ends and instruments of sustainable housing. It therefore can be used to evaluate the sustainability of a housing project by checking whether or not the project has employed all the instruments and achieved all the ends of sustainable housing. The framework tries to embody as much as possible all the dimensions, ends, and instruments of sustainable housing. It gathers all ends and instruments of sustainable housing in the literature reviewed in this study and fieldwork conducted in the two case studies in Adelaide and Hanoi. As completion is impossible, it is no doubt that this framework may miss some ends or instruments of sustainable housing. However, as discussed in Chapter 1, as this framework will be built in flexible ways, it still can be used to evaluate sustainability of a housing project in any city. The framework users can flexibly determine only the elements that are relevant to the local context and add elements that may be addressed in the context but are not included in this framework.

A final framework of sustainable housing in this study has been developed from the basic framework introduced at the end of Chapter 2, and adding elements extracted from Chapters 3, 4, 6, and 7. The basic framework can be seen in Table 2.3, which has extracted all available ends and instruments of sustainable housing in the literature reviewed. The additional elements for the framework drawn from Chapters 3 and 4 are extracted from 'opportunities' for sustainable housing in Adelaide and Hanoi (see Table 3.2 and Table 4.2). These elements are mainly instruments of sustainable housing. All issues related to requirements about sustainable housing raised by the householders and professionals in Chapter 6 and 7 are gathered and put into the framework as the ends of sustainable housing.

It is also important to note that, as discussed in the Chapter 2 when introducing Table 2.3, although the framework classifies elements as ends or instruments, the border between them is very opaque. Many elements in this framework are instruments/means but also ends for more than one dimension of sustainable housing. In addition, in some cases, one instrument can be used to achieve more than one end. For example, 'design flexible plan house' does not only contribute to the suitability of the house to users but also enhances the affordability of the house to the user's financial situation. Actions to conserve resources can benefit not only environmental dimensions but also the economic dimensions. This leads to the repetition of some instruments in different parts of the framework.

Similar to Table 2.3, the final framework is structured with three main columns and three main rows. The three main columns include the three main dimensions of sustainable housing while the three main rows include essential instruments to obtain sustainable housing. The three dimensions of sustainable housing include the environment, society, and the economy. Table 2.3 includes all ends of each dimension in one column. To make it clearer, the final framework divides each dimension into smaller columns containing main ends. For example, the column of environmental dimension is divided into three columns containing the main ends of reducing pollution, conserving resources, and protecting ecosystems. The column of social dimension is divided into three columns containing the main ends of individual well-being, collective well-being, and cultural conservation. The column of economic dimensions is divided into two columns containing the main ends of economic growth (in a long term) and affordability.

Similar to Table 2.3, the final framework also embodies three essential instruments of sustainable housing including the technological, social, and economic instruments. In order to make it clearer, the final framework divides each instrument into smaller rows, containing components or levels of an implementing process. For example, the technological instruments row is divided into four rows containing the components of a housing development including planning, design, materials, and systems and appliances. The social instruments of sustainable housing include instruments applied in different levels from individual, city, to national/global. The economic instruments of sustainable housing include economic growth, monetary, fiscal, and institutional. The structure of the final framework of sustainable housing can be seen in Table 8.1.

8.1.2. Guide for framework users - How to use the framework

The framework is used to evaluate the sustainability of a housing project and to build guidelines for achieving sustainable housing in a city. The users could be stakeholders including local community, architects, developers, city planners and other policy makers (local governors). As the framework is flexible, the users can determine relevant instruments and ends in the framework that address local issues. In order to determine relevant instruments and ends, the users should conduct a survey among local stakeholders examining the importance and achievement level of the instruments and ends in the framework. The local stakeholders should include residents, housing professionals, and governors. The form and content of the survey can be similar to the questionnaires of this study (see Appendix D).

The sustainability of a project can be judged depending on the quantity and quality of the applied instruments and achieved ends. To evaluate a housing project, the users could compare the applied instruments and achieved ends of the project with all the instruments and ends indicated in the framework to see what instruments and ends the project has missed. Based on the assessment of the stakeholders on the achievement level of the instruments and ends of the framework, the users can evaluate the success and failure of the project. This can create bases for building guidelines for other housing development in the area in future.

Guidelines for sustainable housing of an area can be proposed by applying all the relevant instruments indicated in this framework wherever applicable. Based on the assessment result from a field survey of a housing project, the guidelines suggest future housing projects apply all the instruments and ends including ones the project has missed to improve the low quality ends of the project. Reviewing and fixing the application of instruments are needed because, as discussed in Chapter 1, fixing instruments can ensure better sustainable outcomes than fixing the ends. Guidelines for sustainable housing can be proposed based on a trade-off between cost and benefit of instruments to enhance success and minimize failure. As environmental dimension is most important, the basis for the trade-off is the suitability of the guidelines to the local context following the priority order of environmental, social, and economic aspects. The instruments and ends in this framework are evaluated by local people based on the environmental and socio-economic situation of a local context. Guidelines for sustainable housing in one area are therefore often inapplicable to other areas. The following part will develop guidelines for the future development of sustainable housing in Hanoi as an illustration of one way to use the framework.

Table 8.1 Structure of the framework of sustainable housing

	Main means/ Instruments	**Environmental dimensions**			**Social dimensions**			**Economic dimensions**	
Main ends		Reduce pollution	Conserve resources	Protect ecosystems	Individual well-being	Collective well-being	Cultural conservation	Long term economic development	Affordability
Technological instruments	Planning								
	Design								
	Materials								
	Systems and appliances								
Social instruments	Individual								
	City/Town								
	Nation & global								
Economic instruments	Growth								
	Fiscal								
	Monetary								
	Institutional								

Instruments categorised on left to respond to ends categorised above

Table 8.2 Framework of sustainable housing for Hanoi and Adelaide

		Environmental dimension			**Social dimension**			**Economic dimension**	
		Reduce Pollution	Conserve Resources	Protect Ecosystems	Individual well-being	Collective well-being	Culture conservation	Economic growth	Affordability
Technological instruments	**Planning**	Provide infrastructure, clean water, and electricity Provide green space Plant tree Provide public transport Design small building blocks Orient lots to enable microclimate management (solar access) Divide lots having reasonable size and shape	Locate close to city centre Design for high density Minimise footprint Minimise resources consumption Minimise inputs Provide public transport Use brown fields Locate in existing residential area (urban in-filled) Orient lots to enable microclimate management (solar access) Divide lots having reasonable size and shape	Respect for site Limit size of project Minimise impacts on biodiversity Create landscape rich in biodiversity Use brown fields Encourage urban agriculture Leave movement corridor for wildlife Minimise footprint Minimise disturbance to surrounding vegetation	Provide good planning Design attractive, interesting, peaceful & pleasant place Provide a range and mix of lot sizes to suit a variety of dwelling and household types Create lively streets with mass of activities Design diversity landscape Ensure safety Create integration Provide recreation, playgrounds, green spaces Provide enough house Chose good location Ensure healthy environment Ensure easy mobility Design walkable & permeable streets Provide site facilities, parking Ensure access to jobs and services Provide infrastructure, clean water, energy, and waste collecting services	Promote community involvement Enhance community relationships Provide mass of activities Create a rich mix of use Emphasise public space Create lively neighbourhood	Maintain existing scale and typologies of site and buildings Respect existing context Protect traditional rural areas Express culture features in neighbourhood Maintain cultural heritages Protect spiritual and cultural values Create landmarks, vistas, and focal points	Ensure net benefit in housing projects Create access to jobs. Create new jobs & businesses Maintain existing jobs & business Create residential property values Conserve resources (see column Conserve Resources in the left)	Ensure affordable housing Enhance urban economy Encourage urban/sub-urban agriculture Mix living and business at home Create mix of spaces for living, trade, & social activities

		Reduce Pollution	Conserve Resources	Protect Ecosystems	Individual well-being	Collective well-being	Culture conservation	Economic growth	Affordability
Technological instruments	Design	Integrate with nature (natural ventilation & lighting) Design compact & dense houses Design small blocks Require less maintenance Integrate functions	Response to climate: (shading, lighting, ventilation, window orientation, courtyards, set back position, thermal mass, roofs, light wall, insulation) Apply Eco-design (see Rathenau et al., 1997) Apply bio-climatic design (see Auty & Brown, 1975) Apply autonomous house design (see Vale & Vale, 1997) Build good quality & durable housing Design compact & small houses Recycle/reuse buildings Optimise functions Integrate functions Design flexible house plan and finishing Minimise inputs Minimise waste Require less maintenance Design dwelling interior for saving energy	Ensure harmony with nature Design compact houses Recycle water and waste Reuse old buildings	Ensure self expression of status Respect belief (Feng Shui) Respect freedom in design Promote creativeness Ensure home ownership Ensure privacy Ensure safety (house, road) Ensure integration between/of local people Ensure equity Provide independence Ensure easy contact and mobility Ensure convenient plan Ensure easy to clean & maintain Provide spiritual values Select suitable housing type Design healthy & good quality houses Provide thermal (indoor)/ visual/ aural comfort Build houses harmony with nature Have small gardens Have appliances Design flexible housing Design interior for thermal and visual comfort Design noise protection Design fire protection Design reasonable room and house	Select suitable housing type Harmony neighbourhood Good neighbour relationship Provide spiritual values	Ensure an evolvement from traditional housing Apply some traditional techniques in design of a house Ensure diversity Apply new technologies Ensure social development Maintain cultural heritage, mores and wisdom Use local skills and labours for construction and maintenance	Ensure business opportunity Ensure benefit from shop/gardens Build housing attracted to market Conserve resources (see the column on left)	Provide some low-cost housing Design variety of housing standards and prices Design flexible house plan and finishing Build low cost housing

		Reduce Pollution	Conserve Resources	Protect Ecosystems	Individual well-being	Collective well-being	Culture conservation	Economic growth	Affordability
Technological instruments	**Materials**	Minimise toxic, pollution, and greenhouse gas emission in extraction, manufacture, transportation and use Avoid polluting surface water run off	Use durable materials Use local available resources Use recycled and recyclable materials Use less non-renewable resources Use renewable resources Use low embodied energy materials (in mining, manufacture, & transportation) Use high thermal mass materials	Use timber from certified sustainable managed forests Minimise toxic, pollution, and greenhouse gas emission in extraction, manufacture, transport, and use	Use materials having less toxic, pollution, & greenhouse gas emission in extraction, manufacture, transport, and use. Use socially acceptable materials Use materials needing less maintenance	Minimise toxic, pollution, and greenhouse gas emission in extraction, manufacture, transport, and use	Use socially acceptable materials Use local materials	Conserve resources (See column on left)	Produce material locally Use local materials Use economic & affordable materials

		Reduce Pollution	Conserve Resources	Protect Ecosystems	Individual well-being	Collective well-being	Culture conservation	Economic growth	Affordability
	Systems and appliances	Use clean energy Treat water & waste properly	Use renewable technologies (solar, wind, hydro) Use efficient appliances Recycle & reuse wastes Compose household waste Collect rainwater for daily use Use water sensitive systems (waterless toilets) Recycle storm water on site and domestic waste water	Recycle storm water in the landscape and domestic waste water Recycle & reuse wastes	Apply environment technologies Provide technical support	Apply environment technologies	Apply environment technologies	Create beneficial businesses in producing, selling, installing and maintaining new systems & appliances Conserve resources (see the column on the left)	Ensure affordable costs for purchasing and running the systems

		Reduce Pollution	Conserve Resources	Protect Ecosystems	Individual well-being	Collective well-being	Culture conservation	Economic growth	Affordability
Social instruments	**Individual**	Clean the living environment Be concerned with the environment Access to environmental information & education Support & participate in environment actions Use clean energies	Control birth rate Reduce consumption Save end-use energy Use public transport & pedestrians Reduce motorcycle & car Use renewable energies Recycle water and waste Share house, car, & appliances/ live in extended family Mix use of spaces for living, trade, & social activities Operate water utilities carefully and efficiently Use energy efficient appliances	Plant tree Reduce consumption Use local products Protect animals and plantations	Comply with family planning Live in extended family Create a beautiful spirit/ visual house Ensure gender, age equity Participate in design & construction of the house Take sustainable actions Select suitable house type Change to more sustainable lifestyles	Self help Take sustainable actions Promote neighbour / community relationships	Build tight relationships with relatives and community	Open shop or business at home Invest on housing Have a productive life Conserve resources (see column on left)	Open shop or business at home

		Reduce Pollution	Conserve Resources	Protect Ecosystems	Individual well-being	Collective well-being	Culture conservation	Economic growth	Affordability
Social Instruments	City	Provide environmental information Provide education to protect the environment Propagandise & introduce policies to protect the environment Organise and provide facilities to implement environment actions (recycle waste, etc.)	Provide environmental information Provide education to conserve resources Propagandise & introduce policies to conserve resources Promote waste and water recycling technologies Promote renewable energies Promote efficient appliances Control population growth Provide enough public transport	Provide information & education to protect ecosystem Introduce policy to protect the ecosystem.	Provide environmental information Provide education about sustainable housing Promote sustainable lifestyles (promote dematerialised lifestyle, etc.) Provide legibility Ensure home ownership Provide access to house & land Develop new housing Provide just & equity in housing Ensure equal resource distribution Build low cost housing for the poor		Create cultural mix, not loss Highlight spiritual and cultural values Build new housing to save traditional villages	Encourage small business Conserve resources (see column on left) Create beneficial business on environmental services (technical support, etc) & housing development. Build variable standards in houses with different prices (including low cost) Build houses attractive to market	Build affordable housing Provide financial supports
	National/global	Implement national and international agreements or protocols in environmental protection Rich nations take moral lead Aid for the poor Richer help poorer			Implement national and international agreements or protocols in environmental protection Rich nations take moral lead Ensure equal resource distribution Aid for the poor Richer helps poorer			Rich nations take moral lead Aid for the poor Richer help poorer Increase price of raw materials	

		Reduce Pollution	Conserve Resources	Protect Ecosystems	Individual well-being	Collective well-being	Culture conservation	Economic growth	Affordability
Economic instruments	Economic growth	Introduce environmental goods, products (clean energy appliances, etc.) Create beneficial environmental business (maintenance, services, etc.)	Introduce (sell) environmental goods, products (energy efficient appliances)	Create beneficial environmental business	Ensure equal distribution of wealth (housing and environmental services) Ensure equity in access to resources and housing Create beneficial housing development Create jobs in housing development & environmental services			Create beneficial business on environmental services & housing, development (renewable energies, etc.) Increase GDP	Increase income
	Fiscal	Apply pollution tax Include costs of environment, social, health impacts from transportation, mining, using & production into products' price Subsidise/ tax reduced for environment protection activities	Tax on high consumption of energy, water, and resources Higher prices for higher use of resources (differential price) Include the costs of resources depletion from production, transport, and mining into products' price Subsidise/ tax reduced for renewable technologies	Include the costs of ecosystem degradation into products' price Subsidise/ tax reduction for eco products	Tax on high income Tax on high resource consumption Subsidise low income earners Ensure equal finance distribution Include the costs of social/health negative impacts into products' price			Resource conservation (see on left) Tax reduction for green products	Subsidise first home buyer
	Monetary	Control interest rate to encourage sustainable housing projects			Control interest rate to ensure access to housing			Control interest rate to ensure benefit for housing development	Control interest rate to ensure affordable housing
	Institu-tional	Provide loan facilities for sustainable housing projects Create & enable local monetary system							

8.2 Guidelines for sustainable housing in Hanoi

Guidelines for sustainable housing in Hanoi can be proposed by promoting opportunities and diminishing barriers of the instruments indicated in the framework, base on a trade-off between cost and benefit to enhance successes and minimize failures. The basis for the analysis will be the suitability of the guidelines to the environmental, social, and economic situation of Hanoi. Sustainable housing in Hanoi has to take into account all relevant elements of this framework wherever is applicable. It is obvious that some instruments are not applicable to the Hanoi context at present. For instance, urban in-fill is not suitable to the high density of Hanoi.

Guidelines for sustainable housing in Hanoi are proposed based on the results drawn from the case study of Linh Dam Lakes housing project. The case study examined the application of instruments and the achieved ends of the project. As the elements of this framework are evaluated by people in Hanoi, guidelines for sustainable housing in Hanoi are only applicable for Hanoi. For instance, privacy in Hanoi was valued differently from Adelaide, so solutions to provide privacy in Hanoi are likely to be different from Adelaide. The applicability and achievement levels of the elements in this framework are assessed by the stakeholders in the fieldwork reported in Chapter 6. Some elements were not clearly defined in the fieldwork but can be estimated based on housing practices in Hanoi. For instance, although Hanoi's ecological footprint is not calculated in this research, the local based resource supplies in Hanoi show the potentially small ecological footprint. The following part will be structured by instruments of sustainable housing responding to three main dimensions of sustainability including environmental, social, and economic.

8.2.1 Environmental dimensions

This part proposes guidelines for housing projects by employing relevant instruments in the framework to promote environmental quality in Hanoi.

8.2.1.1 Technological instruments

The instruments applied in planning, design, materials, systems, and appliances of the housing project will be proposed. The instruments employed aim to contribute to obtaining three *ends* including reducing pollution, conserving resources, and protecting ecosystems.

Planning

Reduce pollution

Providing good infrastructure could help reducing pollution and improving human comfort and health. Improving the road system can reduce dust, noise, and accidents that are common in most streets. A proper treatment of waste and sewage before release into rivers in the city is needed in Hanoi. As many people are worried about the quality of local tap water, and controlling the quality of water supply is needed.

Providing enough green space and planting trees can reduce pollution and improve the quality of human life (social well-being). Trees have been planted in public open space (at the parks and along the streets) and in the houses (in balconies, on roofs, and even indoor). The area of public open space in Linh Dam Lakes is 6.5 hectares. It includes sport and entertainment areas (0.7 hectares), parkland and lakes for entertainment (5.8 hectares), and accounts for 27% of total land area (HUD, 1996). Public open space was ruled in Australia as consisting of and containing a range of recreation settings and followed the acceptable solutions as seen in Table 8.3. This standard may be suitable to Hanoi as it provides convenient access to users and still can serve a larger number of residents because housing in Hanoi is denser than in Adelaide.

Table 8.3 Public open spaces in South Australia

Public open space	**Minimum area**	**Service distance to dwellings**
District parks	3 hectares	2 kilometres
Local parks	0.4 - 1.0 hectares	500 meters
Small local parks	0.2 hectares	300 meters

Source: CDHRD (1995, p. 93)

Besides providing public open spaces, the planning of a housing project needs to consider setting up standards for home gardens, courtyards, and open spaces for each allotment. The current standard for open space of detached houses in Linh Dam Lakes is 60% of total allotment area. However generally an open space standard was not set up for attached houses and apartments causing a lack of home gardens and the respondents were not satisfied with their gardens. The setback standard of 2m set up for the backyard of attached houses was too small.

Using public transport could reduce pollution, conserve resources, and alleviate traffic jams. With the current policy of encouraging public transport, although city buses have not reached this area, it is possible that buses will be provided when the area is completed. As some respondents were not satisfied with the safety of the road systems in the area, roads, pavements, and walking paths need to provide safety and convenience for pedestrians to access service centers.

Building multi-floor apartments mixed with other small-scale types of housing can contribute to providing human scale feeling. Although having nine and twelve floor apartment buildings that create a big urban grain, many small street houses and detached houses built have provided human scale for the area.

Conserve resources

Housing projects located close to the city (about 10 km) and shopping centers could save energy and time for travel. Linh Dam Lakes is ten kilometers from the city centre and seen as far.

Defining an optimal density level that can provide a quality life for the residents could help save resources. The attached and detached houses in Linh Dam Lakes have an average allotment size of 60 m^2. Although this area was nine times denser than in Adelaide, and had a lower density than the other existing residential areas in Hanoi, as the occupants generally were satisfied with allotment size and types of houses, this density and standard of housing is reasonable.

Minimizing input and limiting the draw of resources from large distances could minimize Hanoi's ecological footprint. Hanoi seems to have a small ecological footprint. Food is supplied mainly from the surrounding countryside and villages located within fifteen kilometers of the city centre. Electricity supply is mainly provided by Hoa Binh hydropower station that is located 50 kilometers away.

The orientation of lots to enable a microclimate could save energy used in conditioning the houses and improve indoor quality. Lots could be designed to face south and south-east to collect cool wind in summer and avoid cold wind in winter.

Protect ecosystems

Urban in-fill developments do not seem to suit Hanoi as the city is already too dense and developing housing in suburbs is more reasonable. The selection of the site for the Linh Dam Lake project was reasonable. The site was a poor agricultural field in a city suburb, so it did not have much of an impact on biodiversity. Although reducing some agricultural land, it resolves the urgent problem of land and house shortage in Hanoi.

Housing projects need to respect the site and create a landscape rich in biodiversity. This project has respected the site as the lakes were maintained and used to increase value for the project. The project has also promoted a landscape that is rich in biodiversity with parkland, lakes, and islands. The open spaces would provide homes for wildlife.

Using lakes, streams, and ponds in local parks cannot only enable the recycling of water, promote ecosystem protection and save resources but also provide eco-recreational areas that promote environmental education for the local community. Although having the opportunity to recycle water in the large lake system, this project has not applied this.

Housing projects need to consider encouraging urban and suburban agriculture. Although using some agricultural land for housing development, this project does not affect surrounding agricultural activities. In fact, agriculture in the surrounding areas is even promoted with a larger market for agricultural products to supply the new urban residents moving to live in this project.

Design

Reduce pollution and conserve resources

Building compact houses could help save resources and reduce pollution. As most respondents in Hanoi were satisfied with the size of their current houses, it is not necessary to increase the current standard of housing in Linh Dam Lakes that has an average dwelling size of 170 m^2. Moreover, the potential shift from an extended family to a nuclear family living arrangement suggests that big houses with more than three bedrooms may be not suitable in the future. This also suggests the number of big houses could be limited to save resources in construction and operation. Although causing inconvenience when going up and down, multi-floor structure houses can save a lot of land compared to one-floor houses. The inconvenience in mobility for occupants can be mitigated by limiting the number of floors to three and arranging a bedroom for elderly or disadvantaged people on the ground level.

Applying climatic responsive design principles can help to reduce energy and resources used in operating the house and pollution caused from energy generation and goods manufacture. If possible, opening windows of bedrooms and lounges to south or south-east can collect cool wind in the summer and solar radiation in the winter. Arranging courtyards inside could provide a good natural lighting and ventilation for the house. Using two-layer windows (shutter and glass) could provide a good indoor climate for the house. Although these windows may cost more initially, a long- term energy saving will pay it back. If exposed, west-orientated parts of the house need shade, for example from balconies or vegetation to reduce heat load during hot times and rainwater coming into the house. Balconies, verandas, overhangs, windows, and courtyards need to comply with the guidelines of 'Architectural physics'[24] suggesting different shapes and sizes for overhangs and window shadings when facing different orientations to avoid glare and darkness in the house. Although the respondents in Hanoi were satisfied with the indoor environment in most climate conditions without using many heaters and air- conditioners, further improvements in design can still be made to improve indoor comfort and save energy. As some respondents found some parts of their house dark, providing good solar access to all rooms in the house can reduce the need for artificial lighting. Also as the respondents found their houses cold because the doors and windows were not sealed properly, better sealing of windows and doors can provide higher comfort and reduce the need for heating during the winter. Insulation is not necessary for the attached walls of street houses. Pitched roofs can help to fasten rainwater running off. A metal

[24] The text book 'Vat Ly Kien Truc' has been introduced in Architectural School in Vietnam for a long time.

pitched roofing above a flat concrete ceiling can protect the house from solar heat gain and at the same time, provide a place for drying clothes, entertaining, or planting vegetation.

Optimizing and integrating functions of the house could provide a higher convenience for the occupants and save resources. Functions of the houses in this project seem to be optimized, as the respondents were satisfied with the convenience, privacy, and indoor environment. The integration of functions has also been applied to save space such as the study room being integrated into the bedroom and the lounge being used as a living room.

Building good quality housing may cost more but could reduce resource consumption and cost in maintenance and increase serving time. Although the apartments in Linh Dam Lakes are new, due to the low quality, many occupants have to replace the plaster on the walls, ceilings, and the floor covers.

Using a simple design and materials that are easy to maintain can save energy and the costs in maintenance. High-rise housing often requires higher maintenance costs compared to the low-rise one, as it is more difficult to renovate in high altitude, and needs technical supports (for example for elevators). The maintenance of the high-rise apartments in this project seems to be easy and low cost as the design is simple with only a few details (see Photograph 6.1), and the outer wall cover is plastered with lime-based paint.

Flexible design can save resources and energy. As the number of households who made or wanted to make changes in the houses was high, apartments can be sold unfinished to let the occupants decide on the finishing aspects. The developers can provide homebuyers with several options for furnishing standards and styles, and then help them finish the furnishing according to their demand. The typical flexible furniture and interior furnishing that fit the temperate climate of Hanoi could be maintained while discouraging fixed carpet and soft furniture.

Protect ecosystem

Designing housing that is harmonious and in balance with nature can enhance ecosystem protection. Although having parklands, the absence of front gardens in the street houses has caused an imbalance between green and built environment in the streets. To improve the balance, small parks in streets, small front gardens, and open space (courtyards) in street houses are needed. Although the green area may occupy some land, the long-term environmental, spiritual, and cultural benefit is invaluable. By having a larger open space, houses need to be compact to maintain high density to protect the ecosystem.

It is necessary to arrange suitable places in a house for installing "green" systems such as solar water heaters and water recycling systems at design stage. For example, roof design need consider arranging a suitable place for setting solar panels that do not cause glare or affect the aesthetics of the house. Every house could have an extra rainwater harvesting system to provide water for toilet flushing together with the main water supply system. Waste water from the toilet (black water) and kitchen and bathroom (grey water) could be collected separately for recycling or treatment. For example, black water could be treated properly and recycled to produce fertilizers while grey water could be simply used at a household scale for watering their gardens or parkland. Removing grey water and rainwater from the main sewage system could reduce a large amount of sewage that needed to be treated, and therefore could help to reduce energy consumption in sewage treatment.

Building materials

Reduce pollution

Brick and concrete are the main building materials used for constructing houses in Hanoi. They are locally produced based on abundant local resources, durable, low cost, and less toxic to humans and the environment. Concrete also allows high-rise structure, and therefore can help to save land and reduce urban sprawl. However, the manufacture of these materials consumes a considerably high energy and causes environmental pollution. Considering the cost and benefit of these materials, it is fair to argue that these materials are worth using, but improving the manufacturing technology could reduce pollution and save resources. For example, using natural gas or hydro electricity instead of coal in producing bricks could reduce pollution.

Lime paint is a traditional material in Hanoi that has no toxicity to human health, less pollution from surface water run-off, and low in cost, and therefore could be encouraged. The newly introduced chemical paints that contain lead (Pb) – a very toxic element - should be discouraged as their use may harm human health and the environment.

Conserve resources

Using low-tech human energy in housing construction is suitable to the Hanoi context. The housing construction often requires high-energy consumption as most of the work is done by low-tech human energy. However, as this energy is clean, and Hanoi has abundant human energy resources, this method is suitable to the Hanoi context.

Using multiple local resources in housing construction could save energy and resources consumed in material transportation. Most building materials were extracted and produced in Hanoi (brick, sand, glass, and labour) and some nearby provinces (cement, steel). Local industries have produced most building materials except a small amount of some materials imported from China and Thailand (floor cover and kitchen and bathroom ware).

Using recyclable and long life materials could save resources. Brick is recyclable and often recycled in Hanoi. Brick, concrete, steel, and timber are long-life materials which therefore could save resources.

Minimizing the use of high-embodied energy materials could contribute to saving energy. On the other hand, although steel and glass embody high energy in manufacturing, their quantity used in Hanoi housing construction is small and these materials are recyclable.

Creating a sustainable timber source could contribute to saving resources. Timber is renewable, however, timber in Hanoi is not from certified sustainable managed sources. Timber is mostly harvested from natural rainforests in Vietnam and Laos. Although Vietnam has been replanting forests for some years to create renewable resources, the benefit may be effective only in the next decades. Hanoi still needs to solve the problem of abusing rainforests for extracting timber.

Using soft timber and hollow doors to replace the hard wood and solid timber doors in Hanoi could save resources. Unlike in Adelaide, where timber is used in a large amount in housing structure, in Hanoi's modern houses, timber is only used for doors, windows, and furniture, but not in the structure. However, as most doors and windows in Hanoi are solid tropical rainforest hard wood, using soft wood and hollow doors could save rainforests, protect ecosystems, and conserve natural resources.

Protect ecosystem

Recycling timber can protect rainforests from destruction. Recycling timber helps to reduce the need for logging trees. Recycling brick can reduce ecosystem destruction from coal burning in their manufacture. Reducing the amount of timber used in housing construction is necessary when timber is currently extracted from unsustainable sources.

Systems and appliances

Reduce pollution

The main pollution emitted from residential areas in Hanoi is from burning coal for cooking and a lack of collecting and treating of household wastes. Despite having hydro electricity that is renewable and emits few greenhouse gases, coal burning for cooking is still common in Hanoi and causes air-pollution. If coal burning was prohibited, it would help protect the environment and human health.

As Hanoi has the potential to use solar energy, promoting solar water heaters and solar generators in the residential sector would benefit the environment and economy in the long term.

Hanoi urgently needs to apply proper waste and sewage treatment technologies to reduce environmental impacts. Waste and sewage are generally released into rivers or dumping sites without treatment causing pollution to the city. Using natural gas for running buses can also help reduce pollution in the city.

Conserve resources

Applying renewable and efficient technologies can save resources. Due to the increase in demand, the energy supply in Hanoi will not be sufficient in the future (Chapter 4). Therefore Hanoi needs to save energy. Fans and fluorescent lamps are commonly used in Hanoi to save energy and resources. The number of air-conditioners and heaters is very small but may increase in the future. Electricity of Vietnam (EVN) promotes energy-efficient lighting to cut demand at peak times (VNS, 2002a), however, actions taken to increase electricity price and advertising some efficient lamps on television (HNTV, November 2002) have not been effective. Efficient lamps are too expensive (at least 10 times more expensive than the conventional one) and it is unreasonable to replace the existing lamps that are working in the house. Moreover, as studied in Chapter 6, the households in Hanoi were concerned with price, quality, and appearance more than with energy efficiency when buying appliances and only 12.6% of the respondents in Hanoi were concerned with energy efficiency. This suggests more actions to promote energy efficient appliances are needed. For example, providing small subsidies for efficient lamps and appliances could encourage people to shift from conventional appliances to energy efficient ones. As only a few households knew of and used solar hot water and photovoltaic, introducing and demonstrating these technologies widely could help increase the use of these systems.

Recycling waste could help to save resources. Apart from a small amount of solid waste that is recycled by some small enterprises in the city using polluted technologies, most waste is not recycled but is collected mixed and dumped outside Hanoi. Organic waste composting is often not applicable in Hanoi, as the home gardens are often too small or not available. Organic wastes of the whole area could be gathered and recycled. Hanoi has built some large-scale waste treatment plants to convert organic wastes into gas for fuel and organic fertilizer for agriculture but the capacity is small compared to demand. Further development of such plants in Hanoi is needed. All household wastes could be collected separately and recycled.

Recycling waste water and collecting rainwater can save water. Waste water from the bathrooms or kitchens is suitable for watering gardens while rainwater is suitable for toilet flushing. These options have not been applied in Hanoi. Only one household in Linh Dam Lakes was harvesting rainwater for daily use. As the need for watering gardens is not high in Hanoi due to having a small or no garden, the development of a large-scale grey water harvesting system in the area for watering the parks would save a lot of water. As well as this, improving tap water (main pipe) management is needed. Water supply charge needs to be based on the usage, not on the number of people in a house as applied at present. Minimizing water losses and charging a high price for high water consumption are needed. Washing motorbikes using a bucket (instead of sprinklers that are common in motorbike cleaning shops in Hanoi) would save water.

Protect ecosystem

Reusing water and waste can protect the ecosystem as this can reduce the amount of waste or sewage needed to be discharged, treated, or recycled. Recycling water and waste can help to conserve natural resources and protect the ecosystem. Using natural gas for running buses can also contribute to protecting the ecosystem.

8.2.1.2 Social instruments

As found in Chapter 6 the residents in Linh Dam Lakes had a poor knowledge about the environment and sustainability. Therefore there is a need to promote environmental knowledge for individuals in Hanoi. Generally, most residents know of only some local problems of air and water pollution, not other national and global problems. Only a few respondents in Hanoi saw the impact of environmental problems on their family's health and most of them did not see any link between global, national, and local environmental problems. Moreover, the respondents seem not to have realized the relationships between multiple dimensions of sustainability.

Individual

Reduce pollution

Individuals need to participate in and support all actions to reduce pollution. As discussed in Chapter 6, most respondents in Hanoi in general were aware of the importance of living in a healthy environment and seem to be willing to take actions but did not know what to do. About 70% of the respondents were worried about the current environmental situation. However, the environmental actions were limited to cleaning the living environment including their houses and streets or defending themselves from environmental problems. Nevertheless, the respondents agreed highly with the statements suggesting using public transport and energy efficient appliances, the necessity to have environmental law, recycling water and waste, and reducing resource consumption. This suggests that setting up an agenda and facilities for actions can help protect the environment.

Individuals need to consider applying green technological systems of water recycling, rainwater tank, solar hot water heater, separate waste collection, household composting, waste recycling, and waste reuse. However, the lack of knowledge about technological systems among individuals was noted in Chapter 6. The number of respondents knowing about these systems was small. In order to encourage the use of these systems, it is important to provide information to improve the knowledge of the residents about these systems and their benefit. Moreover, the respondents indicated social unacceptance (unnecessary and inconvenience), poor service quality (not hygienic, not permitted, not applicable), and costs (unaffordable) as barriers to the application of these systems. This suggests, in order to enhance the application of these systems, besides demonstrating the benefit of these systems, the city needs to provide better service with an acceptable cost.

Individuals need to have a high willingness to pay for environmental costs, and to change into a more sustainable lifestyle. The current willingness of the respondents in Linh Dam Lakes to make changes was not high. The respondents did not highly agree with the statements about the benefit of living in an extended family, discouraging detached houses with gardens to reduce urban sprawl, well-designed multi-floor apartments as good as any other type of house, the cheapness of renewable energies, and paying more for more resources used. Providing education and information about sustainable lifestyles would increase the willingness to pay for environmental costs.

Conserve resource

Individuals need to comply with family planning to reduce population growth and contribute to conserving resources. With family planning, the birth rate in Hanoi has been reduced to 21.23 births per 1,000 people in 2001 (CIA, 2001b).

Individuals may not need to increase the current consumption level of consumption of goods, energy and water to conserve resources to increase their satisfaction with the indoor environment. The number of domestic appliances and energy consumed per household in Hanoi was low compared to Adelaide. However, the respondents ranked their household's energy use reasonable (not high and not low) and they were generally satisfied with the indoor environment of their house. This suggests the households may not necessarily increase the current level of energy consumption (average 767 - 800 kWh/ month). The respondents in Hanoi were concerned with the quality of appliances. It is smart to buy goods only when needed and buy good quality and durable products to make sure they last for a long time. As energy supply will not be sufficient in Vietnam in future, it is necessary that individuals start to consider using efficient appliances, solar water heaters, and recycling gray water and collecting rainwater for toilet flushing to save resources. Water consumption in the households in Hanoi was not high because most houses have no garden. Many respondents said they save water because its price is high. Some households used bore water for washing and watering flowers while they only used tap water for drinking and cooking.

Individuals should start to implement a sustainable lifestyle. Using public transport, pedestrians, and using fewer private motor vehicles can save resources. As sharing a house could save resources, individuals in Hanoi may need to appreciate and try to maintain the common living arrangement of the extended family. Sharing a house could also lead to sharing housework. This could enhance a productive life as each person will do less work and have more time to relax or contribute to the society. Sharing a house also helps in crime prevention because with more people in the house, the chance of someone staying at home is high. Living in a street house and opening a shop or business at home can create a mixed use of spaces, a productive life, and may reduce the need to build a big shopping centre elsewhere.

Protect ecosystem

Reducing consumption and consuming local products can help to save wildlife, land, water, forest, vegetation, and human health from destruction that may be caused by environmental degradation generated in goods manufacture and transportation. Planting trees can provide home for wildlife and promote a balance between the natural and built environments. Trees can be planted along the roads, on parks, in the gardens, and even in pots on balconies and roofs.

City

Reduce pollution

Hanoi needs to set up an agenda and provide facilities to implement concrete activities to protect the environment such as treating and recycling solid waste and sewage, forbidding burning coal for cooking, and so on. The city has undertaken a limited number of environmental promotion activities such as replacing lead petrol with lead free petrol in 2000 and providing good bus systems in mid 2002. Many respondents saw the cause of environmental problems today in human behaviour, bad management, and wrong policy, but they did not see what they could do to protect the environment besides cleaning the house and street (see Table 6.4.7). City and environmental institutions need to go ahead in establishing environmental agenda, policies, strategies, and providing good services, facilities, and management in implementing environmental actions with a reasonable cost and time consuming.

Hanoi also needs to promote information and education about the environmental situation, sustainability, and ways to achieve it. Many practical actions such as stopping burning coal for cooking, using buses, reducing consumption, and using green and local products could be promoted. The city needs to consider providing information and education to all schools, universities, and communities about environmental problems and their impact on human health. The result from the field survey showed the respondents had a poor knowledge of environmental issues. A survey by Energy Institute asking some university students about developing nuclear energy in Vietnam shows the students knew very little about nuclear energy (TV October 2002). The weekly 'Environmental program' on Hanoi television covered topics such as 'protecting the forest and the wildlife', that is not applicable to city life. Environmental actions advised in schools were limited to planting trees and keeping public places clean (e.g. interviews on a children's TV program in Hanoi October 2002 aiming to promote environmental protection on the Environment Day).

City planners and developers need to consider environmental issues when developing housing. Environmental impacts caused from a housing development need to be forecast and advertised to avoid or reduce the impact. City planners and developers need to consider the issues the respondents have pointed out in the field survey to improve the quality of the housing project. The issues pointed out in Hanoi included poor planning, high density, the mixture between residential and industrial areas, over population, poor economic conditions, poor infrastructure systems, lack of green trees, and dust from the construction sites.

The city needs to consider setting up pollution fines that are very effective in reducing pollution. Fines can be introduced for the release of waste in public places (has been applied in Singapore), burning coal for cooking, creating air and water pollution, using motor vehicles, and making noise in residential areas.

Conserve resources

The city needs to provide information and education about resource conservation. Promoting a dematerialized lifestyle with more spiritual values can help to conserve resources. Introducing policies, organizing activities, and providing implementing facilities are important. For example, enhancing family planning could control population growth. Providing buses and facilities for recycling water and waste and introducing and promoting rainwater tanks, solar hot water heaters, and efficient appliances (lamps) could save resources. As most sustainable systems are claimed as expensive, the city could point out the long-term financial benefit of these systems. The city could cooperate with the energy sector to set up policies to provide financial and technical supports for the application of these systems in households.

Protect ecosystems

Besides reducing pollution and conserving resources (see above), the city needs to have plans to protect and develop the existing and new green areas (water surface and parkland). This could provide a home for urban wildlife and contribute to a balance between the natural and built environments to protect ecosystems.

National/Global

All nations need to be more active in working for sustainability to make this world sustainable. As the global economies and environments are interdependent, sustainability of housing in Hanoi depends on the sustainability of Vietnam and the whole world. Although many conferences and negotiations have taken place at an international level, there are not many achievements. With this attitude, sustainability has little feasibility.

> At the international level, talks and negotiations have been held between national governments to work out international responses to the environmental problems facing the world. These talks recently culminated in the Earth Summit in Rio de Janeiro in June 1992. For many, the Earth Summit was disappointing. No specific targets could be agreed on for the reduction of greenhouse emissions. The US refused to sign the Biodiversity Treaty. Agenda 21 was criticized as being weak and lacking any strong statements on some of the more important yet contentious issues such as population control, consumption by people in affluent countries, and the role of transnational corporations. (Beder, 1993, p. XV)

As rich nations have more opportunity to implement environmental protection, a moral lead has to be taken by the rich nations. Aid from rich nations/communities to poor nations/communities could enable actions for sustainability everywhere on Earth.

8.2.1.3 Economic instruments

Economic growth

Reduce pollution, conserve resources, and protect ecosystems

Economic growth can provide funds for environmental actions. Housing development often creates economic growth. A part of the financial benefit gained from housing development could be invested in environmental products and services. The environmental productions and services could create many new jobs and capital benefits for the society that can be used for further environmental actions. For example, applying solar hot water heaters would create jobs in their manufacture and services in installation and maintenance. Operating waste recycling could create jobs in collecting, separating, and recycling services. Funds raised from environmental businesses such as selling solar water heaters and recycled products can be used to finance non-benefit environmental protection actions including ecosystem protection.

Fiscal

Taxation has been believed to be an efficient tool for environmental protection. Taxes can be put on pollution, resource consumption, and ecosystem destruction.

Reduce pollution

The costs of pollution caused by mining, manufacture, and transportation have not been applied in Hanoi. Due to the low income, the full cost system does not seem to be applicable to Hanoi at present, but can be applied in the future, when the income level is higher. The costs of negative impacts on human health and the environment caused by pollution could be estimated and put on petrol, motor vehicle use, housing construction, goods manufacture and transportation, and so on.

Applying pollution taxes could reduce pollution. All polluters including motor vehicle users, coal burners, and high consumers pay pollution tax. A Goods and Services Tax (GST) has been applied to tax consumers in Vietnam since 1999.

Besides taxation, subsidy for environmental protection activities including planting trees, cleaning up the living environment, and treating sewage and waste in housing areas could reduce pollution.

Conserve resources

The costs of resource depletion caused by mining, manufacture, and transportation could be estimated and added to the price of goods in the future. Tax could be applied for the high consumption of energy, water, and goods to save resources. In September 2002, the new electricity price in Vietnam increased about 10 - 20% compared to the old price while the income did not increase that much. This has lead households to spend about 15% of their income on electricity and may cause stress for low-income earners (Labour, October 2002). Subsiding low consumers and putting a tax on high consumers of electricity could be a more reasonable solution. Propagandizing and educating people to consume less could help conserve resources. Subsidies on applying efficient and renewable technological systems such as efficient lamps and solar water heaters could encourage people to use more sustainable resources and avoid stress caused by reducing consumption.

Protect ecosystem

The costs of ecosystem degradation caused by mining, manufacture, and transportation could be estimated and put on the price of goods in the future. Taxation on negative impacts on the ecosystems caused by housing projects could be applied. For example, the tax on using green fields is higher than brown fields (degraded sites).

Monetary

Most developers have to borrow money from banks for developing housing. Monetary instruments could set up a special interest rate for sustainable housing projects and environmental technologies applied in the housing projects. Reasonable interest rates consider the affordability for homebuyers when paying a mortgage. This in the end will promote benefit for housing development and enhance environmental protection. At present, due to general low income, Hanoi has no facility for home loans, but in the future monetary instruments would be very effective.

Institutional

The government loans are very important to overcome the high initial cost of sustainable housing projects that will bring long-term benefits. At present, the city/government subsidizes infrastructure systems and provides loans for building housing for sale to improve living conditions for people in the city. City/government considers providing loans for environmentally friendly projects such as efficient technologies, renewable energies, and waste and water recycling systems in housing areas to improve environmental quality.

As banks in Vietnam have not provided a mechanism to support home ownership and local finance sources are based mainly on unreliable sources of borrowing from relatives and family members, access to housing therefore is very difficult. Banks in Hanoi need to consider introducing home loans to promote home ownership.

Foreign loans and investments play an important role in the Vietnam economy. However, foreign investment such as Foreign Direct Investment (FDI) has decreased due to corruption, bureaucracy, dual pricing, and lack of transparency from Vietnam.

> The four major sources for hard currency have been: Overseas Development Aid (ODA); Foreign Direct Investment (FDI) [less than 2.3 billion USD in 2002 (Labour, 19-9-2002)]; Export-derived Income (ExI); and Vietkieu who support

> domestic families with annual gifts. Loans from foreign institutions are growing, but at a snails pace due to the continued inability of the State to earn hard currency to repay such debt. ODA funding, directly competes with FDI, the other sources are beneficial to FDI. ODA funding has been directed towards infrastructure development, many foreign commercial enterprises from the donor nations have benefited. Export-derived Income (ExI) sends hard currency to the State and profits to the companies that sell the goods. To the extent that they are foreign invested enterprises, such income encourages FDI from other concerns. To the extent that ExI is generated by domestic or State-owned companies, they also put greater wealth into the population as a whole. Vietkieu support for domestic families is estimated to run from 1 to 3 billion USD annually. These funds are used to purchase domestic family needs and supplies include high-end materials such as houses, house renovation, automobiles, motorbikes, and major appliances.
>
> (VVG, April 2001, summary)

Moreover, borrowing finance may also put a burden debt on future generations. Therefore, Vietnam needs to change its administrative system to reduce corruption and make a clear path for future international aids to come. The Vietnamese Communist Party has asked Sweden to probe corruption in Vietnam in the year 2003 (VNS, 2002b). This seems to promise a brighter future for Vietnam.

8.2.2 Social dimensions

The following part will give guidelines using multiple instruments to obtain the social ends of sustainable housing including individual well-being, collective well-being, and cultural conservation.

8.2.2.1 Technological instruments

Planning

Individual well-being

The planning of an area needs to consider environmental sustainability (see planning part in environmental dimension) to provide well-being for individuals because they need a healthy living environment. Besides this, planning of an area needs to consider all social needs for the individual.

The planning of a housing project has to provide an interesting and attractive living place. The Linh Dam Lakes project is attractive as it has different housing types and styles mixed with other public buildings with in a beautiful landscape of parklands, lakes, islands, and peninsular systems. Shops and services in front of many street houses and on the ground floor of the high-rise apartment buildings have created lively streets with many activities on the streets. The project provides plenty of recreational places such as lakes, parks, and swimming pool. The respondents were satisfied with the playground of the area. Although the apartments look similar from outside, their interior has been renovated with a variety of styles and colours.

The planning of a housing area needs to consider the selection of the site because the result drawn from fieldwork reported in Chapter 6 showed that, the respondents saw 'location' as the most important issue in housing. The site of Linh Dam Lakes project has not had much of an impact on the local environment and ecosystems. This area is located in a low-density suburb and far from the city centre. The air in the area is therefore less polluted than in the city centre. However, the respondents were not satisfied with the location of the project as they found it too far from the city centre, especially when the service facilities on site were not complete. The distance being seen as far seems to relate to the lack of buses and the incompletion of the project. Access to jobs was therefore not convenient. However, all these problems will be overcome when the project has been completed.

Providing enough housing and open space could enhance individual well-being. The area of housing and public space per head in the Linh Dam Lakes project is much higher than in the other areas of the city and the respondents were satisfied with it.

Providing good infrastructure and roads, and water and energy supply can promote individual well-being. The infrastructure and roads in the area were not complete. The respondents were therefore not satisfied with these. Most households were satisfied with water and energy supply except some were worried about the quality of tap water. Water needs to be checked and controlled to provide safety for the residents' health. Designing easy mobility streets can reduce accidents and enhance smooth traffic flow.

Collective well-being

Involving the community in housing development could enhance collective well-being. "Community taking control" has been pointed out as an essential tool to make housing projects successful. This has not been applied and therefore is needed in Hanoi to improve to collective well-being.

Ensuring a good relationship between people in a community could help create a sustainable neighbourhood. The relationship between households in Hanoi is tight, as social visits between neighbours are frequent. As people living in a neighbourhood in Hanoi often know and help each other, safety and warmth are available.

Introducing mass activities including living, trading, and a mixture of services in the area can create a lively neighbourhood and provide economic benefit for the community. Many houses in Linh Dam Lakes opened a shop at home for trade or services. A mixture of different jobs, ages, and income levels of the residents in the area also created integration between people and a diversity of activities in the area.

Emphasizing public spaces could enhance collective well-being. Public spaces were emphasized in Linh Dam Lakes by providing site facilities including kindergarten, shopping centre, gymnasium, swimming pools, lakes, and park. This creates the opportunity for increased communication between people living in the neighbourhood. However, streets – an important public space in most existing housing areas in Hanoi, where people trade, meet, and communicate, children play, elderly relax or exercise, and so on - were sometimes not emphasized. Some roads were narrow and some pavements were only one meter wide. Roads and pavements could be wider to suit the lifestyle of people in Hanoi.

Cultural conservation

To conserve culture, a housing development needs respecting the existing context but at the same time needs to present the change in society. Although the development of high-rise apartments has changed the existing context, they were argued by public discourse as providing a new face for Hanoi's housing. The cultural change has led society to accept this new form and size of housing. The project has respected the existing context and typology as all the lakes in the site were kept. The lakes also created a special landmark for the area. Villages and agricultural land around the site were maintained. Moreover, this project, by providing housing for many people, can indirectly help to protect the existing traditional rural villages around Hanoi from urbanization.

Making sure that the project has evolved from and inherited tradition is one way to conserve culture. The introduction of street houses in this project has protected features of Hanoi's streets and expressed cultural heritages. On the other hand, the introduction of high-rise apartments expressed a new value in the society of Hanoi today as culture has changed. The combination of both housing types made a good picture of the evolvement of culture from past to future.

Design

Individual well-being

In order to provide individual well-being, first of all, the design of houses needs to consider applying guidelines for promoting environmental sustainability (see Design part in environmental dimension) because individuals need a healthy environmental house. Besides this, the design of a house needs to consider providing all social needs of the individual.

Allowing the free expression of individual identity, preferable design, pride, and belief in housing can promote social well-being for individuals. The respondents in Linh Dam Lakes expressed the individual identity of wealth, preferable appearance of their homes, their creativeness, and pride in their home through the style of their house. The respondents living in detached and street houses who were free to choose the design of their house have put a lot of effort into decorating their houses. The diverse styles and colours of detailed decorative windows and balconies in the houses presented the freedom of residents in deciding their houses' appearance. With the ready-built apartments, the expression of individual identity is in the indoor finishing. Most occupants changed and upgraded inside finishing, so the apartments often have different interior styles and standards. The application of Feng Shui in many detached and street houses expresses the freedom in belief of the occupants.

Ensuring legality for home ownership contributes to improving individual well-being. Unlike the general complicated custom to get a certificate of legal ownership, this housing project provided easy certificates of home ownership. The respondents were satisfied with this.

Providing freedom and privacy promotes individual well-being. The respondents were satisfied with privacy in their house (at level 4.2). The common living arrangement of the extended family sometimes creates negative impacts on the freedom & privacy of its members such as less privacy. Good design can mitigate these negative impacts by providing private rooms for each individual.

As some respondents did not feel secure when leaving their vehicles in a common garage at the ground floor, leasing private garages as well as public garages can solve this problem. The inconvenience of using stairs or the unreliability of elevators in the nine-storey apartments can be overcome by providing good quality elevators. Building walk-up apartments can also avoid technical problems caused by using elevators and reduce the building and operation cost. Walk-up four to five storey apartments have been argued as having an optimal level of high density and still providing a good quality of life for the residents (Rudlin & Falk, 1999, p. 142). Thuc (2002) has asserted the high cost of building and running high-rise apartments compared to other low-rise housing and it may not ensure the affordability for many poor in Hanoi. Security in the housing area was ranked slightly under the satisfaction level (3.8). Most houses have been built securely with steel mesh at doors and windows to protect the house from thieves.

Ensuring gender and age equity in design and construction of the house can provide a better living environment for all household members. As found in Chapter 6, the main family members involved in designing or building the house were parents and only a few children. Men were dominant in making decisions in designing and constructing the house. Among self-built housing, respectively, 64% and 33% of households had both genders involved in designing and construction, among the rest, only men were involved in making decision on designing and building the house. As women and children spend a lot of time in the kitchen, laundry, and play areas, the low involvement of women and children in house design may cause the unsuitability of these areas in the house to women and children. For example, the kitchens in apartments in Hanoi were often dark and poorly ventilated. The position of an open kitchen and cooking stove next to the main entrance of some apartments has not ensured safety for children. The lack of a play place for children in most houses was obvious. A laundry was not available in many houses in Hanoi as it was combined with the bathroom or kitchen. The lack of a place for drying clothes was common in high-rise apartments. Designers have to take into account the need of all members of a household when designing a house. Education and media systems in Hanoi need to encourage men to do housework to promote gender equity and the suitability of the house for household daily activities.

New housing projects could enhance their suitability to different socio-economic conditions of the occupants by including variable types of houses. As this project has included three types of houses, the individuals had the opportunity to choose their suitable housing type and the people were satisfied with the type of dwelling they live in. Housing projects need to also include low, medium, and high-rise, apartments, street, and detached houses. This creates an interesting living environment and landscape and promotes identities in neighbourhoods. On the other hand, there is no doubt that the perceptions of the respondents about the type of house will change over time when the socio-economic and environmental condition of Hanoi changes. This suggests that Hanoi needs to consider not building a large number of one type of house in a short time period, but rather slowly, to test, to adjust, and adapt different types of houses to the changing situations.

Choosing the right type of house for development is important in enhancing social well-being for individuals and collectively. High-rise apartments in the new urban projects were appreciated in Hanoi. Many occupants said, "it suits their lifestyle", "saves land", and "provides low-cost homes for low-income earners [that are majority in Hanoi]" (field work). Moreover, as studied in Chapter 6, high-rise dwelling is not bad in itself, but its quality and contextual suitability matter. People in Hanoi accepted apartments, but complained about their quality. Ensuring the good quality of apartments could improve the acceptance of apartments.

As street terrace houses have been developed, tested, and survived for almost a thousand years and have many advantages, it is not wise to eliminate them in new urban developments. Street houses are typical in Hanoi and have many advantages such as saving land, infrastructure and road, and creating a rich mix of use for living, trading, and social activities. Many architects such as Hoang (2001) and R. King (personal meeting, December 2001) have pointed out the suitability and adaptability of the street house to the current socio-economic development and environmental condition of Hanoi. However, some new urban projects will not include this housing type in their development (Thuc, 2002) because the city planners claimed that high-rise apartments can save more land than street houses. A detached house is luxurious and because 63% of the respondents in Hanoi saw it as "less secure, isolated, having poor social life, waste of land, and expensive", it seems not to suit the Hanoi context, and therefore its use could be limited.

Ensuring flexibility and durability is one way to enhance social sustainability. Some respondents were not satisfied with the design and quality of their apartments while other respondents were. This means the fixed and monotonous design and standard of the apartments do not suit all occupants. Many respondents complained of the expenses of renovations and changes they made in the new apartments. Applying a flexible plan could provide users with opportunities to decide on the design and quality of their houses, to increase the satisfaction of the occupants with the design and quality of the houses. The houses need to have a good quality to provide durability but with different standards to suit occupants' requirements and affordable levels. The housing project has integrated different social groups as it has included different housing types and standards in the same area.

To reduce noise disturbance between neighbouring houses, the walls between apartments need to have good sound insulation. Distances between windows and doors of neighbouring apartments could be maximized to avoid the noise passing between apartments. The current reparation and renovation works in the apartments caused noise disturbance for the neighbours. This will be eliminated when all the construction and renovation works are completed.

Having glass windows in front of the house, planting trees along pavements and on balconies, limiting motor vehicles' speed, prohibiting noisy car horns, choosing suitable road fabrics and materials could reduce noise and dust from the street coming into the house. Front gardens can not only protect the house from noise and dust, but can also provide a convenient and safe parking place for motorcycles. The houses need to be set back 2 - 2.5 m from the street for front gardens/yards (enough space for the parking of motorcycles). This small set back distance also will not isolate the house from neighbours and street, to avoid the desert pavements that create lifeless streets or are unsafe for pedestrians (Rudlin & Falk, 1999). The position next to street of street houses was also pointed out as causing noise and dust. In fact the traditional tube houses in the Old quarter of Hanoi have the same position to the street but do not have this problem. This was because, the occupants do not live in the front part of the house where the shops are located, but in the middle and end parts that are isolated from the street by the shops and courtyards. So, in order to provide a quieter living environment for the residents, the front part of a street house could be used as a shop, workshop, or garage and the living area could be located behind.

The street house design needs to consider convenient maintenance costs such as having a simple facade without many decorative details and limiting the height of the building. Street houses are generally convenient to live in, but not easy to maintain. The respondents were satisfied with a convenient plan (4), space (4), number of room (4.0), and the suitability for social life (4.2), but not with time spent on housework (level 3.6).

Providing visual comfort for residents about their house can promote individual well-being. The satisfaction level of the respondents in Hanoi with the appearance of the houses was also not obtained (3.7). An example of an obvious common low aesthetic value of the house is the large steel doors used for security in most houses in Hanoi. Designing small doors that have just enough space for motorcycles and bikes to enter the houses can eliminate this.

Providing thermal comfort inside the house could contribute to ensuring individuals' well-being. Thermal comfort inside the house seems to have been achieved, as the respondents were satisfied with indoor environment in the hot and cold climate without using much energy.

Having adequate domestic appliances could enhance thermal comfort inside the house and make housework easier and faster to do. Most households in Linh Dam Lakes have air-conditioning appliances (4.7 fans and 0.3 heaters), entertainment appliances (1.9 televisions, 0.7 videos, and 0.6 computers), and appliances supporting housework (1 fridge, 0.6 washing machines, 0.1 ovens, 1.1 stoves, 1.1 rice cookers, 0.1 microwaves, 1.5 water boilers, and 0.7 water pumps) (see Table 6.1.12).

Housing projects which present a progressive view of the society of Hanoi would enhance the individual's well-being. The Linh Dam Lakes project has a higher living standard and better planning and landscape than other existing housing areas in Hanoi. Most residents were proud of the modernization of the housing area. The quality of infrastructure, landscape, and service facilities of this project is much better than the other existing housing areas. The detached and street houses have larger allotments. The apartments have a bigger floor area, more rooms, and the rooms are larger than the previously built apartments in the city. Lifts were used instead of the stairs that are common in most old apartments in the city.

Collective well-being

Selecting a suitable type of house is not only beneficial to individuals but will also promote the collective good. In Hanoi, people living in a street house and in the same corridor in high-rise apartments often have a closer relationship and higher communication and integration opportunities compared to people living in detached houses. Many residents in Hanoi found detached houses isolated. Street houses and high-rise apartments are also more compact than detached houses, and therefore can save resources and cost for society. Social exclusion between people living in these types of house is minimized, as these housing types are much cheaper than detached houses. Urban projects need to consider including street houses and high-rise apartments.

Streetscape design could provide a nice streetscape and conserve cultural heritage and diversity. The respondents in Linh Dam Lakes were satisfied with the harmony of the neighbourhood (at level 4). However, the disordered appearance of streets is widely criticized by architects in Hanoi because individual houses were built with very little consideration for the streetscape or neighbourhood. The current development of high-rise apartments aiming to solve this problem seems to go too far, as most of them look the same. This may lead to the loss of cultural identity, heritage, and diversity. At present, landscape architecture has not been included as a main subject in architectural schools in Vietnam. Teaching landscape design as a main subject in architectural universities in Hanoi is needed.

As discussed in the individual part above, this housing project has provided the spiritual value of new progress and the development of a whole society, therefore contributing to ensuring collective well-being.

Cultural conservation

Building modern-type housing does not always cause a loss of cultural identity. It can also show a change of culture if it responds to the local climate and lifestyle. Although multi-floor apartments dominate the area, their design has been adapted to the Hanoi climate and provided an acceptable indoor environment. The residents found these dwellings suited their lifestyle and were satisfied with most issues in this housing project.

Developing modern housing types can show the change of culture into a more progressive level. New urban projects with complete infrastructure systems, including in high-rise apartments with elevators have replaced poor housing, showing the social development of Hanoi. However, this is not sufficient. Applying available advanced sustainable technologies such as solar hot water heaters could express a progressive society. (Solar hot water tanks are sold very cheaply in Hanoi, about the same price as electric ones while consuming no electricity).

Applying traditional design techniques in modern housing can both benefit the environment and express elements of local culture. The introduction of some street houses in this project shows the conservation of traditional architecture as it presents an evolvement of traditional housing. However, many traditional techniques have not been applied. Although all the houses have balconies and overhangs, most houses have no courtyards, only 23% of surveyed houses have pitched roofs (see Table 5.4), and 42% of the houses have shutter windows. Hanoi needs to apply more traditional design techniques to new housing development.

Using local skills in construction work can contribute to conserving culture. Most housing projects in Hanoi still use local skills and workers. The houses have a structure of concrete frame and bricks walls and therefore are suitable to the low-tech construction skill.

Building materials

Individual well-being

Using environmentally friendly materials (see materials part in environmental dimension) will also benefit individual and collective well-being because people need a healthy living environment. As well as this, sustainable materials need to be socially acceptable.

The materials used need to provide a feeling of good status (luxury or smart) and be modernity (updated). Modern materials such as concrete, brick, and glass are socially acceptable in Hanoi. These modern materials also provide a higher comfort for the users since they require low energy and less time consumed on maintenance and replacement.

Collective well-being

Using modern materials such as brick and concrete can reduce the disturbance to neighbours from regular maintenance and replacement works required with many traditional materials such as bamboo and straw.

Cultural conservation

Using modern materials reflects the new value of culture since culture is continually changing. The society of Hanoi has accepted many modern materials. Where these modern materials are sourced from sustainable local materials they can be said to support the local culture, providing in the process the environment is not degraded.

Systems and appliances

Applying sustainable systems and appliances can improve individuals and collective social well-being, as well as cultural conservation.

Individual and collective well-being

Applying environmentally friendly systems and appliances such as water and waste recycling and energy efficient appliances and renewable energies often costs more initially and sometimes causes inconvenience. However, it could improve individual well-being as the users would find themselves progressive, and they could improve their quality of life of themselves by contributing to the sustainability of the Earth they live in.

As these systems are often claimed to be expensive and complicated, the technical sector needs to make environmentally friendly systems and appliances more convenient and affordable for users. Setting up technical support for installation, operation, and maintenance of these new systems and appliances is very important. Experience from many new technological application projects in the world shows that following up services (operation and maintenance) is very important in ensuring the success of a project.

Cultural conservation

Many modern environmentally friendly systems are developed from tradition. Solar energy has long been used for heating, drying, and cleaning. Collecting rainwater from roof for daily use has been applied in Vietnam for a long time. Recycling organic waste for agriculture fertilizer has been applied in Vietnam for thousands of years. Therefore, applying environmentally friendly systems and appliances is one way to conserve traditional culture.

8.2.2.2 Social instruments

Individual

Individual well-being

Taking environmental actions can contribute to improving individuals' social well-being. While taking environmental protection activities as described in the individual section on environmental dimensions, an individual becomes an environmentally friendly person. He/she automatically becomes a progressive person in the society. However, taking environmental action requires an individual to change many habits in his/her lifestyle, such as consuming less and using public rather than private transport. Although taking environmental actions may cost time, energy, and money, it can make people feel good as they find themselves useful for the society and that they can contribute to improving the environment they live in. However, this way of thinking is not naturally available, but built up through information and education. Therefore, education and information media need to demonstrate sustainable lifestyles.

Complying with family planning (each family has no more than two children) helps individuals to save time and money to gain a better quality of life for all family members. This also could save society the cost of providing houses, food, health care, and education. Hanoi has been conducting family planning very well.

Involving residents in designing their house, improving knowledge for the residents, and advising them to pay more attention to architectural advice can promote social suitability in housing. The respondents living in high-rise apartments were not allowed to participate in designing and building their apartments. This has caused more complaints of quality, and renovations in apartments than in other housing types. Respondents living in street and detached houses have more often designed their own houses to obtain their visual and spiritual needs of pride and identity. However, with a lack of knowledge, many built their house without a respect for professional consultancy and found inconveniences only after they had lived in them.

Community involvement is required for obtaining sustainability and has been applied in many places in the world. An example is an apartment project in Hensingbörg, Sweden developed by the Local Municipality (site visit, 1996). The apartments were sold before being built and the buyers could choose the position, area, interior designs, and finished solutions for their apartments. Promoting local involvement in housing projects when providing "a full range of options of what is possible within context" (Rudlin & Falk, 1999, p. 205) is needed in Hanoi. Some attached houses in Hanoi have applied this method as they were sold without finishing, letting homebuyers complete the finishing.

As discussed before, people can have a more productive and secure life when living in an extended family. The extended family has been argued as ensuring security for people in critical life times such as in old age and illness, especially in Vietnam where houses for the elderly and nursing homes are very rare. The recent increase in income due to economic development makes the continuity of these efficient living arrangements uncertain as more people can afford a private home (Hall, 2000). However, as many respondents in Hanoi recognize and appreciate the emotional, convenient, and traditional benefit of the extended family and the problem of loneliness of old age parents when living alone, the extended family will not disappear very fast. Among 35% of households in Linh Dam Lakes living in an extended family, 86% of them were satisfied with their living arrangement. About 62% of the respondents not living with their parents wanted to live with their parents.

Collective well-being

As well as taking sustainable actions (see individual part in environmental dimension) a self-help spirit in accessing housing of individuals can promote collective well-being. The respondents in Hanoi have been active in buying and building houses for themselves instead of waiting for a subsidy from the government as existed before 1990. Though having low income, the people in Hanoi have managed to actively improve their living conditions. Self-built housing was 75% of the total housing in Hanoi up to the year 2000 (HPC, 2000, p. 3-1). The living standard of people in Hanoi has improved considerably since then. This has contributed a lot to individual and collective well-being. Economic development and available high quality building materials have provided people with the ability to build good houses to improve their living conditions.

Promoting neighbour relationships enhances individual and community well-being. The individuals in the project had a close relationship with neighbours as they have frequent social visits. The respondents were satisfied with the social relationship with neighbours (level 4.3).

While some individual benefits may be reduced by taking into account collective benefits, sustainability requires individuals to consider the collective benefit when making decisions for action. For example, while living in an extended family benefits the collective, an individual may have to compromise his/her independence and privacy. Therefore, individuals will have to make decisions about the way he/she lives depending on his/her personal situation.

Culture conservation

Individuals need to respect and maintain traditional lifestyles. Cultural conservation can be expressed through continuing traditional lifestyle such as extended family living arrangements, rich social relationships within relatives and neighbourhoods/ communities in Hanoi. People in Hanoi often have close relationships with neighbours as they know and are willing to help each other in daily matters, especially in critical times. Family members often like to live close to each other and keep regular communication.

City

The city needs to go ahead in setting up sustainable housing projects. Local governors have taken some steps to promote social sustainability. The policy of building new urban projects in Hanoi is a big step in moving towards improving living conditions for many local people.

Individual and collective well-being

Developing new urban projects can provide homes for many people, and promote individual and collective well-being. Many respondents expressed their happiness when moving into this new housing area as they found this new area presents a progressive society. The good points of this project have been pointed out, including good planning, complete infrastructure, good amenities, and good service facilities. The developers and policy makers in Hanoi saw this as a revolution moving from unplanned small-scale self-built poor quality housing in the past decades into planned, big-scale, and modern urban housing. Although some architects are afraid that this big-scale development with high-rise houses may internationalize Hanoi and cause the loss of its valuable character, the local community is happy with it. It presents contemporary local culture and provides for individual and collective well-being.

As a home ownership certificate is generally difficult to obtain, changing administrative custom to provide legality for home ownership could provide well-being for people in Hanoi. The new urban projects have created an easy way to provide home ownership certificates.

Besides this, providing a home loan system and building low cost housing are needed to promote equity in access to housing to enhance home ownership. The occupants in Linh Dam Lakes were not satisfied with the cost of the houses. This reflects the reality that the current high price of housing compared to the generally low income of Hanoi people has limited access to housing.

The city also needs to provide policies to promote an equal distribution of wealth and income by ensuring high-income earners pay tax and providing social welfare for disadvantaged people. While many high-income earners do not pay tax because most real incomes are not reported, the social welfare system in Hanoi at present is very weak (generally, disadvantaged people received no support from the government).

Improving the position of women in society, such as providing equal job opportunities, can promote gender equity in income. Gender inequity in designing, building, and changes in the house seem to be associated with the higher income level of men than women. The current inequity in job opportunity is common in Hanoi as most jobs advertised in newspapers indicate clearly the selection of men.

Culture conservation

Developing new urban projects can help to protect traditional villages in Hanoi's suburbs from urbanization. Due to the lack of housing and high population, many traditional job villages such as flower villages and ceramic villages are in danger of being lost as farmlands and gardens have been converted into high-density streets. The development of these urban projects provides alternatives for home seekers and saves the traditional job villages from urbanization.

On the other hand, Hanoi's housing needs to develop but not lose itself. While trying to meet the high housing demand, it is important to avoid the loss of culture or the internationalization of architecture. Highlighting spiritual and cultural values such as applying street houses and traditional design techniques in housing projects can help to avoid the loss of culture of Hanoi.

National/global

Activities to reduce poverty and improve living standards for local people are needed in Vietnam. Currently, the government of Vietnam has a Poverty Eradication Program (Chương trình xóa đói giảm nghèo) that provides funds for building roads, schools, and ward clinics in the poor communities. This helps the communities to improve living conditions, including education and health care, and provides opportunities to access and exchange goods with other locations to enhance local economic growth. In 1993, 25% of the population was living in poverty but this figure was reduced to 15% in 1998 (HPC & Daewoo, 2000). Other sustainable activities need to be extended widely in Vietnam and Hanoi.

As rich nations have more opportunities, taking a moral lead is needed. The rich nations need to start to build up a sustainable society for themselves and help the poor nations/communities to develop a more secure society where everyone can have access to shelter, food, and education.

8.2.2.3 Economic instruments

Economic growth

Economic growth can generate wealth for society to improve living quality and create opportunities to implement sustainable projects. Economic growth needs to consider taking into account long-term benefits to make sure the growth is sustainable. Economic growth also needs to consider equal income distribution to contribute to ensuring social equity. The development of 58 urban projects at present in Hanoi (up to year 2005) can create a lot of economic and social benefit by providing long-term jobs in construction, maintenance, and management. It also provides better quality housing for many urban residents to reduce the social stress caused from shortage and low quality housing in Hanoi. The financial benefit gained from these urban projects can be invested in other housing projects or other sustainable activities.

Economic growth could help to increase income to enhance access to housing and affordability for homebuyers and provide the opportunities to implement sustainable housing projects. Applying efficient appliances and water and renewable energies may require high investment costs but will reduce the long term cost and save finance for the city that can be invested in other sustainable projects. For example, investment in applying energy efficient appliances for households can reduce energy consumption that results in saving the city from building new electricity generators. The saved finance can then be used to improve living quality or to conserve cultural heritage in residential areas.

Fiscal

Taxation on high incomes and consumption can promote social well-being. High taxes can contribute to reducing high consumption that will help to reduce environmental and social destruction.

Taxes on high consumption together with other regulations could encourage people to consume less, have a more sustainable lifestyle, and become environmentally friendly persons. This may help lead to a more sustainable society.

Monetary

As discussed before, a home loan system is needed in Hanoi in the future. A reasonable interest rate would enhance access to housing and affordability for homebuyers when paying mortgages to enhance home ownership.

Institutional

See institutional part in environmental dimension above.

8.2.3 Economic dimensions

8.2.3.1 Technological instruments

Planning

Economic development

Developing new urban projects could provide long-term jobs and a net capital benefit for the city. Housing projects need to maintain and promote the current businesses and jobs in the surrounding areas and create new business opportunities in the area. Building housing that is attractive to the market could provide an economic benefit. Most houses in Linh Dam Lakes were sold before being completed. The respondents in Hanoi were satisfied with the cost of buying the houses (at level 4.1) as residential property values have increased a lot since the project was built three years ago. The households were satisfied with the benefit from their housing investment (level 3.8).

Housing projects need to protect urban agriculture in surrounding areas. The Linh Dam Lakes project has encouraged agriculture in surrounding areas as it provides a market for local agricultural products by introducing a large number of new consumers, the residents living in this project.

Conserving resources could enhance long-term economic growth. The method to conserve resources can be seen in the 'conserve resource' part in the environmental dimension above.

Affordability

The planning of a project needs to take into account the affordability for home purchasers by introducing affordable housing and encouraging a home business (such as opening a shop) to increase household income.

Design

Economic development

Building variable housing standards with variable prices can enhance the market attraction and provide economic benefit for the housing project. As well as developing high standard housing in new urban projects, Hanoi has built for sale some low cost six-floor walk up apartments.

Ensuring benefits from shops and gardens can increase property value and the urban economy. Designing gardens and courtyards for houses and in high-rise apartments can create benefits from a home garden. Due to the new establishment and incompletion of the area, the benefit from home shops in the area has not been high but this will be improved when the project is completed. The residents in Hanoi were not satisfied with the benefits from shops (level 3.3, Table 6.2.21). As most houses in Hanoi have no garden, the residents were not satisfied with the benefit from gardens (level 2, Table 6.2.21).

Applying design guidelines to promote resource conservation can contribute to ensuring economic growth in the long term. The guidelines can be seen in the resource conservation part in the environmental dimension above.

Affordability

As affordability is the percentage of housing cost per household's income, increasing income and reducing housing costs could enhance affordability. Building low cost housing is one way to enhance home ownership to promote collective social well-being. The high-rise apartments in Linh Dam Lakes were built with the aim of providing affordable housing for middle-income earners. However, the house and land price has increased very fast since 2001, making it unaffordable for many. As the number of these apartments is increasing and large, the price of these apartments may go down and become affordable for more people in the near future.

Housing projects need to include variable housing standards and prices to enhance access to housing for different income levels. Flexible design (incomplete finishing) can also give homebuyers an opportunity to choose the finishing standard they can afford.

Materials

Economic development

Applying guidelines for materials to conserve resources can help in ensuring long term economic growth. These guidelines can be seen in the conserving resources part in the environmental dimension.

Affordability

Using materials that are produced locally and are affordable could help to reduce the cost of housing, hence enhancing the affordability of housing.

Systems and appliances

Economic development

Applying guidelines for systems and appliances to conserve resources can help in ensuring long-term economic growth. These guidelines can be seen in the conserving resources part in the environmental dimension.

Affordability

When applying systems and appliances, it is necessary to provide affordable costs in buying and operating them.

8.2.3.2 Social instruments

Individual

Economic development

Individuals consider conserving resources in daily life would contribute to long term economic growth (see the guidelines for individual in the 'conserve resources' part of the environmental dimension).

Beside this, individuals could contribute to enhance economic development by opening a shop or business at home using redundant labour in the family. This could not only generate family economic and contribute wealth to society but also could help to save resources in building big shopping centers and save time and travel for shopping for the clients living in the area. Investments on housing can also bring economic benefits to the family and society.

Affordability

Creating a family business (for example opening a shop at home) or net benefit from housing investment can increase household income. This will help to enhance affordability for housing and other needs.

City

Economic development

Developing new urban projects could encourage urban economic development. It also provides better living quality for people so they can have better health and finance to contribute to economic activities. The current government policy encouraging small private business has contributed a lot of capital benefit to society and promoted economic growth.

As the current housing developments have brought to Hanoi many social and economic benefits, introducing policies and finance would encourage the development of new housing and rebuilding old housing.

Applying guidelines to conserve resources can also contribute to ensuring economic development (see in environmental dimension).

Affordability

Setting up a home loan system with reasonable interest rates would enhance affordability for home purchasers. Besides developing high standard housing, introducing affordable housing and provide some financial support for low-income housing projects is needed.

National/Global policies

Economic development and affordability

Ensuring a fair trade between the rich and poor nations such as increasing the price of raw resources is important. The current unfair trade existing between rich and poor nations leads to raw resources flowing from poor nations to rich nations due to the low price of raw resources exported from poor to rich nations.

8.2.3.3 Economic instruments

Economic growth

Economic development

To promote long term economic development, economic activities conducted in housing development needs to consider embodying guidelines for resource conservation introduced in the environmental dimension part above.

Fiscal

Economic development

Applying taxation to resource use can promote an economic development that is based mainly on renewable resources to promote long-term economic development.

Affordability

Subsidies for first homebuyers and low-income earners can help to increase housing accessibility, and contribute to enhancing affordability.

Monetary

Economic development

Controlling low interest rate loans for housing development and environmental services could promote economic growth.

Affordability

Interest rates set up for home loans in the future need to provide for affordability by considering house prices and people's income and households' daily expenses.

Institutional

Economic development and affordability

The current government funding/loan is mainly used for developing infrastructure and housing. The government needs to provide loans for sustainable projects and technologies, and home loans. Financial sources can also be drawn from international aid, local monetary systems, and housing development itself (see in environmental dimension above).

8.2.4 Summary & discussion

A framework for sustainable housing was developed to evaluate and propose guidelines for sustainable housing. Guidelines for housing development in Hanoi were developed to illustrate the way to use this framework.

The framework has included multiple dimensions, instruments, and ends of sustainable housing available in the reviewed literature and fieldwork conducted in Adelaide and Hanoi. The framework presents the comprehensive character of sustainable housing. The detail can be seen in Table 8.1 and Table 8.2.

This framework therefore can be used to evaluate the sustainability of any housing project by checking the quantity and quality of the applied instruments and achieved ends of the project. The framework was built flexibly, therefore the users can determine relevant instruments and ends wherever suitable to local context and add elements to address local issues that are not included in the framework. This suggests each locality can build up a specific framework suitable to its local context. Moreover, as values of the elements in the framework are ranked by local people depending on its socio-economic and environmental condition, the values would be different for each context. So the framework for sustainable housing can be used worldwide but the applicability of its elements and the value of the elements are contextually dependent.

The guidelines for sustainable housing in Hanoi have used all relevant elements of the general framework whenever applicable. The values of the elements of the framework ranked by households in Hanoi help evaluate the sustainability of the housing projects. Based on this, guidelines for sustainable housing in Hanoi were proposed by promoting opportunities and diminishing barriers of the instruments to achieve better ends for sustainable housing.

As discussed in Chapter 2, sustainability in Asian philosophies has a flexible and changing status, the proposed guidelines for sustainable housing in Hanoi are flexible. Sustainable housing is an evolving process. A housing project could set up several developing stages to allow for delaying some tasks for latter stages when difficulties can be overcome. Current preparation for the future would save energy and resources. For example, although the guidelines suggested recycling water, due to difficulties in technology or finance, the project cannot apply it. However, setting up two separate sewage lines for black and gray water would help recycling in the future to be easier and cheaper.

As values of elements of the framework are contextually dependent, solutions to sustainable housing are also contextually dependent. To define the values of the elements of the framework, the users need to conduct an in-depth study of housing and the perception of the local stakeholders including residents, professionals, and policy makers, about the issues in housing. This also suggests that guidelines for a housing area may not be applicable to other areas. Moreover, the value of the elements changes when society changes. Some guidelines today may not be suitable to the situation of tomorrow. This suggests that updating the guidelines to make them suitable to a new situation is crucially needed.

This chapter has introduced a comprehensive framework of sustainable housing. The framework shows that sustainable housing has to take into account multiple dimensions and instruments and the conventional one-dimensional approach will not ensure sustainability for housing. Guidelines for sustainable housing in Hanoi proposed in this chapter have demonstrated one way to approach sustainable housing.

Chapter 9: Conclusion

9.1 Summary

This work has explored the multi-dimensional nature of sustainability and sustainable housing to build up a framework to evaluate the sustainability of housing projects. Literature about sustainability and sustainable housing was reviewed to build up a theoretical framework. Case studies of housing in Adelaide and Hanoi contributed practical elements for the theoretical framework to build up a comprehensive framework for sustainable housing. The comparison between the two cases showed the contextually dependent character of sustainability. Guidelines for sustainable housing for Hanoi were then proposed as an illustration of how the framework can be used.

Based on the literature review in current western discourse and eastern philosophies, this work declares that sustainable housing embodies multiple dimensions and requires a balance between different dimensions. This work argues that current housing practices introduced in literature as sustainable have actually not ensured sustainable outcomes as they often have embodied only a limited range of aspects and have not considered the multiple dimensions of sustainability. This work therefore has identified instruments and ends to build up a comprehensive framework of sustainable housing.

Sustainable housing is difficult to achieve in cities in developing countries where the needs of today's generation have not been met and therefore a sustainable future has not always been considered. Hanoi is one of those cities. As the researcher is from and therefore knows Hanoi very well, this work has proposed guidelines for sustainable housing in Hanoi based on its environmental, social, and economic context.

Chapter 2 discusses the meaning and instruments of sustainable housing and builds up a brief theoretical framework for assessing sustainability in housing. The current meanings and definitions of sustainability given by different organizations and institutions in the western discourse focus on different issues such as resource or ecosystem conservation, and sometimes are unclear. Humans have always positioned themselves above nature, with little understanding that their lives depend on the health of the environment they live in. Only recently, sustainability has been seen as including the multiple dimensions of the environment, society, and the economy (Scott, 1998; Auty & Brown, 1997; and Edwards, 1998).

This Chapter also identifies the instruments and ends of sustainability to define the key elements for the framework and their benefits and limitations. Technological, social, and economic *instruments* (means), and environmental, social, and economic ends in housing practices introduced in literature are reviewed. This chapter is concluded with the first proposed framework for sustainable housing including multiple dimensions (ends) and instruments (means) of sustainable housing.

Chapters 3 and 4 explore the background of the case studies in Adelaide and Hanoi to define the opportunities and barriers to sustainable housing in reality. The background of socio-economic and environmental conditions as well as the application of instruments of sustainability in housing practice in the two cases was evaluated.

Australia has environmental problems of land degradation; contamination on land and ground water; beach, river, and air pollution; soil erosion; damage to coastal ecosystem; limited fresh water and water salinization. The main contribution to the GDP from exporting non-renewable resources (for example coal) does not promise a sustainable economy. The high-energy consumption in residential areas relies 91% on burning fossil fuels. The high consumption lifestyle endangers resources conservation and environment quality as it creates a huge amount of household waste. The low-density settlement in metropolitan Adelaide causes urban sprawl that consumes many resources. The City of Adelaide had implemented some environmentally friendly housing projects but none have ensured sustainability.

Vietnam is an economically poor and densely populated country. The GDP is low as the economy is based mainly on exporting agricultural products. Environmental problems include deforestation; soil degradation; over fishing; limited ground water; ground water contamination; and flooding. Urbanization causes air and water pollution due to the high density, untreated solid wastes and sewage, mixture of industrial and residential areas, and emission from heavy traffic of massive motor vehicles (motorcycles) in the cities. The energy supply of hydropower (58%), coal (23%), and natural gas (19%) (see Figure 4.1) is not enough for the high and increasing demand. While renewable energies have not been promoted, nuclear power is being planned. Housing in Hanoi is dense and has not ensured the social and physical needs of its residents. The positive side is the extended family living arrangement that can help to save resources consumption, as people share houses and domestic appliances. This living arrangement may not change very fast due to its social expectation. The poor economic situation in Hanoi limits the application of sustainable technological systems of water recycling or renewable energies. Moreover, westernization causes an increase in consumption that mitigates against resource conservation. The government has not yet set up a concrete plan for approaching sustainability.

Chapter 5 describes the content, purpose, and form of the field survey of housing and sustainability in the two cases. The field survey investigated the knowledge, perception, attitudes, and actions of householders and professional stakeholders in many aspects of housing. The issues covered included general socio-economic issues, housing preference, the amount and usage of domestic appliances and systems, and the environmental and sustainability issues.

Chapter 6 presents the analysis of the data collected from the fieldwork. The perceptions of the respondents were compared to one another and differences between the two cases were discussed. This has answered the research question 2 about the context dependence of sustainable housing. Though this Chapter explores a large number of comparisons on many aspects, due to the main purpose of this study being seek differences, only a few attentions to the meaning of the differences was drawn.

The fieldwork conducted in Adelaide and Hanoi aimed at understanding in depth the real context of housing practice in the two cases. The fieldwork interviewed about 40 households and a number of professional stakeholders in each case. Interviews with households provided the users' view of current housing conditions and sustainable housing. Interviews with professional stakeholders including planners, architects, and developers gave information of current practices in the housing industry as well as their perception of sustainable housing and feasibility in the future. Data collected also helped to compare sustainable housing between the two cases to answer the research question 2 about the contextual dependence of sustainable housing and created the basis for evaluating the housing practices. Interviewing different stakeholders involved in the housing industry helped define gaps that need to be bridged to enhance good collaboration between different stakeholders in the community to enable sustainable housing. As the selected housing projects were developed around the year 2000, they therefore reflected current trends of social and market preferences, as well as the level of environmental concern of the local community.

The housing projects in Adelaide built in 1998-1999 were developed on unused land in an existing residential area following the principle of urban in-fill that aims to reduce urban sprawl. However, the current decrease in household size and increase in dwelling size compared to previous periods have caused a high consumption of land, energy, water and resources per head. Most of the houses are one floor detached and only a few are two floors attached houses. They often have double garages. The occupants were mainly couples without children yet they have two cars. The technological systems of water recycling and renewable energy (solar energy) have been introduced in some areas but were not applied in the projects being studied in this work.

The housing project in Hanoi is an urban development project built in a suburb with a mix of houses and high-rise apartments. The houses include many high-rise apartments, some attached street houses, and a few detached villages. The area was developed with a complete planning and infrastructure, presenting progress in the housing sector in Hanoi. This is the first of 58 urban projects planned to be built within the coming years aiming at solving the problem of lack of housing in Hanoi. However, a lack of concern for some environmental and social issues has not ensured sustainability in this project. The massive development often leads to a lack of consideration of the individual's preferences and identities.

Chapter 7 presents a comparison of the perceptions about preferable and sustainable housing between different stakeholder groups including the planners, developers, architects, and householders, and showed many gaps in their perceptions. Bridging these gaps can enhance the success of sustainable housing.

Chapter 8 builds a comprehensive framework of sustainable housing as can be seen in Table 8.2. The framework of sustainable housing presents a comprehensive picture including all ends and instruments of sustainable housing. It gathered all ends and instruments of sustainable housing in the reviewed literature and fieldworks conducted in the two case studies. This framework was built in a flexible way and can therefore be used for evaluating sustainable housing in any city. Guidelines for sustainable housing in Hanoi have been proposed by promoting opportunities and diminishing barriers of the instruments indicated in the framework, based on a trade-off between cost and benefit to enhance successes and minimize failures.

9.2 Discussion

The main contributions to knowledge offered by this thesis include a detailed exploration of the multiple dimensions of sustainability, the development of a framework for assessing sustainable housing, an investigation of the context dependence of sustainability and finally the application of the framework for generating guidelines for sustainable housing in Hanoi.

Main findings of this thesis include:

- Sustainability is a multi-dimensional cultural concept.

- Perceptions of sustainability (like perceptions of 'needs', income and well-being) are relative to personal experience and community expectations. Sustainability is a relative term. Some people allow themselves to use excessive resources while others are struggling to obtain their basic needs. This shows sustainability is also a moral/ethical issue.

- It is not housing or houses *per se* that are sustainable or not sustainable, but ways of living. Issues in sustainable housing get intertwined with issues of family planning, extended or nuclear families, lifestyle, age care, taxation, income, women's rights and power relationships, public transport and more.

- A generally applicable framework can be set out that draws attention to the multi-dimensional nature of housing sustainability. Any city can apply this framework to evaluate sustainability of housing and build guidelines for sustainable housing in that city.

- The application of the framework of sustainability is a working process (not a final end). It needs to be updated all the time to adapt to the changing status over time of the environmental, social, economic, and political situations in a local context.

9.2.1 Sustainability is a multi-dimensional concept

For decades, *sustainability* or *sustainable* terms have appeared in a number of public forums, literature, and international government conferences. However, the nature of these terms has not been clearly defined or confirmed. This has caused many incorrect applications and has even been abused for economic purposes. This work clarifies the nature of sustainability to help avoid mistakes and promote sustainable outcomes for housing practices.

The meaning of sustainability in this study was defined by combining modern Western discourses and Eastern philosophies. In Western discourse, most of the definitions of sustainability focus mainly on human interest and are narrow, limited to a few aspects such as resource conservation (for continuing economic growth), and ecosystem protection (for human survival) only. At Habitat II in 1996, sustainability was reinforced as embodying social, economic, and environmental dimensions. Although having a wider perspective, this meaning of sustainability is still often oriented to the benefit of the human species.

Sustainability has existed in Eastern philosophies since a long time ago and is different from the Western discourse. Sustainability is seen as a tool for achieving human benefit in the Western discourse, but human species are seen as only a part of sustainability in Eastern philosophies. Sustainability in Eastern philosophies is therefore conceived as not providing the best status for human species but ensuring a balanced status for all its elements. Although the current practice in the East has not ensured sustainability due to many reasons outside its philosophies, theoretically, its definition is convincing. Being aware of the uncertainties, this study accepts and combines the best available definitions from the West and East to declare the meaning of sustainability. *Sustainability has multiple dimensions including environmental, social, and economic dimensions and requires a balanced status of all dimensions.* This has answered a part of research question 1 - *How can housing projects (existing or proposed) be meaningfully evaluated by stakeholders as sustainable?*

9.2.2 Framework of sustainable housing

A framework of sustainable housing has been built based on literature reviews and data gathered from field studies to answer the last part of research question 1 - *What would be the nature and form of an assessment framework (including its elements)? Would this framework embody multiple dimensions?* This framework shows the multi-dimensional nature of sustainable housing and aims for general application. The theoretical framework includes elements found in the literature related to sustainability, sustainable housing, sustainable city, and sustainable architecture. Case studies in Adelaide and Hanoi provided additional elements for the framework. The elements include all instruments of sustainable housing applied in housing practices in the two cases and the sustainable housing ends required in the perception of the housing occupants (householders) and professional stakeholders. The framework tries to embody all available instruments and ends to evaluate the sustainability of a housing project and to build up guidelines for sustainable housing in a city.

As the framework is flexible, the users (stakeholders) can identify relevant instruments and ends in the framework that are applicable to the context of the project. In order to know what instruments and ends of the framework are relevant to the local context, a range of consultative techniques including survey, focus group, workshop, public meeting, local community forum, consultative committee can be used. These consultations would aim at defining the applicability and values (importance and expected/accepted satiation levels) of the instruments and ends for the project at hand. This would also help in developing indicators to define the successes and failures of a completed housing project by checking the quantity and quality of the applied instruments and achieved ends of the project. The suggestion is that each locality can build up a specific framework suitable to its local context. Moreover, as the values of the elements in the framework are ranked by local people, the values (expectations, priorities, and the like) would be different for each context, depending on its socio-economic and environmental condition. The framework for sustainable housing can be used worldwide but the applicability of its elements and the value of the elements are contextually dependent. The comprehensive framework can be seen in Table 8.1.

9.2.3 Sustainable housing is contextually dependent

This work demonstrated the contextually dependent characters of sustainable housing to answer research question 2 - *Is the meaning of sustainable housing context specific? Would the framework and/or the values of some of the elements are different in Adelaide and Hanoi?* This work studied housing practices in two very different background cases, in Adelaide and Hanoi, to compare the perceptions of the local people about the meaning of sustainability and sustainable housing in the two contexts to identify differences between the two cases and points to the contextual nature of sustainable housing.

Technological instruments were different in the two cases (see section 6.1). Housing development often depends on the local land availability, climatic conditions, available building materials, technological development, and social, cultural, and economic conditions. As these factors are different in the two cases, the housing construction and design were different. Beside this, and perhaps more importantly, the household traveling mode, energy use and water consumption were different due to the difference in lifestyle and urban patterns in the two cases. This work suggests that Hanoi should not repeat the lifestyle of car and appliance dependence of Adelaide while Adelaide needs to change to a more efficient lifestyle. The application of green systems was limited in both cases due to limited knowledge, high initial cost, and mainly - the social acceptance of the respondents of these systems. This suggests that providing information and education to change social perception about these technological systems is important to promote the use of these systems.

In addition, the perceptions of the householders in the two cases about living arrangements, neighbourhood, and preferred houses were different (see section 6.2). The people in Hanoi were willing to have more people sharing a house and appeared to have a richer relationship with neighbours than in Adelaide. Unlike the respondents in Adelaide, the respondents in Hanoi preferred street houses as they found detached houses too expensive and isolated (see section 6.2.3). The perceptions of the householders in the two cases about space, privacy, and housing types were also different. This suggests once more that sustainable housing in the two cases is different and depends very much on its culture.

Having a lower GDP, housing affordability in Hanoi was lower than in Adelaide and the financial resources is different in the two cases (see section 6.3). Besides earnings, while the householders in Adelaide rely a lot on bank loans, the people in Hanoi rely on borrowing from relatives and friends to buy a house because no home loan system has yet been set up in Hanoi. A home loan system introduced in Hanoi would increase affordability and access to home ownership. The respondents in the two cases also had different perceptions about dimensions of sustainability (see section 6.4). Economy was seen as an independent factor in Adelaide while it was only seen as dependent to the social factor in Hanoi.

This work has found that some elements of the framework of sustainable housing could be suitable to one context but not the other, for example Feng Shui application was mentioned in Hanoi but not in Adelaide. Housing preference is also not the same in the two cases (see 6.2.3), for instance, detached houses were preferred in Adelaide more than in Hanoi. Moreover, the values of the elements of sustainable housing were seen differently in the local people's perception in Hanoi and Adelaide. While the households in Adelaide found their detached houses with gardens too close to their neighbours, the households in Hanoi found detached houses isolated and lonely. This shows sustainable housing is different in different contexts and there is no one model for sustainable housing for the whole world. Sustainable housing can be based tightly on local context, especially the social and cultural context. Technological transfer needs to be adaptable to local context to avoid failure.

9.2.4 Sustainability is a relative term.

Perceptions of sustainable housing such as needs in housing, income, and well-being are relative to personal experience and community expectations and are different in the two cases. Although the households in Adelaide used many more resources than the households in Hanoi, both groups thought they were at nearly the same level of satisfaction (see section 6.2.3) or 'green-ness' (see section 6.1.5). *Understanding of sustainability is relative.*

As the global economy is growing, more people will be able to afford using more energy and resources, this causes their needs to grow, not only in rich nations but also in developing nations like Vietnam. With this tendency of life, sustainability seems to be hard to obtain. While most people see themselves as being concerned for the environment (see section 6.4) discounting how many resources they consumed, a change for the better would be very difficult.

9.2.5 Gaps in understanding sustainability

Results from interviewing stakeholders (see Chapter 7) also show that the stakeholders have different perceptions about a good house, sustainable housing, and the importance of issues in housing. The factors they considered when building and designing housing are different and depend on the local context. The architects, builders, and planners in Adelaide seem to be concerned more with social, economic, and environmental dimensions while these stakeholders in Hanoi considered mainly the social and environmental dimensions when building houses (see section 7.2). The households in the both cases were concerned with many social and economic issues but with only a few environmental issues when defining sustainable housing (see section 7.3). Although seeing the importance of multiple dimensions of sustainability, their housing practices and solutions for housing in the future do not seem to embody multiple dimensions. Moreover, generally, stakeholders in the both cases did not see a link between global and local environmental problems (see sections 6.4.2 and 7.10). Stakeholders in both Adelaide and Hanoi saw more environmental problems at a global level but less at a national and local level (see Figure 6.4.4). The stakeholders in Hanoi tended to see more day-to-day local problems than the stakeholders in Adelaide while the stakeholders in Adelaide saw more global problems than those in Hanoi.

Bridging the gaps of knowledge and perceptions between the stakeholders is important. The co-operation between social experts (householders), technological professionals (architects), economic experts (developers), and city managers (planners) could enable the collaboration of multiple instruments of sustainability to promise sustainable outcomes. Many issues such as living arrangements, consumption levels, and lifestyle are a part of sustainable housing but are out of the hand of many professional stakeholders, therefore collaboration between the professional stakeholders and with the householders is needed for the development of sustainable housing. Further collaborations with related sectors or plans that are not in housing sector but could contribute a lot to the success of sustainable housing. These are family planning, raising income, introducing taxes, enhancing gender equity, and so on.

9.2.6 Guidelines for sustainable housing for Hanoi

Based on the developed framework, guidelines for sustainable housing for Hanoi were proposed to answer research question 3 - *What guidelines could be suggested for sustainable housing in present day Hanoi?* This aims to illustrate the way for stakeholders to use this framework by the stakeholders. Hanoi needs to maintain the high density and multiple housing types, including high-rise apartments with a good quality and standard. To promote energy conservation, housing in Hanoi needs to apply the traditional techniques of south facing windows, courtyards, pitched roofs, as well as new renewable technological systems such as solar hot water heating, water and waste recycling. Together with these, applying social instruments is important. Education and information about sustainability and its instruments can increase people's awareness and willingness to pay. To enhance social sustainability, housing projects need to consider involving users in the design and construction process. Encouraging more people to share a house (such as in an extended family) can promote resources conservation and social security. Providing gender and age equity in housing design can enhance the suitability of the house to all households' members. Gender equity can be obtained by ensuring gender equity in work and promotion. Flexible housing design could be effective for approaching sustainability as it enhances social satisfaction and promotes economic growth by promoting affordability for different income levels. Taxation and charges applied to high use of electricity and especially water would conserve resources and enhance social equity.

9.2.7 The adaptability and changeability of sustainable housing

As discussed in Chapter 2, sustainability in Eastern philosophies has a flexible and changing status, therefore frameworks or guidelines for sustainable housing are not fixed. The users of the frameworks and guidelines need to be flexible when applying them. Sustainable housing is an evolving process therefore a housing project may need to set up several developing stages to allow for delaying some tasks to later stages when all difficulties have been overcome. The preparation for the future from now may save a lot of energy and resources. For example, although the guidelines suggest recycling water, due to difficulties in technology or finance, a project may not be able to apply it. However, setting up two separate sewage lines for back and gray water may help the application of recycling technologies in the future by making it easier and cheaper. Sustainable housing requires adaptability and changeability. New housing developments can be sustainable if they are environmentally, socially and economically suited to the locality at the time. On the other hand, all these factors are subject to change over time, and social change could enhance social acceptability.

As values of the elements of the assessment framework are contextually dependent, the solutions to sustainable housing must be contextually dependent. To define true values of the elements of the framework, an in-depth study of housing and the perception of the residents and professionals about issues in housing need to be conducted. This also suggests that guidelines for one housing area may not be applicable to other areas. Moreover, when society changes over time, the values of the elements change. Some guidelines today may not be suitable to the situations of tomorrow. This suggests that updating the guidelines, to be suitable to new situations, is crucially needed.

9.4 Suggestion for further studies

The developed framework provides a basis for building guidelines for sustainable housing in any context. Further studies could be based on the proposed framework to build a specific framework for a locality by employing relevant elements. This could help to propose sustainable housing solutions and guidelines for other locations. For instance, a framework of sustainable housing for a housing project in Adelaide and other cities in Australia can be built by identifying all elements that are relevant to their context. Based on the value of its elements assessed by the local stakeholders, proposals for a sustainable housing project could be prompted.

"You should never plan a road if you haven't visited the place many times. It is not enough to go there once... You should go in different moods. You should go when you're drunk, and try the feeling of how it is to sing in the forest. You should go the following day when you have a hangover. You should go when your heart broken... Then perhaps you know if you can build that road or not"

Risto Lotvonen, resident of Hyvinkää (quoted in Vernon Pratt, Jane Harwarth, and Emily Brady, 2000, 159)

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Appendices

Appendix A. The checklists and descriptions for sustainability

A1: The original checklist for sustainable architecture (Williamson, 2001, Appendix 1) is pasted below:

A Partial Checklist for Sustainable Architecture

Discourse issue	*Stakeholders*	*Objectives*	*Principal active stakeholders*	*Architects' possible process means*	*Aspects of possible product means*	*Notes*
1. Environmental impact						
Climate change	Many existing ecosystems, present and future generations of people.	• **Reduce lifecycle greenhouse gas emissions** • **Create carbon sinks** • **Mitigate effects of possible climate change**	Designers, clients, occupiers, government, builders, product manufacturers	• Life cycle greenhouse gas analysis. • Work with client and occupiers on future operation of the building. • Work with client in considering the wider system of which the building is a part. • Work with builders and product manufacturers on production sources and processes	*Consider:* • Reducing the need for heating and cooling through building form, materials, and control systems. • Using forms of energy in the operation of the building that does not produce greenhouse gases. • Using highly energy efficient appliances, water heating and space heating and cooling systems. • Using materials and equipment where the use of fuels producing greenhouse gases in their extraction, manufacture and transport is low. • Allowing for uncertain future climate. • Planting trees.	• Credible local data for a life cycle greenhouse gas analysis is hard to find. • There are many published strategies for reducing the need for energy-using heating and cooling systems: shading, orientation, insulation, Trombe walls, ventilation chimneys, geo-thermal systems, double skin enclosures, etc. Remember local context, the 'credibility, transferability, dependability and confirmability' criteria, and the need for a life-cycle (and not just operating) impact perspective. • Future climate change may effect rain, wind, temperatures etc.

Discourse issue	*Stakeholders*	***Objectives***	*Principal active stakeholders*	*Architects' possible process means*	*Aspects of possible product means*	*Notes*
Pollution	Many existing ecosystems, including present and future generations of people.	• **Reduce acid rain** • **Reduce air pollution** • **Reduce water pollution** • **Reduce land pollution**	Designers, clients, occupiers, government, builders, product manufacturers	• Life cycle pollution impact analysis. • Work with client and occupiers on future operation of the building. • Work with client in considering the wider system of which the building is a part. • Work with builders and product manufacturers on production sources and processes.	*Consider reducing pollution during construction by:* • Reducing waste materials. • Using components that have caused little pollution in extraction, manufacture and transport. *Consider reducing pollution during building operation by:* • using non-polluting energy sources • avoiding potential polluted surface water run-off • recycling water *Consider reducing pollution at end of building or component life by:* • using long life materials • using biodegradable materials • using recyclable materials	• Credible local data for a pollution impact analysis is hard to find. • Re-using buildings (see 'longevity') and building components is a significant means of reducing land fill. • The generation of nuclear energy creates no greenhouse gases, but does create potentially serious sources of pollution.

Discourse issue	*Stakeholders*	*Objectives*	*Principal active stakeholders*	*Architects' possible process means*	*Aspects of possible product means*	*Notes*
Resource depletion	Present and future generations of people.	**Use resources wisely**	Designers, clients, occupiers, government, builders, product manufacturers	Determine renewability and rarity of resources	*Consider:* • Using renewable resources (eg plantation timber, managed regrowth timber, solar energy) • Using plentiful resources (many building stones, clays, silicon, iron ore) • Very careful, appropriate use of rare and non-renewable resources. • Building small.	• Adding 'intellectual' value by good design while limiting resource use by 'building small' may be an effective strategy for this and other environmental objectives.
Bio-diversity	Many existing ecosystems, including present and future generations of people.	**Avoid actions that lead to reduction of biodiversity**	Designers, clients, government, product manufacturers	Determine what ecosystems are effected by the project, and how.	*Consider:* • Avoiding building in places that are particularly significant for biodiversity. • Using timber with an authoritative certificate of origin. • Shifting use of rainforest timbers to low-volume, high value applications. • Creating landscapes rich in biodiversity.	• The reduction of rainforest is often cited as the most urgent issue in maintaining biodiversity. • Consider water- as well as land-based ecosystems.
Indigenous flora and fauna	Local non-human ecosystems	▪ Minimize disturbance to local flora and fauna ▪ Maintain viability of local ecosystems	Designers, owners, government	Analyse existing local ecosystems	*Consider:* • Minimal building footprint. • Minimal disturbance to surrounding vegetation. • Leaving wildlife movement corridors. • Designing to avoid bird strikes on windows, wind turbines, etc.	There are places where the appropriate *overall* decision is not to build at all.

Discourse issue	*Stakeholders*	***Objectives***	*Principal active stakeholders*	*Architects' possible process means*	*Aspects of possible product means*	*Notes*
2. Social and Cultural Relevance						
Society and culture	People	▪ **Reflect and express culture** ▪ **Relate built form to social and economic activity** ▪ **Maintain significant building heritage values** ▪ **Create future heritage value**	Design professionals, owners government	• Consult with local community about buildings and urban patterns that are socially and culturally relevant to it. • Work with government on the development of appropriate development and heritage guidelines. • Invite peer and public review.	*Consider:* • Using locally sourced materials. • Designing to enable the use of locally sourced skills for construction and future maintenance. • Adapting existing buildings. • Maintaining existing mix of spaces for living, trade and social activities. • Maintaining existing scale and typologies of buildings. • Emphasising public space. • Respecting existing built context. • Using pre-used 'blighted' sites rather than 'green field' sites.	• Achieving a balance between 'continuity' and 'vitality' is central to this issue. • The 'culture' or 'society' for which relevance is sought may not be a geographically-defined entity or group. • There is much published advice about strategies for community consultation.

Discourse issue	*Stakeholders*	***Objectives***	*Principal active stakeholders*	*Architects' possible process means*	*Aspects of possible product means*	*Notes*
3. Occupants						
Health	Occupants and neighbouring people	**Healthy people**	Designers, clients, government	Assess potential health impacts of design decisions.	*Consider* • Designing for high fresh air change rate (above minimum requirements) • Using materials with authoritative guarantees of non-toxicity. • Designing for easy cleaning and maintenance.	Health problems can arise through lack of anticipated maintenance – consider the likelihood and effects of breakdown in expected maintenance regimes.
Comfort	Occupants	• **Thermal comfort** • **Visual comfort** • **Aural comfort**	Designers, clients, government	Determine context-related preferences for 'comfort'.	*Consider* • Designing so that the building itself offers internal conditions that are within or approach culturally acceptable limits. • Using energy-using systems only when appropriate in relation to other sustainability issues.	• Perceptions of, and preferences for, comfort levels vary quite widely. • Preferences in the trade-off between 'comfort' and other qualities, such as indoor-outdoor links, also vary widely. • Acceptable variations in conditions partly depend on whether occupants are able to change activity and/or location in response to feelings of discomfort.

Discourse issue	*Stakeholders*	***Objectives***	*Principal active stakeholders*	*Architects' possible process means*	*Aspects of possible product means*	*Notes*
4. Economic performance						
Cost effective-ness	Clients, (other) people	▪ **Net benefit** ▪ **Return on investment**	Designers, financiers, clients, builders, government.	• Determine life-cycle costs. • Work with client in considering wider objectives and whether building is the best way to meet those objectives. • Recognise expertise of builder in cost-effective design. • Consider how uncertainty in economic conditions may effect building use and life. • Cost planning and control	*Consider* • Designing for low imported energy use. • Design for low maintenance	Also note the process and product means for 'longevity'.

Discourse issue	*Stakeholders*	*Objectives*	*Principal active stakeholders*	*Architects' possible process means*	*Aspects of possible product means*	*Notes*
5. The Building						
Longevity	Clients, (other) people	• **Durability** • **Adapt-ability** • **Service-ability** • **Maintain-ability**	Designers, clients, government,	• Consult possible future users. • Seek flexibility in interpretation of 'fit' between use and building. • Work with client on asset management plan	*Consider* • Adapting and using existing building stock rather than building new. • Designing for adaptability and future change of use. • Using long-life materials. • Allowing provision for possible future services. • Using measures to protect from place-dependant risks such as bush fires and corrosive seaside air. • Designing for low maintenance and easy serviceability. • Allowing for uncertainty in future climate.	The potential physical life of a building may be much longer than its economic, functional, social, legal (eg changing fire, earthquake or disability access codes) or technological life. Buildings 'die' because they are deemed to be obsolete in any of these aspects. Moreover, (as with humans) 'death' typically occurs when only a part of the building 'fails'.

A2 Girardet has provided a list of features of a sustainable city:

- A *just city*, where justice, food shelter, education, health and hope are fairly distributed;
- A beautiful city, where art, architecture, and landscape spark the imagination and move spirit;
- A creative city, where open-mindedness and experimentation mobilise the full potential of its human resources and allows the fast response to change;
- An ecological city, which minimises its ecological impact, where landscape and built form are balanced and where buildings and infrastructure are safe and resource efficient;
- A city of easy contact and mobility, where information is exchanged both face-to face and electronically;
- A compact and polycentric city, which protects the countryside, focus and integrate communities within neighbourhoods and maximise proximity;
- Diverse cities, where a broad range of overlapping activities create animation, inspiration and foster a vital public life.

(Retyped from Girardet, 1999, p. 72)

He suggested , to help cities develop and implement viable sustainability policies, key questions have to be asked such as : Does my city _

- compile an annual environmental report?
- use life cycle analysis in its own purchasing decisions?
- support public environmental education?
- create jobs from environmental regeneration?
- practice comprehensive waste reduction and recycling?
- have policies for transport integration and pedestrianization?
- have plans to develop a sustainable energy system?
- encourage ecological business?
- support ecological architecture and new urban village?
- encourage urban agriculture and farmers market?
- create wildlife sanctuaries?
- avoid the use of timber from virgin forest? (p. 67)

A3: The compartments of Environmental Impacts Assessment (collected and retyped from Erickson, 1994)

Environmental	Social	Economic
Geological	Economic/ racial inequity	Employment/shopping facilities
Aquatic	Cultural inequity	Residential property values
Atmospheric	Sexual inequity	Property tax base
Biological	Age or generation inequity	Displaced residents
	Economic well-being	Displaced businesses
	Recreational opportunity	Remaining businesses
	Educational opportunities	New businesses
	Self- and social image	Multiple uses of local resources

A4: Eco-design (Rathenau et al., 1997, p.37)

Eco-design considers environmental aspects at all stages of the product development process, striving for products, which make the lowest possible environmental impact throughout the product lifecycle. In the end, eco-design should lead to more sustainable production and consumption. Other terms referring to the same approach are design for the environment, life cycle design, and environmentally conscious design and manufacturing.

The basic principles:
Sustainable development;
Cleaner production; and
The lifecycle approach

Check list of eco- design is scanned and pasted below:

The Ecodesign Checklist

NEEDS ANALYSIS

How does the product system actually fulfil social needs?	Ecodesign strategy @: New Concept Development[1]
● What are the product's main and auxiliary functions? ● Does the product fulfil these functions effectively and efficiently? ● What user needs does the product currently meet? ● Can the product functions be expanded or improved to fulfil users' needs better? ● Will this need change over a period of time? ● Can we anticipate this through (radical) product innovation?	● Dematerialization ● Shared use of the product ● Integration of functions ● Functional optimization of product (components)

Life cycle stage 1: PRODUCTION AND SUPPLY OF MATERIALS AND COMPONENTS

What problems can arise in the production and supply of materials and components?	Ecodesign strategy 1: Selection of low-impact materials[1]
● How much, and what types of plastic and rubber are used? ● How much, and what types of additives are used? ● How much, and what types of metals are used? ● How much, and what other types of materials (glass, ceramics etc.) are used? ● How much, and which type of surface treatment is used? ● What is the environmental profile of the components? ● How much energy is required to transport the components and materials?	● Clean materials ● Renewable materials ● Low energy content materials ● Recycled materials ● Recyclable materials **Ecodesign strategy 2: Reduction of material usage[1]** ● Reduction in weight ● Reduction in (transport) volume

Life cycle stage 2: IN-HOUSE PRODUCTION

What problems can arise in the production process in your own company?	Ecodesign strategy 3: Optimization of production techniques[1]
● How many, and what types of production processes are used (including connections, surface treatments, printing and labelling) ● How much, and what types of auxiliary materials are needed?[2] ● How high is the energy consumption? ● How much waste is generated? ● How many products don't meet the required quality norms?	● Alternative production techniques ● Fewer production steps ● Low/clean energy consumption ● Less production waste ● Few/clean production consumables

Life cycle stage 3: DISTRIBUTION

What problems arise in the distribution of the product to the customer?	Ecodesign strategy 2: Reduction of materials usage[1]
● What kind of transport packaging, bulk packaging and retail packaging are used (volumes, weights, materials, reusability) ● Which means of transport are used? ● Is transport efficiently organized?	● Reduction in weight ● Reduction in (transport) volume **Ecodesign strategy 4: Optimization of the distribution system[1]** ● Less/clean/reusable packaging ● Energy-efficient transport mode ● Energy-efficient logistics

[1] The suggested improvement options are further discussed in Module A, *Ecodesign Strategies*

[2] Auxiliary materials are solvents for cleaning, cutting oil for drilling, etc.

Life cycle stage 4: UTILIZATION

What problems arise when using, operating, servicing and repairing the product?	Ecodesign strategy 5: Reduction of impact in the user stage[3]
● How much, and what type of energy is required, direct or indirect?[1] ● How much, and what kind of consumables are needed?[2] ● What is the technical lifetime? ● How much maintenance and repairs are needed? ● What and how much auxiliary materials and energy are required for operating, servicing and repair? ● Can the product be disassembled by a layman? ● Are those parts often requiring replacement detachable? ● What is the aesthetic lifetime of the product?	● Low energy consumption ● Clean energy source ● Few consumables needed[2] ● Clean consumables ● No wastage of energy or consumables **Ecodesign strategy 6: Optimization of initial lifetime[3]** ● Reliability and durability ● Easy maintenance and repair ● Modular product structure ● Classic design[4] ● Strong product-user relation[5]

Life cycle stage 5: RECOVERY AND DISPOSAL

What problems can arise in the recovery and disposal of the product?	Ecodesign strategy 7: Optimization of the end-of-life system[6]
● How is the product currently disposed of? ● Are components or materials being reused? ● What components could be reused? ● Can the components be disassembled without damage? ● What materials are recyclable? ● Are the materials identifiable? ● Can they be detached quickly? ● Are any incompatible inks, surface treatments or stickers used? ● Are any hazardous components easily detachable? ● Do problems occur while incinerating non-reusable product parts?	● Reuse of product (components) ● Remanufacturing/refurbishing ● Recycling of materials ● Safe incineration

[1] While a shower head does not consume energy directly, it does determine indirectly how much energy is consumed for each shower.

[2] Consumables such as water/detergents for a washing machine, coffee/cups/filters for a coffee machine, films for cameras, paper for a copier etc.

[3] The suggested improvement options are further discussed in Module A, *Ecodesign Strategies*.

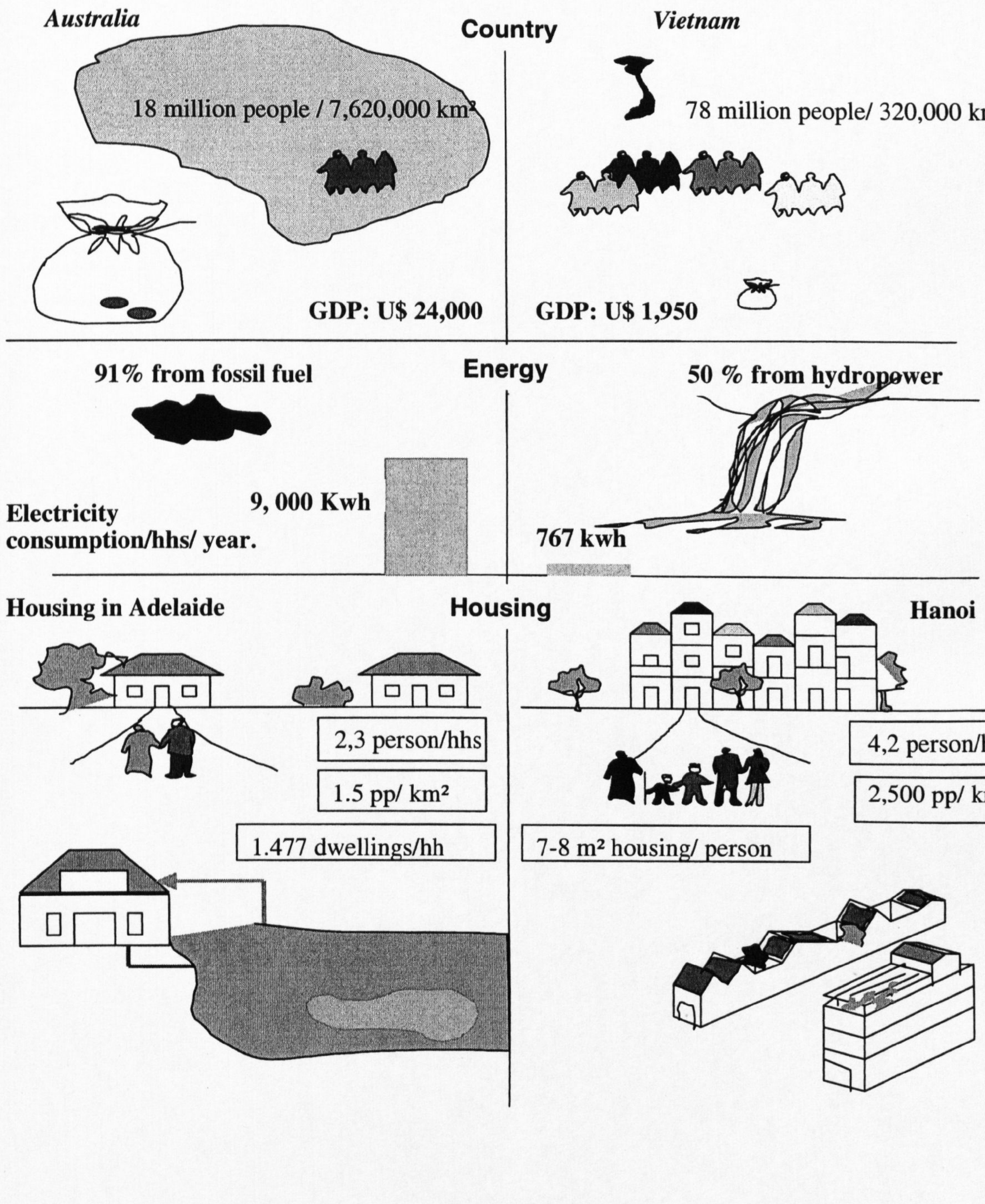
[4] A classic design refers to a product that will never become unfashionable such as many chairs, some of the Levi's jeans and the Citroën DS.

[5] A strong product-user relation is achieved when the customer takes the effort to have the product repaired instead of disposing of it after it is broken.

[6] The suggested improvement options are further discussed in Module A, *Ecodesign Strategies*, and in Module B, *Optimization of the End-of-Life System*.

Appendix B

Summary the background of the two cases



Note:

The average gross income of Adelaide was 28,300 A$ per capita per year (ABS, 2001, p. 149) while this was 1,300 A$ in Hanoi 1998 (HPC, 2000, 2-6). Other source: 1100 A$ in Hanoi 1998 yearly (HPC, 2000b, p. 2-6) and of Adelaide: 16,000 (ABS, 2001).

Appendix C

Embodied energy of building elements (Bennetts & Williamson, 2000)

Elements	Material	Embodied energy (MJ /m²)	Life-cycle CO2 production (Tonnes)
Floors	Concrete slap on ground	1045	
	Timber suspended	645	
Walls	Double brick	1220	89
	Brick veneer, timber frame	830	69
	Brick veneer, steel frame	940	67.5
	Weather board, timber frame	330	62
Roof	Concrete tire, timber frame	610	
	Concrete tire, steel frame	925	
	Steel decking, timber frame	800	
	Steel decking, steel frame	1115	

Appendix D

Questionnaires. These questionnaires were translated in to Vietnamese to be used in field survey in Hanoi.

D.1 *Questionnaires to households*

HH No.:

Suburb: Date of interview:

I. General social – economic - environmental issues related to housing

I would like to begin by asking you some questions about general social issues related to your household

1 a) Name: **R1** Male:................................ **R2** Female:....................................

b) Occupation: **R1**: ....**R2**:..

c) Education level: **R1**............................. **R2**: ....

2. Family members by age (number): Mark R1 and R2

<7		7-17		18-34		35-54		55-64		>65	
M (a)	F (b)	M (a)	F(b)	M(a)	F(b)	M(a)	F(b)	M (a)	F(b)	M(a)	F(b)

3. How many generations live in your house? ☐

4. a) What model of living arrangement does your family belong to?

Couple with dependent children ☐

Sole parent family with dependent children ☐

Couple without children ☐

Lone person ☐

Group (non family) ☐

Extended family (living with parents or married children) ☐

b) PROMPT: **If extended family:** Who are the extended members? How many of them?

Grandparents	Aunt	Uncle	Brother	Sister	Grandchildren	Others:

c) If not extended family: Where are your parents living?

1. In elder care centers ☐
2. With other children ☐
3. By themselves ☐
4. Passed away ☐
5. Others ☐

d) Do your parents have any difficulties in their living arrangement such as health care or mobility? (1) **Y** ☐ (0) **N** ☐

e) What are the difficulties:

....

....

5. a) Are you satisfied with your current living arrangement?

R1: (1)**Y** ☐ (0) **N** ☐ **R2:** (1) **Y** ☐ (0) **N** ☐

b) if N, what would you like to be changed?

R1:..

R2:..

(If not living with parents)

6. a)Would you want to live with your parents?

R1: (1)**Y** ☐ (0) **N** ☐ **R2:** (1) **Y** ☐ (0) **N** ☐

b) if **Yes**, why ? (advantages?)

R1:..

R2:..

c) If **Yes**, Why don't you? (Prompt: What is barrier?)

R1:..

R2:..

d) if **No**: why? (Prompt disadvantages?)

R1:..

R2:..

II. Housing preference: *Now I am going to ask you about your house.*

7. a) Do you rent or own your house? (1). Rent ☐ (2). Own ☐

b) How you pay for the house?

1. Loan from the bank ☐
2. Loan from relatives and friends ☐
3. Inherit from parent ☐
4. Pay by salary ☐
5. Others: ☐

8. Would you tell me what are the most important requirements when choosing or building a house?

R1: ....

....

R2:..

....

9. a) Why did you choose this house?

R1:..

....

R2:..

....

b) Who decided to choose this house? **R1**: ☐ **R2**: ☐

10. a) In this list, name the most important place in your house? **R1:** ☐ **R2:** ☐

b) and the least important place in your house? **R1:** ☐ **R2:** ☐

Lounge	Balcony	Bathroom	Shop/garage
Kitchen	Dining	Garden	Other
Family room	Bedroom	All of them	Non of them

11. Show Card 1

Referring to this card, how would you rank these issues, in comparison to each other:

1= least important, 3= most important		**R1**			**R2**	
Living in a house of your choice	1	2	3	1	2	3
Having good relationships with neighbours	1	2	3	1	2	3
Living in a clean and healthy environment	1	2	3	1	2	3

12. Show Card 2

a) Referring to this card, would you tell me how **satisfied you are with this house**?

1	2	3	4	5	
Completely dissatisfied	*Dissatisfied*		*Satisfied*	*Completely satisfied*	**R1** ☐ **R2** ☐

b) What things do you like the most about your house?

R1: ....

R2: ....

c) What things do you dislike the most about your house?

R1: ....

R2:..

d) Would you please indicate the level of importance of the following issues:

						R1	R2
The appearance of the house	1	2	3	4	5		
The area of the house (space)	1	2	3	4	5		
The convenient plan	1	2	3	4	5		
The cost of the house	1	2	3	4	5		
Natural lighting and ventilation in the house	1	2	3	4	5		

13. Show Card 2 (again)

Referring again to this card, would you tell me how satisfied you are in following issues of your house.

	Completely Dissatisfied	*Dissatisfied*		*Satisfied*	*Completely Satisfied*	**R1**	**R2**
a) The appearance of the house	1	2	3	4	5		
a) Visual harmony of neighbourhood	1	2	3	4	5		
b) Security	1	2	3	4	5		
c) Privacy	1	2	3	4	5		
d) Time spent on maintenance/ housework	1	2	3	4	5		
e) Suitability to culture/social life	1	2	3	4	5		
f) Disturbance from neighbours	1	2	3	4	5		
g) Neighbour relationship	1	2	3	4	5		
h) Location	1	2	3	4	5		
i) Area of the house (space)	1	2	3	4	5		
j) Number of rooms in the house	1	2	3	4	5		
k) Convenient plan	1	2	3	4	5		
l) Garden	1	2	3	4	5		
m)Environmental quality of the area	1	2	3	4	5		
n) Quietness (traffic/ neighbour)	1	2	3	4	5		
o) Convenient public transport	1	2	3	4	5		
p) Distance to go to buy food	1	2	3	4	5		
q) Safety of road system	1	2	3	4	5		
r) In infrastructure quality in the area	1	2	3	4	5		
s) Public out door areas (e.g. playground)	1	2	3	4	5		
t) Benefit from the shop (if have)	1	2	3	4	5		
u) Benefit from the garden	1	2	3	4	5		
v) Benefit from housing investment	1	2	3	4	5		
w) Cost for buying-renting this house	1	2	3	4	5		
x) Cost for running & maintaining this house	1	2	3	4	5		

14. Show Card 2 (again)

Referring to this card again, would you tell me how satisfied you are with **the indoor environment** of your house:

	Completely Dissatisfied	*Dissatisfied*		*Satisfied*	*Completely Satisfied*
	1	2	3	4	5
a) day time in winter?	+--------------	+--------------	+--------------	+--------------	+

R1: ☐ **R2:** ☐

b) Why? **R1**..

R2..

	1	2	3	4	5
c) night time in winter?	+--------------	+--------------	+--------------	+--------------	+

R1: ☐ **R2:** ☐

d) Why? **R1**..

R2..

	1	2	3	4	5
e) day time in summer?	+--------------	+--------------	+--------------	+--------------	+

R1: ☐ **R2:** ☐

f) Why? R1..

R2..

	1	2	3	4	5
g) night time in summer?	+--------------	+--------------	+--------------	+--------------	+

R1: ☐ **R2:** ☐

h) Why? R1..

R2..

15. a) In response to your house being hot inside, what do you do?

R1:..

R2:..

b) In response to your house being cold inside, what do you do?

R1:..

R2:..

16. a) Do you consider parts of your house to be **dark** during the daytime?

R1: (1)**Y** ☐ (0) **N** ☐ **R2:** (1) **Y** ☐ (0) **N** ☐

b) if Yes, what do you do in response?

R1:..

R2:..

c) Do you consider part of your house to be **too glary** during summer days?

R1: (1)**Y** ☐ (0) **N** ☐ **R2:** (1) **Y** ☐ (0) **N** ☐

d) if Yes, what do you do in response?

R1:..

R2:...

e) Do you consider that your house has **good ventilation**?

R1: (1)**Y** ☐ (0) **N** ☐ **R2:** (1) **Y** ☐ (0) **N** ☐

f) if No, what do you do in response?

R1:...

R2...

17. a) Have you made any **major changes** to this house? (1)**Y** ☐ (0) **N** ☐

b) Prompt: if Yes, inside or outside? (1) Inside ☐ (2) outside ☐

c) How?

....

....

....

d) If Yes, **who** decided on these change(s):

R1: ☐ **R2:** ☐ **Others:** ☐

e) who paid: **R1:** ☐ **R2:** ☐ **Others:** ☐

18. a) Are there any changes you would like to make to your house?

R1: ....

R2: ....

b) Why?

R1:..

R2..

c) Why haven't you made these changes yet?

R1: ....

R2: ....

19. If you were to give advice to friends from interstate (from country) or overseas, who was intending to buy or build a house in Adelaide (Hanoi), what would you tell them?

R1:...

R2:...

Now I would like to ask you about family's transportation

20. a) What **mode of transport** does your household often use?

1. Bus☐ 2. Train ☐ 3. Car: ☐ 4. Motorbike ☐ 5. Bike ☐ 6. Walk ☐

b) Number of vehicle: ☐ ☐ ☐

c) Who drives?...

21. Show Card 3

a) Referring to this card, how would you rate the **amount** of your household travel per week taken as a whole? **R1:** ☐ **R2:** ☐

1	2	3	4	5
Very low	*Low*	*Middle*	*High*	*Very high*

b) What are the **main reasons** for the most of travel?

(1) Work ☐ (2) Entertainment ☐ (3) Shopping ☐ (4) Visit friends ☐ (5) Others ☐

c) Can you estimate in Km, the **main modes** of household travel per week:

R1: ☐ **R2:** ☐

d) What are the modes: ....

22. Show Card 3 again

Referring to this card again, would you please rank your **household income level:**

R1: ☐ **R2:** ☐

1	2	3	4	5
Very low	*Low*	*Middle*	*High*	*Very high*

23. Show Card 4

Referring to this card and taking into account your household income, would you assess the overall ***affordability*** of your house:

R1: ☐ **R2:** ☐

1	2	3	4	5
Very unaffordable	*Unaffordable*	*Middle*	*Affordable*	*Very affordable*

24. Neighbourhood's relationships

a) How many neighbours would regularly visit your house for a social occasion? ☐

b) How often does it occur ? Daily? ☐ Weekly? ☐ Monthly? ☐

25. Are you involved in any community activities? (active community)

1: (1) **Y** ☐ (0) **N** ☐ **R2:** (1) **Y** ☐ (0) **N** ☐

b) If **R1**: Yes, what activities?...

If **R2**: Yes, what activities: ....

III. Appliances and energy consumption

26. I am now going to ask about appliances and equipment use in your house

Appliances		(1) No.	Hours of use/ day. Otherwise indicated		In which room?	Energy type	(5) When it is used	
			Sum -mer	Win -ter			(0)off peak	(1)on peak
Main cooler								
Main heater								
Fans	Portable							
	Ceiling							
TV								
Video player								
Computer								
Main illumination	Fluorescent							
	Incandescent							
	Efficient							
Refrigerator								
Dishwasher (load/day)								
Separate freezer								
Washing machine (load/week)								
Clothes drier (load/week)								
Oven								
Stove/ cookers								
Rice cooker/ Barbecue								
Toaster								
Bread makers								
Microwave								
Hot water heater								
Water pump (hours/week)								
Swimming pool with hot water								
Others:								

27. Show Card 5

Would you tell me what factors are more important when buying appliances?

R1: ☐ ☐ ☐ ☐ **R2:** ☐ ☐ ☐ ☐

1. Price:
2. Features:
3. Brand:
4. Energy efficiency
5. Appearance:
6. Quality
7. Easy to use
8. Others:

28. Show Card 3

a) Referring to this card, how do you consider your household **energy consumption** in comparison to other households?

R1: ☐ **R2:** ☐

1 2 3 4 5

+-------------------+-------------------+-------------------+-------------------+

Very low *Middle* *Very high*

b) Why?

R1..

....

R2..

....

29. Taking into account all energy types, would you know how much you pay

Monthly ☐ or annual ☐ Don't know: ☐

30. Show Card 3

Referring to this card, how do you consider the price of energy you use in your house?

Prompt: for example, electricity, gas, coal,

R1: ☐ **R2:** ☐

1 2 3 4 5

+-------------------+-------------------+-------------------+-------------------+

Very low *Low* *Middle* *High* *Very high*

31. Show Card 3 (again)

a) Referring again to this card, how do you consider your household **water consumption**?

R1: ☐ **R2:** ☐

1 2 3 4 5

+-------------------+-------------------+-------------------+-------------------+

Very low *Low* *Middle* *High* *Very high*

b) Why? **R1**:..

R2: ....

32. Show Card 3 (again)

a) Referring to this card again, how do you consider the price of water?

R1: ☐ **R2:** ☐

1	2	3	4	5
Very low	*Low*	*Middle*	*High*	*Very high*

Why? **R1**:..

R2..

33. Would you estimate how much money you pay for water use per year/ month? **(U$/A$)**

monthly ☐ or annually ☐ Don't know: ☐

34. Are you buying bottled water: (1)**Y** ☐ (0) **N** ☐

35. a) Do you water your garden during summer? (1) **Y** ☐ (0) **N** ☐

b) If Yes: What method: (1). By hand ☐ (2). Moveable sprinkler

(3). Fixed sprinkler ☐ (4). Drip ☐

IV. Technological application:

36. a) Is the outside of your house shaded during hot weather? (1) **Y** ☐ (0) **N** ☐

b) If Yes, How?

(1) Neighbour houses ☐ (4)Veranda ☐ (6)Tree(s) ☐ (8) Balcony ☐

(2) Overhang: ☐ (5) Pergola: ☐ (7)Other ☐ indicate:

(3) Blinds ☐

I am now going to ask you about some **technologies** that may be used in your house.

37. Water management	(1) Do you know about it?		(2) If Y, are you using it?		(3) If Y: Are you satisfied?		(4) If N, do you want to use it?	(5) If n, why?
	Y	**N**	Y	N	**y**	**n**		
a) Grey water recycling								
b) Sewage water recycling								
c) Bore water								
d) Tap water								
e) Rain water collection								
38. Solar energy								
a) Solar hot water heater								
b) Photovoltaic								
39. Solid waste								
a) Waste collected mix								
b) Waste collected separate								
c) Household compost								
d) Waste recycling								
e) Waste reuse								

V. Environmental attitude

40. Show Card 3. Referring to this card, would you indicate how you see the importance of these issues:

R1: **a** ☐ **b** ☐ **c** ☐ **R2: a** ☐ **b** ☐ **c** ☐

	Very low				*Very high*
a) Environmental protection	1	2	3	4	5
b) Economic growth	1	2	3	4	5
c) Increase human welfare	1	2	3	4	5

41. a) Do you see any relationships between these issues?

R1: (1)**Y** ☐ (0) **N** ☐ **R2:** (1) **Y** ☐ (0) **N** ☐

b) if **R1**: Yes, how? ....

if **R2**: Yes, how?..

42. What do you see as the current environmental problems,

a) Globally?

R1:..

....

R2:..

....

b) in Australia?

R1:...

....

R2: ....

....

c) in your housing area?

R1:...

....

R2: ....

....

43. Do these environmental issues worry you?

R1: (1) **Y** ☐ (0) **N** ☐ **R2:** (1) **Y** ☐ (0) **N** ☐

44. a) Are you or have you been involved in any environmental protection actions?

R1: (1) Y ☐ (0) N ☐ R2: (1) Y ☐ (0) N ☐

b) If R1 Yes how?...

....

If R2 Yes how?...

....

45. Which environmental issue (s) do you think affect your family's health?

R1...

....

R2...

....

46. What do you think is the main reason for the present environmental problems?

R1...

....

R2...

....

47. If there is one thing that you can do to protect the environment, what would it be?

R1...

R2...

48. Are you willing to do it?

R1: (1) **Y** ☐ (0) **N** ☐ **R2:** (1) **Y** ☐ (0) **N** ☐

49. Show card 6.

Referring to this card, would you please indicate your idea of the following statements?

Disagree strongly *Disagree* *Neither agree or disagree* *Agree* *Agree strongly*

1 2 3 4 5

+--------------------+--------------------+--------------------+--------------------+

	R1	R2
a) Living in an extended family has more advantages than disadvantages		
b) Separate house with garden causes urban sprawl and should be discouraged.		
c) A house should have just enough room for the essential daily needs of a family.		
d) A high standard and well-designed multi-floor apartment is as good as any other type of a house.		
e) Using public transport is good idea to reduce pollution and save resources.		
f) Energy efficient appliances would save money.		
g) Renewable energy such as solar energy and wind energy, is cheap.		
h) It is better to use fans for cooling instead of air-conditioners.		
i) It is the responsibility of individuals to protect the environment.		
j) The government should make laws to protect the environment.		
k) Water is not a scarce resource.		
l) It is good idea to recycle the grey water used for toilet flushing.		
m) If we consume too many resources today, there might be nothing left for our grand children.		
n) All household waste should be recycled.		
o) It is the practical idea to recycle household wastewater for other uses.		
p) Environment pollution directly affects your health.		
q) You should pay more for resources (of land, petrol and water) the more you use them.		

VI. Design of the house:

Finally I am going to ask some questions about this house.

50. Types of the house?

a) Separate house ☐

b) Semi-detached/ terrace/ town house ☐

c) Flat in a multi-floor building ☐

d) Others ☐

51. a) Did you have any input in the design of the house? (1)**Y** ☐ (2) **N** ☐

b) If Yes, who were involved? ? **R1**☐ **R2**☐ **Others**☐

c) How?

R1: ....

....

R2:..

....

Others: ....

....

52. a) Were you involved in the construction of the house? (1)Y ☐ (2) N ☐

b) If Yes: Who involved? ? R1 ☐ R2 ☐ Others ☐

c) How?

R1: ....

....

R2:..

....

Others:..

....

53. What are the disadvantages of the following types of houses:

Multi-floor apartments

R1:..

R2:..

Terrace houses

R1:..

R2:..

Separate houses?

R1:..

R2:..

54. Other comments in housing design, housing construction, environmental management, and the cost of housing and other technical appliances:

....

....

....

55. Estimated land area (m2): [ ]

56. Estimated floor area (m2): [ ]

57. Number of car park? [ ]

58. Building material (if know)

a) Internal walls:
b) External wall:
c) Roof:
d) Floor:
e) Ceiling:
f) Floor cover:
g) Windows:
h) Doors:

THANK YOU FOR YOUR CO-OPERATION!

Would you mind if I do a quick sketch of your house?

Sketch:

D2: Questionnaire to designers/ architects

A No.:

Interviewer: Date of interview:

I. General information

1. Name: .... 2. Male ☐ Female ☐

3. Age: (1)18-34 ☐ (2)35-54 ☐ (3) 55-64 ☐ (4)>65 ☐

4. a) Name of your company/ firm: ....

b) Your position in the company/ firm:...

5. How long have you been working as a designer?.........................

6. Could you please indicate some housing projects you have designed within 5 years

Name of project/ Address	1. Type of dwelling			2. Location		3. Year built	4. Land area/ Dw.	5. Floor area/ Dw.	6. No. room	7. No. car park	8. Price/ dw. (A$)
	separate	attached	flat	Inner.	Suburb		m2	m2			
a)											
b)											
c)											
d)											
e)											

7. According to you what is a good house?

....

....

....

8. What factors do you considered when designing a house?

....

....

....

9. What do you understand of the term "sustainable housing"?

....

....

10. Would you please rank the important level of the following issues in designing housing:

a) The appearance of the house	1	2	3	4	5
b) The space	1	2	3	4	5
c) The layout (plan)	1	2	3	4	5
d) The cost	1	2	3	4	5
e) Natural lighting and ventilation	1	2	3	4	5

11. Please select one of your preferred design of housing: (sketch/ picture)

Address:..

12. Show card 2.

Would you tell me how satisfied you are in the following issues of the housing project:

	Completely Dissatisfied	*Dissatisfied*		*Satisfied*	*Completely Satisfied*	
a) The appearance of the house(s)	1	2	3	4	5	
b) The harmony of neighbourhood	1	2	3	4	5	
c) Privacy	1	2	3	4	5	
d) Suitability to culture/social life	1	2	3	4	5	
e) Location	1	2	3	4	5	
f) Area of the house (space)	1	2	3	4	5	
g) Number of rooms in the house	1	2	3	4	5	
h) Planning convenience	1	2	3	4	5	
i) Provision of garden(s)	1	2	3	4	5	
j) Local environment quality	1	2	3	4	5	
k) Indoor environment of the houses as a whole	1	2	3	4	5	
l) Safety of road system	1	2	3	4	5	
m) Quality of infrastructure in housing area	1	2	3	4	5	
n) Public areas (eg. play grounds)	1	2	3	4	5	
o) Energy efficiency of the houses	1	2	3	4	5	
p) Efficiency in the construction	1	2	3	4	5	
q) The cost of the house	1	2	3	4	5	

13. Show card 2.

Could you indicate your prediction of the degree of the **indoor environment comfort** to occupants of the house, what would they be?

	Completely Dissatisfied	*Dissatisfied*	*Neither satisfied or dissatisfied*	*Satisfied*	*Completely satisfied*
	1	2	3	4	5
a) Day time in winter?	+	+	+	+	+

c) Why?

....

	1	2	3	4	5
c) Night time in winter?	+	+	+	+	+

d) Why?

....

	1	2	3	4	5
e) Day time in summer?	+	+	+	+	+

f) Why?

....

	1	2	3	4	5
g) Night time in summer?	+	+	+	+	+

h) Why?

....

Technical applications (design document collected)

14. What is the main structure of the house:

Detached ☐ Attached ☐ Apartment ☐

Building material.

a) Internal walls:..

b) External wall:..

c) Roof:..

d) Floor:..

e) Ceiling:..

f) Floor cover:..

g) Windows:..

h) Doors:..

16. a) Compare to other similar developments, how could you see ***the density*** of the housing area? Higher ☐ The same ☐ Lower ☐

b) Why?..

c) if higher, how has it been achieved?..

17. a) Has any provision been made to maintain ***solar and light access to all houses?***

Y ☐ **N** ☐

b) Why? ....

c) If Y, how has it been achieved?...

....

18 a) Has any provision been made to maintain ***cross ventilation to all houses***?

Y ☐ N ☐

b) Why? ....

c) If Y, how? ....

....

19. a) Has any provision been made to require **high energy efficiency** of the houses

Y ☐ N ☐

b) If Y, how? ....

....

20 a) Do you consider ***avoiding direct sun*** in to the house ***in summer***? Y ☐ N ☐

b) Why?...

c) How? ....

21. How the house is ***shaded*** to protect the heat

a) Neighbour houses	☐	e) Overhang:	☐
b) Veranda	☐	f) Pergola:	☐
c) Tree	☐	g) Other indicate	☐
d) Balcony	☐		

22. How the insulation of the house:

a) Roof/ceiling: ....

b) External walls:...

c) Windows/doors: ....

d) Floor:..

e) Others:..

Now I would like to ask you about technologies that may be applied in this housing project.

	(1) Do you know about it?		(2) If Y, Is it applied in this house?		(3) If Y: How does it work?	(4) If N, do you want to apply it in your design?		(5) If n, why?
23. Water management	Y	N	Y	N		y	n	
Grey water recycling								
Sewage water recycling								
Bore water								
Tap water								
Rain water collection								
24. Solar energy								
Solar hot water heater								
Photovoltaic								
25. Solid waste								
Waste collected mix								
Waste collected separate								
Household compost								
Waste recycling								
Waste reuse								

26. What appliances were pre-installed in this house?

Appliances	No	In which room	Type of energy	Share with other HHs	
				Y	N
Refrigerator					
Main cooler					
Main heater					
Hot water heater					
Swimming pool heater					
Washing machine					
Clothes drier					
Others					

Environmental issues

27. How do you value the important level of these aspects?

(Show **Card 1**)	*Very low*				*Very high*
a) Environment protection	1	2	3	4	5
b) Economic growth	1	2	3	4	5
c) Increase human welfare	1	2	3	4	5

28. What are the environmental problems?

a) Globally?..

....

b) In Australia?..

....

c) In this housing area? ....

....

29. a) What issues have you considered in designing housing to protect the environment while still maintaining human comfort and ensure an acceptable cost?

....

....

....

b) In your opinion, what a designer can do in designing new housing projects to protect the environment while still maintaining human comfort and ensure an acceptable cost?

....

....

....

30. What are barriers: Technical? ☐ Financial? ☐ Legal? ☐ Others? ☐
(explain)..

....

....

....

31. Would you tell me what affects could housing design have on the following issues:

The environment..

Society ....

The economy..

32. What are the advantages and disadvantages of the following types of housing?

a) Detached houses?

....

....

b) Terrace houses?

....

....

c) 2-5 floor apartment?

....

....

d) high-rise apartment?

....

....

33. Show card 6.

Referring to this card, would you please indicate your idea of the following statements?

Disagree strongly	*Disagree*	*Neither agree or disagree*	*Agree*	*Agree strongly*
1	2	3	4	5

+-----------------------+-----------------------+-----------------------+-----------------------+

a) Living in an extended family has more advantages than disadvantages
b) Separate house should with garden cause urban sprawl and should be discouraged.
c) A house should have just enough room for the essential daily needs of a family.
d) A high standard and well-designed multi-floor apartment is as good as any other type of a house.
e) Using public transport is good idea to reduce pollution and save resources.
f) Energy efficient appliances would save money.
g) Renewable energy is cheap.
h) It is better to use fans for cooling instead of air-conditioners.
i) It is the responsibility of individuals to protect the environment.
j) The government should make laws to protect the environment.
k) Water is not a scarce resource.
l) It is good idea to recycle the grey water used for toilet flushing.
m) If we consume too many resources today, there might be nothing left for our grand children.
n) All household waste should be recycled.
o) It is the practical idea to recycle household waste-water for other uses.
p) Environment pollution directly affects your health.
q) You should pay more for resources (of land, petrol, water) the more you use them.

34. Do you have any general comments in housing design, housing policy, environmental management, and cost of housing and technical application:

....

....

THANK YOU VERY MUCH FOR YOUR CO-OPERATION!

A No.:

D3: Questionnaire to developers/ builders

Interviewer: Date of interview:

I. General information

1. Name: .... **2.** Male ☐ Female ☐

3. Age: (1)18-34 ☐ (2)35-54 ☐ (3) 55-64 ☐ (4)>65 ☐

4. a) Name of your company/ firm: ....

b) Your position in the company/ firm..

5. How long have you been working as a developer?.........................

6. Could you please indicate some housing projects you have developed within 5 years

Name of project/ Address	1. Type of dwelling			2. Location		3. Year built	4. Land area/ Dw.	5. Floor area/ Dw.	6. No. room	7. No. car park	8. Price/ dw. (A$)
	separate	attached	flat	Inner.	Suburb		m2	m2			
a)											
b)											
c)											
d)											
e)											

7. In your opinion, what is a good house?

....

....

8. What factors have you considered when developing a new housing area?

....

....

....

9. What do you understand by the term "sustainable housing"?

....

....

....

10. Would you please rank the important level of the following issues in developing housing:

a) The appearance of the house	1	2	3	4	5
b) The space	1	2	3	4	5
c) The layout (plan)	1	2	3	4	5
d) The cost	1	2	3	4	5
e) Natural lighting and ventilation	1	2	3	4	5

11. Please select one of your preferred housing projects: (sketch/ picture)

Address:...

12. Show card 2.

Would you tell me how satisfied you are in the following issues of the housing project:

	Completely Dissatisfied	*Dissatisfied*	*Middle*	*Satisfied*	*Completely Satisfied*
a) The appearance of the house(s)	1	2	3	4	5
b) The harmony of neighbourhood	1	2	3	4	5
c) Privacy	1	2	3	4	5
d) Suitability to culture/social life	1	2	3	4	5
e) Location	1	2	3	4	5
f) Area of the house (space)	1	2	3	4	5
g) Number of rooms in the house	1	2	3	4	5
h) Planning convenience	1	2	3	4	5
i) Provision of garden(s)	1	2	3	4	5
j) Local environment quality	1	2	3	4	5
k) Indoor environment of the houses as a whole	1	2	3	4	5
l) Safety of road system	1	2	3	4	5
m) Quality of infrastructure in housing area	1	2	3	4	5
n) Public areas (eg. play grounds)	1	2	3	4	5
o) Energy efficiency of the houses	1	2	3	4	5
p) Efficiency in the construction	1	2	3	4	5
q) The cost of the house	1	2	3	4	5

13. Show card 2.

Could you indicate your prediction of the degree of the **indoor environment comfort** to occupants of the house, what would they be?

	Completely Dissatisfied	*Dissatisfied*	*Neither satisfied or dissatisfied*	*Satisfied*	*Completely satisfied*
	1	2	3	4	5
a) Day time in winter?	+	+	+	+	+

b) Why?

....

	1	2	3	4	5
c) Night time in winter?	+	+	+	+	+

d) Why?

....

	1	2	3	4	5
e) Day time in summer?	+	+	+	+	+

f) Why?

....

	1	2	3	4	5
g) Night time in summer?	+	+	+	+	+

h) Why? ....

Technical applications (design document collected)

14. What is the main structure of the house:

(1) Detached ☐ (3) 2-5 floors apartment ☐

(2) Attached ☐ (4) High-rise apartment ☐

15. Building material.

a) Internal walls:..
b) External wall:..
c) Roof:..
d) Floor:..
e) Ceiling:...
f) Floor cover:..
g) Windows:...
h) Doors:...

16. a) Compare to other similar developments, how could you compare ***the density*** of the housing area? Higher ☐ The same ☐ Lower ☐

b) Why?..

c) if higher, how has it been achieved?..

17. a) Has any provision been made to maintain ***solar and light access to all houses?***

Y ☐ **N** ☐

b) Why? ....

c) If Y, how has it been achieved?...

18 a) Has any provision been made to maintain ***cross ventilation to all houses***?

Y ☐ N ☐

b) Why? ....

c) If Y, how? ....

....

19. a) Has any provision been made to require ***high energy efficiency*** of the houses

Y ☐ N ☐

b) If Y, how? ....

....

Now I would like to ask you about technologies that may be applied in this housing project.

	(1) Do you know about it?		(2) If Y, Is it applied in this project?		(3) If Y: How does it work?	(4) If N, do you want to apply it in your projects?		(5) If n, why?
20. Water management	**Y**	**N**	Y	N		**y**	**n**	
Grey water recycling								
Sewage water recycling								
Bore water								
Tap water								
Rain water collection								
21. Solar energy								
Solar hot water heater								
Photovoltaic								
22. Solid waste								
Waste collected mix								
Waste collected separate								
Household composting								
Waste recycling								
Waste reuse								

23. What appliances were pre-installed in this project?

Appliances	No	In which room	Type of energy	Share with other HHs	
				Y	N
Refrigerator					
Main cooler					
Main heater					
Hot water heater					
Swimming pool heater					
Washing machine					
Clothes drier					
Others					

Environmental issues

24. Would you tell me what affects the above housing project may have on the following issues:

a) The environment...

b) The economy...

c) Society ....

25. Show card 1.

How do you value the level of importance that you see in these issues in related to following issues? *Very low* *Very high* ☐

a) Environment protection 1 2 3 4 5

Why? .... ☐

b) Economic growth 1 2 3 4 5

Why? ....

c) Increase human welfare 1 2 3 4 5 ☐

Why? ....

26. What are the environmental problems

a) Globally?...

....

b) In Australia, in Vietnam?...

....

c) In this housing area?...

27. a) What issues have you considered in developing this housing project to protect the environment while still maintaining human welfare and ensuring an acceptable cost ?

....
....

b) In your opinion, what would you do in developing new housing projects to protect the environment while still maintaining human welfare and ensuring an acceptable cost?

....

....

28. What are barriers to developers to achieve environmental protection while still can provide human comfort and ensure benefit?

Technical? ☐ Financial? ☐ Legal? ☐ Others? ☐

(explain)..
....

....

29. What are the advantages and disadvantages of following types of housing?

a) Detached houses?

....

b) Terrace houses?

....

c) 2-5 floor apartments?

....

d) High-rise apartments?

....

30. Show card 6.

Referring to this card, would you please indicate your idea of the following statements?

Disagree strongly	Disagree	Neither agree or disagree	Agree	Agree strongly
1	2	3	4	5

+------------------------+-----------------------+------------------------+------------------------+

a) Living in an extended family has more advantages than disadvantages
b) Separate house should with garden cause urban sprawl and should be discouraged.
c) (c) A house should have just enough room for the essential daily needs of a family.
d) A high standard and well-designed multi-floor apartment is as good as any other type of a house.
e) Using public transport is good idea to reduce pollution and save resources.
f) Energy efficient appliances would save money.
g) Renewable energy is cheap.
h) It is better to use fans for cooling instead of air-conditioners.
i) It is the responsibility of individuals to protect the environment.
j) The government should make laws to protect the environment.
k) Water is not a scarce resource.
l) It is good idea to recycle the grey water used for toilet flushing.
m) If we consume too many resources today, there might be nothing left for our grand children.
n) All household waste should be recycled.
o) It is the practical idea to recycle household wastewater for other uses.
p) Environment pollution directly affects your health.
q) You should pay more for resources (of land, petrol, water) the more you use them.

31. Comments in housing design, housing policy, environmental management, and cost of housing and technical application:

....

THANK YOU VERY MUCH FOR YOUR CO-OPERATION!

P. No.:

D4: Questionnaire to housing managers/ planners/ policy makers

Date of interview: ______________________________

I. General information

1. Name: .... **2.** Male ☐ Female ☐

3. Age: (1)18-34 ☐ (2)35-54 ☐ (3) 55-64 ☐ (4)>65 ☐

4. a) Name of your office: ....

b) Your position in the office..

5. How long have you been working as a planner?..

II. Perceptions in Housing

6. a) What plans have been made for housing development in this city in the two coming decades?

....

....

....

....

....

....

....

b)What are the main factors determining these developments?.....................................

....

....

....

....

7. According to you, what is a good housing development?

....

....

....

8. Could you please indicate one good housing project in the city you have been involved with over the last five years.

Name of project/ Address	1. Type of dwelling			2. Location		3. Year built	4. Land area/ Dw.	5. No. of floors	7. No. car park	8. Price/ dw.
	separate	attached	flat	Inner.	Suburb		m2			(A$)

9. What were the main issues that you considered in planning these new housing developments in the city?

....

....

....

10. What do you understand by the term "sustainable housing"?

....

....

....

11. a) Compare to other similar developments, how do you see ***the density*** of **these** housing area**?** Higher ☐ The same ☐ Lower ☐

b) Why?..

c) if higher, how has it been achieved?...

12. a) Has any provision been made to maintain ***solar and light access to all houses?***

Y ☐ **N** ☐

b) Why? ....

c) If Y, how has it been achieved?..

....

13 a) Has any provision been made to maintain ***cross ventilation to all houses***?

Y ☐ N ☐

b) Why? ....

c) If Y, how? ....

....

14. a) Has any provision been made to require ***high energy efficiency*** of these houses

Y ☐ N ☐

b) If Y, how? ....

....

III. Technical applications

Now I would like to ask you about technologies that may be applied in these housing projects.

	(1) Do you know about it?		(2) If **Y**, Is it applied in these projects?		(3) If Y: How does it work?	(4) If N, do you want to apply it in these projects?		(5) If **n**, why?
15. Water management	**Y**	**N**	Y	N		**y**	**n**	
Grey water recycling								
Sewage water recycling								
Bore water								
Tap water								
Rain water collection								
16. Solar energy								
Solar hot water heater								
Photovoltaic								
17. Solid waste								
Waste collected mix								
Waste collected separate								
Household composting								
Waste recycling								
Waste reuse								

Environmental issues

18. In your opinion, what affect does planning have on the design of a new housing estate, taking into account the following issues:

a) The environment...

....

b) The economy...

....

c) Society...

....

19. What are the ***current policies*** in this city for new housing developments related to the following issues?

Land price: ....

Land use:..

Housing regulation/ policy...

The preferred types of housing:

(1). Detached houses ☐ (3). 2-5 floors apartments ☐

(2). Attached houses ☐ (4). High-rise apartments ☐

The preferred location:

1. Inner city ☐ 2. Suburb ☐

20. Show card 1.

a) Could you indicate the ***level of importance you see in*** the following issues related to housing development:

	Very low				*Very high*	
Environment protection	1	2	3	4	5	☐

b) Why?

....

....

Economic growth	1	2	3	4	5	☐

b) Why?

....

....

Increase human welfare	1	2	3	4	5	☐

b) Why?

....

....

21. What do you see as current environmental problems?

a) Globally?...

....

....

b) In Australia/Vietnam?..

....

c) In this housing area?...

....

22. In your opinion, what could you do in planning new housing developments to protect the environment, while maintaining human welfare and economic growth?

....

....

....

23. In your opinion, what role do economic factors have in environmental protection?

....

....

24. In your opinion, what role do economic factors have in ensuring human welfare?

....

....

25. In your opinion, what role do regulations for housing development have in promoting protection of the environment?

....

....

26. In your opinion, what role do regulations for housing development have in ensuring human welfare?

....

....

27. What are the barriers to planners in achieving environmental protection?

Technical? ☐ Financial? ☐ Legal? ☐ Others? ☐

(Explain)..

....

....

28. Would you tell me what are the advantages and disadvantages of the following types of housing?

a) Detached houses?

....

b) Terrace houses?

....

c) 2-5 floors apartments?

....

d) High-rise housing apartments?

....

Questions to energy policy makers

29. What are the current policies in?

Energy price: ....

Reduce energy consumption: ....

Alternative energy resources ....

30. In your opinion, what can you do to enhance energy efficiency in the housing sector while maintaining human welfare and economic growth?

....

....

31. In your opinion, what role do economic factors have in promoting energy efficiency in housing developments?

....

....

32. In your opinion, what role do regulations in energy have in promoting energy efficiency in housing developments?

....

....

33. Show card 6.

Disagree strongly	Disagree	Neither agree or disagree	Agree	Agree strongly
1	2	3	4	5

+-----------------------+-----------------------+-----------------------+-----------------------+

a) Living in an extended family has more advantages than disadvantages
b) Separate house should with garden cause urban sprawl and should be discouraged.
c) (c) A house should have just enough room for the essential daily needs of a family.
d) A high standard and well-designed multi-floor apartment is as good as any other type of a house.
e) Using public transport is good idea to reduce pollution and save resources.
f) Energy efficient appliances would save money.
g) Renewable energy is cheap.
h) It is better to use fans for cooling instead of air-conditioners.
i) It is the responsibility of individuals to protect the environment.
j) The government should make laws to protect the environment.
k) Water is not a scarce resource.
l) It is good idea to recycle the grey water used for toilet flushing.
m) If we consume too many resources today, there might be nothing left for our grand children.
n) All household waste should be recycled.
o) It is the practical idea to recycle household wastewater for other uses.
p) Environment pollution directly affects your health.
q) You should pay more for resources (of land, petrol, water) the more you use them.

34. Do you have any general comments in housing design, housing policy, environmental management, and cost of housing and technical application:

....

....

....

....

THANK YOU VERY MUCH FOR YOUR CO-OPERATION!

D5: Scales

Scale 1

1	2	3	4	5
Not important at al	Not important	Middle	Important	Crucially important

Scale 2

1	2	3	4	5
Completely dissatisfied	Dissatisfied	Middle	Satisfied	Completely satisfied

Scale 3

1	2	3	4	5
Very low		Middle		Very high

Scale 4

1	2	3	4	5
Very unaffordable	Unaffordable	Middle	Affordable	Very affordable

Scale 5

1	2	3	4	5
Disagree strongly	Disagree	Neither agree or disagree	Agree	Agree strongly

Appendix E

Temperature of Adelaide and Hanoi (OnlineWeather.com, 2001)

Max (oC)	AD	Jan 30	Feb 30	Mar 27	Apr 23	May 19	Jun 16	Jul 15	Aug 17	Sep 19	Oct 23	Nov 26	Dec 28
	HN	Jul 33	Aug 32	Sep 31	Oct 29	Nov 26	Dec 22	Jan 20	Feb 21	Mar 23	Apr 28	May 32	Jun 33
Min (cC)	AD	Jan 16	Feb 17	Mar 15	Apr 13	May 10	Jun 8	Jul 7	Aug 8	Sep 9	Oct 11	Nov 13	Dec 15
	HN	Jul 26	Aug 26	Sep 24	Oct 22	Nov 18	Dec 15	Jan 13	Feb 14	Mar 17	Apr 20	May 23	Jun 26