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IND 1 Industry Research Impacts and Alternatives

For Beacon Pathway Ltd – Sustainability in the Residential Built Environment Research Programme 2004-2010

Landcare Research
PO Box 69, Lincoln 8152
New Zealand

Principal contact: Ann Smith
SmithA@landcareresearch.co.nz
Tel 03 325 6701 ext 3887
Cell 027 229 9079

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Authors: Ann Smith (Landcare Research), Jeska McNicol (Landcare Research), Graeme Finlay (Warren and Mahoney)

Reviewed by:	Approved for release by:
xxxxxxxxxxxxx	Richard Gordon
xxxxxxxxxxxxx Landcare Research	Science Manager Sustainable Business and Government Landcare Research

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Executive Summary

The purpose of this report is to evaluate, for Beacon Pathway Limited, their proposed Industry Research programme to ensure that it contributes to optimisation of the overall Sustainability in the Residential Built Environment Research Programme. In evaluating the Industry Research programme, the project team developed:

- A summary of relevant knowledge from around the world with regard to initiatives to encourage industry uptake and sustainability for homes, including success factors.
- A conceptual map of the industry in New Zealand (in its broadest sense, the 'housing supply industry' which incorporates financial institutions and real estate agents).
- A high level assessment of the current and likely future capacity of the industry to deliver sustainability outcomes, particularly (but not limited to) the capacity for retrofit.
- An alternative approach to achieving this objective (Industry Research) described and costed.
- An estimate of the likely impact of each alternative approach (including the existing one) as well as in terms of the inputs required for the optimisation tool established under INT1.

Overall, this report provides a better understanding of the research needed to develop and implement successful strategies to improve the housing industry's ability to facilitate and supply products, services, systems and solutions that improve sustainability in the residential built environment (RBE).

The overview of international initiatives identifies the various types of approach that have been or are being implemented with emphasis on identifying the lessons learnt (drivers, barriers, success factors) from interventions in the housing industry. The research confirms that there is considerable international effort to engage industry in delivering more sustainable homes but there is little evidence to date to demonstrate how effective these measures have been.

In developing a framework for describing how sustainable solutions are delivered within the housing industry supply chain, the research focused on the relationships between housing industry actors. A cross section of housing industry representatives participated in a workshop and their input helped to inform the resulting conceptual map of the industry. Despite the complexity of the network of housing industry actors, their

interactions indicate the key decision-making points where intervention could influence the uptake of sustainable housing solutions.

The capacity of the industry to deliver sustainability outcomes was also explored during the workshop and found to be a serious concern with respect to the New Zealand housing industry. This was also the case for international sustainable housing initiatives. Innovative resources and support mechanisms are needed to promote and facilitate sustainable housing practices as well as increased effort through traditional professional training routes.

Analysis of the 'current' industry research programme, proposed by Beacon, generated a number of recommendations that were used to create an 'alternative' research programme. The 'current' programme was found to have serious limitations due to the time allowed to develop, test and implement an industry-wide strategy. The 'alternative' programme proposes earlier implementation of the strategy and includes assessment and performance measurement so that demonstrable progress in delivering sustainable housing can be reported against a present practice baseline. An economic study is included to generate industry case studies where the costs and benefits have been identified for sustainable housing solutions.

EXISTING PROGRAMME				
Milestones		**Outcomes**		
		social	**economic**	**environment**
September 2004 to July 2008	Determine what models have worked internationally	✓		✓
	Develop a New Zealand Strategy			✓
	Test and validate in test groups			✓
	Expand to an industry wide approach			✓
ALTERNATIVE PROGRAMME				
Milestones		**Outcomes**		
		social	**economic**	**environment**
September 2004 to July 2008	Determine what models have worked overseas and assess New Zealand RBE industry for sustainability	✓		✓
	Develop scenarios, 2050 vision and New Zealand RBE industry strategy	✓	✓	✓
	Establish sustainable RBE network and demonstration projects, implement strategy	✓		✓
	Economic study – costs and benefits of sustainable practices for the RBE industry		✓	
	Evaluate and refine New Zealand RBE industry strategy as industry-wide approach	✓	✓	✓

Figure 1: Comparison of the sustainability outcomes for the two industry research programmes.

A simple sustainability risk assessment was used to compare the two industry research programmes for their contributions to environmental, social and economic outcomes in the residential housing industry. Figure 1 illustrates the summary results and confirms that the 'alternative' programme will deliver a more holistic sustainable housing strategy.

In terms of the data requirements for integration with the other Beacon workstreams, it is unlikely that either of the two industry research programmes would be able to generate data at the level of the number of houses impacted and the sustainability change per house. However, the alternative industry research programme includes a baseline assessment and subsequent monitoring to assess progress in achieving sustainability outcomes by the housing industry. Performance measures that are meaningful to the housing industry are needed if companies are to be engaged in providing the data needed to generate a national picture of sustainability in the industry.

Further work is needed on the capacity of the industry to retrofit the existing housing stock to a high standard of sustainability. The report for the RF1: Housing Stock Analysis programme was not available at the time of writing this report. A definition for the standard of sustainability to be achieved for both new homes and retrofitted property is needed as part of the assessment of the capacity of the housing industry to deliver sustainable homes.

1 Introduction

Beacon Pathway Limited is implementing a research programme intended to deliver a strategy for the construction sector to bring the vast majority (90%+) of New Zealand homes to a high standard of sustainability by 2012. In order for this to be achieved there must be a mix of supply-side and demand-side drivers pushing toward the goal of sustainability. This report evaluates the proposed industry programme in the context of international experience and consultation with a cross section of the New Zealand housing industry.

Section 1.1 of the report explains how sustainability is defined for the housing industry within the Beacon programme and Section 1.2 explains the roles of supply-side and demand-side drivers in influencing the industry to adopt more sustainable practices. Section 2 sets out the objectives for the research designed to examine concerns about the industry's level of knowledge and capacity to deliver sustainable housing and Section 3 describes the research methods used for each of the objectives. Section 4 explores international initiatives to engage the industry in delivering sustainable housing. The various approaches are summarised and the lessons learned are described along with the success factors, drivers and barriers. In Section 5, the complex network of housing industry actors is examined to identify relationships and critical decision-making interactions. The analysis of five housing industry chains comes together in the form of a conceptual map of the housing industry and identifies the dominant controls (decision-making interactions) where interventions might be introduced to influence the uptake of sustainable practices. The industry research programme proposed by the Beacon project is assessed in Section 6; from this assessment, an alternative research programme is developed. Section 7 uses a simple sustainability risk assessment to compare the two industry research programmes. Finally, Section 8 uses the results of a cross-sectoral housing industry workshop to examine the capacity of the industry to deliver sustainability outcomes. To assist the reader, key findings are listed at the end of each section. Within the report, hyperlinks are provided to external internet sites and all the references cited are linked to electronic copies provided on the CD-ROM.

1.1 Sustainability and the housing industry

The housing industry makes important contributions to sustainable development through employment, expenditure through the supply chain, wealth generation through equity in homes, by providing training opportunities for school leavers and through its contribution to GDP and indirect tax revenues.

House construction, retrofit and major refurbishment involves numerous industry sectors and the use of a wide range of building materials and services. Site planning, subdivision

and building design, construction methods, manufacturing of building materials, the materials themselves and material flows have a number of environmental impacts (see Figure 1.1). Many of the impacts are a consequence of development but the largest environmental impact is in the use of the building. The 'ecological footprint' of development can be reduced by incorporating the principles of sustainable construction (Beyer 2002). At each step in the process from commissioning the work to handover of the finished product, there are many opportunities for introducing sustainable solutions for both new build and retrofit.

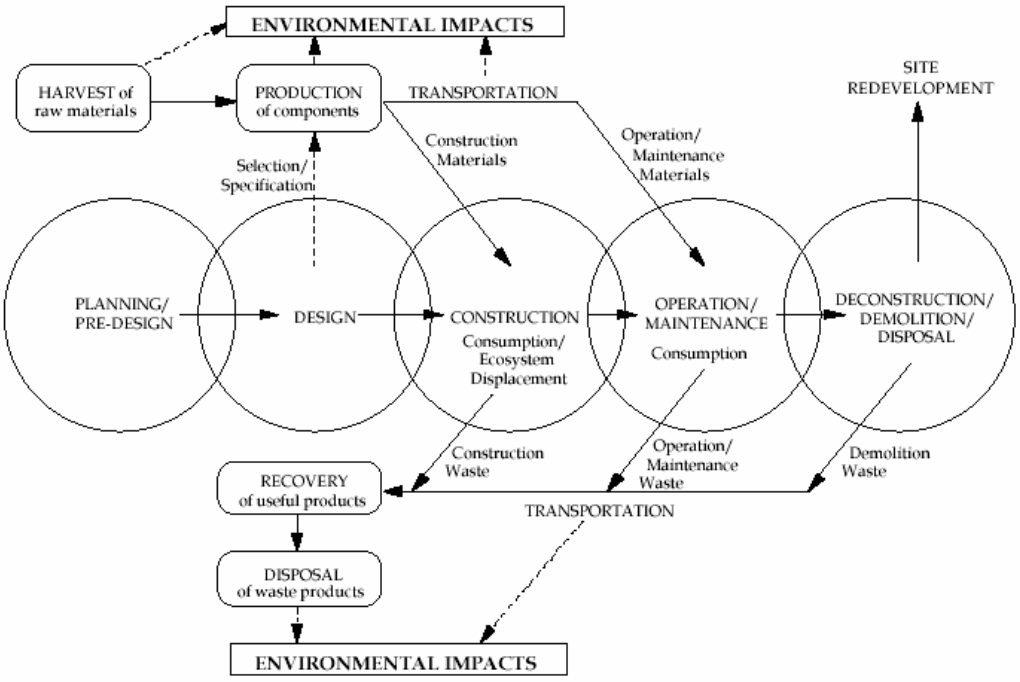

Figure 1.1: Material flows across the life cycle of a construction project (adapted from Yeang, 1995).

Until recently, sustainable construction initiatives focussed mainly on resource efficiency and reducing impacts on the natural environment. Emphasis was placed on technical issues such as construction materials and energy-related design concepts. The level of engagement of the construction industry in environmental management can be gauged from the number companies certified to the international environmental management systems standard ISO 14001. By the end of the year 2000, 1,035 ISO 14001 certificates had been issued to construction companies worldwide; just under 6% of all ISO 14001 certificates issued. By the end of 2003, the number of ISO 14001 certificates had increased to 66,000 and the number of ISO 14001 certificates issued to construction companies can be expected to have reached around 4,000. In terms of numbers of

certificates issued, the construction industry was placed fifth out of the 39 sectors recognised by the International Standards Organisation (ISO 2001).

Today, leaders in sustainable construction recognise that their activities also have social, economic and cultural impacts. The housing industry has particular responsibilities towards the people they employ, the people who live in the houses they build and to local communities. Despite efforts to promote a more holistic interpretation for sustainable construction, environmental sustainability remains central to the strategies, guidance and initiatives in much of the literature and in mainstream construction companies (CIB 1999, BSHF 2002, WWF 2004a and 2004b). The majority of reports provide considerable detail on environmental criteria relevant to the housing industry but few identify social and economic criteria. WWF (2004a) included governance, risk assessment, impact on the environment and impact on society in a survey of leading house builders. Social criteria that were considered important to the housing industry included: health and safety, considerate construction, employment, sustainable communities and stakeholder engagement.

An increasing recognised measure of engagement in sustainable development is reporting in accordance with the Global Reporting Initiative (GRI) guidelines. By the end of 2003, some 569 companies were reporting to GRI guidelines, of which 23 (4%) were construction and construction-related companies (see Figure 1.2). Of the 11 construction companies reporting, four were major house builders: John Laing and Crest Nicholson in the United Kingdom and Panahome and Sekisui House in Japan (GRI 2004).

Sector	Number	%
Construction	11	1.9
Construction materials	12	2.1
Real estate	4	0.7
Waste management	4	0.7
Financial services	47	8.3
All companies	569	

Figure 1.2: Construction and construction-related companies reporting in accordance with the GRI guidelines by end of 2003.

Within the Beacon project, objective SF1.1 Sustainability Framework Design undertook to develop a sustainability framework for the residential built environment. The SF1.1 project team (Hargreaves *et al* 2004) recommend that The Natural Step and Natural Capitalism be adopted as the ‘principles for sustainability as the desired outcome'.

The Natural Step’s definition of sustainability includes four system conditions (see Figure 1.3) that must be met in order to achieve a sustainable system. Basically, it is a naturalistic approach strongly favouring environmental sustainability. The Natural Step

has been used successfully for construction projects by DuBose and Pearce (1997), Oregon Natural Step Construction Industry Group (2001) and Leiper *et al (*2003). Using the Natural Step as the basis for assessing sustainability involves testing the building or development project to identify violations of the four system conditions through backcasting or the use of a sustainability matrix (DuBose and Pearce 1997, Oregon Natural Step Construction Industry Group 2001.). Carillion Group, a United Kingdom construction company has successfully applied The Natural Step to both their own company's operations and to construction projects (Leiper *et al* 2003).

Natural Step System Conditions
1. Substances from the Earth's crust must not systematically increase in the biosphere. 2. Substances produced by society must not systematically increase in the biosphere. 3. The physical basis for the productivity and diversity of nature must not be systematically deteriorated. 4. In order to meet the previous three system conditions, there must be a fair and efficient use of resources with respect to meeting human needs.

Figure 1.3: The four system conditions of The Natural Step.

Natural Capitalism is based on the assumption that future economic growth will be limited by natural capital rather than human-made capital, and that radical increases in resource productivity are necessary for sustainable development. The principles of Natural Capitalism (see Figure 1.4) have been successfully applied to business strategies including for the construction industry (Lovins, Lovins and Hawken 1999).

Natural Capitalism Elements
1. Radically increase the productivity of resource use. 2. Shift to biologically inspired production with closed loops, no waste, and no toxicity. 3. Shift the business model away from making and selling of "things" to providing the service that the "thing" delivers. 4. Reinvest in natural and human capital.

Figure 1.4: The four major elements of Natural Capitalism.

There is a strong business case for sustainable development and a growing number of large companies in the housing industry have shown leadership in adopting holistic approaches to sustainability. There is a clear need for such business role models to lead

both by example and by encouraging their suppliers and contractors to improve their practices. However, the majority of the housing industry comprises small businesses where the realities of day-to-day operations and business survival dominate (Jaunzens undated). Small businesses do not have the same capacity and need to be supported through smaller steps such as regulatory compliance, resource efficiency, waste minimisation and cleaner production.

1.2 Supply-side and demand-side drivers for the housing industry

Although there are many opportunities in the life cycle of a construction project to introduce sustainable solutions (see Figure 1.5), the cost and environmental effectiveness of the solution diminishes as the project progresses through the design, construct and operate stages (see Figure 1.6). The window of opportunity closes as the cost resistance to changing the design increases and the potential environmental benefits become harder to demonstrate. It is at the design stage and at the point of application and approval that a potential building project can be assessed and influenced for the inclusion of features that improve its sustainability performance. Remedial action after construction is more expensive than if the modifications are made at the outset. The payback period for modifications is also affected by the estimated life of the building; for example, there is no point putting double glazing into a house that will be demolished in ten years.

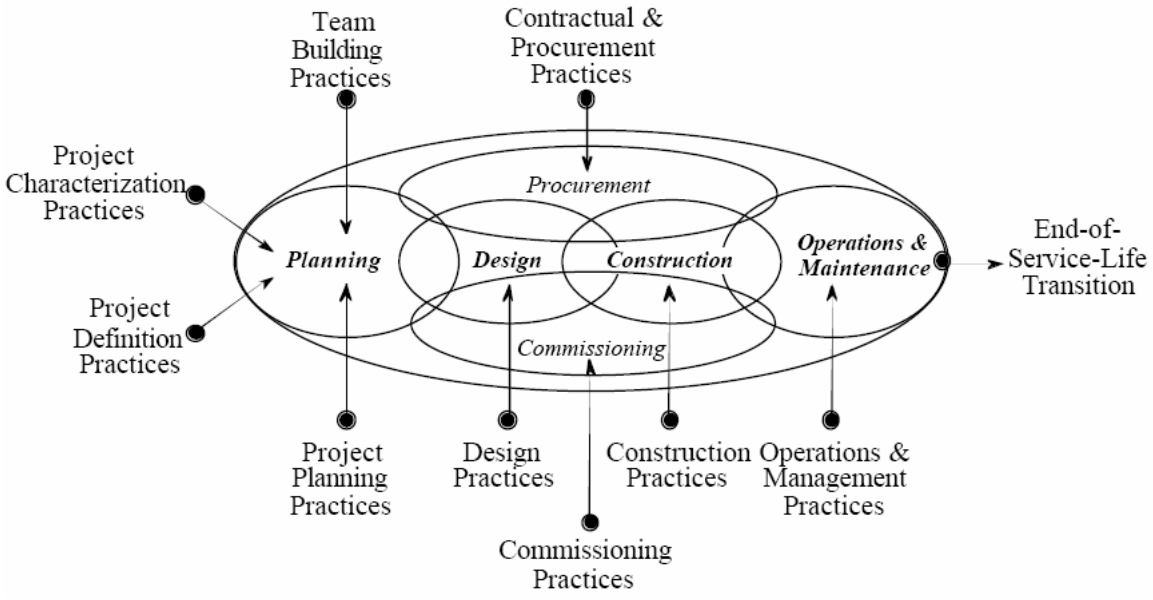

Figure 1.5: The life cycle of a construction project and some of the interactions (after Vanegas 2000).

The council planners and building inspectors are at the centre of the approvals process and given the right authority and resources they can direct and influence an application

based on its level of sustainability characteristics. Planning that explicitly supports sustainable building guidelines in terms of placement, shape and orientation would encourage building designers to deliver passive solar heating, energy efficiency, and more liveable homes (Beyer, 2002). Designers also play an important role; they can influence the client to adopt better environmental design. The design brief of the client is more important than the minimum regulations and in turn the choice of a sustainable design by the client requires a guaranteed market where financiers, developers, estate agents, buyers and sellers, and the consumer marketing sector understand the benefits and added value of such a product.

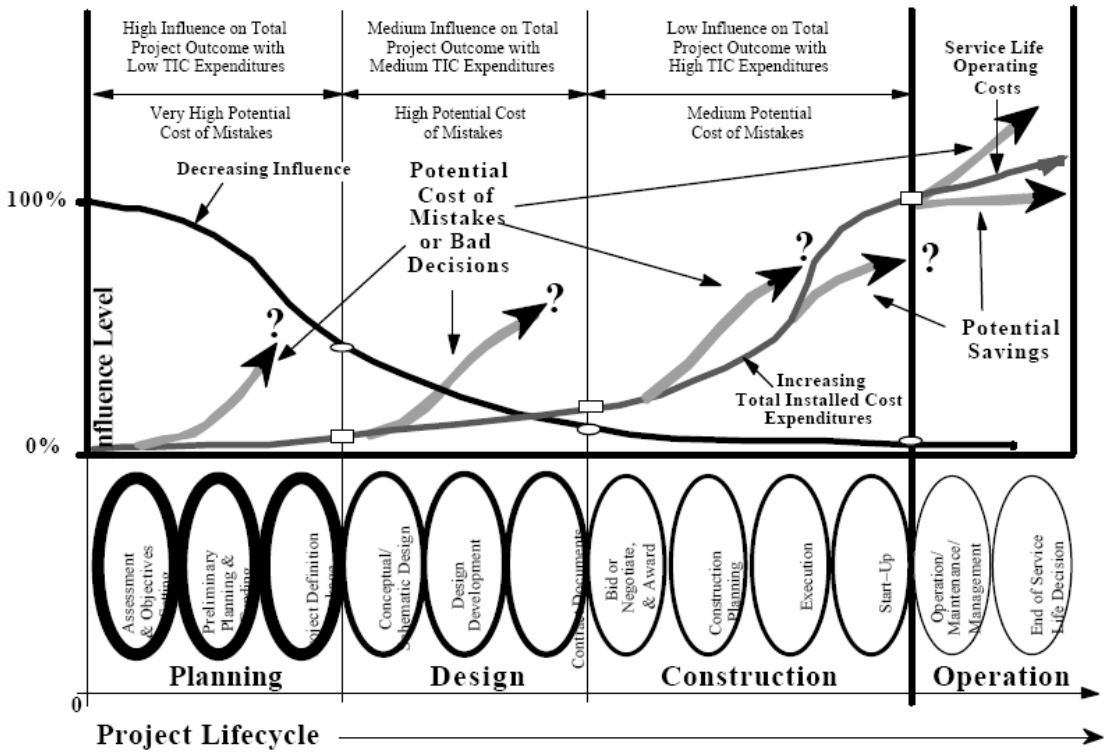

Figure 1.6: Influence on total installed cost (TIC) over construction stage with time (after Vanegas *et al*, 1998).

Favourable finance packages offering reduced interest rates on home loans for energy efficient and sustainably built homes have great potential to stimulate interest and uptake for industry and the consumer. A number of overseas financial institutions are offering packages that reward customers for including sustainable design and energy efficient appliances within the new or renovated home. The reduced loans along with healthier homes that cost less to run have the potential to free up disposable income, reduce loan repayment periods and improve longer term well-being (Beyer, 2002).

Building and construction to achieve sustainable homes requires an understanding of the impacts of construction methods, installation requirements and resource use by builders and contractors. In current building practice, the builders choose where to buy materials and products although the designer may specify particular materials, even providing a full materials specification list (Beyer, 2002). The larger building companies integrate design and materials specification, with many of the materials sourced from preferred manufacturers and suppliers.

The building and construction stages for a house are mostly determined by the design process and this stage is critical to creating a sustainable built form. However, mass house builders do not spend money on the design process; repetition of standard plans is prevalent within the industry despite the aspect or location. This stage of the building chain requires mainly education and training for both building supervisors and contractors to achieve better practice in terms of environmental management and materials use (Beyer, 2002). A good example of this is waste management and recycling where the key process is separating construction waste so it can be recycled. Other important aspects include product selection, installation practices, quality control, on site use of energy, water and other resources, site stormwater pollution, landscape protection etc. The dissemination of adequate easy to use training materials and costs are also important factors.

Key Findings:

1) the housing industry makes a significant contribution to economic and social sustainability outcomes but at the cost of high resource consumption, environmental and social impacts;
2) engagement of the housing industry in sustainable development is dominated by measures to address environmental impacts – governance, social impacts and economic impacts are poorly addressed;
3) the proposed sustainability framework based on The Natural Step and Natural Capitalism needs to be broken down into achievable steps for the majority of housing industry companies;
4) sustainable solutions are more cost-effective and bring more environmental benefits if introduced at the design stage;
5) planners, clients, designers and regulators are most important in influencing the demand for more sustainable homes;
6) lenders, insurers, developers, estate agents, consumer marketing, buyers and sellers are most important in creating the market for more sustainable homes;
7) education and training are most important in influencing house builders and their supply chain to deliver more sustainable homes.

2 Objectives

The objectives for the IND1: Industry Research Programme were to provide:

- A summary of relevant knowledge from around the world with regard to initiatives to encourage industry uptake and sustainability for homes, including success factors.

- A conceptual map of the industry in New Zealand (in its broadest sense, the 'housing supply industry' which incorporates financial institutions and real estate agents).

- At least one alternative approach to achieving this objective (Industry Research), described and costed, that delivers the result much more quickly (for example in two years instead of four).

- An estimate of the likely impact of each alternative approach (including the existing one) in terms of the inputs required for the optimisation tool established under INT1.

- A high level assessment of the current and likely future capacity of the industry to deliver sustainability outcomes, particularly (but not limited to) the capacity for retrofit.

3 Methods

A desktop survey was conducted of national and international policies and strategies relevant to this project through internet resources and influential reports. The study explored the work of key overseas thinkers, practitioners, sector and professional bodies to identify the issues being addressed by the industry, document success factors and to identify future directions for the industry.

Landcare Research engaged Warren & Mahoney, architects experienced in delivering sustainable construction designs, to produce a conceptual map of the housing supply industry in New Zealand. The map examines relationships between housing industry actors and critical paths to identify the potential drivers and barriers to the goal of sustainable housing. The resultant map was tested through a workshop involving a cross section of representatives of the housing industry.

A review of the current research programme IND1-6 was undertaken. This involved accessing information available on overseas projects (seeking to achieve similar outcomes). This provided information on existing practices with similar intended outcomes and also provided a list of potential but untested ideas. The current (intended) research programme was analysed in the context of these approaches and a SWOT analysis was undertaken for each stage of the programme. Keeping in mind the aim of being able to achieve the results more quickly than the current approach. Based on recommendations that emerged from this analysis, an alternative research programme was developed.

A sustainability risk/impact assessment was conducted on the current and alternative research programmes. A simple matrix of the social, environmental, economic, and cultural risks was established, as well as in terms of the inputs required for the optimisations tool under INT1.

Through the information gathered (desk study, overseas examples, national workshop) a picture was generated of the industry's level of knowledge about sustainability, and their current and future capacity to deliver.

4 Summary of relevant knowledge from around the world

4.1 Relevant initiatives

Australia, Canada, Denmark, Finland, France, Japan, the Netherlands, South Africa, the United Kingdom and the United States are foremost in the countries that have national strategies for sustainable housing. This section gives an overview of sustainable housing initiatives and strategies in some of these countries. In particular, it looks at the lessons learnt (success factors, drivers and barriers) and, where possible, how the residential supply industry was involved. The initiatives have been listed either by the country they originate from or where initiatives are transnational, by the country that is primarily managing the initiative. The strategies for engaging the RBE industry in delivering sustainable homes are summarised in Figure 4.1.

Strategies	Approach	Country (examples)
Awareness raising	Best practice guidance, business networks, sustainable home awards, demonstration homes, case studies, checklists, fact sheets.	Australia, Canada, Denmark, Germany, Netherlands, United Kingdom, United States
Legislative and economic instruments	Fiscal incentives, ensuring legislation facilitates sustainable homes, priorities for environmental policy.	Australia, Canada, Finland, France, Germany, Japan, Netherlands, South Africa, United Kingdom, United States
Promoting market-based incentives	Sustainable homes buyers club, investor support, scenarios for ecologically relevant savings.	Germany, United Kingdom, United States
Building industry capacity	Sustainable housing resource centre, skills centre, library, Infodesk, databases, building software, training courses, qualifications, new knowledge development, new building technologies, gap analysis.	Australia, Canada, Netherlands, United Kingdom, United States
Performance	Developing standards, rating systems, eco-labelling, benchmarking, environmental performance indicators, reporting, national indicators.	Australia, Canada, Germany, Netherlands, United Kingdom, United States,
Partnerships	Collaboration and integration with industry associations.	Australia, Netherlands, United Kingdom, United States

Figure 4.1: Overseas strategies and approaches used to engage industry in delivering sustainable solutions for residential housing. Further details for the initiatives in each country are provided in Table 4.2 and Appendix 10.1.

Awareness Raising: Awareness and know-how were found to be particularly important in engaging construction firms, developers, builders, architects, planners and corporations in initiatives to deliver more sustainable homes. The quality of work was improved where these industry groups understood the reasons for the initiatives (Charter and Blackburn, 1999). The Sustainable Construction Task Group (2003) recognised that best practice was followed by larger product suppliers, developers and contractors but this behaviour needed to be cascaded down the construction supply chain in order to engage a wider range of organisations and the smaller companies.

Legislative and Economic Instruments: After consulting with a range of organisations including industry representatives, WWF (2003) concluded that strong planning policies requiring developers to build sustainability into new developments would create a level playing field in which developers would compete and this would stimulate sustainable development across the housing industry. A number of governments have incorporated the principles of environmental sustainability into urban development policies and building regulations especially for new housing – these include most of the member states of the European Union, Australia, Canada, United States and Japan. Denmark has a mandatory labelling scheme (energy and water) and Finland and the Netherlands are developing environmental assessment systems for houses. Although these policies have been largely limited to new build, most of these governments now recognise that the sustainability of the existing housing stock must also be improved in order to achieve national sustainable development targets (Novem, 2002).

Promoting Market-based Incentives: Werner *et al* (2002) identified financiers (credit institutions, insurance companies) and utility companies (water and energy supply) as having considerable capacity to influence the use of sustainable solutions in housing through the pricing of their products.

Building Industry Capacity: There are many initiatives that gather and develop resources about sustainable practices and make these available to the housing industry through various knowledge transfer mechanisms. These are usually led by local authorities, government agencies and research institutions. There are some resource centres specific to the housing industry. Training and qualifications are generally obtained through professional bodies and training organisations and many of these include sustainability in their curricula.

Performance: In a survey of the UK's top house builders, WWF (2004a) found that although the companies recognised the growing importance of sustainable development, they had not integrated sustainability into their own mainstream business practices. In particular, disclosure of information on sustainability issues was weak and this represents a missed opportunity to enhance their reputation. The Sustainable Buildings Task Group (2003) concluded that the construction, development and house building industries had not yet subscribed to much of the sustainability agenda, and had not been persuaded of its long-term benefits. They observed that the normal operation of the housing market has not encouraged volume house builders to seek higher environmental standards, and that:

"the housing market lacks the features of choice, reliable labelling, product information and comparability which characterise consumer-led markets in most other goods …"

Partnerships: Many of the initiatives to engage industry in delivering more sustainable homes are partnerships, usually involving local authorities, housing associations and professional bodies along with industry participants. The Housing Forum (2002) details some 125 new build and refurbishment demonstration projects, many of which were public-private partnerships. Other examples of public-private partnership projects can be found in Australia, Canada, the Netherlands and the United States, Novem (2002) identified the demonstration project as an effective tool for introducing and testing new policies.

Projects	Initiatives	Country
Alphabet Gardens Environmentally Efficient Housing Development (Charter & Blackburn, 1999)	Used BREEAM standard, focus on sustainable building materials and energy efficiency. Problems with contractors having to return to correct mistakes.	United Kingdom – new build
BedZED (WWF, 2004b)	Demonstration project, to demonstrate to a sceptical industry that sustainability is possible and cost-effective. Environmental benefits: Hot water heating 45% less. Electricity for lighting, cooking, and all appliances 55% less. Water consumption 60% less. Command a significant premium above market rates.	United Kingdom – new build
Building and Social Housing Foundation	Awareness raising, best practice, advocacy, financial incentives, training, research, knowledge transfer.	United Kingdom
Canada Green Building Council	Develop industry standards, design guides, educational materials, rating scheme, advocacy.	Canada
Center for Resourceful Building Technology	Promotes environmentally responsible building practices, develops new building technologies and materials, community-based approaches.	United States
Constructing Excellence	Rethinking Construction - partnership with industry, 400 demonstration projects with over 1000 construction organisations involved, best practice, performance indicators, online forum.	United Kingdom
Danish Centre for Urban Ecology	Creating social housing estate of 130 homes, international partnership.	Denmark – new build
Derby Eco Houses (Charter & Blackburn, 1999)	Local products and local contractors used. Completed project used to educate house builders. Found that building contractors need to be involved at the planning stage. Better quality work if builders understand the purpose of the project.	United Kingdom – new build
Development Center for Appropriate Technology	Work to improve building codes and standards.	United States
Energy Efficient Building, Schiedam (Charter & Blackburn, 1999)	Awareness and know-how particularly important in construction firms, developers, builders, architects, planners and corporations who will	Netherlands – renovation

	take their knowledge with them to new projects and developments.	
Environment Trust Green Homes Programme (Charter & Blackburn, 1999)	Public, private and voluntary sector partnership and private funding.	United Kingdom – new build
Federation of Master Builders - Cowboy Builders Pilot Scheme	Qualifications for small contractors, quality mark scheme, resources for consumers, training, identification cards.	United Kingdom
German Federal Environmental Agency	Material flows, resource efficiency, waste reduction, measures and mechanisms for sustainable construction.	Germany
Glasgow Wise Goup (Charter & Blackburn, 1999)	Partnership with local businesses – provided training and work experience. Problem with drop-out rate of trainees.	United Kingdom - renovation
Green Building Council of Australia	Green building rating tool, economic incentives, new technologies, professional development, facilitating industry partnerships, lobbying government, award scheme.	Australia
Green Buildings Policy Network	International network linked to iiSBE, putting together international resource collection.	Canada
GreenSmart	Educational resources, training and accreditation, demonstration homes, environmental benefits identified.	Australia
International Council for Research and Innovation in Building and Construction (CIB)	Agenda 21 on sustainable construction, advocacy, conferences, performance measurement, publications.	Netherlands
International Initiative for a Sustainable Built Environment	Map current activities, develop standards, awareness raising, databases, performance assessment, green building challenge.	Canada
Leicester Home Energy Strategy (Charter & Blackburn, 1999)	Large number of public and private partners including utilities companies. Strong emphasis on training and work creation for the private sector: carrying out energy surveys, installing insulation, improving heating systems.	United Kingdom - renovation
National Sustainable Building Centre	Dubo Infodesk, national sustainable building package – guidance, databases, newsletters, symposia, visits to building sites.	Netherlands
One Million Sustainable Homes	Using and improving BRE Ecohomes standard, regional checklists, fiscal incentives, lobbying government for changes in planning and building regulations, benchmarking sustainability performance of house builders, sustainable home buyers club, award recognising best practice in new homes.	United Kingdom - study
Smart Housing Initiative	Checklist, demonstration homes, contact list of builders, architects and designers, factsheets and guides, resource centre (library), research to demonstrate health benefits, promoting design for disability access.	Australia
Somerset Sustainable Housing (Charter & Blackburn, 1999)	Practical guide, cross sectoral partnership with industry, business network, a trust to fund sustainable housing, resource centres, skills	United Kingdom - new build

	centre.	
Sustainable Construction Task Group	Events, seminars, conferences, awareness raising, guidance, courses, training materials, skills review, demonstration homes, guide to sustainable housing schemes, performance. measurement, case studies, best practice, targets, reporting.	United Kingdom
Sustainable Housing and Urban Regeneration in Hulme (Charter & Blackburn, 1999)	Public and private sector partnership. High level of consultation with tenants required patience, energy and commitment from professionals. Difficulties with confusion, duplication and delays.	United Kingdom - renovation
Sustainable Housing in Europe	Over 700 demonstration houses in four countries, tenant participation in design, guidelines, best practice, assessment, costs and benefits, evaluate tenant satisfaction, integration to mainstream sustainable practices.	Denmark, France, Italy, Portugal – new build
The Housing Forum	125 demonstration projects, partnering the supply chain, measurement, dissemination, offsite fabrication, product innovation, surveys.	United Kingdom
Torsted Vest: A New and Different Neighbourhood in Horsens (Charter & Blackburn, 1999)	User groups of contractors, contractors purchased the land and built homes to council and community specifications. Professionals (architects, engineers, financiers) were not comfortable having their expertise questioned.	Denmark – new built
US DOE Energy Efficiency and renewable Energy Network	Catalogue of green builders, green builder programme, green home certification, checklists, standard for green homes, facilitate healthier homes and workplaces, design guides, case studies, advocacy.	United States – new build and renovation
US Green Building Council	Green building rating system, policy guidance, educational resources, certified products, professional accreditation, annual conferences, partnership projects with industry.	United States
Village Homes, Davis California (Corbett, 2000).	Subdivisions with ecological and new urbanist features. Increased on-sale price by $170 per square metre than comparable houses elsewhere.	United States – new build
Westerpark Eco Estate (Charter & Blackburn, 1999)	Housing department and architects needed considerable expertise. The project gave mainstream companies experience in delivering sustainable solutions.	Netherlands – new build
World Green Building Council	Develop green building councils, databases, case studies, toolkit, conferences.	

Figure 4.2: Summary of overseas projects and organisations examined to develop generic information on types of intervention, success factors, drivers and barriers.

4.2 Success factors

The Sustainable Construction Task Group (2003) identified some of the measures of success for sustainable construction as:

- reduction in the number of pollution incidents on construction sites;
- reduction in the amount of construction waste going to landfill;
- improvements in health and safety on construction sites;
- improved client satisfaction;
- reduced defects;
- recruitment of the best graduates.

Despite the progress made by industry leaders, The Sustainable Construction Task Group (2003) found that most of the United Kingdom construction industry has made little or no progress towards providing more sustainable housing. Figure 4.3 summarises some of the interventions and outcomes of initiatives to facilitate the delivery of sustainable housing in the United Kingdom. Similar examples can be drawn from sustainable housing initiatives in Australia and the United States.

WWF (2004b) found that the leading house builders in the United Kingdom recognised the growing importance of sustainability to their businesses but most companies had not implemented best practice. Where there was good practice, this was not reflected in publicly available information. Countryside Properties and the Berkeley group were singled out as exceptions for the quality of their public disclosure which included performance data and case studies demonstrating sustainable practices. The companies surveyed were generally good at addressing short term environmental impacts such as minimising construction waste on site, but they did not recognise their ability to influence the longer term environmental impacts of their developments. The house builders were not used to being scrutinised by stakeholders and they performed poorly in addressing their social impacts. John Laing has a long history of involvement in social housing projects in the United Kingdom and is one of the few house building companies in the FTSE4Good. Ethical investment was the main driver for implementing ISO 14001 (Laing 2002). There is little evidence within the housing industry of studies to evaluate their economic impacts; for example measuring the value added through improved performance of developments and cost savings through safer working practices and the use of healthier building materials.

An important factor in the international initiatives examined was the involvement of industry sector bodies in partnership projects. Most the success factors and measures of success are related to housing rather than the housing industry and there is little assessment of housing industry progress in adopting sustainable practices. Sharing experience of successes and failures is regarded as important but there is little to no reporting of learning from mistakes.

Table 4.3 summarises examples of interventions and outcomes in the housing industry to promote and facilitate the adoption of more sustainable construction practices.

Interventions	Outcomes	Initiatives and Organisations (Examples)
Regulation	Legislation has provided a level playing field; additional costs related to compliance were a small proportion of overall build costs. For example: Landfill Tax, Aggregates Tax, Climate Change Levy, revisions to Building Regulations, European Energy Performance of Buildings Directive	
Leverage off other policy areas	National energy efficiency programme has raised industry awareness.	Action Energy (formerly Energy Efficiency Best Practice Programme)
Promotion by the regulator	Training materials produced by the regulator were sent to all training institutions.	Environment Agency
Awareness raising	High profile initiatives have raised public awareness.	WWF One million sustainable homes
Training and qualifications	Professional bodies have integrated sustainability issues into accreditation guidelines for undergraduate degrees leading to chartered status and into membership requirements.	Institution of Civil Engineers, Royal Institute of British Architects, Royal Town Planning Institute
Practical examples and best practice	Demonstration projects, case studies guidance and publications compiling these have provided evidence and raised awareness.	Building and Social Housing Foundation, The Housing Forum, Sustainable Buildings Task Group, Constructing Excellence, Construction Best Practice, Rethinking Construction, Sponge (for young property and construction professionals interested in sustainability)
Standards, ratings, self-assessment	External and industry schemes monitor and reward achievement of environmental and social criteria.	BRE Ecohomes rating for houses, Considerate Constructors Scheme for construction sites
Benchmarking	Industry-based and sector-based performance indicators covering environmental and social issues.	Department of Trade and Industry Construction Product Association
Industry awards	Construction and design awards that include sustainability criteria.	The Civic Trust, Design Council and many others in the UK
Ethical investment	Listed companies benefit by being recognised by ethical fund managers.	Dow Jones Sustainability Index, FTSE4Good, Morley Fund Management Sustainability Matrix, BiE Corporate Environmental Responsibility Index

Business Case	Exemplar companies and evidence for the business benefits of more environmentally and socially aware construction activity promoted to the industry.	Carillion, SIGMA, Commission for Architecture and the Built Environment, Royal Institution of Chartered Surveyors, Forum for the Future
Targets	Improvements in housing through targets set by major clients - that developments must meet a particular standard or achieve accreditation e.g. achieving Ecohomes "good" rating with new housing schemes and developments..	Housing Corporation, Countryside Property
Reporting	Requiring housing industry to report social, environmental and economic performance.	Pioneers Club, CIRIA Industry Sustainability Indicators and Targets, London Sustainable Construction Initiative

Figure 4.3: Summary of interventions and their outcomes towards sustainable housing in the United Kingdom (The Sustainable Construction Task Group 2003).

4.3 Barriers

In order to engage the housing industry in delivering more sustainable housing, it is important to understand the barriers that act as an impediment to change. WWF (2004a) identified six key barriers to delivering sustainable housing as:

- lack of fiscal incentives;
- current planning and building regulations;
- perceived lack of investor support;
- perception of extra cost;
- lack of consensus around the definition of a sustainable home; and
- perceived lack of consumer demand.

The Building and Social Housing Foundation (2002) identified the barriers to more sustainable housing as:

- lack of a clear strategic objective and consensus on how to move forward;
- lack of political will;
- existing vested interests;
- lack of understanding as to the benefits of sustainable housing construction;
- poor/old fashioned image;
- personal agency beliefs;
- saliency;
- lack of knowledge about sustainable housing; and
- inertia.

There is little information on the barriers to sustainable housing from the perspective of the housing industry. Figure 4.4 summarises barriers to the delivery of more sustainable housing identified in the international initiatives examined.

Barriers	Issue	Implications
Commitment	The house building industry has not yet subscribed to very much of the sustainability agenda.	Need to raise awareness of sustainability among those who procure buildings.
Evidence	Lack of clear evidence to convince those who are skeptical.	More work is needed to analyse the business benefits of sustainable construction, and collect data from the industry on what it is achieving.
	The overload of initiatives for the construction sector can be confusing.	The right information must be collected and presented in the right way to the right audiences.
Regulations	Growing complexity of taxation and other business regulation.	Need reduced regulation and more certainty to maintain costs.
	Compliance burden of red-tape and paperwork steals scarce time from productive work.	
	Onerous and/or unnecessary regulations are a significant deterrent to innovation.	Regulators could be able to make some discretionary judgments and be protected from liability through legislation.
	Risk and liability regimes influence the attitudes of businesses to innovate.	Liability could be reduced through sharing liability.
	Some regulations are expensive and benefits are not commensurate with their cost.	Decisions on regulatory requirements should include cost considerations.
Supply chain	There are continuing problems reaching small and medium sized enterprises, and the entirety of supply chains.	
Lack of incentives	There are no incentives for home buyers to purchase property built to high environmental standards.	
Too little research	Industry spending on research and development is low.	Cost saving innovations are taken up quickly but not strategic improvements with a long pay back.
	The cost of developing and adopting innovation is a deterrent in the housing industry.	Government funded research, development and demonstration programmes help to offset some of these costs.

Figure 4.4: Barriers and their implications (The Sustainable Construction Task Group 2003, Housing Industry Association undated).

The housing industry operates in an uncertain economic environment often under high pressure accompanied by shortages of skilled labour. Health and safety incidents are around three times higher and environmental impacts, such as resource consumption and waste generation are among the highest, for industry in general. The housing industry is highly regulated especially with respect to the health and safety of home owners. Real and perceived costs and risks are the basis for most of the barriers to sustainable housing.

4.4 Supply-side and demand-side drivers

	Driver	Factors	Countries (examples)
SUPPLY ↓ DEMAND	Health	Indoor climate can be improved through choice of building materials and insulation.	European Union
	Demographic trends	An ageing population with different housing needs	Australia
		Growth in home owners who work from home.	Australia
	Lifestyle choices	Growing consumer concern over the environmental footprint of their new home.	Australia
	Energy efficiency	Standards, tax exemption, premium loans, energy taxes, energy labeling.	Japan, United Kingdom, France, USA
	Reducing carbon dioxide emissions	Standards, utility company obligations (legislation), capital subsidy, energy labeling, energy audits.	USA, United Kingdom, Germany, Netherlands
	Minimising construction and demolition waste	Ban on landfill, mandatory separation, licensing system, landfill tax, exchange schemes, regulatory instruments, virgin material tax, premium loans.	Japan, Sweden, Germany, United Kingdom, Czech Republic, Italy, France, Demark, Netherlands
	Regulation	Many countries have implemented planning and building regulations that aim to deliver safer, healthier homes with less energy, water and waste impacts.	Japan, Sweden, Germany, United Kingdom, Czech Republic, Italy, France, Demark, Netherlands
	Financial incentives	Green mortgages, insurance premiums, utilities charges reduced for houses with energy and water conservation features.	Australia, United Kingdom, United States
	Supply chain	Customers and/or clients requiring suppliers to have environmental management credentials or to supply certified building materials.	United Kingdom
	Standards	Standards, ecolabels, house	Australia, United Kingdom

		rating schemes	
	Awards	Recognition for sustainable design and industry practices	United Kingdom

Figure 4.5: Drivers for sustainable housing (The Sustainable Construction Task Group 2003 and 2004, WWF 2004a, Housing Industry Association undated; Canadian Home Builders' Association 2003). Further details are provided in Appendix 10.2.

The forces that drive the housing industry to adopt more sustainable practices will generally be related to internal and external threats and opportunities. Typically, drivers for sustainability can be categorised as business drivers, external forces and organisational leadership.

Business Drivers	Licence to operate Cost reduction Market growth New markets Profitable growth Competition
External Forces	Environmental change Demographic trends Technological change Political pressure
Organisational Leadership	Values Vision Business models Change Measurement

Figure 4.6: Drivers of business sustainability.

The drivers identified from the international sustainable housing initiatives (see Figure 4.5) generally fall into the categories of business drivers and external forces. There were few examples of drivers based on organisational leadership where the housing industry itself instigated change towards more sustainable outcomes.

4.5 Industry's level of knowledge on sustainability and capacity to deliver

A number of international initiatives have discussed the challenges that need to be addressed in order to deliver more sustainable housing.

The Canadian Home Builders Association (2003) identified four challenges facing the housing industry as:

- knowledge;
- skills;
- innovation environment; and
- communities.

Novem (2002) surveyed European countries and identified common challenges for the delivery of sustainable housing as:

- regulation;
- existing building stock;
- process innovations rather than product innovation; and
- closing the materials cycle.

The issues and implications that affect the industry's capacity to deliver sustainable housing are summarised in Figure 4.7. The main factors limiting the housing industry are related to the availability of skilled labour and information in the form of case studies, best practice guidance and evidence for the benefits of sustainable housing solutions. However, the skills shortage also brought additional costs to sustainable housing projects due to the introduction of new materials and practices. Demonstrating progress towards more sustainable housing inevitably requires monitoring and reporting. Inappropriate performance indicators, difficulties obtaining life cycle costs and skepticism about the economic benefits of sustainable housing solutions limit the capacity of the industry to respond to external drivers as a business opportunities rather than threats.

Factor	Issue	Implications
Knowledge	Awareness within the construction professions and trades is increasing, but is not enough.	The systems that inform industry about innovations and their benefits need to be improved
	More exemplar development is needed but it must be publicised so they become normal practice	The current balance of information is heavily weighted towards new build projects, speculative developments and refurbishments are rarely featured.
Skills and availability	Skilled work force is critical to innovation.	Sustainability requires new construction and managerial processes as well as a change in culture within the sector as a whole.

	Low availability of skilled site staff for housing construction.	The recruitment, retention and skills crisis of the industry has a serious economic impact on the construction process.
	Low take-up of local labour training initiatives	Programmes needed to inspire young people to connect with, understand and get more from the built environment.
	The housing industry suffers from a serious shortage of skilled labour. The shortage is expected to increase.	Housing as a career option has to compete against other industries, occupations and vocations for skilled people.
	Perceptions of construction are at odds with the aspirations of younger generations	Off-site manufacturing where skills and training, materials and waste handling, and efficiency can be better provided
	Difficulties in recruiting and retaining enough trained staff uses site management time, increases costs and reduces time predictability.	Some companies are overcoming these problems by using innovative construction techniques, procurement processes and training programmes to guarantee the future of their company and therefore the industry.
	The majority of employees prefer to work relatively locally.	If a housing estate has a roll-out refurbishment programme over many years, it is in the contractor's interest to recruit and train local employees.
	Higher skills requirements due to technical advances in building products and systems.	The training framework needs to be responsive to the underlying shifts in skill requirements and adapt to the flexible work and business practices in place.
	On top of the basic build price there were costs related to extra project staff training, management, supervision, and quality control, one-off innovation costs related to design research, materials sourcing and establishing their environmental impact, establishing quality control methods for recycled materials and non-standard components, obtaining the associated statutory approvals, and the added programming time this needed	On site, particular care and effort were needed to ensure that the complete construction sequence was fully thought through in advance. All the sub-contractors needed proper briefing on the work methods needed to avoid substandard workmanship, thereby attracting high remedial costs.
Cost	Companies are questioning whether sustainable construction processes will ensure continuing cost reduction, repeat business and profits.	Best practice is mainly undertaken by larger product suppliers, developers and contractors. This behaviour needs to be cascaded down to more types of organisation and smaller companies.
	The application of whole life costing is constrained by the separation of developer and end user, or capital and revenue.	More authoritative reports needed from unbiased organisations.
Performance measurement and	Too many indicators.	Absolute and normalised indicators must be developed, with robust

reporting		measures and both short-term and aspirational SMART targets.
	Little reporting and mistakes not reported.	This has implications for reputation, governance and risk management.
	Impacts on employees and local communities not being addressed and there is insufficient disclosure on health and safety.	Many companies have not considered the full range of impacts on stakeholders or how they can contribute to building social capital in the communities in which they operate.

Figure 4.7: Issues and their implications for sustainable housing (The Sustainable Construction Task Group, 2003 and 2004; WWF 2004a; Housing Industry Association; Canadian Home Builders Association, 2003).

Key Findings:

1) there are many international examples of sustainable housing initiatives but few focus on the housing industry as a sector;
2) for the majority of the housing industry, there is little uptake of sustainable practices;
3) there are few incentives for voluntary adoption of sustainable practices by the housing industry;
4) there are few industry specific performance indicators for delivery of sustainable housing;
5) disclosure by the housing industry is poor leading to a lack of transparency and accountability;
6) most international strategies recognise that the existing housing stock must be upgraded to achieve sustainable housing outcomes; however, there are few initiatives to engage with renovation and refurbishment businesses;
7) there is little reporting of the lessons learned from mistakes and failures.

5 Conceptual map of the industry in New Zealand

Several of the international studies have attempted to map the complex interactions that take place in the housing industry. As part of the process for developing a sustainable construction and housing strategy for Germany, the German Federal Environment Agency (2003) recognised the need to understand different industry actors and the impacts of their actions. Holmen Enterprises Ltd (2001) described the roles and characteristics of the housing industry in the form a relationship diagram when they examined the mechanism needed to foster more innovation in the housing industry. The International Council for Research and Innovation in Building and Construction (CIB 1999) analysed the main links between the large number of actors involved in construction activities ranging from the development phase through the operation phase to the deconstruction phase. Their map was used to identify which stakeholders were responsible for delivering various sustainability objectives.

To create a conceptual map of the New Zealand housing industry, the first step was to consider the life cycle of a typical domestic building. Buildings have an effect on the environment at every stage of their life. The environmental impacts of domestic buildings can be categorised under the following 6 headings:

- **Energy use** – embodied energy, services energy, transport energy.
- **Water management** – water use, sewage treatment, storm water management.
- **Material selection** – extraction / manufacturing process, toxicity.
- **Waste production** – manufacturing waste, construction waste, life cycle waste demolition waste.
- **Health / cultural** – manufacturers / contractors health, occupant health, accessibility. Cultural sensibilities.
- **Site Ecology**– biodiversity, landscaping, storm water systems

In order to assess the overall environmental impacts of such buildings, it is necessary to adopt a holistic understanding of the building's life from the extraction of the materials used to construct the building through the occupation and use of the building until its eventual demolition.

A cursory investigation into the interrelated actions and participants over the lifespan of a domestic building inevitably leads to the conclusion that the network of relationships is extremely complex and will require some rationalisation if the conceptual map is to be of any benefit for further study.

It was therefore decided to break the network into five interconnected chains which together combine to create a conceptual map of the industry. These chains are as follows:

- **The Component Chain** which maps the extraction of raw materials, the manufacture of building components to their eventual installation in the building construction.
- **The Design Chain** which maps the influences of the construction of a domestic building from land use zoning, to developer investment, to design and construction.
- **The Purchase Chain** which maps the procedures involved in the marketing, financing and purchase of domestic buildings.
- **The Life Chain** which maps the inhabited life of the building.
- **The Demolition Chain** which maps the eventual redundancy of the buildings and its eventual demolition.

The chains represent a linear progression through time however at certain periods there are notable overlaps between the chains see Figure 5.1. The relationships between the chains are complex with events in one chain having both direct and indirect influences on other chains.

Once the concept of five linear chains of events is accepted it is necessary to define each chain in terms of its constituent events and the various participants involved. See Figures 5.2, 5.3, 5.4, 5.5, and 5.6. Each chain can be represented as a complex series of interactions or more simply as a linear diagram.

Both diagrams are valid. If the model is to be useful as a diagram to identify the leverage points to influence the adoption of sustainable practices then it is also necessary to identify the parties involved in the chains, how they interact and what the overriding controls or influences are.

When the linear chain diagrams are arranged in a matrix not only is it possible to represent the participants involved but also the dominant influences and controls (critical decision-making points or opportunities for intervention) become apparent - see Figure 5.7. These are as follows:-

- **Legal (and regulatory) controls**: import regulations, manufacturing regulations, product certification, resource consent, building consent, health and safety, legal liability.
- **Economic controls:** land prices, economic climate, material costs, labour costs, house prices, rental values, rates, utilities costs, service costs, maintenance costs payback periods, private wealth, incentive schemes, lending rates.
- **Knowledge controls:** education system, continuing practical education, education of public, media articles, R&D investment, built examples.
- **Supply controls:** market size, raw material supplies, technological ability, workforce skills, R&D investment.
- **Market controls:** media, fashion, lifestyle changes, demographic changes, ethical changes, priority changes, public knowledge, costs.

- **Cultural controls:** environmental, social, society ethics, political environment, population wealth, health and safety.
- **Infrastructure controls:** long term urban planning, transport facilities, health and education provision, services supplies, use zoning, general environment, urban management.

Clearly leverage of any one of these dominant controls will have a significant effect across the whole building life cycle. However analysis also indicates that controls rarely operate on their own to influence any stage of the building life. For example market influences cannot be considered independently of knowledge and economic factors.

When the complex chain diagrams are analysed together a number of dominant player groups also become apparent. Clearly leverage of any one of these dominant controls will have a significant effect across the whole building life cycle These are as follows:-

- **Urban planning teams:** politicians, urban planners, architects, landscape architects.
- **Investors/financers** investors, mortgage providers, employers, investment companies
- **Entrepreneurs:** importers, manufactures, developers.
- **Knowledge providers:** education providers, trade/professional organisations, manufacturers/suppliers, R&D institutes, media, marketing teams.
- **Design teams:** architects, designers, engineers, surveyors, landscape architects, quantity surveyors.
- **Construction teams:** product suppliers, builders, demolition contractors, jobbing contractors, DIYers.
- **Service providers:** utility companies, transport providers.
- **Regulatory bodies:** planners, building consent, health and safety, standards bodies, legal system.
- **Building users:** owners, landlords, tenants.
- **Advisors:** lawyers, surveyors, valuers.
- **Sales and marketing teams:** estate agents, marketing companies, PR companies
- **Society influencers:** media, marketing companies, society heroes, public advisory organisations, knowledge providers.
- **Insurers –** product warrantors, guarantee providers, professional indemnity insurers, home insurers.

This analysis provides a broad-brush overview of the industry and in general the dominant players, influences and controls; however, one final analysis is required and that is the development of a diagrammatic representation of the industry and the interrelation of the parties involved - see Figure 5.8.

Key Findings:

1) five interconnected chains based on material flows and the lifecycle of a residential building can be used to describe the New Zealand housing industry;
2) interventions to influence the housing industry will work best at the critical decision-making points or controls;
3) awareness raising, interventions and performance indicators need to be specifically tailored for each of the dominant player groups or teams;
4) sector bodies for each of the dominant player groups may provide an efficient route for awareness raising and for developing appropriate performance indicators.

Figure 5.1: Interconnections of chains.

Figure 5.2: Component chain.

Figure 5.3: Design chain.

Figure 5.4: Purchase chain.

Figure 5.5: Life chain.

Figure 5.6: Demolition chain.

Figure 5.7: Dominant controls.

Figure 5.8: Integrating diagram.

6 Consideration of alternative approach to achieving objective

The key areas of activity identified by The Sustainable Construction Task Group (2003) in their strategy for promoting and facilitating sustainable construction in the United Kingdom construction industry are:

- Promoting awareness and educating people
- Collecting information on sustainability initiatives and practical examples of sustainability in action
- Monitoring and observing performance
- Demonstrating a clear business case for more sustainable construction
- Stakeholder dialogue
- Spreading best practice
- Setting and promoting targets
- Establishing a Voluntary Code of Practice
- Reviewing performance
- Learning from failures

A coordinated national programme would reduce duplication of effort but may be difficult to achieve due to the number of interest groups and the complexity of their interactions.

Figure 6.1 provides a detailed analysis of the proposed milestones IND2-IND6 for the current research programme for Objective 2: Customers-Industry. Each milestone was tested for strengths, weaknesses, opportunities and threats (SWOT analysis). Recommendations leading to the alternative research programme were developed from this analysis and the review of overseas initiatives – see Figure 6.2.

The alternative industry research programme proposed is of a similar length and cost to the current programme but aims to deliver more and to be more strategic.

- The identification of successful overseas models will be based on criteria established to efficiently focus the research on models that are appropriate to the New Zealand situation and aligned with the aims and objectives of the Beacon programme

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- An assessment of the current uptake of sustainable practices by the RBE industry is recommended and should include relevant professional bodies and curricula of

educational programmes and training that lead to qualifications. This step is essential in order to demonstrate progress and for benchmarking.

- As part of developing a New Zealand strategy for the RBE industry, the use of scenarios is proposed. This provides the opportunity to examine the implications likely to arise from possible interventions to increase the uptake of sustainable practices. Four possible scenarios are suggested ranging from "business as usual" to the industry as a whole "fully engaged in sustainable practices and reporting". The results from the scenarios will be fed into an envisioning process to develop a 2050 vision for the RBE industry. This process will require engagement with all the key stakeholders for the industry and adequate time must be allowed.

- The scenarios and the envisioning process will provide the basis for development of a strategy for the New Zealand RBE industry. The strategy will be developed through an advisory group drawn from across all the RBE industry sectors. It should include the vision, principles for the RBE industry as well as objectives, targets and an action plan.

The current industry research programme allowed a year to develop the stategy and two additional years to test and validate it before extending the strategy out to all the RBE industry. It is our considered opinion that the strategy must be implemented much sooner than 2008 otherwise it will be overtaken by other competing initiatives. Larger companies within the RBE industry in New Zealand are already engaged in developing their own sustainability strategies and the government is already engaged in an awareness raising programme aimed at the broader construction industry as the new Building Act is enacted. There is a risk that by the time the strategy is extended to an industry wide approach, the Beacon project will have to "catch-up" to other strategies instead of "leading" the development of a New Zealand strategy.

- In addition to the establishment of an advisory group to develop the strategy, it is envisaged that the strategy will be implemented through a sustainable RBE industry network. The activities of the network may include the development guidance for the sectors (with the relevant professional bodies), facilitation and evaluation of demonstration projects, developing performance measures, standards and benchmarking for the sectors.

- If a national catalogue of sustainable building materials and products were to be established and the large manufacturers encouraged to achieve some form of environmental accreditation, this would cover, by volume and cost, the majority of building products: cement/concrete, clay bricks and tiles, steel and aluminium, and timber. If these industries were to see themselves as key stakeholders in the building and construction chain and they were to recognise their own involvement as being crucial to creating a more sustainable sector then their voluntary

compliance would play a critical role. With government, industry and community pressure these companies could close the loop to create a more sustainable sector.

- An essential part of engaging with the RBE industry is the availability of appropriate case studies which provide robust analysis of the costs and benefits for sustainable solutions and practices. There are few such examples available for the international initiatives examined and we propose that economic studies of best practice examples in New Zealand is an important part of the industry programme.

- For the final year of the programme, we propose that the New Zealand strategy is evaluated. This provides the opportunity to test and refine performance indicators and benchmarking for the RBE industry sectors.

In brief, the alternative programme identifies, in the context of sustainable practices, where the RBE industry is now, where it wants to get to, how to get there and it tests whether it is headed in the right direction.

Key Findings:

1) further work to examine international initiatives to engage the housing industry in delivering sustainability outcomes should be informed by criteria that reflect the aims and objectives of the Beacon programme, for example a definition for the standard of sustainability to be achieved for both new and retrofitted homes;
2) feedback from visits by key industry groups to appropriate overseas sustainable housing projects would be effective in raising awareness and encouraging the uptake of sustainable practices and solutions;
3) a coordinated national strategy with a common vision for the housing industry requires support by both government and the relevant sector bodies;
4) monitoring and reporting against relevant performance indicators and feedback to the housing industry and policy makers to demonstrate progress towards sustainability outcomes is essential to gain industry commitment and their continued involvement;
5) more emphasis is needed on the development of appropriate social, cultural and economic objectives for the Beacon progamme.

Figure 6.1: Analysis of the existing industry research programme.

CUSTOMERS – INDUSTRY: This objective aims to develop and implement strategies to improve industry ability to facilitate and supply products, services, systems and solutions that improve sustainability in the residential built environment (RBE)

SWOT Analysis: S strengths, **W** weaknesses, **O** opportunities, **T** threats

Timeline/ Budget	Milestone	Activity	Natural Step System Conditions	SWOT Analysis	Recommendations
June 2004 $100K	Identify international industry initiatives regarding sustainable RBEs and determine their success from an industry perspective	Determine what models have worked internationally 1) scope the models to be examined 2) develop criteria/checklist for identifying suitable models 3) identify drivers for industry initiatives 4) identify models with purposes compatible to Beacon objective 5) identify what was successful for the industry participants 6) analysis to determine whether the initiative is transferable to the NZ situation 7) visit selected models with industry representatives 8) develop links with suitable successful initiatives	Apply the four system conditions to the selected projects by backcasting to identify system violations	**S** – avoids reinventing the wheel, provides motivation **W** – models may not be transferable to NZ because the NZ market is so small, most of the overseas examples have not yet been evaluated and it is not cost effective or appropriate for the Beacon project to do this **O** – may identify ways to develop better models from overseas experience, may be able to establish relationship with projects where there is a good match with the Beacon objective **T** – there are many overseas examples and these could be overwhelming, overseas models may be met with "not made here" scepticism by NZ industry	Look for overseas examples where: 1) the main activities involved in RBE are identified 2) the material flows for those activities are understood, 3) ecoefficiency principles have been applied, 4) life cycle impacts of products and components have been analysed and/or whole life costing applied 5) the relationships in the RBE supply chain (demand and supply sides) are understood and the key decision-making interactions are identified where influence in favour of sustainable solutions has be applied 6) performance has been monitored via targets and sustainability indicators 7) economic, social and environmental benefits have been identified
Dec 2005 $100K	Develop a business model for sustainable products, services, (P3S) solutions, systems for New Zealand industry	Develop a New Zealand Strategy 1) identify relevant factors in national, regional and local strategies and policies 2) compare the key policy drivers, significant impacts of RBE industry and its supply chain with	Ensure that the principles deliver the four system conditions, are aligned with national policies and address the significant impacts of the RBE industry in NZ	**S** – the strategy has been designed for the NZ situation and is supported by the RBE industry **W** – the process is too slow for leading sectors and companies that have developed their own sustainability strategies and are already responding to	8) survey the industry to establish the current take up of sustainability practices – include professional bodies and curricula for education and training 9) use scenarios to gain a better understanding of the potential for possible interventions to influence the RBE industry

		the selected international case studies to identify commonality and differences unique to NZ 3) develop a vision for the RBE industry with a small group of key industry representatives 4) identify cross sectoral values, wealth drivers, issues and options for engaging with the RBE industry 5) consult with RBE industry sectors to establish consensus on the vision, issues and options 6) establish an advisory group to develop sustainability principles, a framework and strategy for the RBE industry 7) identify business benefits and barriers to implementation		the new Building Act, the RBE industry in NZ has little knowledge of overseas initiatives, it is unlikely that one business model will work with all the RBE industry sectors **O** – may develop innovative approaches and create synergistic partnerships **T** – the project may be in competition with government bodies developing strategies for delivering the new Building Act, RBE industry is suffering from consultation fatigue and not willing to participate, there is an economic downturn in the RBE industry or the demand for new houses is so high that sustainable construction is the casualty, the work of the proposed advisory group is not recognised by the wider RBE industry	10) establish national sustainability targets and indicators that the RBE industry agree are realistic and deliverable 11) encourage relevant sector bodies to develop their own sustainability policies and guidance for their members 12) compile examples of best practice for sectors and for different sized companies including examples that will work in high pressure projects where individuals or companies come together only for that project 13) promote the implementation of a certified environmental management system but develop sector specific guidance especially to support compliance, the identification of environmental impacts, best practice and benchmarking 14) develop a 2050 vision for the RBE industry
July 2006 $150K	Develop a strategy for test groups that builds the capability to deliver P3S in the RBE	Test and validate in test groups 8) identify test groups in at least three areas of NZ	Test against the four system conditions	**S** – the partnership model facilitates access to government and private funds to support professional	15) define and agree standards for products, technologies, training and education 16) establish a national catalogue

July 2007 $100K	Validate the strategy within test groups eg industry networks	where the RBE industry operates under different conditions 9) develop an appropriate sustainability assessment tool to measure the performance of the test groups 10) develop a programme of training workshops to support the RBE test groups 11) monitor progress through regular feedback meetings 12) establish a project website as the respository for resources and as a means of disseminating progress and best practice 13) engage industry professional bodies in auditing the test groups		bodies in the development of curricula, certification schemes and independent monitoring of the uptake of sustainability by the RBE industry **W** – likely to be resource intensive as groups will need considerable support **O** – able to refine strategy before expanding to industry wide approach **T** – unable to engage RBE industry groups in the three areas, industry reluctant to share best practice for reasons of commercial confidentiality	of sustainable products and services 17) develop appropriate sustainability assessment tools and audit checklists to measure progress of the test groups
July 2008 $200K	Develop an industry wide strategy to deliver sustainable P3S in the RBE and communicate this to industry	Expand to an industry wide approach 14) identify existing industry networks and structures that can be used to disseminate the strategy 15) engage the media, retailers and training bodies in promoting the strategy to the RBE industry including contractors	Test against the four system conditions	**S** – the strategy is well tested and closely aligns with industry needs **W** – demand for sustainable solutions does not match developments on the supply side of the RBE industry **O** – may be able to integrate the strategy with existing RBE industry structures and networks **T** – the strategy is competing with other initiatives such as affordability and health, too late, other competing strategies implemented	18) undertake economic study to establish costs and benefits of sustainable practices for the RBE industry

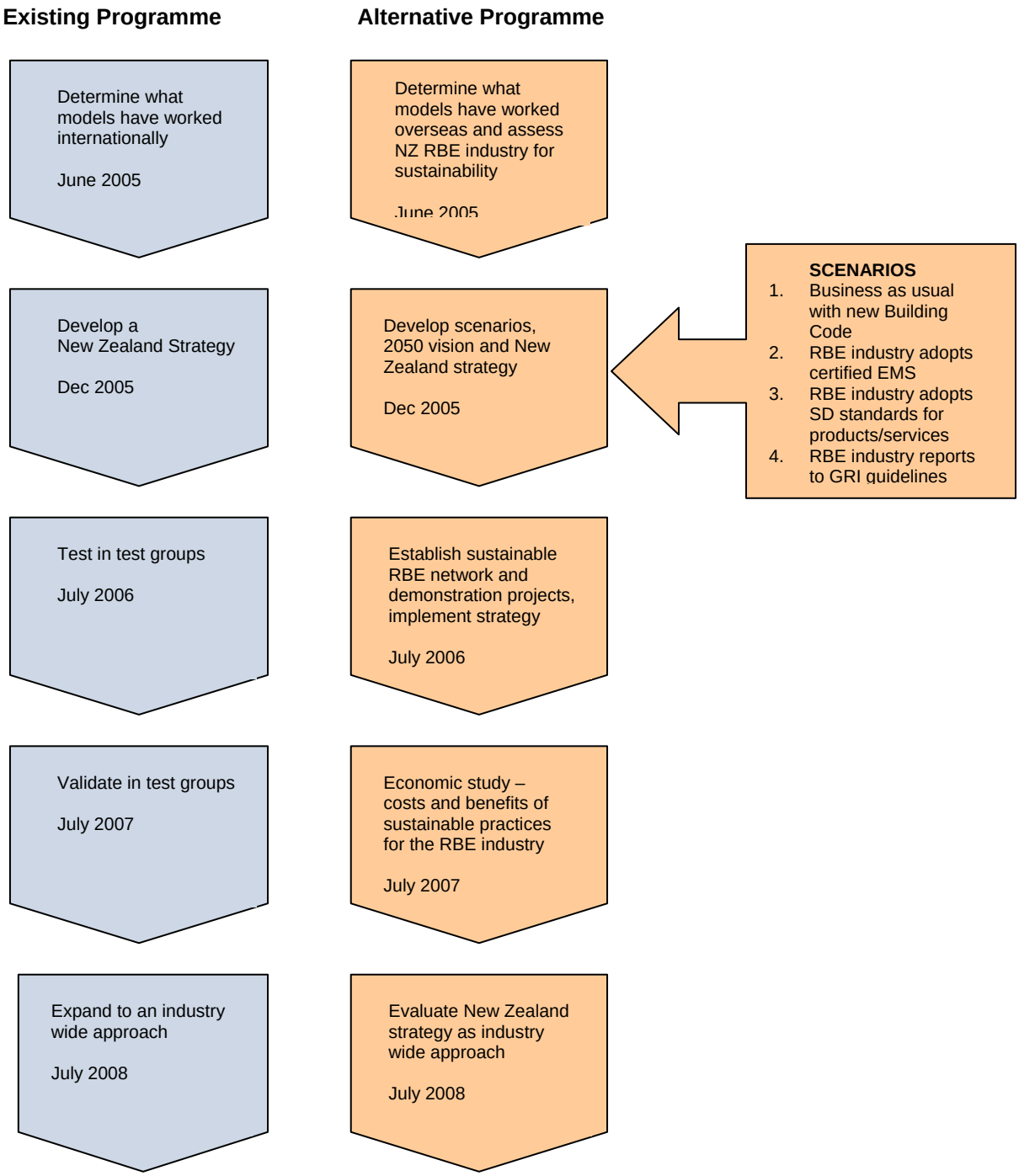

Figure 6.2: Comparison of the milestones for the current and alternative industry

7 An estimate of the likely impacts of each alternative approach

Thee milestones for both programmes were considered in the context of the four system conditions of the Natural Step as that has been proposed as the basis for the sustainability framework for the Beacon Project in SF1.1 Sustainability Framework Design (Hargreaves *et a*l, 2004).

The Sustainability Assessment Model (SAM) is a method for comparing the environmental, social, economic and resource capitals of development projects (Bebbington and Frame, 2003). SAM is a decision-making tool based on modeling life cycle flows and evaluating sustainable development profiles of projects. SAM is a variant of cost accounting methods and environmental, social, economic and resource flows can be converted into monetary units as part of the analysis.

Before assessing the impacts of the two programmes, it is necessary to clarify the possible outputs for each milestone (see Figures 7.1 and 7.2).

A simple analysis (see Figures 7.3-7.5) of the two research programmes against social, economic and environmental outcomes and risks, based on the SAM was undertaken assuming that The Natural Step is used as the sustainability framework for the current programme.

CURRENT PROGRAMME	MILESTONE	POSSIBLE OUTPUTS
	Determine what models have worked internationally	Knowledge, ideas, best practice, case studies, tools and methods, drivers, success factors, barriers, possible benchmarking, links with international projects
	Develop a New Zealand Strategy	Vision and principles for sustainable housing, engagement with the RBE industry, action plan for sustainable housing objectives and targets, indicators
	Test and validate in test groups	Strategy better matched to industry needs and aspirations, drivers, success factors, barriers, tools and methods, educational resources
	Expand to an industry wide approach	Guidelines, educational resources, tools, methods, best practice, benchmarking, national catalogue

Figure 7.1: Possible outputs for the proposed industry research programme.

ALTERNATIVE PROGRAMME	MILESTONE	POSSIBLE OUTPUTS
	Determine what models have worked internationally and assess New Zealand RBE industry for sustainability	As above plus material flows, supply chain relationships, significant impacts, existing best practice, critical decision-making interventions, alignment with national policy
	Develop scenarios, 2050 vision and New Zealand strategy	Options, principles, vision for sustainable housing, engagement with the RBE industry, action plan for sustainable housing objectives and targets, indicators
	Establish sustainable RBE network and demonstration projects, implement strategy	Guidelines, educational resources, tools, methods, best practice, benchmarking, national catalogue, standards, performance measures, monitoring and reporting
	Economic study – costs and benefits of sustainable practices for the RBE industry	Costs and benefits, case studies
	Evaluate New Zealand strategy as industry wide approach	National performance measures, monitoring, reporting and benchmarking

Figure 7.2: Possible outputs for the alternative industry research programme.

Milestones	**Figure 7.3:** Simple sustainability assessment for the **Current Programme**							
	Activities	**Budget**	**Outputs**	**Environment**	**Social**	**Economic**	**Risk**	**Costs**
Determine what models have worked internationally	Scope, test overseas models; desk study and visit(s)	$100K 6 months June 2005	Knowledge, tools, case studies, best practice, lessons learnt, links	Large amount of information much readily transferable	Moderate amount of information, some transferable	Almost no information, not directly comparable	**Low** - lots of examples, may not be transferable, easy to control	Labour, overseas travel
Develop a New Zealand Strategy	Policy analysis, workshops, consultation, advisory group meetings	$100K 6 months Dec 2005	Vision, principles, action plan, objectives, targets, indicators	Current policies mainly environmental sustainability	Current policies mainly health and safety	Current policies have almost no inclusion of economic objectives	**High** – competing with other initiatives, consultation fatigue, high effort needed	Labour, national travel, catering, publishing
Test and validate in test groups	Recruit groups of companies, training, develop educational resources, meetings, monitoring, auditing and reporting	$250K 18 months July 2007 Could charge for contribution for training	Strategy better matched to industry needs and aspirations, drivers, success factors, barriers, tools and methods, educational resources	Sustainability framework based on The Natural Step, largely environmental	Mainly health and safety	Low	**Moderate** – industry too busy and reluctant to share best practice, resource intensive	Labour, national travel, catering, publishing
Expand to an industry wide approach	Engage with professional bodies and educators, establish networks, meetings, workshops, develop and disseminate promotional materials	$200K 12 months July 2008 Advisory body may raise revenue	Guidelines, educational resources, tools, methods, best practice, benchmarking, national catalogue	Environmental impacts reduced and and practice improved	Emphasis remains on health and safety but social impacts better understood	Understanding of economic impacts remains low	**High** – too late, other strategies in place, not aligned with industry needs, high effort needed	Labour, national travel, catering, publishing

Milestones	**Figure 7.4:** Simple sustainability assessment for the **Alternative Programme**							
	Activities	**Budget**	**Outputs**	**Environment**	**Social**	**Economic**	**Risks**	**Costs**
Determine what models have worked internationally, assess RBE industry for sustainability	Scope, test overseas models; desk study and visit(s), surveys and interviews	$100K 6 months June 2005	Knowledge, tools, case studies, best practice, lessons learnt, links, baseline data for NZ industry	Large amount of information much readily transferable, survey will establish baseline data	Survey will establish baseline data	Survey will establish baseline data	**Moderate** - effort needed to get good response rate, easy to control	Labour, overseas travel, publishing
Develop alternative scenarios, 2050 vision, New Zealand strategy	Policy analysis, workshops, consultation	$100K 6 months Dec 2005	Options, vision, principles, action plan, objectives, targets, indicators	Remains high	Other social aspects included	Likely to remain low until research results available	**High** – competing with other initiatives, consultation fatigue, high effort needed	Labour, national travel, catering, publishing
Establish sustainable RBE network, demonstration projects, implement strategy	Advisory group meetings, engage with professional bodies and educators, recruit companies, dissemination	$200K 12 months Dec 2006	Guidelines, educational resources, tools, best practice, benchmarking, national catalogue	Remains high	More awareness of other social aspects	Low	**Moderate** – industry too busy, resource intensive	Labour, national travel, catering, publishing
Economic study – costs and benefits of sustainable practices for the RBE industry	Data collection, analysis	$100K 6 months July 2007	Costs and benefits, case studies	Benefits quantified	Benefits quantified	High	**Low** – industry has vested interest in results, easy to control	Labour, national travel
Evaluate New Zealand strategy as industry wide approach	Data collection, surveys, interviews, workshops, analysis	$150K 12 months July 2008	Performance measurement, monitoring, reporting and benchmarking	Environmental impacts reduced and and practice improved	Improved corporate social responsibility	Improved understanding of economic impacts	**Low –** industry has vested interest in results, easy to control	Labour, national travel, catering, publishing

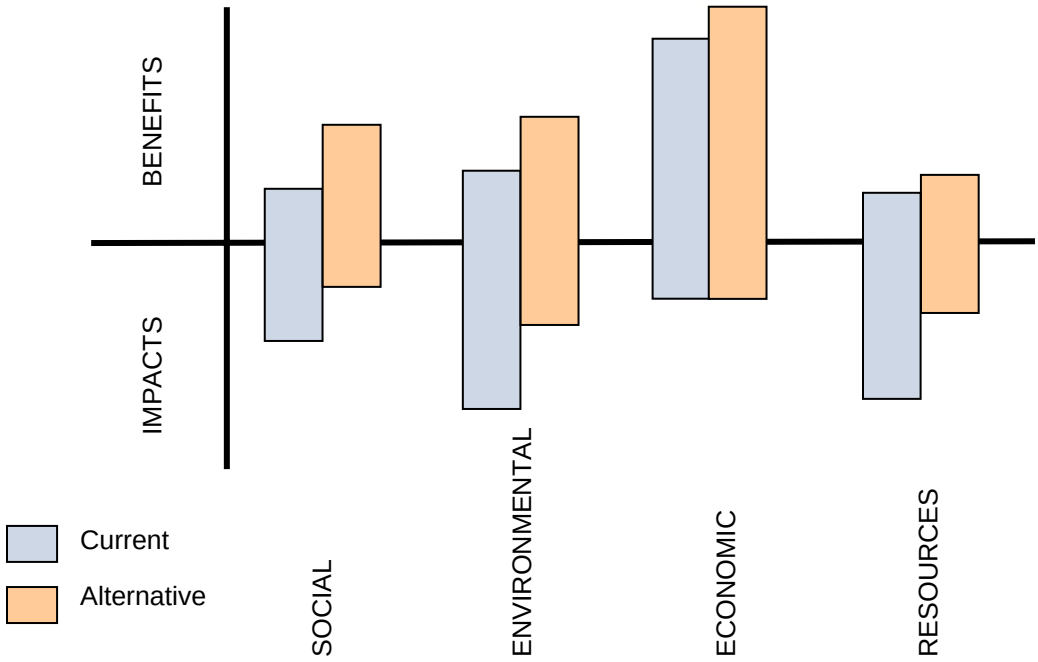

Figure 7.5: Comparison of the two industry research programmes using a simple sustainability assessment to show the social, environmental, economic and resource consumption outcomes.

Figure 7.5 indicates the possible results that could be obtained using the sustainability assessment model (SAM). The illustration here is based on a crude scoring system where the height of the columns is roughly proportional to the sum of the positive and negative environmental, social, economic and resource impacts for all the milestones.

The alternative research programme takes a long-term view through the lens of the 2050 vision and hence is expected to deliver a robust industry strategy able to accommodate longer pay-back periods. Identifying and addressing social impacts will contribute to both economic and environmental outcomes. Economic studies of sustainable housing solutions provide positive feedback for industry and will encourage wider adoption of these practices – this in turn contributes to the social and environmental outcomes. The development of performance indicators appropriate to the housing industry helps to measure progress towards sustainability goals and provides feedback for industry and policy makers.

8 A high level assessment of the current and likely future capacity of the industry to deliver sustainability outcomes

A workshop was held with 30 participants from across a wide range of sectors from the housing industry. The workshop explored the issues and their implications for the New Zealand housing industry associated with delivering sustainable housing solutions. Detailed notes from the workshop are provided in the IND1 CD-ROM <Housing_Industry_Workshop_Notes 10 sept 2004 v3>

During the workshop, industry participants identified a wide range of initiatives that are currently practiced by the New Zealand companies. These can be categorised as:

- Guidance
- Software packages provided by retailers for builders
- Energy efficiency initiatives (home energy checks, passive design, insulation, double glazing)
- Water conservation measures (grey water recycling, source control of stormwater)
- Demonstration homes
- Holistic subdivision development
- Increased recycled content in products
- Certified building materials
- Training installers to ensure product performance
- Sustainability included in educational programmes

There was very little knowledge of overseas initiatives. When the workshop participants were asked what initiatives they would like to see implemented, rating schemes and fiscal incentives were added to the current practices. The need to seek advice from planners and building inspectors at the design stage of a development rather than at the planning application stage was emphasised. For rating schemes, the importance of post-completion inspection or enforcement was highlighted. Suggestions for fiscal incentives included lower insurance premiums and “green” mortgages for houses with fire prevention and energy efficiency features.

Possible interventions to encourage sustainable housing solutions were explored and the interventions rated as most important are listed in Figure 8.1. Four of the interventions were examined in more detail to identify the consequences of the intervention, why these practices were not in place currently and what was needed to implement them (see Figure 8.2). The full notes from the workshop are provided on the CD-ROM accompanying this report.

Group 1	Group 2	Group 3	Group 4	Conclusion
Building code	Trade and public education (create consumer demand)	Consumer influences (scoping, ideas) advertising, media, trends	Public awareness	Cost
District plan	Designers brief and contract	Designer education	Regulation	Political process
Client/consumer education	Regulatory framework (building code and district plan)	Building codes, consent process and other regulatory procedures	Subsidies	Rating schemes
Government subsidies	Subsidies	Material availability and distribution	Education/training of professionals	Media
Preferential finance arrangements (lower interest rates)	Product availability	Construction skills to build sustainable features (training role)	Creating supply	Industry network
				Financial incentives (private service providers)
				Giving control to renters and owners

Figure 8.1: Most important interventions in the delivery of housing as identified by the workshop participants.

	Consequences of intervention	Reasons for not doing it	Measures to make it happen
BUILDING CODE	• Big stick approach • Stifle innovation • Push out smaller companies • Price people out • Definite results e.g. all new houses meet a prescribed standard • Force people into doing something • Push new house values • People only build to minimum requirements • Create undesirable housing stock	• Standard not known • Might not work, might not be uptake • 7 year turnover period for houses is a disincentive for initiatives that have a longer payback	• Encourage voluntary performance standards • Need lots of consumer education e.g. health benefits • Not big stick – better to leave use market pressures
EDUCATION	• Creates demand • Demonstrate positive benefit for the individual • Flow on to supply chain • Potential for job creation	• Information overload • Shortfall in supply (products and services) • Build up unrealistic expectations • Too hard basket/ fear of the unknown • No collective responsibility	• Collective of providers • Range of incentives • Buy-in by consumers, politicians etc • Expand existing sustainable suppliers • Information – better use of existing resources – popularise through the media • Who monitors, enforces etc • Incentives e.g. subsidies
SKILLS	• Better standard of housing construction • Warmer drier houses • Houses with increased life and reduced maintenance • Enhanced customer satisfaction • houses worth when built to sustainability standard	• Lack of capacity in workforce (numbers) • Lack of training • Inadequate checks and measures in training/practice • Lack of glamour in vocational training • Low pay for building trade so low skills • Repetition of old methods • More young people going into tertiary education • Need more people to teach skills • Fear in industry of setting standards too high	• Require qualifications for trades, checked by independent inspectors on quality of work • Ongoing responsibility for work • Incentives to develop skills • Customer education on using right trades people • Use more factory construction/pre construction where there are systems to check compliance

PUBLIC AWARENESS	• Designer education and public education - sharing of conceptual ideals • Refinement of technological processes and products	• People don't know about it • It must look good and fit in with lifestyle fashions • Availability of materials, lack of construction skills	• Trade shows, conferences, seminars • Use sustainable products/experiments in TV makeovers • Demonstration homes/show homes for sustainability performance • Raise profile of designers who use sustainable methods • Media needs to make the topic mainstream • Good design, comfort, health and affordability with minimum impact on the environment • Rebrand sustainable development and green to make it mainstream • Practical solutions for architects/buyers etc • Collaboration of all partners to integrate individual sustainability features

Figure 8.2: Ability to deliver sustainability solutions for interventions in regulations, education, skills and public awareness.

Some additional points that were made by the workshop participants that are worth capturing here are:

1) The building inspector is able to delay or prevent the introduction of sustainable or innovative solutions especially for retrofit projects where the proposed building work was outside the scope of the building code. The building inspector is obliged to review building applications from the viewpoint of the regulator's liability.

2) Home owners who implement water saving measures may be penalised by the water utility companies due to the way in which water is metered. Incentives are needed for home owners who reduce water consumption and make further savings through source control of stormwater runoff or grey water use.

3) Decision making of home buyers varies before and after they have sold their own home. In the period before the sale, the prospective home buyer will remain firmly committed to a checklist of features that they desire in their new home. Prospective houses may be rejected for failing to meet some of the points on the

checklist. Once the existing house has been sold, the home buyer is under pressure to make a choice and commitment to the original checklist is relaxed. Now the situation is reversed and a house may be selected for matching some of the points on the checklist.

Key Findings:

1) knowledge and practice in the New Zealand housing industry for delivering sustainability outcomes and solutions were limited and largely aimed at reducing environmental impacts;
2) the delivery of sustainable solutions should be a collaborative process involving all the key industry actors and should take place at the planning and design stage for both new and retrofit housing projects;
3) fiscal incentives and rating schemes were favoured and both mechanisms needed to be reinforced by post project evaluation to demonstrate that sustainable outcomes had been achieved;
4) more resources are needed for awareness raising, education and training within the housing industry;
5) qualifications should be developed for a wider range of the trades operating in the housing industry, there should be ongoing responsibility for the work and the there should be an independent inspection process to check the quality of the work;
6) in order to promote sustainable solutions throughout the housing industry, the terms “sustainability” and “green” need to be rebranded to link their values with more mainstream consumer interests; for example, good design, comfort and affordability with minimum impact on the environment.

9 References

Bebbington, J. and Frame, B. (2003). *Moving from Sustainable Development Reporting to Evaluation: The Sustainability Assessment Model*. Paper presented at a meeting of the New Zealand Business Council for Sustainable Development and published on their web site. <Sustainability_Assessment_Model.doc>

Beyer, D. (2002). *Sustainable Building and Construction. Initiatives and Regulatory Options towards a Sustainable Planning, Building, Design and Construction Sector in Western Australia.* Background Paper for the State Sustainability Strategy (Western Australia). <Beyer_WA_Sustainable_Building.pdf>

Building and Social Housing Foundation (BSHF) (2002). *Sustainable Housing Solutions. Transferring Good Practice from the Margins to the Mainstream*. BSHF, Coalville, Leicestershire. <BSHF_Sustainable_Housing_Solutions.pdf>

Canadian Home Builders Association (CHBA) (2003). The Housing Industry. Submission to Industry Canada's Innovation Initiative. http://www.innovationstrategy.gc.ca/gol/innovation/interface.nsf/vSSGBasic/in02277e.htm

Charter, S. and Blackburn, J. (1999). *Sustainable Housing: What and How? Case Studies for New Build and Refurbishment Projects.* A Somerset Sustainable Housing Study. <SSH_Sustainable_Housing.doc>

DuBose, J.R. and Pearce, A.R. (1997) *The Natural Step as an Assessment Tool for the Built Environment.* CIB Conference on Green Building, Paris, France. <DuBose_Natural_Step_Assessment.pdf>

German Federal Environmental Agency (UBA) (2003). *Sustainable Construction and Housing in Germany. material-flow-related components for a national sustainable development strategy – linking the construction and housing sector with the complementary area of 'public infrastructure'*. Institute for Applied Ecology, Institute of Ecological and Regional Development, and Dresden University of Technology. <Germany_Material_Flows1.pdf>

Global Reporting Initiative (2004). Database search by sector. http://www.globalreporting.org/

Hargreaves, R., O'Connell, M., Vale, R., Nebel, B., Lietz, K. and Jacques, R. (2004). *Sustainability Framework. SF1.1 Sustainability Framework Design*. A report for Beacon

Pathway Ltd – Sustainability in the Residential Built Environment Research Programme 2004-2010. <Hargreaves_Sustainability_Framework.doc>

Holmen Enterprises Ltd (2001*). Innovation in the Housing Industry. A discussion paper presenting an overview of innovation in housing: how it works, what facilitates it, what constrains it, and how it might be stimulated.* National Research Council of Canada. <Holmen_Housing_Industry_Innovation.pdf>

Housing Industry Association Limited (undated). *Housing Australians*. <HIA_Housing_Australians.pdf>

International Council for Research and Innovation in Building and Construction (CIB) (1999). *Agenda 21 on Sustainable Construction*. CIB Report Publication 237. <CIB_A21_Sustianable_Construction.pdf>

International Standards Organisation (2001). The ISO Survey of ISO 9000 and ISO 14000 certificates. Tenth Cycle: Up to and including 31 December 2000. ISO, Geneva. <ISO_Survey_2000.pdf>

Jaunzens, D. (undated). *Influencing Small Businesses in the Construction Sector Through Research*. Buildings Research Establishment, Watford, UK. <Jaunzens_BRE.doc>

Laing, C. (2002). Environment Director, John Laing plc, personal communication.

Leiper, Q., Fagan, N., Engstrom, S. and Fenn, G. (2003). A Strategy for Sustainability. *Engineering Sustainability* **156**, 59-66. <Leiper_Carillion.pdf>

Lovins, A.B., Lovins, H.L.and Hawken, P. (1999). A Road Map for Natural Capitalism. *Harvard Business Review*, **May-June**, 145-158. <Lovins_Roadmap_Natural_Capitalism.pdf>

Novem (2002). *Sustainable Housing Policies in Europe.* Synthesis Report on Sustainable Housing Policies for the Third EU Ministers' Conference on Sustainable Housing 27 and 28 June 2002, Genval, Belgium. <EU_Ministers_Conference_Sustainable_Housing.pdf>

Oregon Natural Step Construction Industry Group (2001). Using the Natural Step as a Framework Toward the Construction and Operation of Fully Sustainable Buildings. <Oregon_Natural_Step.pdf>

Orgasnisation for Economic Co-operation and Development (2003). *Environmentally Sustainable Buildings: Challenges and Policies*. OECD, Paris. <OECD_Environmentally_Sustainable_Buildings.pdf>.

Queensland Government Department of Housing (undated). How *Smart is Your Home?* A checklist of some of the features of Smart Housing. <Queensland_Smart_Housing_Checklist.pdf>

Sustainable Construction Task Group (2003). *Better Buildings – Better Lives.* <UK_EA_Better_Buildings.pdf>

The Housing Forum (2002). *The Housing Forum Demonstration Projects Report. The Challenges Ahead.* The Housing Forum, London. <The_Housing_Forum_Demostration_Projects.pdf>

Sustainable Construction Task Group (2003). *The UK Construction Industry: Progress Towards More Sustainable Construction 2000-2003.* <UK_Sustainable_Construction_Task_Group.pdf>

Vanegas, J.A., Hastak, M., Pearce, A.R. and Maldonado, F. (1998). *A Framework and Practices for Cost-Effective Engineering in Capital Projects in the A/E/C Industry*. Construction Industry Institute, Austin, TX. Cited in Sustainable Facilities & Infrastructure Program, The Safety, Health, and Environmental Technology Division, Electro-Optics, Environment and Materials Laboratory, Georgia Tech Research Institute (2001). *Resource Guide for Systems-Based Sustainability Analysis of Building 170 Fort McPherson, Georgia.* <Systems_Based_Sustainability_Analysis.pdf>

Vaneagas, J.A. (2000). *Project Definition Package.* School of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta. Cited in Sustainable Facilities & Infrastructure Program, The Safety, Health, and Environmental Technology Division, Electro-Optics, Environment and Materials Laboratory, Georgia Tech Research Institute (2001). *Resource Guide for Systems-Based Sustainability Analysis of Building 170 Fort McPherson, Georgia.* <Systems_Based_Sustainability_Analysis.pdf>

Werner, P., Henseling, K-O., Lützkendorf, T., Deilmann, C. and Fritsche, U.R. (2002) *Criteria and Indicators for Environmentally Sustainable Construction and Housing. An ongoing research project in Germany.* <Werner_Germany_Indicators_Sustainable_Homes.pdf>

World Wildlife Fund (2002). Fiscal *Incentives for Sustainable Homes.* Environmental Resources Management, London. <WWF_Fiscal_Incentives.pdf>

Sustainable Housing Forum (2003). *Building Sustainability. How to Plan and Construct New Housing for the 21st Century.* WWF, Golalming, Surrey. <WWF_Building_Sustainably.pdf>

World Wildlife Fund (2004a). *Building Towards Sustainability. Performance and Progress Among the UK's Leading Housebuilders.* WWF, Golalming, Surrey. <WWF_Performance_House_Builders.pdf>

World Wildlife Fund (2004b). *One Million Sustainable Homes. Moving Best Practice from the Finges to the Mainstream of UK Housing*. WWF, Golalming, Surrey. <WWF_One_Million_Sustainable_Homes.pdf>

Yeang, K.P. (1995). *Designing With Nature*. McGraw Hill, New York, NY. Cited in Sustainable Facilities & Infrastructure Program, The Safety, Health, and Environmental Technology Division, Electro-Optics, Environment and Materials Laboratory, Georgia Tech Research Institute (2001). *Resource Guide for Systems-Based Sustainability Analysis of Building 170 Fort McPherson, Georgia.* <Systems_Based_Sustainability_Analysis.pdf>

10 Appendices

10.1 Summary of relevant initiatives from around the world

The following is a summary of relevant initiatives from around the world. They have been listed either by the country they originate from or where initiatives are a collaboration of multiple countries by the country who is primarily managing the initiative.

10.1.1 United Kingdom

Somerset Sustainable Housing (SSH)
Somerset Sustainable Housing (SSH) http://www.sustainablehousing.org.uk/ was established in June 1999 as a not-for-profit community enterprise, working to promote and create sustainable housing in Somerset. SSH's objectives for 1999 and 2000 include:

- **Produce and disseminate a practical Guide to Sustainable Housing for Somerset (What is it? and how do we create it?). Progress:** The Somerset Sustainable Housing Study was completed in November 1999 and received very good feedback both locally and from national 'experts' - and the Study is now available to Councils, individuals, businesses, etc.

- **To encourage the establishment, through consultation, of a partnership based, cross-sectoral sustainable housing strategy for Somerset, and a Sustainable Housing Partnership in Somerset, involving local authorities, housing associations and other relevant community and business organisations. Progress:** SSH is part of a working group seeking to establish a partnership based sustainable housing strategy in South Somerset.

- **To establish a Somerset Sustainable Housing Community and Business Network. Progress:** SSH is part of an informal network of local individuals, groups and businesses with an interest in sustainable housing, but currently lacks the resources to formally launch and service such a network.

- **To establish or help establish a Somerset based Development Trust (or similar organisation) to both: a) build a range of sustainable housing and b) undertake sustainable improvements to the existing housing stock in Somerset. Progress:** The Somerset Trust for Sustainable Development was launched in May 2000.

- **To help establish one or more Sustainable Housing Resource Centres in Somerset. Progress:** a list of appropriate resources for a 'Sustainable Housing library' has been developed - now established at The Somerset Trust for Sustainable Development offices in Langport, Somerset.

- **To help establish a working Sustainable Housing Skills Centre, ideally in partnership with others, to act as a significant centre for work, education and training that can help deliver a variety of sustainable housing solutions in Somerset. Progress:** SSH has been involved in exploratory discussions about a Skills Centre with both Mendip DC and South Somerset DC, both of which have expressed interest. A potential source for funding the training elements of the project has been identified via a potential private sector partner.

The Somerset Trust for Sustainable Development has now taken over this initiative as a core objective. The SSH project is endorsed by the Association for Environment Conscious Building, the ethical bank Triodos, and is receiving start-up funding from The Carpenters Company Charitable Trust and The Glastonbury Trust for the first stage of the project. SSH has also received grants from Mendip DC, South Somerset DC and West Somerset DC in exchange for use of the Sustainable Housing Study. Much of SSH's work has now been incorporated into the work and aims of The Somerset Trust for Sustainable Development.

Practical Next Steps: Key issues
Focus on the Local Context: Sustainability and housing in the local area. Understand what sustainable housing is and how to create it. What are the various pieces of the jigsaw needed to put in place to create sustainable housing? What are the gaps at present? Take advantage of the SSH Study i) this draws a number of key conclusions about the local and national situation; ii) makes practical Recommendations about how to take things forward; and iii) includes various appendices with useful information on contacts for skills, materials, information, etc.

Mendip is seen as one of the country's leading authorities on Agenda 21 issues. Three initiatives promoted by Mendip that have particular relevance to housing are: **Solar Club:** Mendip are one of the first Councils in Britain to launch the Solar Club scheme. This provides professional training for groups of local people to help each other in fitting their own solar panels. Through the Solar Club systems have typically been fitted for £1300, which is around half the cost of a typical solar system.

Global Action Plan (GAP): The Global Action Plan is a national project that is designed to raise environmental awareness in relation to lifestyle issues. Amongst its targets are energy and water efficiency, and reduction of domestic waste.

The Affordable Warmth Programme for Mendip DC's housing stock, and their two sustainability working groups which work in partnership with Housing Associations. Mendip are partners in the Somerset Food Links project with South Somerset DC.

A report entitled *Sustainable Housing: What and How? - Case studies for new build and refurbishment projects* includes case studies from the United Kingdom, Denmark and the Netherlands – a copy of the article is provided on the IND1 CD-ROM. <SSH_Sustainable_Housing.doc>.

WWF- one million sustainable homes

At the World Summit on Sustainable Development in Johannesburg in August 2002, WWF launched their campaign for sustainable homes. WWF is working with government, industry, and consumers with a target to ensure one million sustainable homes are developed across the UK by 2010, including refurbished as well as new homes. They state that one of the principal barriers to progress in this area was the definition of a 'sustainable home'. They are using the Building Research Establishments (BRE) EcoHomes standard as a starting point and support EcoHomes 'Very Good' and 'Excellent' standards as a good measure for new and refurbished homes which have significantly less impact on the environment. WWF is working with BRE, South East England Development Agency (SEEDA), and other Regional Development Agencies to develop regional checklists, which take account of local circumstances and case studies. An example of the South-east checklist can be obtained from www.sustainability-checklist.org.uk

WWF identified the barriers to sustainable homes to include:

- A lack of fiscal incentives;
- Current planning and building regulations not facilitating sustainable homes;
- A perceived lack of investor support;
- A perception of extra cost;
- A lack of consensus around the definition of a sustainable home; and
- A perceived lack of consumer demand.

WWF are working with a range of partners to implement six strategies to overcome these barriers. These strategies are:

- Ensuring that a range of fiscal incentives are introduced: a copy of the report is provided on the IND1 CD_ROM. <WWF_Fiscal_Incentives>.

- Ensuring that Planning and Building Regulations facilitate the development of sustainable homes: WWF is part of the Government's Sustainable Buildings Task Group. WWF will work to ensure that tough but realistic standards are set for all

new homes and major refurbishment. A copy of the report is provided on the IND1 CD-ROM. <WWF_Building_Sustainably>.

- Demonstrating strong investor support for sustainable homes: WWF has been benchmarking the sustainability performance of house-builders. They are also discussing opportunities to create market-based incentives for the development of sustainable homes. They have published a report, a copy of which is provided on the IND1 CD_ROM <WWF_Performance_House_Builders>.

- Ensuring the cost of sustainable homes is competitive: A scoping study has been commissioned for a 'sustainable homes buyers club'. This will offer developers practical means of reducing the cost of key products and materials required for sustainable homes. Further information is available at www.bioregional.com.

- Developing the EcoHomes standard: WWF is a member of BRE's EcoHomes Steering Group which oversees the continuing development and improvement of the standard.

- Building consumer awareness and demand for sustainable homes: The Sustainable New Homes Award recognises and rewards examples of best practice in the new homes market. Further details can be obtained at www.wwf.org.uk/sustainablehomes/index.asp.

10.1.2 Australia

Smart Housing Initiative

The Queensland Government Department of Housing has a Smart Housing Initiative http://www.housing.qld.gov.au/builders/smart_housing/index.htm. Its aim is to help Queenslanders to plan and build homes that are more sustainable over time. They provide the following resources:

- Checklist for determining how smart your home is (a copy is provided on the IND1 project CD-ROM <Queensland_Smart_Housing_Checklist.pdf>.
- Examples of smart homes.
- A contact list of a list of builders, architects and building designers who have recently worked with the Department on Smart Housing projects.
- Publications including: factsheets (e.g. kitchen, bathroom, outdoor living etc), booklets (e.g. design, safety and security, cost effeciency etc), residential design manual and maintenance management plan.
- A Smart Housing Library including:housing standards and policies, Smart Housing Bulletins , the history of construction and design issues already handled by the Department, related information from other states and countries , and general resources relating to Smart Housing.

- The Towards Health and Sustainable Housing Research Project. The Research House is Queensland's first ever house to test and demonstrate new and innovative technologies, building practices and products in a single, living sub-tropical environment. The aim of the project is to investigate ways to improve housing for Queenslanders. The project involves the design, construction and monitoring of an inhabited four-bedroom house in Rockhampton in Central Queensland, which demonstrates the elements of Smart Housing - social, environmental and economic sustainability.
- The Home Access intiative which addresses the need for accessible housing in the private housing system (private rental and owner occupation) and to enhance housing options for people with a disability.

GreenSmart

GreenSmart was developed by the Housing Industry Association in collaboration with Australian Government agencies Environment Australia and the Australian Greenhouse Office, the community based organisation Greening Australia, and industry.

GreenSmart is a practical approach to building that focuses on educating builders, designers, product manufacturers and consumers about the benefits of environmentally responsible housing. GreenSmart is an industry-driven initiative that aims to encourage a mainstream application of its principles to today's housing.

GreenSmart Village homes are a showcase of environmentally sustainable housing design. The main goals are:

- to improve the energy and water efficiency of the homes;
- to enable home-owners to waste less and recycle more;
- to reduce the waste from the building process; and
- to improve site management during construction.

Benefits of a GreenSmart home include lower energy and water bills, a warmer house in winter, a cooler house in summer, great soil for beautiful gardens and, as more than half the waste from the building process has been recycled, the environment has been helped even before occupation.

The GreenSmart Training and Accreditation has been launched in all States through the Housing Industry Association's Partnership Advancing the Housing Environment (PATHE) national environment initiative. GreenSmart ® is an HIA registered brand for sustainable development in the building industry. GreenSmart will provide Australia's homebuilders with environmental skills. Upon the successful completion of the 16-hour course, homebuilders will be accredited as "GreenSmart Professionals", which will qualify their customers for Australia's first GreenSmart Home Loan.

Lend Lease Development is the sole industry sponsor of the GreenSmart Training and Accreditation Package and is keen to market the GreenSmart training package to all builders active in Lend Lease residential developments across Australia.

Funding for the GreenSmart Training and Accreditation Package was provided by the Commonwealth Government jointly by the Australian Greenhouse Office and Environment Australia.

Green Building Council of Australia (www.gbcaus.org)
The Green Building Council of Australia's mission is to define and develop a sustainable property industry in Australia and to drive the adoption of green building practices through market-based solutions. The Council's objective is to promote sustainable development and the transition of the property industry to implementing green building programs, technologies, design practice and operations.

To do this, it advances and promotes the creation of a green building rating tool, economic incentives, government initiatives and programs, new technologies and industry knowledge.

Key activities include:

- **Advocacy** - working with governments to remove barriers to sustainable development and create real incentives to change industry practice.
- **Rating System** - implementing an internationally recognised and national umbrella for assessing green building initiatives.
- **Information Dissemination** - delivering Australia's pre-eminent source of expertise on green buildings and regular newsletters to keep members abreast of the latest developments.
- **Professional Development** - running courses and hosting seminars and events to expand industry knowledge.
- **Award Program** - recognising industry achievements.
- **Industry Integration** - leveraging collaboration between all sectors of the property and construction industry.
- **Collaboration** - working in partnership with industry associations to coordinate activities and develop strategies to ensure green building initiatives are maximised.

10.1.3 Netherlands

National Sustainable Building Centre
The National Sustainable Building Centre is a national, independent centre for information, communication and knowledge about sustainable building for all professionals who are involved in the design of the built-up environment. At this centre knowledge about sustainable building is actively collected, made accessible and

distributed among professionals throughout the entire building column. The National Sustainable Building Centre also encourages the application of this knowledge in the building process and the development of new knowledge where gaps in knowledge occur. Its many contacts with different parties in the building sector enable the National Sustainable Building Centre to observe where bottlenecks exist or are likely to develop. By developing these activities the centre sets out to make a contribution to embedding sustainable building in the broad-based building sector. Sustainable building as standard in the planning, design, construction and management process is of overriding importance to improving our living and working environment. Providing information and stimulating support are central factors in this.

Part of the National Sustainable Building Centre's transfer of knowledge and dissemination of information takes place via the Dubo Infodesk. All building professionals can contact this desk - either e-mail or fax - with their questions about sustainable building. The Dubo Infodesk bases its approach on harmonised knowledge as compiled in the National Sustainable Building Packages, for instance. These packages, which contain measures with a tried-and-tested environmental effect, enjoy broad support in the market.

The transfer of knowledge via Internet is becoming increasingly important. The National Sustainable Building Centre offers access to its comprehensive database in various ways via its own website. In this way, it satisfies the growing demand for customised information.

The National Sustainable Building Centre also publishes a Dubo Newsletter (4 times a year, in Dutch). As well as putting out and collaborating with the production of publications, the centre's activities also include acting as a sales outlet for other organisation's publications. The centre organises an annual National Dubo Day, which combines a sizeable conference programme with an extensive trade fair. Theme meetings and symposiums are also organised at a smaller scale. The centre thus fulfils the function of a knowledge platform.

The National Sustainable Building Centre organises made-to-measure excursions under the motto 'seeing is believing'. Finally, the centre conducts a large number of projects that are commissioned by third parties. Many of these projects concern knowledge transfer and communication processes. Increasingly, these projects involve communications advice at a strategic level.

10.1.4 Denmark

Danish Centre for Urban Ecology
Ringgaarden Housing Association, Aarhus Denmark, together with Carl Bro, engineers, Aarhus Denmark and The Danish Centre for Urban Ecology runs a project with the aim

of creating a social housing estate of 130 sustainable homes of superior architectural quality. 50 of these houses are part of an European project called *SHE: Sustainable Housing in Europe*. The project leader is Federabitazione Europe Confcooperatione, Rome Italy and the project have partners in Italy, France, Portugal Greece and Denmark.

The Danish project is supported by the foundation Realdania, given financial support to an international project competition with 8 teams of architects and engineers in order to select the best project to be build in Aarhus Denmark.

10.1.5 Germany

German Federal Environmental Agency (Umweltbundesamt, UBA)
In 2000 the German Federal Environmental Agency commissioned a research project entitled *Sustainable construction and housing in Germany*. The objectives of this project were:

- To identifiy ecologically relevant savings potentials and options for action.
- To involve and senstise selected key actors.
- To derive priorities for precautionary environmental policy in the construction and housing sector.

Applying a BASiS-2 material-flow model to the scenario period 2001-2005 (baseline year: 2000) they present results for the key challenges in the construction and housing sector, namely: land and raw material appropriation, climate protection, and arisings of construction debris under a sustainability scenario. They say that with reference to the scenario results that it has been possible to quantify major potential in the construction and housing sector for reducing the environmental impacts of land take, energy consumption, raw materials consumption, debris generation, and greenhouse gas emissions. It has been shown that resource-efficient construction and housing coupled with improvement of supply of housing is a realistic prospect if the assumptions of the sustainability scenario are used as a basis. They also present some interesting perspectives for sustainable construction and housing including ‘measures and mechanisms’.

A copy of the executive summary of their report is available on the IND1 CD-ROM <Germany_Material_Flows1.pdf>.

10.1.6 United States

U.S Green Building Council (USGBC)
The U.S. Green Building Council (www.usgbc.org) is a coalition of leaders from across the building industry working to promote buildings that are environmentally responsible, profitable and healthy places to live and work. The particular:

- The U.S. Green Building Council (USGBC) is leading a national consensus for producing a new generation of buildings that deliver high performance inside and outside.

- Council members work together to develop LEED® products and resources, the Greenbuild Annual International Conference and Expo, policy guidance, product certification, professional accreditation and educational and marketing tools that support the adoption of sustainable building.

- Members also forge strategic alliances with key industry and research organisations and federal, state and local government agencies to transform the built environment.

- The LEED® Green Building Rating System was developed by the USGBC membership, the Leadership in Energy and Environmental Design (LEED) Green Building Rating System is a national consensus-based, market-driven building rating system designed to accelerate the development and implementation of green building practices (designing, constructing and certifying). tThe full program offers training workshops, professional accreditation, resource support and third-party certification of building performance.

Center for Resourceful Building Technology (CRBT)
CRBT is dedicated to promoting environmentally responsible practices in construction. It works to serve as both catalyst and facilitator in encouraging building technologies which realise a sustainable and efficient use of resources. CRBT actively promotes resource efficiency in building design, materials selection and construction practices. These activities support National Centre for Appropriate Technology (NCAT's) mission to champion sustainable technologies and community-based approaches that protect natural resources and assist people, especially the economically disadvantaged, in becoming self-reliant. CRBT's research to date includes: small-diameter timber, construction and demolition waste, biobased building materials, and post-consumer glass in construction.

Development Centre for Appropriate Technology (DCAT)
The Development Center for Appropriate Technology works to enhance the health of the planet and our communities by promoting a shift to sustainable construction and development through leadership, strategic relationships, and education.

DCAT's primary program is called *Building Sustainability into the Codes* in which they explore approaches to creating a sustainable context for building codes, working with national regulatory and green building organisations. Specific groups served include:

- Building code groups and code officials;
- Standards making organisations;

- Green building organisations;
- Construction and development community; and
- Public service organisations.

U.S DOE Energy Efficiency and Renewable Energy Network (EEREN)
The EEREN website (http://www.sustainable.doe.gov/buildings/gbprogrm.shtml) lists out a number of green building programs sponsored by state or local government, or others are administered by home building industry associations or by other nonprofit groups. Initiatives of particular note are:

- Built Green Colorado was developed to highlight green builders in the Denver Metro Region, which now applies statewide. The program is voluntary and serves as a guide and a marketing tool for homes that meet certain green criteria. Builders and remodelers that participate in the program receive technical assistance, discounts on educational seminars, and other benefits.

- California Green Builder Program is a voluntary program developed by the Building Industry Institute that sets standards for improvements in energy efficiency, reduction in air emissions, on-site waste recycling and reduction in water use.

- City of Austin Green Building Program is a voluntary program that certifies green homes on a scale of one to four stars, with more stars being awarded to homes with more green features. The program also provides assistance to building professionals, such as architects, engineers, and builders, in exchange for offering and promoting green building practices. For more information, see Green Builder Program: A Sustainable Approach.

- Florida Green Building Coalition Green Home Designation Standard is a standard for green homes, available online in checklist or complete form. The Florida Green Building Coalition also has a broader Green Development Designation Standard.

- Green Building is a city program in San Jose, California that has been created to encourage and facilitate new construction or remodeling of homes or workplaces into spaces that are healthier for people and the planet. Program policies are available online.

- Green Building Guidelines is the second generation of sustainable residential design guidelines from the Sustainable Buildings Industry Council, in cooperation with the National Association of Home Builders. With illustrations, case studies, and checklists, the six-chapter book is a valuable resource for builders and even buyers interested in producing or purchasing energy- and resource-efficient

homes. The book can be ordered from the Sustainable Buildings Industry Council, which also offers a companion workshop.

- Green Built Home™, a green building initiative that reviews and certifies homes that meet sustainable building and energy standards, is a voluntary program of Wisconsin Environmental Initiative and is sponsored by participating home builder associations in cooperation with leading utilities, organisations that promote green building and energy efficiency and the State of Wisconsin.

- Green Points Building Program is a green builder program in Boulder, Colorado that applies to both new construction and remodeling projects. The Green Points New Home Program applies to new construction and additions larger that 500 square feet, and requires building permit applicants to earn "points" by selecting optional measures in order to receive a building permit. The Green Points Remodeling Program is voluntary and applies to remodeling projects and additions less than 500 square feet. Homeowners and contractors are encouraged to include as many green options in their projects as possible.

- Hawaii BuiltGreen™ is a voluntary green building program of the Hawaii Building Industry Association.

- New Jersey Green Homes Office is working to fundamentally improve the environmental performance, energy efficiency, quality, and affordability of housing in New Jersey. Through advocacy, education, and technical assistance they are accelerating the use of innovative green design and building technologies, raising building standards and creating consumer demand for efficient and environmentally responsible high performance homes.

10.1.7 Canada

International Initiative for a Sustainable Built Environment (iiSBE)
The iiSBE http://greenbuilding.ca/iisbe/start/iisbe.htm is an international non-profit organisation whose overall aim is to actively facilitate and promote the adoption of policies, methods and tools to accelerate the movement towards a global sustainable built environment. It has a small Secretariat located in Ottawa, Canada.

Specific objectives include:

- Map current activities and establish a forum for information exchange on SBE intiatives, so that gaps and overlaps may be reduced and common standards established;
- Increase awareness of existing SBE initiatives and issues among the international buildings and construction community; and
- Take action on fields not covered by existing organisations and networks.

Their key activities include:

- The Sustainable Building Information System (SBIS), a web-based database of international information relation to sustainable building, has been launched at http://www.sbsis.info.

- iiSBE leads the Green Building Challenge (GBC) http://greenbuilding.ca/iisbe/start/iisbe.htm an international collaborative project to develop the theory and practice of environmental performance assessment system for buildings. GBC is now operating in more than 15 countries (see below for further detail).

Green Building Challenge

Green Building Challenge is an international collaborative effort to develop a building environmental assessment tool that exposes and addresses controversial aspects of building performance and from which the participating countries can selectively draw ideas to either incorporate into or modify their own tools. Green Building Challenge 2005 / SB05 is a continuation of the GBC '98 - 2002 process and a multi-year period of review, modification and testing of the GBC Assessment Framework and Green Building Tool (GBTool) - the operational software for the assessment framework. This round of the GBC process will culminate in the presentation of the assessed buildings at the Sustainable Building 05 Conference (SB'05) to be held in Tokyo, Japan in September 2005 while intermediate stages and the preparation phase will be discussed at the five Regional Conferences SB'04

The assessment framework and software used to assess the selected projects was developed by a team of international experts under the direction of an International Framework Committee. The process began in 1996 and will continue until at least the SB05 Tokyo conference. current GBC 2005 version of GBTool (in Microsoft Excel format will be available soon with the integrated manual.

The core assessment framework has been adapted by national teams to the conditions of their own countries and regions. The regionally adapted systems reflect issues such as regional energy and environmental priorities, cost-effectiveness and urban planning issues. Each national GBC team selects case study buildings to be assessed according to the GBC framework, and to be presented at the SB-series of international conferences. Buildings assessed are selected by national teams to represent at least “Good Practice” and to provide a good learning experience for the respective national industries. National teams gather information about these buildings, including a detailed physical characterisation, a description of the process followed in its design, construction and operation and planned building operation procedures. The teams undertake energy simulations using accepted computer programs like DOE-2 or EE4 (in Canada).

The three general goals for the *Green Building Challenge* process were:

- To advance the state-of-the-art in building environmental performance assessment methodologies.

- To maintain a watching brief on sustainability issues to ascertain their relevance to "green" building in general, and to the content and structuring of building environmental assessment methods in particular.

- Sponsor conferences that promote exchange between the building environmental research community and building practitioners and showcase the performance assessments of environmentally progressive buildings.

These goals reflect the acknowledged success of the *GBC* process in having significantly increased the understanding of building environmental assessment through international collaboration. In addition to the above general goals, two specific objectives of *GBC 2002* and GBC 2005 processes are:

- To develop an internationally accepted generic framework that can be used to compare existing building environmental assessment methods and used by others to produce regionally based industry systems.

- To expand the scope of the *GBC Assessment Framework* from green building to include environmental sustainability issues and to facilitate international comparisons of the environmental performance of buildings.

Green Buildings Policy Network (GBpN)
The Green Building Policies Network (GBPn) is being developed by the SBS Centre of Wageningen University under the auspices of iiSBE, the International Initiative for a Sustainable Built Environment. The project involves an ambitious plan to collect all existing policies, regulations, national programmes, governmental instruments etc., that are related to sustainable building and construction. Most materials will be gathered from countries that are participating as members in the project, but additional materials will also be gathered from other countries. The purpose of the GBPn project is to create insight in the different approaches and to act as example for new policy development. An annual analysis will be made of trends and innovations in Green Building Policies within the member countries, and this report will be available exclusively to member countries. Members will also obtain regular updates on trends and innovations in SB policies.

Countries can join the network by appointing a national contact to collect material for the network, and by making a contribution towards the operating costs of the project.

Members have also access to GBpN links, Policies, Analysis Documents related to member country policies.

Canadian Green Building Council (CaGBC)

The Canada Green Building Council is being formed to accelerate the design and construction of Green Buildings across Canada. The Council is a broad-based inclusive coalition of representatives from different segments of the design and building industry.

The Council will work to:

- Change industry standards;
- Develop best design practices and guidelines;
- Advocate for green buildings; and
- Develop educational tools to support its members in implementing sustainable design and construction practices.

They support the LEED (leadership in energy and environmental design) certification in line with the USBGC.

LEED's stated purpose is:

- define "green building" by establishing a common standard of measurement;
- promote integrated, whole-building design practices;
- recognise environmental leadership in the building industry;
- stimulate green competition;
- raise consumer awareness of green building benefits; and
- transform the building market.

10.1.8 Other

SHE: Sustainable Housing in Europe

SHE: Sustainable Housing in Europe (www.she.coop) is a demonstration project funded by the European Commission under the 5th Framework Programme Research and Development programme on *Energy, Environment and Sustainable Development* Key Action 4 "City of tomorrow and cultural heritage". The project, coordinated by Federabitazione Europe (Italy), association of Confcooperative, started on March 2003 and will end on February 2008. SHE aims to demonstrate the real feasibility of sustainable housing, through pilot projects (714 dwellings) in 4 different countries, Denmark, France, Italy and Portugal.

The project aims to:

- assess and demonstrate the real feasibility of sustainable housing using pilot projects (200 dwellings co-financed by the EU in four different countries, namely Denmark, France, Italy and Portugal and some other 280 completely financed by the Italian co-operatives);

- integrate sustainability and closer participation of tenants in the principal stages of the construction decision-making process, at a reasonable cost and with high potential to be replicated;
- develop best practice solutions to set up quality assessment and guidelines based on the direct experience acquired;
- create a transferable and demonstrative effect of the innovative methods, operations and achievements by defining tools and procedures in a general methodology to manage sustainability throughout the whole building process and equipping all stakeholders with the understanding of long-term costs and direct and indirect benefits of sustainable construction; and
- evaluate the degree of satisfaction of sustainable houses by future tenants.

The expected outcomes are:

- the development, integration and demonstration of practical methodologies to improve assessment of best practice solutions for sustainable constructions in order to move it "from the extraordinary to the ordinary";
- the definition of new procedures to ensure effective direct participation of the final users in the decision-making process thus increasing environmental awareness; and
- an integrated approach aimed at the building up of the cities of tomorrow in accordance with sustainability principles.

World Green Building Council (WGBC)

Since 1999, WorldGBC has helped nine countries develop non-profit, consensus-based Green Building Councils, the purpose of which is to promote programs, projects and activities related to green building design, construction and operations to decrease greenhouse gas emissions through the design, development and implementation of environmentally sustainable, energy efficient and resource conserving building practices, technology and processes.

WorldGBC is currently working to develop three specific tools/resources:

- An enhanced website with data template for use by member and non-member countries to share green building information, case studies, government initiatives, construction projects, rating systems, technologies.

- A GBC Toolkit to provide models and examples of Green Building Council organisational structures, by-laws, officer/board responsibilities, funding opportunities, and products such as green building rating systems.

- An organisational congress in Sydney, Australia in October 2003 with two goals: sharing successful models of Green Building Councils and organising the WorldGBC by member delegations.

10.2 Supply-side and demand-side drivers

Environmental Policies for the Building Sector

The OECD presents an analysis of the environmental impacts of the building sector and of current policies to mitigate these impacts, in particular with regard to reduction of CO_2 emission, minimisation of construction and demolition waste and prevention of indoor air pollution. It covers a wide range of policy instruments; building regulation, capital subsidy programmes, energy tax, landfill tax, environmental labelling schemes, energy audit schemes. A copy of the report is available the on the IND1 project CD-ROM <OECD_Environmentally_Sustainable_Buildings.pdf>. A summary of the policy instruments are as follows:

Energy efficiency improvement:

- Mandatory standards for building design. All countries except for Japan, now have energy effeciency standards in their building regulation.
- Subsidary programmes and tax exemption schemes. Subsidary programmes and tax exceptions have reportedly been introduced in nine countries.
- Premium loan schemes. Six countries where premium loan schemes are reportedly used in the building sector (e.g. Japan Housing Loan Corporation grants lower interest rates to houses that meet the recommended energy efficiency standards.
- Energy taxes and tradable permit schemes. There are five countries that have implemented environmentally related tax that covers energy use in the building sectors.
- Mandatory energy labelling for buildings. This has been introduced in six European countries. For example, as of 2001, in the UK, all new dwellings are required to carry an energy label to provide prospective buyers with information on each home's energy efficiency.
- Voluntary environmental labelling for buildings. Seven schemes have been reportedly established with a commitment from government. One of the best examples is the Building Research Establishment Environmental Assessment Method (BREEAM).
- Voluntary comprehensive labelling for building. This has been introduced in four countries and is not limited to environmental characteristics. Examples are the Qualitel scheme in France and the Housing Performance Indication Scheme in Japan.
- Environmental lavelling for building materials and products. These mainly deal with issues of waste minimisation and indoor air quality. One of the few exampel dealing strictly with energy efficiency is the Energy Star Products Scheme in the USA.

Reducing carbon dioxide emissions from existing buildings:

- Mandatory standards for building design. A number of communities and states in the US have implemented residential energy conservation ordinances (RECOs). RECOs are regulatory insturments that require owners of buildings to implement special low-cost energy conservation measures at the time their building is sold or renovated.
- Obligation for utilities companies. Under the Utilities Act, the UK government is scheduled to set the Energy Efficiency Commitment obligation, which was imposed on on electricity and gas suppliers from 2002 to promote the energy effeciency of domestic consumers.
- Capital subsidy programmes. The UK and USA have large-scale programmes aimed at low-income households. The Dutch government has reported implementing capital subsidy programmes for dwellings (Energy Premium Scheme), but this does not take the income level of occupants into consideration.
- Mandatory energy labelling for buildings. Few schemes cover existing building. However the German government has recently introduced a scheme.
- Energy audit programmes. Five countries reportedly have implemented energy audit programmes. An example of this is the Energy Performance Advice Programme in the Netherlands.

Minimisation of Construction and Demolition Waste (upstream stages - design and construction):

- Few countries have reports introducing regulatory or economic instruments in this area except Japan who has introduced a premium loan programme for dwellings with a high level of physical durability.

Minimisation of Construction and Demolition Waste (demolition stage)

- Ban on landfill. Five Europen countries have a total ban on landfilling certain categorie.
- Mandatory separation and mandatory delivery of waste to processing facilities. In seven European countries and in Japan there is a requirement to separate some materials from others on demolition sites.
- Mandatory reporting and demolition permission. In four countries, it is required to submit a document describing how demotion waste will be treated to autthorities, before demolishing buildings. In Sweden, a waste managemetn plan must accompany the notification of demotion of buildings that must be submitted to authorities.
- Licensing system. Six countries have reported that some demolition and disposal activities can be carried out only by those who have obtained licences from authories. There is a licensing system for demolition contractors in Japan, Sweden, and Germany.
- Landfill tax. Ten countries have reported using a tax including UK, Czech Republic, Italy, France, Demark, and the Netherlands.

- Waste information exchange schemes. In the UK, an internet-based waste information exchange scheme has been established.

Minimisation of Construction and Demolition Waste (downstream stages - recycling and reuse):

- Regulatory instruments. Few exist at this stage of the life-cycle of buildings. However in 1999 the Netherlands introduced a Building Materials Decree that imposes a maximum amount of hazardous chemicals contained in materials, that could potentially damage water or soil.
- Vigin material tax. Used in four European countries. For example Denmark has an aggregate tax which is levied on the quarrying of gravel.
- Premium loans. The only reported instrument was the premium loan scheme in Japan for dwellings that incorporate a certain amount of recycled materials.