STUDY REPORT

SR 275 (2013)

Application of Environmental Profiling to Whole Building Whole of Life Assessment – A Plan for New Zealand

David C Dowdell

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Preface

Based on the importance of whole building whole of life assessment recognised by the New Zealand building sector, BRANZ has been conducting research into environmental profiles, and their application to evaluate building environmental performance, in the interests of the industry. This report sets out the full text of a Plan to establish a whole building whole of life assessment framework in New Zealand, based on research carried out by BRANZ from November 2011 to September 2012 and comments and input received from interested stakeholders during a consultation with the New Zealand construction industry in October/November 2012. An accompanying Key Features report provides a summary of this Plan. All reports arising from the research are available on the BRANZ website (www.branz.co.nz/environmental_profiling). Other reports in the series include:

Dowdell D. (2012). Evaluation of Environmental Choice New Zealand as a Best Practice Ecolabel and Comparison with the GBCA Framework; BRANZ Study Report (SR 271), Judgeford.

Dowdell D. (2012). Review of how Life Cycle Assessment is used in International Building Environmental Rating Tools – Issues for Consideration in New Zealand; BRANZ Study Report (SR 272), Judgeford.

Dowdell D. (2013). Application of Environmental Profiling to Whole Building Whole of Life Assessment – Key Features; BRANZ Study Report (SR 276), Judgeford.

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Stuart Ng, Head of Building & Construction/Senior Manager Solutions, Standards New Zealand.

Stephen Hicks, Chair, Sustainable Steel Council.

Kevin Golding, Sustainability Manager, Winstone Wallboards Limited.

Dan McCallum, Consultant.

Note

This report is intended for stakeholders across the New Zealand construction industry.

APPLICATION OF ENVIRONMENTAL PROFILING TO WHOLE BUILDING WHOLE OF LIFE ASSESSMENT – CREATING A "LEVEL PLAYING FIELD" USING A LIFE CYCLE ASSESSMENT (LCA) BASED APPROACH TO EVALUATE THE ENVIRONMENTAL PERFORMANCE OF BUILDINGS

BRANZ Study Report SR 275 David C Dowdell

Reference

Dowdell D. (2013). Application of Environmental Profiling to Whole Building Whole of Life Assessment – A Plan for New Zealand; BRANZ Study Report (SR 275), Judgeford.

Abstract

This Plan sets out the benefits and opportunities that arise from establishing a whole building whole of life assessment framework as a basis for evaluating the environmental performance of office buildings in New Zealand, using Life Cycle Assessment (LCA) and Environmental Product Declarations (EPD).

It sets a vision for the framework and the steps required to deliver this, both in terms of preparation by the industry and underlying supporting activities and research. The framework, which would be available to all, would provide a quantitative assessment based on international standards for use in the evaluation of the environmental performance of buildings, for which an example application based on NZGBC's Green Star tool is provided.

The framework, underpinned by robust information would find application by manufacturers and importers of construction products, architects, designers and their clients, providers of building design tools, local and national Government (including links to developing tools such as Building Information Modelling (BIM) and GeoBuild), researchers and consultants.

Acronyms and Terms

ABSDO: Accreditation Board for Standards Development Organisations.

AFNOR: Association Française de Normalisation.

AGO: Australian Greenhouse Office.

ALCAS: Australian Life Cycle Assessment Society.

API: Australian Property Institute.

AusLCI: An initiative to develop an Australian Life Cycle Inventory database.

BEES: Six year New Zealand wide survey examining energy and water use in commercial buildings. For further information, see www.branz.co.nz/bees.

BIM: Building Information Modelling.

BPIC: Building Products Innovation Council.

BRANZ: Building Research Association of New Zealand.

BRE: Building Research Establishment.

BREEAM: Building Research Establishment Environmental Assessment Method, a rating tool developed in the UK by BRE.

Building Code: New Zealand Building Code.

CEN: European Committee for Standardisation.

CPA: (UK) Construction Products Association.

CPR: Construction Products Regulation.

CSR: Corporate Social Responsibility.

DBH: New Zealand Department of Building and Housing (now the Building & Housing Group within the Ministry of Business, Innovation and Employment (MBIE)).

Declared Unit: Quantity of a building product for use as a reference unit in an EPD, based on LCA, for the expression of environmental information needed in information modules (ISO, 2006a).

DGNB: Deutsche Gesellschaft für Nachhaltiges Bauen (the German Sustainable Building Council).

EC: European Commission.

ECNZ: Environmental Choice New Zealand.

ECO: Environmental Construction products Organisation.

Ecolabel: Voluntary, multiple-criteria based third party programme that awards a licence authorising the use of an environmental label on products indicating overall environmental preferability of a product within a product category based on life cycle considerations. Also known as a Type I ecolabel and underpinned by ISO 14024 (ISO; 1999). Environmental Choice New Zealand is the New Zealand scheme that awards this type of ecolabel.

EeBGuide: Energy Efficient Buildings Guide – a European research project under the 7th Framework Programme to develop methods and operational guidance for the preparation of LCA studies for energy efficient buildings and building products**.** It has been published as a draft for consultation at the time of this Plan.

ELCD: European Life Cycle Database.

Environmental Choice New Zealand: A New Zealand Government owned Type I ecolabel scheme.

Environmental Product Declaration: Voluntary declaration providing quantified environmental data using predetermined parameters and, where relevant, additional quantitative or qualitative environmental information. Also known as a Type III ecolabel and underpinned by ISO 14025 (ISO; 2006). There is no current scheme in New Zealand that awards EPD although ALCAS and LCANZ are in the process of establishing a scheme for Australia and New Zealand.

Environmental Profile: A quantitative method of assessing the environmental performance of building materials. See Environmental Product Declaration.

EPD: Environmental Product Declaration.

ESUCO: European Sustainable Construction Database.

Functional Unit: Quantified performance of a product system for a building product for use as a reference unit in an EPD based on LCA (ISO, 2006a).

GBCA: Green Building Council of Australia.

GBCA Framework: Green Building Council of Australia Framework for Product Certification Schemes – a framework recognised by NZGBC onto which ecolabel schemes can be mapped to gain recognition in Green Star.

GBRS: Green Building Rating System, rating tool operated by DGNB.

GeoBuild: A developing New Zealand information exchange framework that digitises building, geographical and environmental data and information which is available online to users.

Green Star: Suite of green building rating tools managed by the GBCA and NZGBC covering various building typologies. Reference to Green Star in this report specifically concerns Green Star Office in New Zealand unless otherwise stated.

Greenwash: False or misleading environmental claim.

GRI: Global Reporting Initiative.

HEEP: Research programme looking at energy use in New Zealand households. For further information, see www.branz.co.nz/heep.

HM Government: (Her Majesty's) Government in the UK.

HQE: Haute Qualité Environnementale, the French green building rating tool developed by ASSOHQE.

HVAC: Heating, ventilation and air conditioning.

ICE: Inventory of Carbon and Energy.

ILCD: International Life Cycle reference Data system.

Information Module: Compilation of data to be used as a basis for a Type III environmental declaration, covering a unit process or a combination of unit processes that are part of the life cycle of a product (ISO, 2006a).

International reference Life Cycle Data system: a developing global initiative with the aim of providing a consistent platform for production and reporting of life cycle data.

ISO: International Organisation for Standardisation.

JAS-ANZ: Joint Accreditation System of Australia and New Zealand.

JEMAI: Japan Environmental Management Association for Industry.

JRC: Joint Research Centre.

LCA: Life Cycle Assessment.

LCANZ: Life Cycle Association of New Zealand.

LCI: Life Cycle Inventory.

LCIA: Life Cycle Impact Assessment.

LCM: Life Cycle Management.

LEED: Leadership in Energy and Environmental Design, the building environmental rating tool of USGBC.

Life Cycle Assessment: Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.

Life Cycle Impact Assessment: Phase of LCA aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts of a product system (ISO; 2006b).

Life Cycle Inventory: Phase of the LCA involving the compilation and quantification of inputs and outputs, for a given product system throughout its life cycle (ISO; 2006b).

Life Cycle Management: A business management approach aimed at improving sustainability performance of products across the value chain.

Manufacturer: Manufacturer of building materials and construction products for use in office developments supplying domestically and/or overseas. The term also includes importers to New Zealand of materials and products contributing to building elements used in construction of offices.

MBIE: New Zealand Ministry of Business, Innovation & Employment.

MED: New Zealand Ministry of Economic Development.

MfE: New Zealand Ministry for Environment.

NABERS: National Australian Built Environment Rating Scheme.

NZGBC: New Zealand Green Building Council.

NZ LCI: New Zealand Life Cycle Inventory.

NZLCM Centre: New Zealand Life Cycle Management Centre (at Massey University).

OJEU: Official Journal of the European Union.

PCR: Product Category Rules.

PFA: Property Funds Australia.

Product Category Rules: Set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories (ISO, 2006a).

SME: Small or medium sized enterprise.

UNEP: United Nations Environment Program.

USGBC: United States Green Building Council.

WTO: World Trade Organisation.

FOREWORD by Pieter Burghout, Chief Executive, BRANZ

The New Zealand building and construction sector is New Zealand's fifth largest, contributing 4% of GDP and employing 178,000 people. The industry is not only tasked with delivering a sustainable built environment for New Zealand but also provides NZ$3 billion in exports annually.

To ensure we can deliver, the New Zealand construction industry is now faced with a decision. Other parts of the world have developed or are developing product environmental reporting schemes to provide a basis for openness and transparency and facilitate more informed decisions about the environmental impacts of materials in the context of the buildings in which they are used. This is increasingly being required by architects, designers, builders and their clients.

Environmental profiles and underlying databases have developed or are developing in important markets for New Zealand – Australia, China, Japan, North America, South East Asia and other regions such as Europe and South America. This will increasingly create an expectation for provision of New Zealand-specific data on environmental performance of products and materials. To do this requires an investment now – but will provide many businesses with benefits such as cost savings, access to new markets (or consolidating existing ones), improved awareness of product environmental issues amongst staff and more informed decision making and R&D.

The industry has asked for a more consistent approach to the assessment of environmental performance of products and materials. International experience shows that evaluation of designed buildings across the life cycle provides the level playing field sought by the industry. Such an approach lends itself to emerging technologies such as BIM, providing further opportunities to integrate consideration of environmental impacts early in the design process.

The benefits are there, demonstrated by Case Studies in this Plan. We need to ask the question - where do we want the New Zealand construction sector to be in five years time? There has been and will continue to be a necessary focus on energy reduction and energy efficiency in buildings, due to the overall impacts this has. But as we see improvements here, focus will increasingly shift to materials and products used in buildings. It would be prudent to begin preparing now by raising our understanding, knowledge and skills and developing our LCA data, EPD and whole building whole of life assessment method.

This Plan is about opportunity. It carefully sets out a view on how we can use LCA to help deliver more sustainable and better buildings. We would like to thank everyone who has contributed to the development of this Plan.

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1. KEY FEATURES

A separate report entitled *Application of Environmental Profiling to Whole Building Whole of Life Assessment – Key Features* (BRANZ Study Report SR 276) provides an Executive Summary of this document and can be downloaded from the Environmental Profiling page of the BRANZ website at the following address – www.branz.co.nz/environmental_profiling.

2. INTRODUCTION

> **The building industry is intrinsically conservative, with small profit margins and a disaggregated supply chain. We need to break this nexus** Property Australia Magazine, December 2011/January 2012

BRANZ began researching environmental profiling in 2010 to help answer questions raised by the construction industry. The first stage of research sought to better understand the opportunities that exist for environmental profiling of materials in New Zealand. It piloted the development of draft New Zealand Environmental Product Declarations (EPD), recognising that EPD are increasingly being used and valued internationally to communicate environmental product information that is robust, credible and transparent, and set out a Roadmap for further research and development (Jaques *et al*.; 2011).

The second stage of research commenced in December 2011 and was informed by the Roadmap. It has focussed on how EPD underpinned by Life Cycle Assessment (LCA) can provide an optimal approach to a more robust and consistent evaluation of the environmental performance of New Zealand buildings across the life cycle – *an LCA-based whole building whole of life assessment*. Development of such a framework, based on the findings and recommendations of this research, is presented in this Plan because:

- The sector wants an internationally aligned basis for declaring the environmental performance of products that facilitates a robust evaluation mechanism for the delivery of a sustainable built environment in New Zealand.
- Exporters of New Zealand construction materials and products need to be able to compete with product manufacturers in other countries that already have programmes in place for declaring environmental performance of products and evaluating buildings. Similarly, manufacturers who supply domestically should have the tools and capability to demonstrate how their products, instead of imported products, can contribute to achievement of higher performing buildings.
- EPD are increasingly being used (within and outside the construction sector) internationally as the basis for declaring the environmental performance of materials and products.
- Designers and their clients want robust data and information on environmental performance of products which can be used to inform design decisions.
- Manufacturers want a fair basis for comparison of the environmental performance of their products with competitor products.
- There is recognition in the sector that product performance needs to be considered across the building life cycle, in order to provide a level playing field for assessment and comparison.

- Increasing use of tools such as BIM provide further opportunities for rapid, iterative, quantitative assessment of building environmental performance during the design process.

Whilst this document focuses on the environmental assessment of office buildings, the framework proposed in this Plan would be valid, with some modification, for other building types including houses, schools and industrial premises.

A New Zealand whole building whole of life assessment framework would be available for all to use including manufacturers and importers of construction products, architects, designers and their clients, providers of building design and rating tools, local and national Government (including links to developing tools such as BIM and GeoBuild), researchers and consultants.

This Plan provides an example application of the proposed framework as part of a future building evaluation process based on NZGBC's Green Star, the building environmental rating tool used in New Zealand and Australia. Green Star currently rates offices across nine categories (management, indoor environment quality, energy, transport, water, materials, land use & ecology, emissions and innovation). Each category includes a list of questions against which responses (backed by supporting evidence) and in some cases, calculated values, provides the basis for gaining points, the total of which results in a final assessment and star rating for a building. In the materials category in particular, a limited number of materials are included and there continues to be challenges in establishing and agreeing a consistent set of criteria by which they can be evaluated.

The Plan sets out a vision for a whole building whole of life assessment framework and how it can be developed, with the aim of providing the "level playing field" sought by the New Zealand construction industry. This should, in turn, stimulate the development of locally relevant information and data about the environmental performance of products. The approach uses quantified, LCA-based, independently verified environmental impacts of materials and products from EPD as an input to a quantitative evaluation of building environmental performance. It does not seek to "reinvent the wheel" but instead draws on existing and developing international standards and guidance, as well as current experience in rating schemes internationally.

2.1 About this Plan

This Plan is organised as follows:

- Why the need for this Plan? (Section 3).
- Whole building whole of life assessment (Section 4).
- The case for EPD and whole building whole of life assessment (Section 5).
- Key stakeholders (Section 6).
- A Plan for whole building whole of life assessment for New Zealand (Section 7).
- Summary of how this Plan responds to New Zealand construction industry recommendations (Section 8).

Section 5 features five case studies providing examples of manufacturers globally that are using LCA and/or are developing EPD. The case studies explore why these companies decided to use LCA and the benefits that they are gaining as a result of engaging in this activity.

3. WHY THE NEED FOR THIS PLAN?

Many people now believe that the days of unlimited energy use and resource extraction are over, and that economic and consumption growth may have natural limits KPMG International; *Climate Changes Your Business*; 2008.

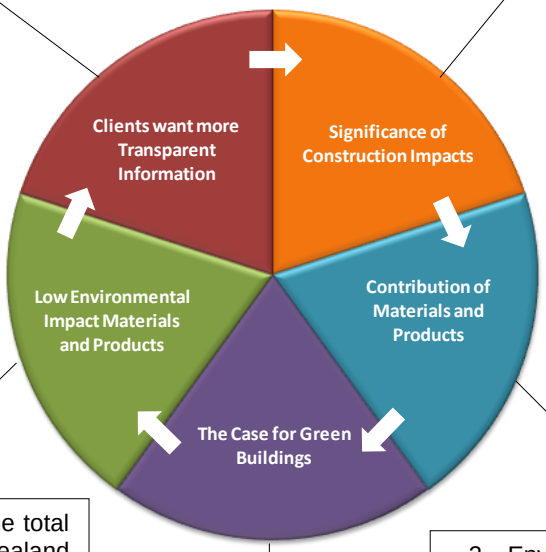
Globally, manufacturing is responsible for 35% of electricity use, more than 20% of carbon dioxide emissions and over 25% of primary resource extraction, directly impacting economic growth, the environment and human health (UNEP, 2012).

It is well documented that the greatest environmental impact of buildings is typically incurred during their occupation, through use of energy and water, generation of wastes, maintenance and replacement of products. This has led to a necessary focus on improving measurement and understanding of utility use in buildings, through for example BRANZ's HEEP and BEES programmes, and incentivising energy efficiency as set out in the New Zealand Energy Strategy 2011 – 2021 (MED, 2011).

By contrast, the environmental impact of building materials and products (or embodied impact) typically contributes 10 - 20% (Edwards and Bennett, 2003) of a building's environmental impacts. However, there are five reasons why the environmental impacts of building materials and products in New Zealand and overseas are coming under increasing focus, summarised in Figure 1.

5. Designers and their clients want better information and data about the environmental performance of building products. This calls for greater transparency, robustness and consistency of information that avoids "greenwash". EPD and ecolabel programmes meeting international standards can provide the basis for information sought by the market. Building environmental rating tools internationally are increasingly using EPD and LCA derived data to support whole building whole of life assessment. Many countries and regions have already or are actively developing databases of environmental impacts of construction products and materials.

1. Construction materials and products have a considerable impact on the environment from raw material acquisition and manufacture through to end of life, with estimations that they are responsible for 50% of total material resources taken from nature and 50% of total waste generated (Edwards and Bennett, 2003).



4. Putting in place 11% of the total outputs of the New Zealand economy and contributing over NZ$3 billion annually in exports, the sector has the capacity to deliver a more sustainable built environment for New Zealand. Businesses with products that are innovative and environmentally preferable will be well positioned to benefit from an increasing demand for green buildings domestically and internationally.

2. Environmental impacts associated with use of buildings are likely to reduce over time with improved performance meaning the contribution that materials and products make to the overall environmental impact of buildings will rise. This increasing scrutiny will be driven by clients, designers and the media and is already happening in other parts of the world.

3. Local and overseas studies are increasingly communicating the benefits of more sustainable buildings, including financial savings during construction and use, and improved productivity experienced by occupants. Governments, as significant procurers of buildings in many countries, want to provide a strong signal to their construction markets whilst companies increasingly want to occupy buildings that help them meet sustainability targets and reflect them as responsible "corporate citizens".

Figure 1. Summary Reasons why Focus on the Environmental Impact of Materials and Products is Likely to Rise

3.1 Manufacture of Building Materials and Products in New Zealand

The construction sector is important to New Zealand for its supply of materials and products domestically and its contribution to exports. The value of materials in non-residential applications in the year ending March 2012 totalled nearly NZ$1.3 billion[1], broken down in Figure 2.

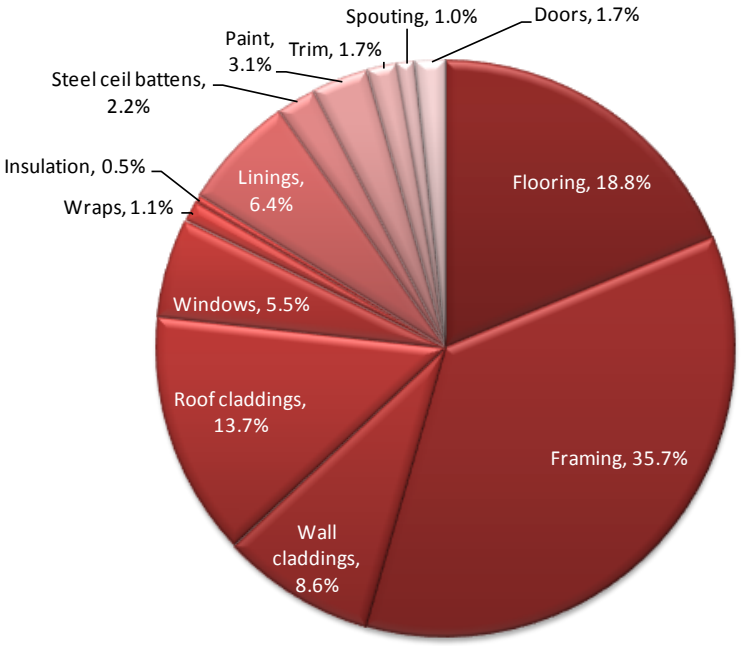


Figure 2. Value of Materials and Products in Non-Residential Buildings (Year to 31st March 2012)

By comparison, the value of the same materials and products in residential construction and refurbishment totalled over NZ$2 billion with another NZ$2.4 billion during the same 12 month period for electrical, plumbing, floor coverings, joinery and other services (HVAC, lifts etc). In addition, New Zealand exports of construction products made up almost NZ$3 billion (based on Statistics New Zealand data for 2011). Figure 3 provides a summary of selected exports (with destination markets) and imports (with countries of origin) in New Zealand in 2011.

Taking into account all the other activities required to construct and maintain non-residential and residential buildings (such as design, project management, procurement, commissioning, maintenance and renovations discounted over life), the value of the industry has been calculated at over NZ$15 billion (Page, 2012).

As New Zealand and other countries tackle the issue of developing a more sustainable built environment against a backdrop of increasing energy and material costs, manufacturers who practice good environmental management and innovate for environmental performance should increasingly benefit from reducing their risk of exposure to these cost pressures and from opportunities to develop new markets for their products. It is therefore useful to gain some insight into how New Zealand construction product manufacturers are dealing with these pressures through resource efficiency and environmental management practices within their businesses.

[1] Based on consent data from Statistics New Zealand, BRANZ materials surveys and Rawlinsons (2011) price information.

To obtain a better understanding, BRANZ sent out a short web-based questionnaire to almost 200 New Zealand manufacturers in July 2012. The survey had an 18% response rate from a spread of manufacturers of different sizes within the sector, summarised in Figure 4.

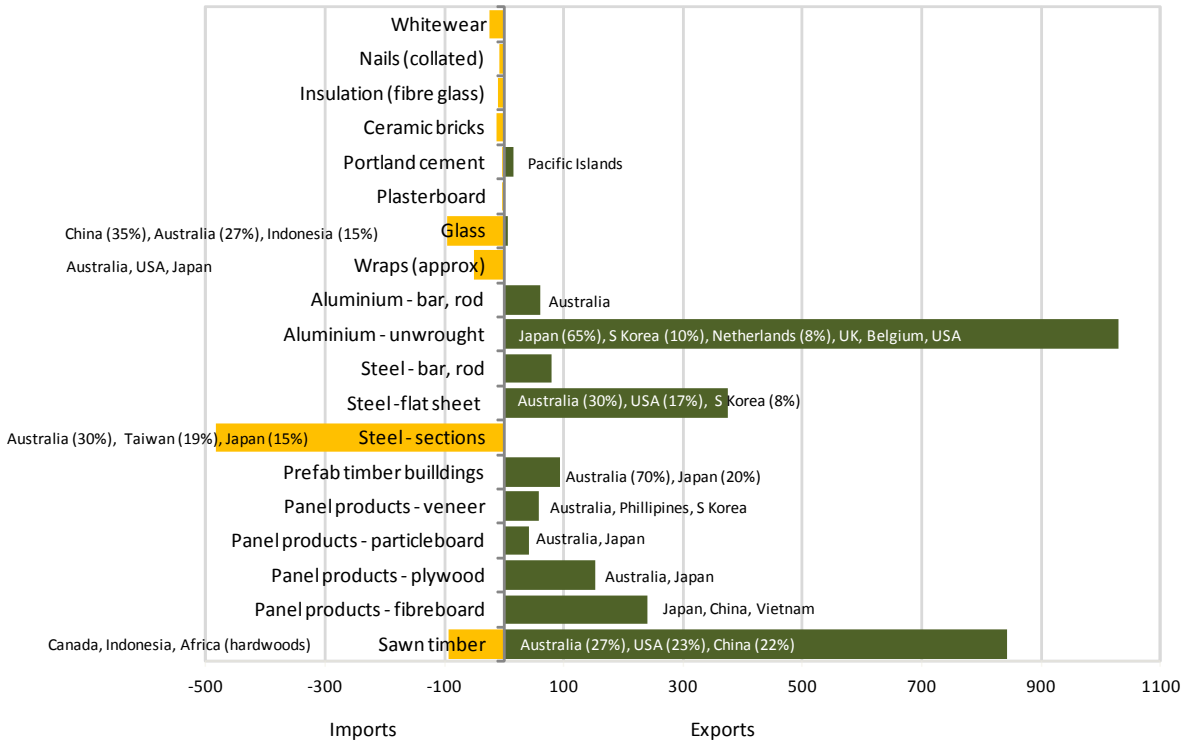


Figure 3. Export and Import (NZ$ million) of Selected Building Products in 2011

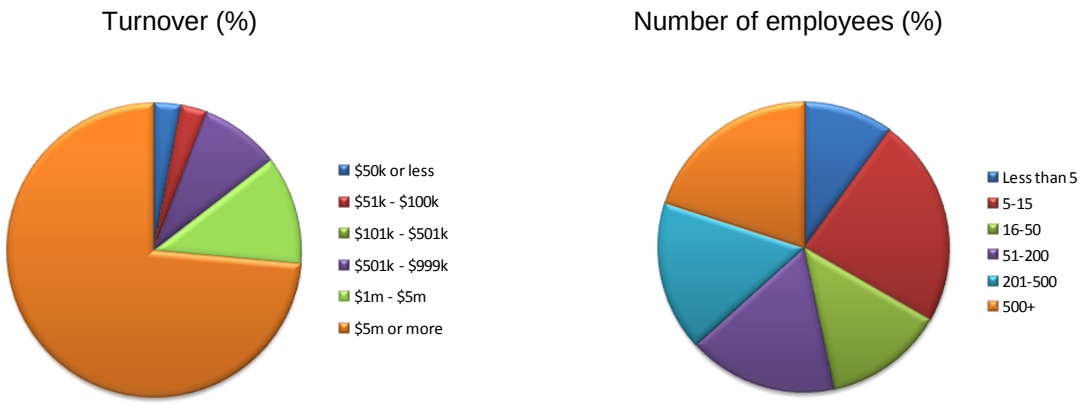


Figure 4. Survey Respondents by Turnover and Number of Employees

Overall 48% of respondents represented manufacturers with 50 employees or less, providing a similar breakdown to New Zealand manufacturing as a whole of 42% reported in Page

(2011) for 2010 (reproduced in Section 7.8.1.4 of this Plan). About 80% of respondents have an annual turnover of at least NZ$1 million.

Whilst all respondents supply to New Zealand and see this as having the largest growth potential over the next five years, more than half export to Australia, nearly a third to South East Asia and about a quarter to Europe and China (Figure 5). Australia and South East Asia have the greatest growth potential (after New Zealand) over the next five years according to respondents.

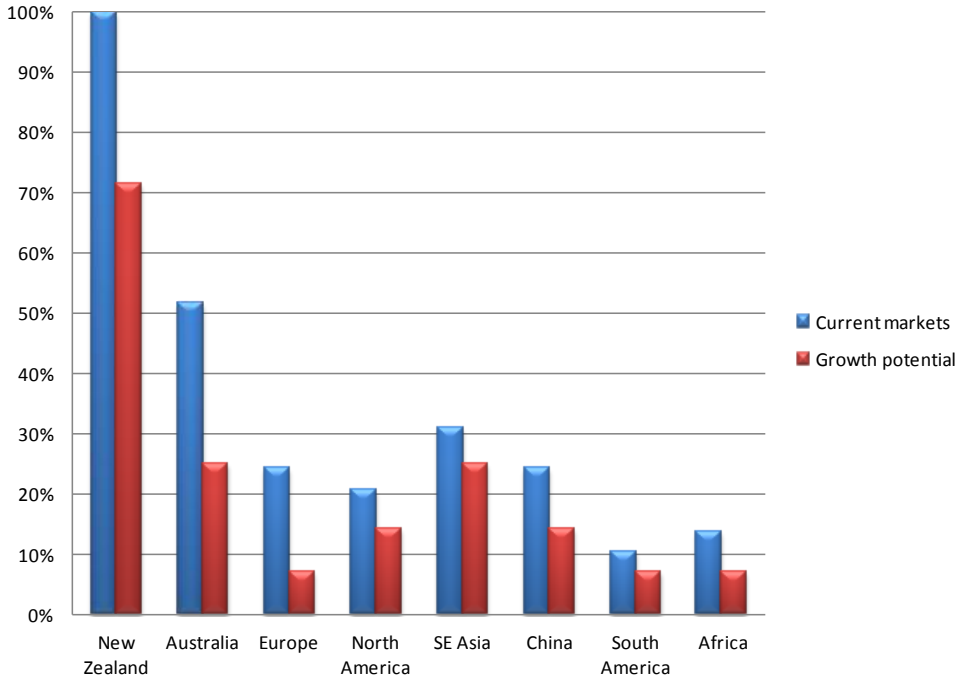


Figure 5. Markets currently supplied and perceived to have Growth Potential over the next Five Years

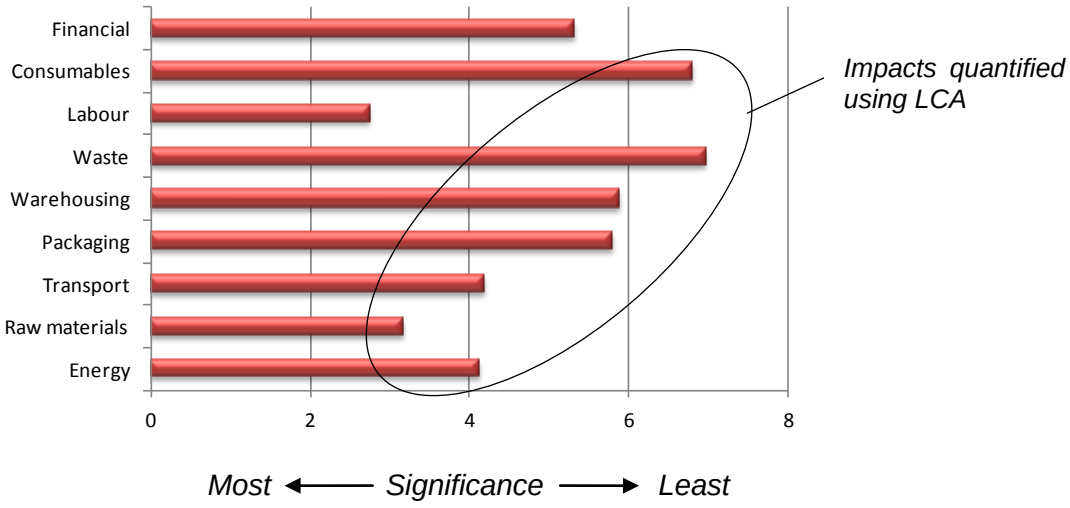


Figure 6. Summary of Significance of Costs to Survey Respondents

When asked to rank the significance of different costs to their businesses (where 1 equals greatest cost and 9 equals least cost), labour was highlighted as the most significant (Figure 6), closely followed by raw materials, transport and energy, the impacts of which are important to resource efficiency and quantified using LCA (in addition to packaging, warehousing, consumables and waste).

Nearly 90% of survey respondents view resource efficiency as reducing expenditure on materials and waste within their manufacturing operations (Figure 7). Additionally, towards two-thirds of respondents understand and use tools to evaluate and quantify resource use across their supply chains. This awareness of the life cycle impacts of their products and use of tools to quantify these impacts implies that respondents already have a good level of preparedness for developing EPD. Nearly 90% of respondents have already implemented solutions to reduce their use of resources and production of wastes.

Most survey respondents (over 80%) consider environmental management at an organisation level (Figure 8) presumably for internal and corporate reporting purposes whilst 70% are already considering environmental impacts associated with their products. Less than half currently consider environmental impacts of their suppliers. Key issues considered are waste, energy and resources (due to cost drivers) and monitoring required for regulation purposes (Figure 9).

Whilst the findings of this survey cannot be considered as representative of New Zealand construction product manufacturers as a whole due to its limited size, it does provide useful insight amongst respondents many of which appear to be in a good position to develop EPD, based on the knowledge and activities they have reported.

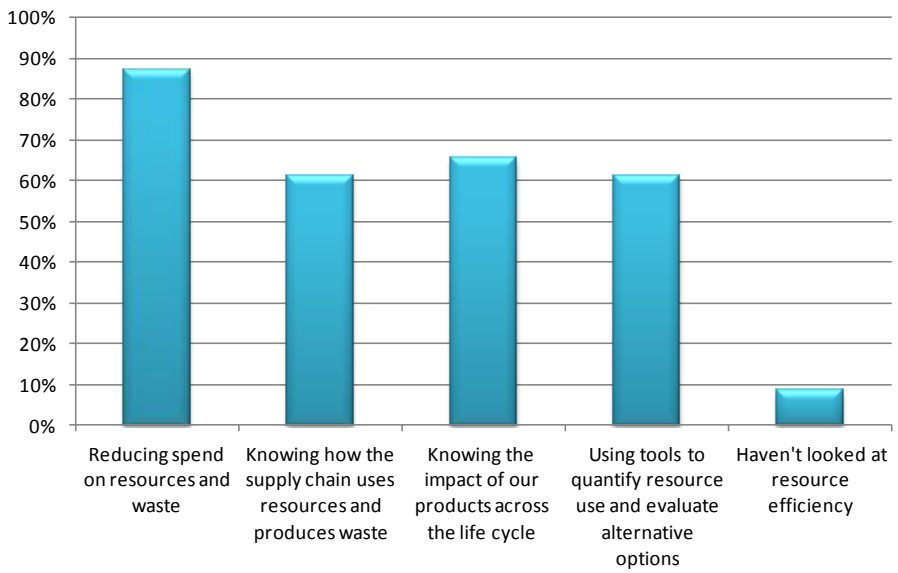


Figure 7. Summary of how Survey Respondents view Resource Efficiency

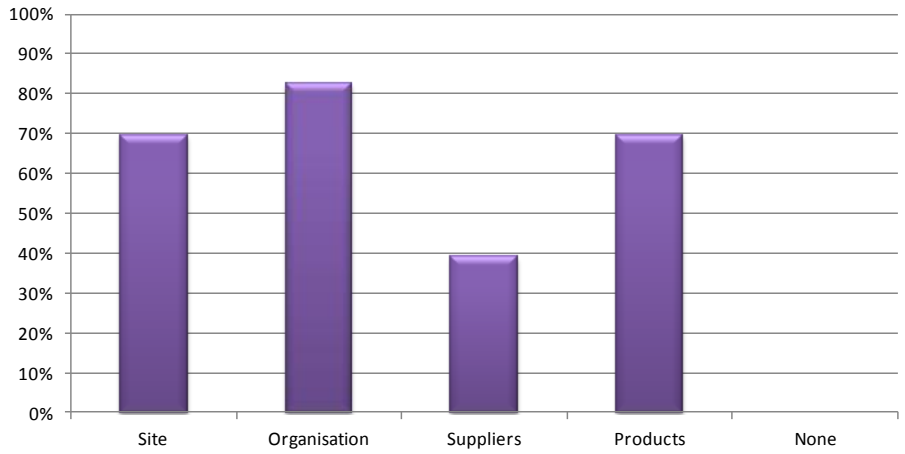


Figure 8. Level at which Environmental Management is considered amongst Survey Respondents

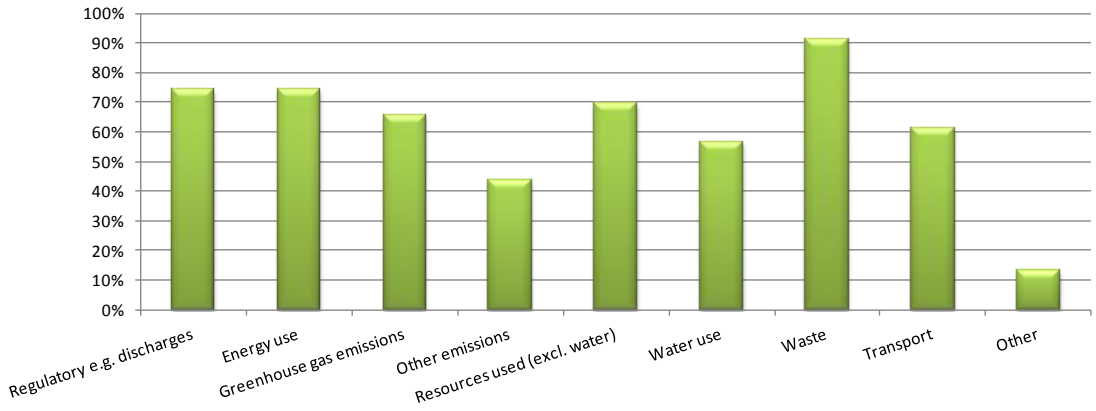


Figure 9 Summary of Environmental Issues that are assessed amongst Survey Respondents

3.2 Needs identified by the New Zealand Construction Industry

As reported in Jaques *et al*. (2011), BRANZ and Arup International conducted workshops in 2010 with New Zealand designers and materials and product manufacturers in order to better understand their needs. During the designers' workshops, participants were asked to list key sustainability issues relating to materials when designing buildings on behalf of clients. These issues were grouped under four themes – *resource efficiency, embodied impact, healthy & safe* and *responsibly sourced*. In total, 36 issues were identified under these four headings by workshop participants of which nearly 80% could be measured and reported using LCA.

Of primary concern to designers was the need to more easily consider materials sustainability as part of the design process. Authoritative sources of locally relevant robust information and data about environmental impacts of building products are increasingly needed.

Information derived from LCA was supported as a means to address this issue, respecting that the practicalities of implementing an LCA step in the design cycle would need to be considered. Whilst Green Star is primarily a rating tool rather than a design tool, its development to incorporate LCA was recommended as a basis for driving industry participation, defining building performance thresholds and encouraging consistency. With this expressed view in mind, this Plan provides an illustration of how the framework, once established, could be used in Green Star.

Amongst manufacturers, there was a concern about the perceived cost implications and a lack of understanding about environmental profiling and therefore buy-in from executive management. The limited availability of New Zealand LCA-based data was also seen as an issue.

To address these issues, workshop participants made recommendations summarised in Table 1.

Table 1. Summary of Recommendations arising from 2010 Workshops

Issue	Designers Workshop	Manufacturers Workshop
Governance	A credible authoritative body or process needs to oversee implementation.	Establish a credible body or mechanism.
Methodology	The methodological approach needs to be robust enough to ensure unbiased fair comparison, yet flexible to encompass different applications.	Examine the different options for establishing an LCA approach for New Zealand recognising lessons learnt from international experience.
Suggested Actions to address Barriers	Green Star should be developed to incorporate LCA data, to encourage a consistent and robust approach to materials sustainability assessment in New Zealand using LCA.	Consult with industry groups and improve knowledge using training, coaching and workshops. Encourage the development of a working group to champion the LCA agenda.
	Further design tools will be needed to maximise data uptake by practitioners. A ‘one tool suits all’ approach is unlikely to be appropriate.	Develop a business case for the New Zealand building sector and promote case studies illustrating industry lessons from use of LCA.

This Plan seeks to address recommendations made by the industry during the 2010 workshops and provide a pathway for establishment of a credible, robust system for assessing materials and products as part of a building level assessment in New Zealand based on international experience.

This pathway is called whole building whole of life assessment.

4. WHOLE BUILDING WHOLE OF LIFE ASSESSMENT

The benefits to business of adopting greener and resource efficient practices are obvious, and the consequences to business of ecosystem collapse are disastrous. So, why are sustainability strategies not more widely adopted? Significant barriers remain, most notably the deep-seated financial short-termism that exists in businesses, markets and governments UNEP; *The Business Case for the Green Economy*; 2012

4.1 The Vision

Figure 10 provides an overview of inputs to establishment of a whole building whole of life assessment framework including potential users and their applications.

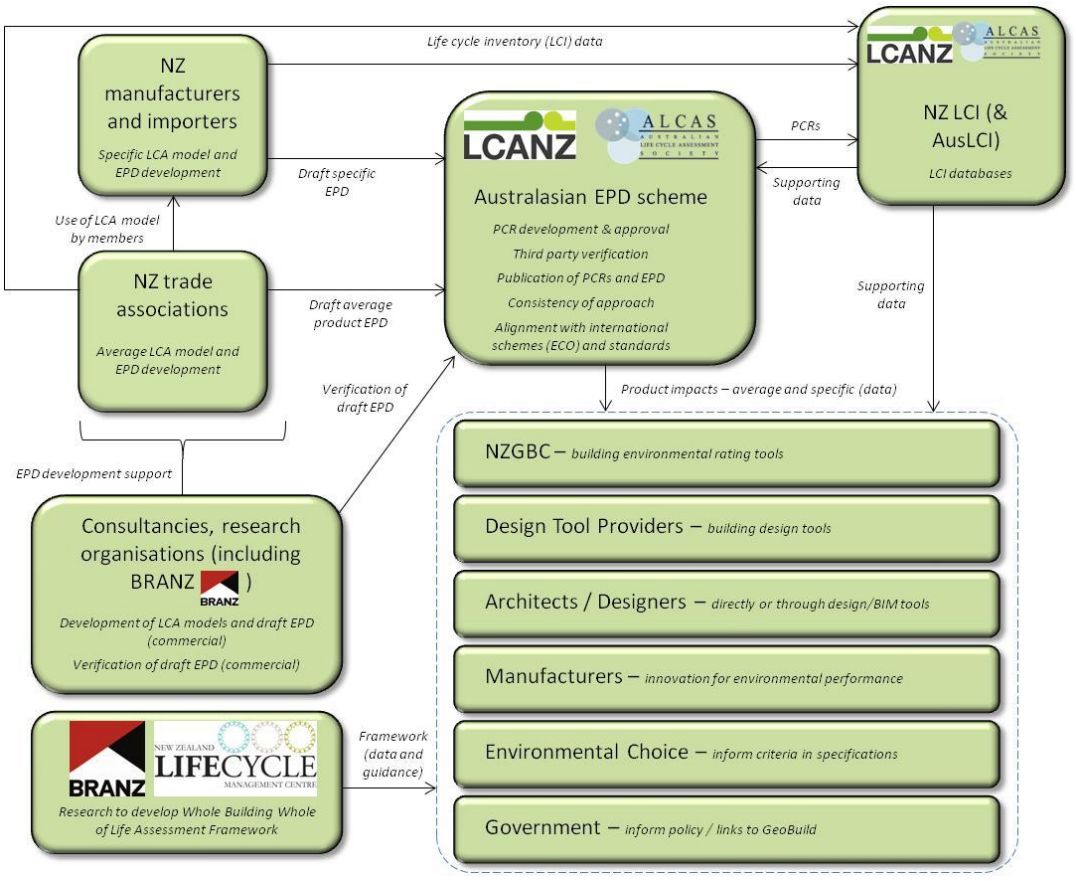


Figure 10. Overview of a New Zealand Whole Building Whole of Life Assessment Framework

Under such a framework, trade associations or sector bodies can assist their members by overseeing development of independently verified sector average product EPD to establish sector benchmarks and facilitate member understanding and engagement. Individual manufacturers may develop their own independently verified product specific EPD as a basis

for communication with their customers and to demonstrate the environmental credentials of their products in comparison with competitor products.

Consistency between EPD is achieved through definition of detailed, locally relevant rules (called Product Category Rules or PCRs) established through a consultative process administered by an LCANZ/ALCAS Australasian EPD scheme. The Australasian EPD scheme would operate in accordance with published governance arrangements and relevant international standards, ensuring scientific credibility and close alignment with other schemes internationally. Verified EPD would be published by the EPD scheme, providing information about the environmental performance of products and data on quantified impacts for all or parts of the life cycle.

Based on underlying LCA models needed to underpin the development of EPD, manufacturers and/or trade associations may also choose to submit life cycle inventory (LCI) data to a New Zealand Life Cycle Inventory database (NZ LCI) being developed by LCANZ which would align with an international LCI database initiative called the ILCD (International reference Life Cycle Data system). This will help ensure that practitioners seeking and accessing databases of materials, products and processes are using regionally and technologically representative, accurate and recent information.

Published, locally relevant EPD and data in an NZ LCI would provide a sound basis for whole building whole of life assessment, accessible to all.

4.2 Example Application for Rating the Environmental Performance of Offices

Figure 11 provides an example application, illustrating how whole building whole of life assessment can be used to inform the rating of the environmental performance of buildings (in this case, offices) in Green Star. This example is provided following recommendations received at a BRANZ industry workshop in 2010 (Section 3.2).

Whole building whole of life assessment as a basis for evaluating building environmental performance typically uses:

- Product information and data reported in EPD and from LCI.
- Data and information specific to a building design potentially held by architects, engineers, designers, quantity surveyors, project managers, contractors and other building professionals .
- Data in design, BIM, thermal simulation and other tools potentially applied to a project.

These data are used to quantify impacts of a designed building across its life cycle compared to a reference building e.g. achieving New Zealand Building Code. The assessment would calculate environmental performance as potential environmental impacts (reflected as a quantified impact/m^2/year) across the life of the building, incorporating the following:

- ***Location*****:** site characteristics, topography, climate zone.
- ***Design:*** orientation, floor area, number of storeys, inclusion of passive design features such as shading, natural ventilation and thermal mass, embedded renewable technologies, modelled thermal performance, incorporation of water saving features, and internal design options e.g. open plan or use of internal walls.
- ***Materials and Products Use*****:** Specification of materials and products to provide building elements meeting designed functions, manufacture, transport, on-site (or off-site) construction, assembly and installation, maintenance, repair and replacement during the life of the building.

- ***End of Life*:** deconstruction of the building, recycling, recovery and/or disposal of materials and products, including transport.

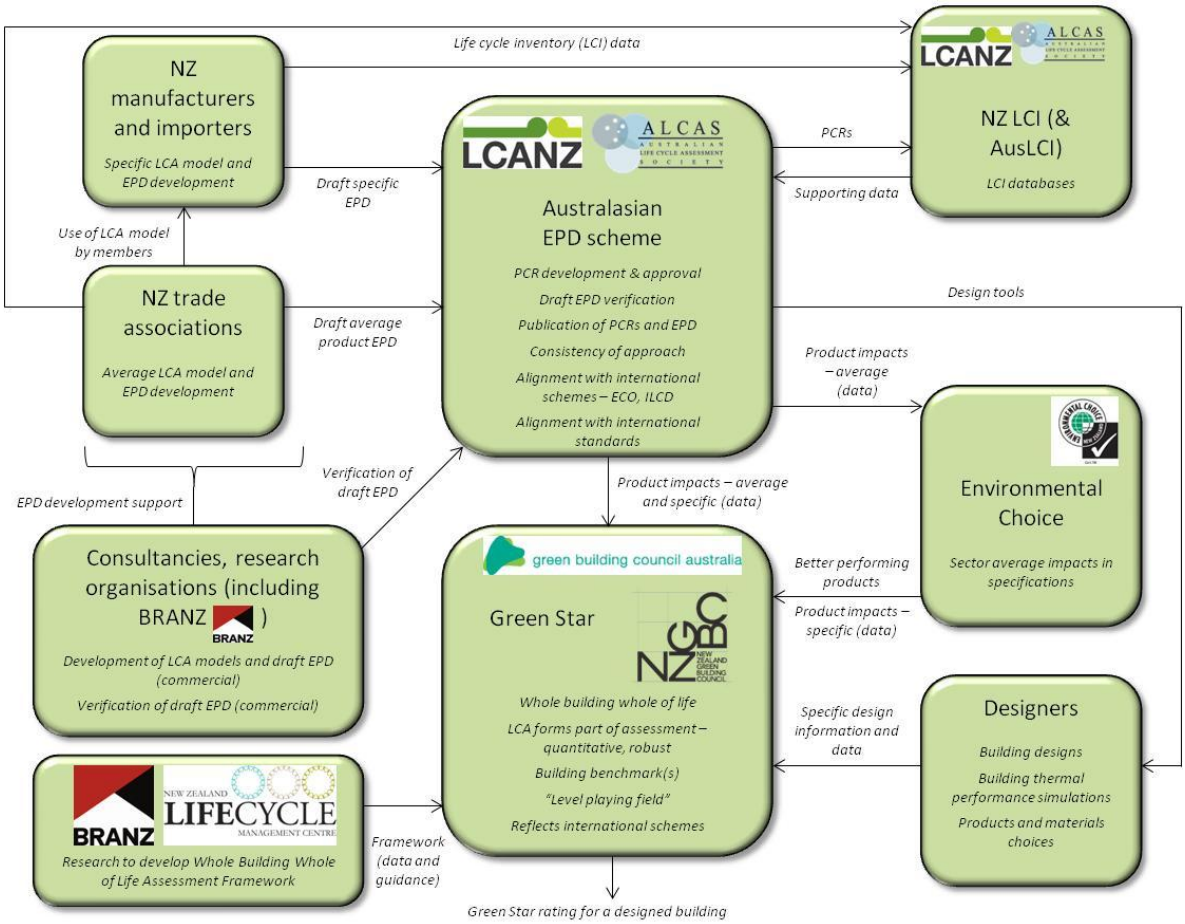


Figure 11 Example Application of the Framework for evaluating Building Environmental Performance

This type of assessment ensures that the contribution that products make to the overall performance characteristics of a designed building across its life cycle are fairly considered taking into account its location and design, by not drawing artificial and subjective boundaries around parts of the building's life cycle that can lead to unfair comparisons.

Environmental impacts reported in sector average EPD (representing the same or similar technologies and fulfilling the same function within a sector) provide useful industry benchmarks which could be incorporated into specification criteria of Type I ecolabels (Environmental Choice New Zealand (ECNZ) in New Zealand) in the future. Individual manufacturers who wish to demonstrate the environmental performance of their products may then choose to:

- Publish product specific EPD (which may be compared to sector average EPD), or;
- Obtain a Type I ecolabel (featuring environmental impacts incorporated from sector average EPD).

Manufacturers that do not want to publicly disclose environmental impacts in a product specific EPD could choose the second option above, where impacts reported in sector average EPD have been incorporated into relevant Type 1 ecolabel product specifications.

Both routes would require independent verification:

- Product specific EPD would be independently reviewed as part of the LCANZ/ALCAS EPD scheme.
- Manufacturers choosing the Type I ecolabel route could submit their LCA and other information for assessment against product specification requirements (including against sector average impacts derived from sector average EPD). In this second case, the Type I ecolabel could be awarded based on an assessment which includes verification of demonstrated lower than sector average environmental impacts, in addition to attaining other criteria defined by the Type I ecolabel in its specification.

Verification of the underlying LCA model and data in order to obtain a product specific EPD or Type I ecolabel is likely to have similar components and may be undertaken by the same verifiers. Following the Type I ecolabel route and having met the criteria to be awarded an ecolabel, product specific data would be submitted for inclusion in the whole building whole of life assessment but need not necessarily be published.

To calculate building environmental impacts, product data from EPD (or data from the Type I ecolabel route) would be used in combination with data about the performance of a designed building (for example, its thermal performance and use of water) as well as maintenance, replacement of products over the building life and eventual deconstruction. Calculated impacts for a designed building could then be compared to impacts for a reference building.

In Green Star, points for the LCA-based assessment would comprise a proportion of the points currently available in categories such as Materials and Energy. Points from other non-LCA issues such as Management, Indoor Environment Quality, Land Use & Ecology, for example, would then be added to obtain a final star rating for the designed building (Figure 12).

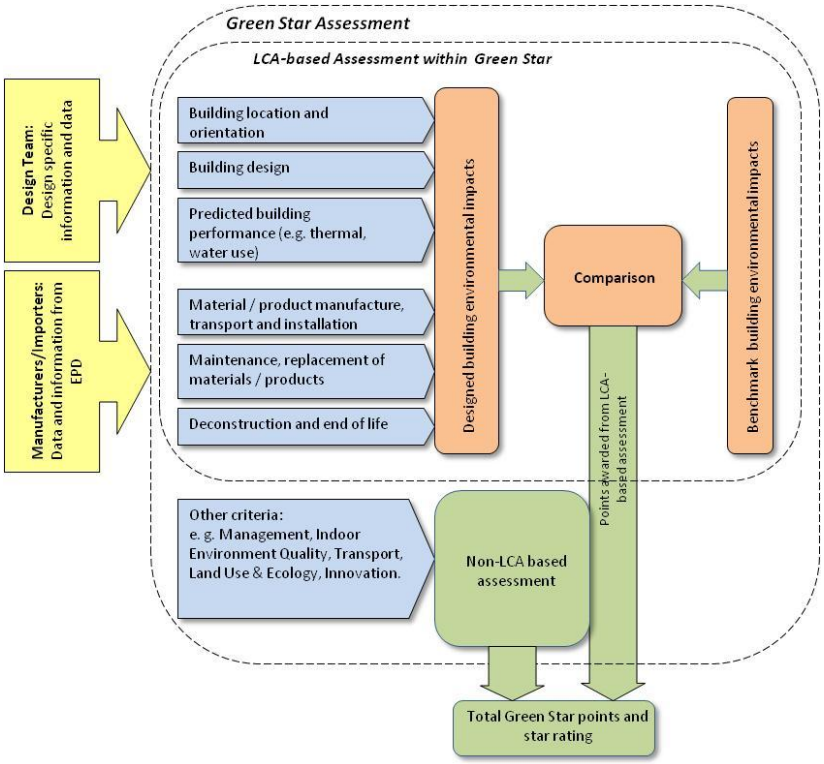


Figure 12. Example of how the Assessment Framework could be used in Green Star

The points derived from the whole building whole of life assessment may be awarded according to the percentage improvement achieved for each impact or the number of impacts in which an improvement is achieved, relative to the reference building (Figure 13). Similarly, there may be some weighting of impacts to reflect priorities.

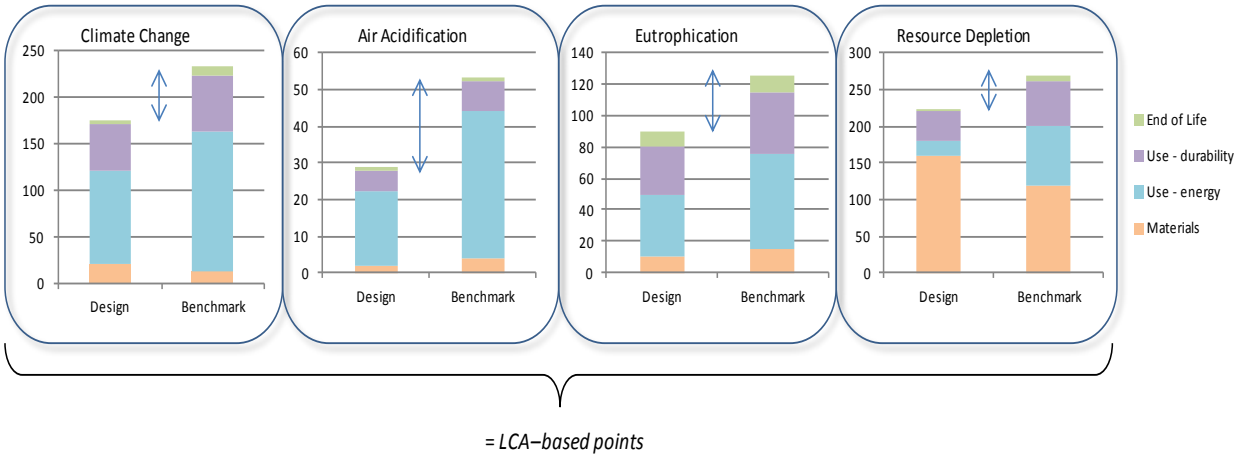


Figure 13. Illustration of how Points could be obtained using the Assessment Framework in Green Star

Underlying data to support this type of assessment are from measured, reported and independently reviewed values derived from EPD and information from the design process such as outputs of building performance models. The calculated potential environmental impacts of the building will reflect the design brief issued by the client and the decisions taken about the design to meet this brief, including the building's performance and choice of materials.

The assessment of environmental performance is therefore based on how materials and design contribute to calculated potential impacts across the life of the building rather than assessing materials based on proxy measures such as recycled content, distance materials are transported or whether a manufacturer has ISO 14001. These issues lead to environmental impacts but are not impacts themselves and therefore not necessarily a sound basis for comparison of alternatives.

The UK Construction Products Association states that products cannot really be compared unless their functionality and use are considered at the building level (CPA; 2012). The approach proposed in this Plan takes this whole building whole of life assessment process and provides a "level playing field" in which materials are considered in terms of the contribution they make to building elements and overall building environmental performance, based on its location, orientation and design. The assessment, like the New Zealand Building Code, will be performance based – in this case, environmental performance.

The robust, data-driven approach provides a sound platform for helping to inform design iteratively, potentially through use of Green Star (before formal assessment of a building) and/or by incorporation of available data on environmental impacts of products from EPD, in design tools.

This type of assessment already occurs in other countries and is likely to see increasing use – it is an objective, transparent approach and once established, should reduce the cost and time for assessment due to the potential to automate much of the LCA-based component of the process.

Furthermore, at a time when 75% of the sector in New Zealand sees Building Information Modelling (BIM) as the future of project information (Masterspec CIL; 2012), and the New Zealand Government invests in GeoBuild, the framework recommended in this Plan entirely aligns, having the potential for interoperability and provide a basis for online, real time assessments of building designs in the future.

4.3 Benefits

This section summarises benefits that can be derived from EPD and whole building whole of life assessment.

Further information about EPD and how they can be used to underpin a whole building whole of life assessment are provided in Appendix A.

4.3.1 Benefits of EPD

- **Credibility**: EPD development would be overseen by an authoritative LCA body (LCANZ and ALCAS) setting consistent requirements across the Tasman and with other schemes internationally. The scope of the scheme would cover all products and services (not just building products) and should align with relevant international standards including ISO 14025 (ISO, 2006a), ISO 21930 (ISO, 2007)) and ideally EN 15804 (CEN, 2012). EPD should therefore be recognisable in other countries.
- **Consistency:** PCRs in the Australasian EPD scheme would draw on and align with international PCRs where they have been developed, with adaptation to reflect local conditions. This would provide manufacturers with the assurance that competing product manufacturers must use the same rules for their EPD.
- **Transparency:** EPD require manufacturers to declare across a range of environmental impacts to allow a full understanding of issues. This would provide manufacturers with a stimulus for continuous improvement and would ensure that impacts are less able to be hidden through non-reporting.
- **Market driven:** EPD provide manufacturers with a market driven basis for demonstrating better environmental performance of products through comparison with competitor products.
- **Informative:** EPD allow manufacturers to better understand their supply chains and develop stronger links and co-ordination with their suppliers, as a basis for working towards improvement. They provide a means of communication of information about the environmental performance of products to customers (for business to business and business to consumer transactions), including provision of data on associated environmental impacts.
- **Independent verification:** EPD are independently reviewed for accuracy, ensuring rules have been applied correctly and the reported environmental impacts are based on sound data and assumptions.
- **Integrity:** Provides a format for disclosure of data and information to challenge perception or consensus driven thinking and avoid “greenwash”.
- **Non-judgemental**: EPD do not reflect values and priorities of others.

4.3.2 Benefits of Whole Building Whole of Life Assessment

- **Less risk of incorrect or inappropriate decisions:** Assessment based on quantified, independently verified impacts across the life cycle of a building allows better

understanding of the implications of design and materials decisions. Concentrating on specific impacts, such as global warming, or parts of the life cycle, such as embodied impacts, runs the risk of incorrect or inappropriate decisions being taken due to the more limited scope of these assessments.

- **Location and design specific:** Evaluates building design in specific locations against a suitable benchmark, rather than considering average buildings in generic locations. Building design needs to be in the context of its location. This is important because two buildings with apparently identical materials can have dramatically different operational energy performance depending on design, detailing and construction (AGO; 2006).
- **Can inform the design process:** by demonstrating significant contributors to environmental impacts across the life cycle and by aspect. This allows identification of key issues to which further focus can be given.
- **Flexibility:** Provides the framework and data for a more rigorous, quantitative assessment of the environmental performance of designed buildings without prescribing how this is achieved. Environmental improvement may be defined in comparison with a benchmark such as the New Zealand Building Code for reference. Calculation of life cycle environmental impacts of buildings using this process can additionally facilitate adoption and use of other benchmarks or aspirational targets for comparison with designed buildings, where desired.
- **Better information for valuers:** Calculated building impacts across the life cycle provides a common basis for valuers to identify where there is a differentiation in the market value of buildings with higher levels of sustainability. The current approach provides different pathways for demonstrating sustainability making comparison of buildings inherently difficult (Warren *et al*.; 2009).

5. THE CASE FOR EPD AND WHOLE BUILDING WHOLE OF LIFE ASSESSMENT

While companies can take many simple, quick and profitable actions on, say, energy efficiency, many don't. They grudgingly accept rising costs or believe savings are not worth the effort. But once companies begin their sustainability journey, many get a taste for more Sunday Star Times, 5th December 2011 in an article entitled *Sustainability Key to Success.*

With so many issues demanding the attention of CEOs and Boards of Directors of New Zealand building product manufacturers, why should use of LCA and publishing of EPD be worthy of consideration amongst so many other priorities?

There is no "one size fits all" answer to this question due to differences between companies with respect to size, products, markets, profitability, reputation, client relationships and management, cost and pricing structures, employee relations, resources and supply chains, attitude to sustainability and to change.

This section summarises opportunities that can arise out of using LCA as a tool for decision making and publishing EPD. The relevance and degree to which these opportunities present themselves to businesses now and in the near future will vary greatly depending on the nature of the business. It is therefore timely to take at least preparatory steps to better understand how LCA and EPD can benefit manufacturers by considering the following:

- Opportunity 1: Identification of cost savings.
- Opportunity 2: Meeting customer needs.
- Opportunity 3: Ensuring products are assessed on a "level playing field".
- Opportunity 4: Avoiding greenwash.
- Opportunity 5: Preparing for changing market needs.
- Opportunity 6: Benefitting from standards and guidance.
- Opportunity 7: Building Information Modelling (BIM).

The section also includes five case studies describing companies that have developed their use of LCA and EPD, why they embarked on this path and the benefits that they have obtained.

5.1 Opportunity 1: Identification of Cost Savings

When 72 companies were surveyed by the United Nations Global Compact, the top three risks identified were increasing costs for materials, water and energy scarcity and threats to human health (UNEP; 2012).

McKinsey (2010a) report that oil prices will rise and become more volatile as key providers are highly exposed to geopolitical instability and new supply is proving hard to find. Internationally, increasing use of emission trading schemes that put a market price on carbon are likely to provide a further price pressure on fossil fuel derived energy as generators and large users seek to pass on extra costs to their customers.

International Monetary Fund measures for 2003 – 2008 showed an increase in the price of energy of 275% and of mining products of 150% relative to the price of manufactured goods. New Zealand energy costs for manufacturing and transport have also increased significantly since 1996, as noted in Page (2008). Figure 14 summarises real energy prices in New Zealand since 2000 based on MED data. The recent downward trend in electricity prices is due to a flattening of demand coupled with excess generation.

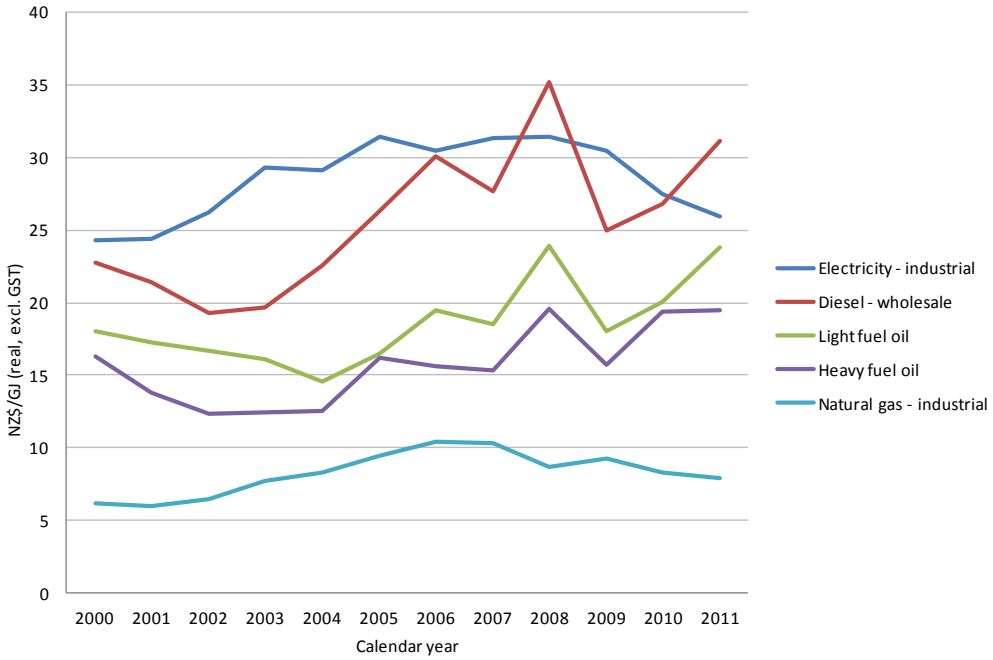


Figure 14. Summary of Real New Zealand Energy Prices 2000 – 2011 excluding GST

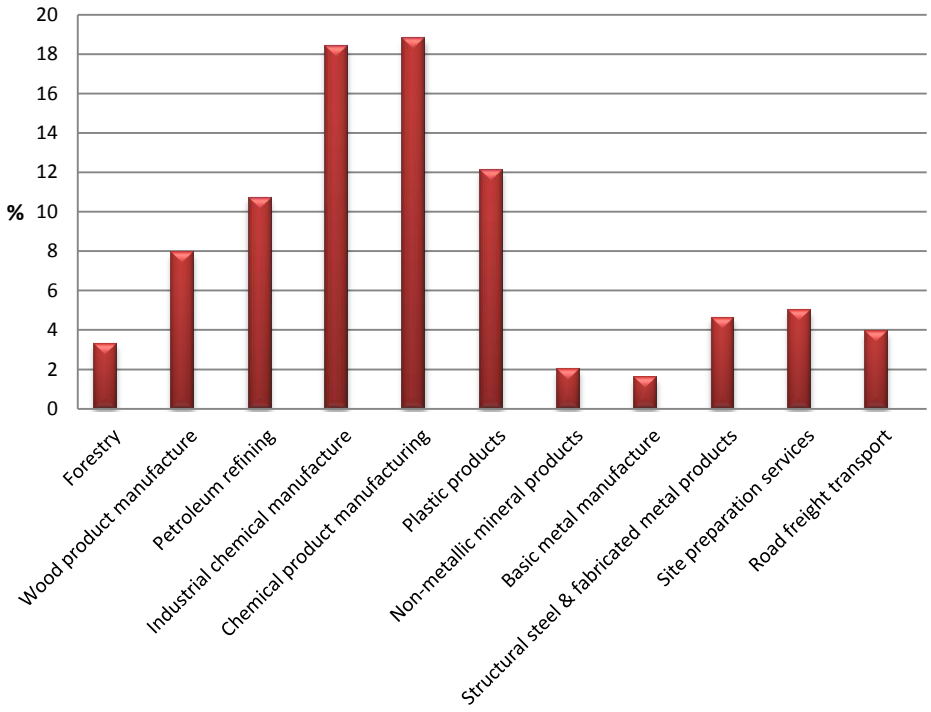


Figure 15. Petrochemicals as a Percentage of Feedstock Materials by Industry Sector

Raw petrochemical feedstock costs have also risen sharply from US$25/barrel in 1996 to US$100/barrel in 2007. Figure 15, based on Page (2008) illustrates the exposure of some industries supplying the New Zealand construction sector in terms of the proportion of their feedstock material which is petrochemical (based on 1996 input output tables).

Manufacturers can no longer rely on business-as-usual scenarios for resources – they must factor in higher base-level prices and increased volatility (McKinsey, 2010a). A BRANZ survey in Section 3.1 shows many respondents are actively pursuing more resource efficient practices in order to reduce exposure. As costs of energy, raw materials and transport rise, manufacturers who do not factor materials use and waste generation into decisions about the manufacture of their products will increasingly face cost pressures and reduced margins.

Gasser, a brick manufacturer based in a tourism region of Italy, has obtained financial savings and improved market share, through greater consideration of sustainability, use of tools such as LCA and publication of EPD (**Case Study 1**).

CASE STUDY 1: Gasser

Business: Brick manufacturer
Location: Europe
Source: UNEP (2008)

Gasser's Story

Gasser made the decision to develop EPD because:

- They wanted a credible, science based communication tool rather than using other environmental claims methods with generic and sometimes misleading information.
- They wanted to develop their market amongst consumers looking for credible information and for whom environmental impacts influenced their purchasing choices.

This decision was taken, in part, as a response to a Eurobarometer survey which found that:

- 41% of people did not feel that they were informed about the impacts on health of everyday products.
- 39% of people did not believe that their individual efforts would have an impact whilst industry did not do the same.
- 39% of the population wanted to reduce home energy consumption.
- 24% of the population considered environmental aspects when making large purchases.

By developing EPD, Gasser's strategy was to target the 41% of people who did not feel informed about health impacts of products and the 24% who considered environmental aspects in their purchases.

Business Benefits

Gasser found developing EPD beneficial because:

- Employees have a higher sensitivity to energy saving, avoiding waste production and more environmental sense resulting in company savings of 700 000 euros (over NZ$ 1 million) per year in energy costs.
- Gasser's market share of environmentally conscious purchasers (the 24% in the Eurobarometer survey) has increased. Gasser now has robust information available to provide a strong case for its products, where purchasers are looking for environmental credentials. This resulted in orders from National Parks and the 2006 winter Olympics.

Opportunity 1: With forecasts for rising and more volatile energy and resource costs, manufacturers using tools such as LCA that quantify resource and energy use across the value chain of their products will be better positioned to investigate alternative strategies and options that can lead to cost savings and reduced exposure to these trends.

5.2 Opportunity 2: Meeting Customer Needs

Customers are increasingly requesting information about the environmental performance of products and wanting to see progressive reductions in environmental impacts. Designers and architects also want more robust information about construction products to inform the design process and meet their customers' needs.

This customer driven demand is arising from increased awareness of the benefits of occupying more sustainable buildings (Section 5.5.1) and the brand and reputation benefits that companies can gain and portray to their customers.

A rapidly growing number of companies globally practice some form of corporate social responsibility (CSR) in which business creates value for shareholders in a way that also creates value for society. In 2008, an Economist online survey found that 55% of 1192 global executives reported that their companies gave a high priority to CSR. A McKinsey survey in February 2010 of 1946 executives globally found more than 50% considered sustainability as very or extremely important, particularly in the areas of new product development, reputation building and overall corporate strategy (McKinsey; 2010b). Over the last two years, the number of companies that are part of the Global Reporting Initiative (GRI) has more than doubled (from 1400 to 3500), with the issue of more than 8000 environmental and social sustainability reports.

Despite this, only about 30% of companies are seeking to invest in sustainability or embed it in their processes, meaning the majority are missing opportunities (McKinsey; 2010b).

Whereas good reputations are linked to resilience and enduring organisational success, poor reputations take a long time to fix (UNEP; 2012). Increased and rapid access to information made possible by the Internet has the potential to rapidly change a company's reputation.

In a recent UNEP survey, both "embracers" and "cautious adopters" of sustainability ranked brand reputation as the top benefit. Whilst "embracers" saw competitive advantage, access to new markets and increased margins as also being important, "cautious adopters" highlighted reduced costs due to energy, resource and waste efficiencies as drivers (UNEP; 2012).

Interface is an example of a company whose CSR objectives include a commitment to transparency and reporting across its product range (not just its better performing products) using EPD which it sees as important for accountability and as a key driver to continuous improvement (**Case Study 2**).

CASE STUDY 2: Interface

Business: Floor covering manufacturer
Location: Global
Source: www.interfaceglobal.com

Interface's Story

Interface began in 1973 as a flexible floor covering manufacturer and over the following twenty years, acquired more than 50 businesses to become the world's largest producer of modular carpet, with sales in more than 110 countries. In 1994, the company's founder, Ray Anderson, recognised that valuing success only by a company's economic value was fundamentally flawed and set out changing the course of the company moving it towards a business focused on sustainability, using a cyclical model that sought to recreate natural processes. Significant changes occurred across the business including developing modular carpet tiles that could be replaced or repaired when worn rather than requiring replacement of entire carpets and developing carpet leasing rather than selling, with contracts for cleaning and maintenance across the life of the carpet.

A philosophy to be the first company that, by its deeds, shows the industrial world what sustainability is in all its dimensions – people, process, product, place and profit – by 2020, has resulted in Mission Zero – a commitment to eliminate any negative impact on the environment by 2020. This commitment continues despite Ray Anderson's death in August 2011.

Part of this philosophy requires EPD for all products in order that the company can be held accountable for its effort for continuous improvement. By January 2012, this target was 90% complete. Transparency across the best and worst environmentally performing products will provide the internal drive for improvement and put pressure on competition according to the Director of Corporate LCA Programs at the company.

Business Benefits

- Interface is now a billion US$ corporation named by Fortune magazine as one of the "Most Admired Companies in America" and in the "100 Best Companies to Work For" list.
- Total waste to landfill down 77% since 1996. Achieved 42% reduction in waste cost per unit, resulting in US$433 million (over NZ$500 million) in avoided waste cost since 1996.
- Energy used at manufacturing facilities down 43% per unit of product and 30% of energy from renewable sources. Greenhouse gas emissions down 44%.
- Helping create more sustainable, closed loop products.

Opportunity 2: As corporate clients increasingly develop their CSR and sustainability objectives and targets, manufacturers who use LCA and publish EPD demonstrate their own commitment to reporting and continuous improvement, providing a basis for communication with specifiers, architects and clients.

5.3 Opportunity 3: Ensuring Products are Assessed on a "Level Playing Field"

Currently, there are 433 ecolabels in 246 countries spanning 25 industrial sectors (www.ecolabelindex.com/). This proliferation makes it increasingly difficult for purchasers to make comparisons based on the best available science – a holistic cradle to grave assessment of environmental performance.

The aim of EPD schemes is to provide manufacturers with a robust, consistent basis for reporting the environmental performance of their products, which facilitates whole building whole of life assessment (for construction sector applications). EPD are a public declaration of the environmental performance of products, including reporting outputs derived from LCA models. They are generally voluntary and developed within EPD schemes of which there are a number around the world, with an Australasian scheme aiming for launch in 2013. EPD are based on detailed rules (called Product Category Rules) to ensure better consistency and comparability between similar products. They may cover all or part of the life cycle of the product. Where a product makes a contribution to the in-use performance of a building eg. thermal performance, or may be used for different purposes in the building, EPD cover those parts of the life cycle which are common, such as manufacture and potentially transport and construction. In these cases, in-use impacts and other parts of the life cycle not reflected in the EPD are calculated in the whole building whole of life assessment at the building level. Further information about EPD is provided in Appendix A.

EPD are developing internationally due to the greater robustness and transparency they provide, for example:

- Eighteen existing EPD schemes in Europe are currently participating in the European Construction products Organisation (ECO) initiative to more closely align their requirements and formats.
- On 1st July 2011, France became the first country to make EPD mandatory rather than voluntary, for high volume consumer goods. This has been driven by national legislation and is administered by the national standards body – the Association Française de Normalisation (AFNOR). Companies selling these types of products are required to develop the supporting LCAs and publish EPD.
- EPD are mandatory for public building construction projects in Germany (ALCAS; 2012).
- Japan launched a national EPD scheme in 2000. The scheme, called Eco-Leaf (www.ecoleaf-jemai.jp/eng/) was developed by the Japan Government (the Ministry of Economy, Trade and Industry), the national standards body and the Japan Environmental Management Association for Industry (JEMAI). There is an intention that this will be applied to all products sold in Japan (Schenck; 2009).
- In the USA, The Green Standard was launched in 2008 as a building product EPD scheme. In a paper advocating development of a national EPD scheme for the USA, Schenck (2009) states that:
    - EPD are not considered to be technical barriers to trade under World Trade Organisation (WTO) rules.
    - Mandatory EPD schemes will be “adopted to a greater or lesser extent around the world”.
    - “A national EPD system provides an opportunity to use market forces rather than regulation to decrease climate change and other environmental impacts. The simple fact of disclosure has proven to be a very effective spur to pollution prevention, as companies see where they stand vis-à-vis their competition. Decreasing pollution leads to better public health, lower medical costs, and therefore an economically stronger nation. EPD provide a low-cost method to decrease the environmental impacts of the economy, and ongoing measurement provides an embedded continuous improvement mechanism”.

Closer to home, Australia faces similar issues to New Zealand. In his 2011 paper, Woodard noted that “current approaches to improving the environmental performance of buildings in Australia are disjointed, uncoordinated, varied in their complexity and sometimes perverse in their outcomes”. He went on to say that “the building and construction sector is one of the

major drivers of LCA in Australia because it clearly recognises that LCA brings a truly scientifically based, and if done correctly, level-playing field approach to whole of building, whole of life assessment".

In a response to the need for a more consistent approach, LCANZ and ALCAS announced plans to establish an Australasian EPD scheme. This should provide the process, governance and rules for developing EPD in New Zealand and Australia.

The robust, quantitative outputs from LCA and EPD have successfully been used by manufacturers to show compliance and provide evidence to support changes to criteria in ecolabel schemes. NatSteel Holdings, a steel bar and coil manufacturer, used LCA to show that its products met and exceeded revised steel credit criteria developed by the GBCA (**Case Study 3**). Similarly, **Case Study 4** in Section 5.5 shows how LCA has been used to demonstrate how alternative options to specification criteria lead to similar environmental benefits.

CASE STUDY 3: NatSteel Holdings

Business: Steel bar and coil manufacturer
Location: Singapore
Source: Moore & Chatfield, 2nd LCANZ and NZLCM Centre Conference Proceedings; 2012

NatSteel Holdings' Story

Prior to 2010, NatSteel Holdings (and Best Bar Reinforcements Australia which imported and used steel bar and coil from NatSteel Holdings) achieved the Green Star steel credit awarded by the GBCA due to its high recycled content. However, in 2010, the GBCA revised its Green Star steel credit criteria to require steel makers to demonstrate that they are using "energy reducing processes" in the production of steel billet.

The company decided to engage PE Australasia to use LCA as a means of evaluating the potential energy and greenhouse gas benefits of three processes operating at their plant including scrap preheating, use of virtual lance burners and hot charging from the steel mill directly into the rolling mill.

Business Benefits

- The work demonstrated that each of the three energy reducing processes individually meets the revised GBCA steel credit criteria of a 40 MJ/tonne of steel billet energy reduction.
- An issue with the revised GBCA steel credit criteria is that it was expressed per tonne of steel billet which is an intermediary product when hot charging directly from the steel mill into the rolling mill. The revised GBCA steel credit therefore omits and does not credit important available energy reducing technologies.
- Total benefits using the GBCA boundary were calculated as 406 MJ/tonne due to use of scrap preheating and virtual lance burners. However, adding the benefit of hot charging (not included in the GBCA boundary) increases this benefit to 665 MJ/tonne. The company was therefore able to demonstrate that it easily met the revised steel credit criteria.
- The study, plus others, has allowed the importer, Best Bar Reinforcements Australia, to demonstrate their commitment to improving environmental performance.

Opportunity 3: Materials and products can only really be assessed on a "level playing field" if their functionality and use is considered at the building level (CPA, 2012). It is this recognition that has led to the development of whole building whole of life assessment, underpinned by LCA, in other rating schemes globally. Manufacturers using LCA and publishing EPD can ensure their products are properly represented in schemes recognising environmental performance in building level assessment.

5.4 Opportunity 4: Avoiding Greenwash

In its 2010 report *The Sins of Greenwashing*, TerraChoice reported that globally, there were more green products available and green product innovation was being rewarded in comparison with its previous report. Businesses that can show they are on a journey of improvement, and can demonstrate genuine environmental gains that avoid the seven deadly sins of greenwash (TerraChoice, 2010) have better opportunity to benefit and reduce the risk of litigation due to use of false, misleading or unsubstantiated environmental claims.

EPD can provide the necessary robustness to underpin environmental claims helping to avoid potential accusations of greenwashing that can lead to negative press, adverse reaction, damaged reputation and potential legal claims.

Table 2 sets out the seven deadly sins of greenwash (TerraChoice, 2010) and how EPD can help companies to avoid these pitfalls.

Table 2. How EPD can help avoid Greenwash

Sin of		Definition (from TerraChoice, 2010)	How EPD help to avoid this Sin
1	Hidden trade-Off	Suggesting a product is "green" based on an unreasonably narrow set of attributes without attention to other important environmental issues.	EPD report on a range of environmental impacts and do not focus on specific issues (such as global warming, for example)
2	No proof	An environmental claim that cannot be substantiated by easily accessible supporting information or by a reliable third-party certification.	EPD provide a format for environmental declaration of products, enshrined in international standards, including ISO 14025 and for construction products, ISO 21930.
3	Vagueness	A claim that is so poorly defined or broad that its real meaning is likely to be misunderstood by the consumer.	EPD outputs include quantified potential impacts associated with a product or service meeting a specific, stated function or amount, based on well defined rules (PCRs).
4	Irrelevance	An environmental claim that may be truthful but is unimportant or unhelpful for consumers seeking environmentally preferable products.	EPD report across a range of potential impacts allowing the reader to clearly see the magnitude of each impact and where impacts occur in all or part of the life cycle.
5	Lesser of two evils	Claims that may be true within the product category, but that risk distracting the consumer from the greater environmental impacts of the category as a whole.	EPD provide a market driven basis for declaring environmental performance which can be used in building level assessment so that the impacts of products can be viewed in the context of the life cycle of the building in which they are used.
6	Fibbing	The least frequent Sin, making environmental claims that are simply false.	Participation in an EPD scheme requires adherence to EPD format, content and rules requirements, which are independently verified. This is preferable to developing own marketing material to avoid misinterpretation.
7	Worshipping false labels	A product that, through either words or images, gives the impression of third-party endorsement where no such endorsement actually exists.	Development of EPD requires third party verification of declared data and information.

In a three month analysis of 729 building products making a total of 1726 green claims available in North American DIY centres during 2010, TerraChoice (2010) found that whilst the overall proportion of "sin-free" construction/DIY products was greater than an all-product average which included other sectors (6% as opposed to 4.4%), the sin of the hidden trade-off was higher for building and construction products. Well over half of building products were guilty of vagueness and no proof.

Opportunity 4: EPD, and the LCAs behind them, are developed using consistent rules and are independently verified providing a robust basis for declaration of environmental performance.

5.5 Opportunity 5: Preparing for Changing Market Needs

There are two drivers that create this opportunity – interest in more sustainable, higher performing buildings and the increasing requirement or desire for better information about material and product environmental performance.

5.5.1 Interest in More Sustainable, Higher Performing Buildings

In studies undertaken locally (NZGBC, 2010) and overseas (API & PFA, 2011; Jones Lang La Salle; 2009) the main benefits of more sustainable, higher performing buildings are:

- Improved public image.
- Lower operating and maintenance costs and a "green" premium in value of office buildings.
- Increased employee satisfaction and productivity (ranges from 0% to 20% productivity improvements in different studies).
- Reduced risk arising through better coordination of the design-build process forced by green design (which may save 2-5% in capital costs through improved design).
- Better understanding of potential indoor environmental hazards (mould, off-gassing, etc) and the future potential to link lower insurance premiums to green buildings.
- Increased market value through lower operating cost and more satisfied tenants (up to 30% increase).

Manufacturers who demonstrate that their products can aid good design and operation in buildings across the life cycle will be in a stronger position to capitalise on the "green market" and create opportunities to improve competitive position.

Sustainability in buildings has evolved from initially being a vague feel-good factor, to saving energy and water costs, to the current realisation that there is an improvement in occupant productivity in well designed, higher environmentally performing buildings.

It is not easy to quantify how use of materials with lower environmental impacts contribute to worker productivity but recent studies show better occupant productivity, rental premiums and selling prices for "greener" buildings in comparison with equivalent buildings. Indeed, the case for buildings with higher environmental performance in Australia is strong enough for the General Manager of Sustainability, Safety and Environment for the Investa Property Group to state "we have a clear alignment between environmental objectives and commercial objectives in the Australian commercial property sector" (Property Australia Magazine; 2011/12).

The Australian Property Institute (API) and Property Funds Australia (PFA) published a significant report in 2011 that used an empirical analysis of National Australian Built Environment Rating Scheme (NABERS) and Green Star ratings achieved by office buildings in Sydney and Canberra to assess whether there is a financial premium on green office buildings (defined by achievement of NABERS or Green Star rating levels). The authors reported a clear value of green office buildings in comparison with other office buildings summarised as follows (API & PFA; 2011):

- A green premium in the value of office buildings with higher NABERS energy ratings, with a 5 star NABERS energy rating delivering a 9% premium.
- A variation in the level of premium according to office markets with Sydney suburbs yielding an 8% premium and a 21% premium in Canberra for 5 star NABERS ratings.
- Evidence of major discounts in value in the lower NABERS energy rating categories (less than 3 stars) for the Sydney CBD (10% discount in value) and Canberra (13% discount in value).
- A Green Star rating showed a green premium in building value of 12% and a premium in rents of 5%.
- Discounts on rent of up to 9% were found for offices with lower NABERS energy ratings and a premium of 3% in the Sydney CBD for a 5 star NABERS energy rating.
- Green premiums were also evident in terms of reduced vacancy, reduced outgoings, reduced incentives and reduced yields, particularly at the higher rated NABERS energy categories.

In a similar study carried out in the USA by Eichholtz *et al*. (2010), 10,000 office buildings were surveyed on the basis of rent, effective rent (rent adjusting for building occupancy levels) and selling prices. The findings in this report were similar to those in the Australian study:

- Buildings with a green rating obtain rental rates about 3% higher per square foot than otherwise identical buildings— controlling for the quality and specific location of office buildings.
- Premiums in effective rents were even higher—above 7%.
- Selling prices of green buildings were higher by about 16%.
- The relative premium for green buildings is higher in places where the economic premium for location is lower i.e. the percentage increase in rent or value for a green building is systematically greater in smaller or lower-cost regions or in less expensive parts of metropolitan areas.
- Variations in market value were systematically related to the energy efficiency of buildings.

Based on a number of studies, UNEP (2012) reports that green buildings also deliver improved employee productivity, work quality and health, due to reduced air and noise pollution. Productivity gains are calculated as:

- 6-9% from indoor air quality.
- 3-18% from natural ventilation.
- 3.5-37% from local thermal comfort.
- 3-40% from daylighting.

In New Zealand, obtaining an ECNZ ecolabel provides a pathway for recognition of environmental performance of products in Green Star. Winstone Wallboards Ltd wanted to

obtain the ECNZ ecolabel to demonstrate the environmental performance of its plasterboard but needed to use LCA to show that an alternative end of life route was equivalent environmentally to specification criteria for recycled content (**Case Study 4**).

CASE STUDY 4: Winstone Wallboards Ltd

Business: Plasterboard and drywall systems manufacturer
Location: New Zealand
Source: Winstone Wallboards Ltd

Winstone Wallboards' Story

Winstone Wallboards wanted to obtain the ECNZ Type I ecolabel in order to demonstrate the environmental performance of its GIB plasterboard product. One of the criteria in the ECNZ specification for plasterboard products was a requirement for 5% recycled content which Winstone Wallboards Ltd was unable to meet.

The company decided to use LCA as a means to assess and quantify the potential environmental benefits of achieving this recycled content requirement and found that they were not significant. Furthermore, the study went on to quantify and demonstrate that using waste plasterboard for composting at end of life yields similar environmental benefits to 5% recycled content. Transport of waste plasterboard as a feedstock material to plasterboard manufacture or for composting has a significant influence on both pathways.

Business Benefits

- Enabled Winstone Wallboards to provide supporting evidence and secure agreement from ECNZ to modify the specification for plasterboard to allow composting as an alternative to 5% recycled content, thus enabling certification by ECNZ.
- Validated the use of waste plasterboard as an input to cement manufacture. Currently, 3 – 5000 tonnes of gypsum from waste plasterboard is being used in cement manufacture in the South Island, reducing the need to import gypsum. Process trials have also commenced in the North Island.
- Improved understanding of the stages of the life cycle, and processes that contribute most to the environmental impact of plasterboard.

5.5.2 The Requirement or Desire for Better Information

In parts of Europe, use of LCA and EPD for construction materials and products and building level assessment is well developed, including the three largest economies of France, Germany and the UK. However the need for a consistent basis for trade in Europe is resulting in the most significant change to manufacturers in (and importers of construction materials to) Europe in over a decade.

The Construction Products Regulation (CPR) 305/2011/EU (OJEU, 2011) was adopted by the European Parliament and Council of the European Union in March 2011 setting out harmonised requirements for marketing of construction products across the European Union. European Regulations are legally binding on all countries in Europe meaning national governments do not need to take action to implement them. From 1st July 2013, the CPR will supersede the Construction Products Directive (89/106/EU).

The CPR sets out a common technical language on the performance of construction materials and products and places a legal obligation on manufacturers to provide proof of their products' fitness for purpose. This is demonstrated by obtaining a CE mark which is, in

effect, a passport that enables construction products, irrespective of origin, to be legally placed on the market in all European member states.

The CE mark, which will be mandatory after 1st July 2013 for products supplied to Europe, confirms that the product or material will enable the finished construction works to comply with seven CPR Basic Works Requirements (CPA, 2012):

1. Mechanical resistance and stability.
2. Safety in case of fire.
3. Hygiene, health and environment.
4. Safety and accessibility in use.
5. Protection against noise.
6. Energy economy and heat retention.
7. Sustainable use of natural resources.

Basic Works Requirement 7 on sustainable use of natural resources will be new and will cover reuse or recycling of materials and parts after demolition, durability and use of environmentally compatible raw and secondary materials (Passer *et al*., 2012). EPD are recognised as the basis by which the sustainability requirements in the CPR can be demonstrated (CPA, 2012).

In the USA, the non-profit organisation Architecture 2030 issued its 2030 Challenge for Products to building product manufacturers, to reduce the embodied carbon of products by 50% by 2030. To achieve this target has been calculated to be the equivalent of shutting 222 coal fired power stations[2]. Progress will be measured by establishing benchmark values for different products using LCA starting in 2014, and then manufacturers will be able to track individual progress using EPD.

There is a proliferation of building environmental rating tools across the planet with over 100 now in existence that measure some form of environmental performance (Warren *et al*., 2009). BRANZ has researched a selection of voluntary tools on the market (Dowdell, 2012) that use environmental profiling as part of the assessment process, and found a trend towards incorporation of LCA and EPD. The UK scheme BREEAM was the first to feature this type of approach back in 1999 and since then other building environmental rating tools are increasingly including LCA-based approaches, including LEED which now features pilot credits based on LCA.

In Australia, the GBCA closed a consultation on incorporation of LCA into Green Star in August 2012. With the interest both the GBCA and NZGBC have in LCA and EPD, and LCANZ/ALCAS' intention to develop an Australasian EPD scheme, there would be considerable benefits in developing an aligned approach to whole building whole of life assessment based on EPD across the Tasman.

In New Zealand, MBIE (2012) has published five guiding principles of Government procurement. Whilst not detailed, there are a number of criteria that are relevant to this Plan and its outputs under Principle 4: Get the Best Deal for Everyone:

- Get best value for money – account for all costs and benefits over the lifetime of the goods or services.

[2] http://greensource.construction.com/news/2011/02/1102162030-Challenge-for-BPM.asp

- Make balanced decisions – consider the social, environmental and economic effects of the deal.
- Encourage and be receptive to new ideas and ways of doing things – don't be too prescriptive.

In addition to voluntary or regulatory drivers that encourage greater use of LCA and publication of EPD globally, there is an increasing trend towards greater availability of LCA-based data (for construction and other products) including in:

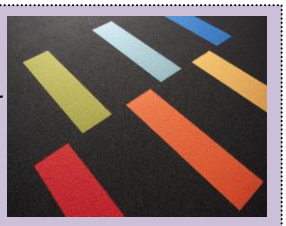
- Europe - examples include www.oekobau.dat (Germany), www.inies.fr (France), BRE Green Guide (www.bre.co.uk/greenguide/) and ICE (UK), and at a European level, the ELCD (http://lca.jrc.ec.europa.eu/lcainfohub/datasetCategories.vm) and a developing initiative for a European Sustainable Construction (ESUCO) database.
- North America – including US LCI in the USA (www.nrel.gov/lci/) and Canadian Raw Materials Database (http://crmd.uwaterloo.ca/).
- Asia – examples of developing programs include Japan[3], China[4], Thailand[5] and Korea[6].
- South America – e.g. Brazil (http://acv.ibict.br).

In Australia, there has been an initiative to develop life cycle inventory (LCI) data for construction materials and products (www.bpic.asn.au/LCI) by the Building Products Innovation Council (BPIC). This construction sector specific activity is part of a wider initiative called AusLCI to establish an LCI database for Australia (http://auslci.com.au/datasets). NZ LCI is a similar New Zealand initiative under development by LCANZ.

Gradus is an example of a company that saw changes in its markets and wanted to position itself to meet the additional requirements of clients procuring its products (**Case Study 5**).

[3] www.jemai.or.jp/english/lca/project.cfm
[4] www.chinacp.org.cn/eng/cptools/cpt_lca.html, www.sciencedirect.com/science/article/pii/S1001052108600613
[5] http://doi.eng.cmu.ac.th/Thailca
[6] http://sdo.ew.eea.europa.eu/networks/korean-lca-and-dfe-development-and-links/

CASE STUDY 5: Gradus



Business: Broadloom carpet, impervious carpet and carpet tile manufacturer
Location: Europe, Middle East, Asia
Source: www.breglobal.co.uk

Gradus' Story

Gradus has supplied floor coverings for education, healthcare, retail and commercial buildings for over 20 years during which time it has increasingly monitored environmental impacts of its products and implemented measures to improve environmental performance.

Gradus opted to obtain a Green Guide rating (a rating based on LCA under the BRE scheme in the UK) for 14 of its carpet ranges due to this increasingly becoming a prerequisite for many Government funded projects such as State schools.

Business Benefits

- Greater energy and carbon savings achieved (beyond what was achieved prior to obtaining Green Guide ratings).
- Improved understanding of environmental attributes to consider from suppliers.
- Improved access to public sector markets, as environmental information sought by architects can now be provided.
- Greater confidence to grow its Private Finance Initiative (PFI) business.
- Competitive advantage.

Opportunity 5: There is an increasingly strong case for building more sustainable offices and other buildings. This does not just equate to a premium on value and lower operating costs, but also in increased occupant productivity and reduced days when staff are ill. Corporate tenants and owners are becoming more discerning and want to realise these benefits. Similarly, better transparency of information about the environmental performance of products is increasingly required or desired in design and/or procurement. Manufacturers who understand the environmental impacts of their products, and have EPD to demonstrate this, can more easily meet these changing needs and take advantage of the opportunities they present.

5.6 Opportunity 6: Benefitting from Standards and Guidance

There is increasing standardisation and guidance available for developing LCA of building products and materials, elements and whole buildings, leading to better consistency and reproducibility.

ISO 21930 (2007) sets out requirements for the environmental declaration of building products, and is based on the ISO 14040 (2006b) LCA standards. It is part of a series of international standards that cover sustainability in buildings and building products, summarised in Figure 16.

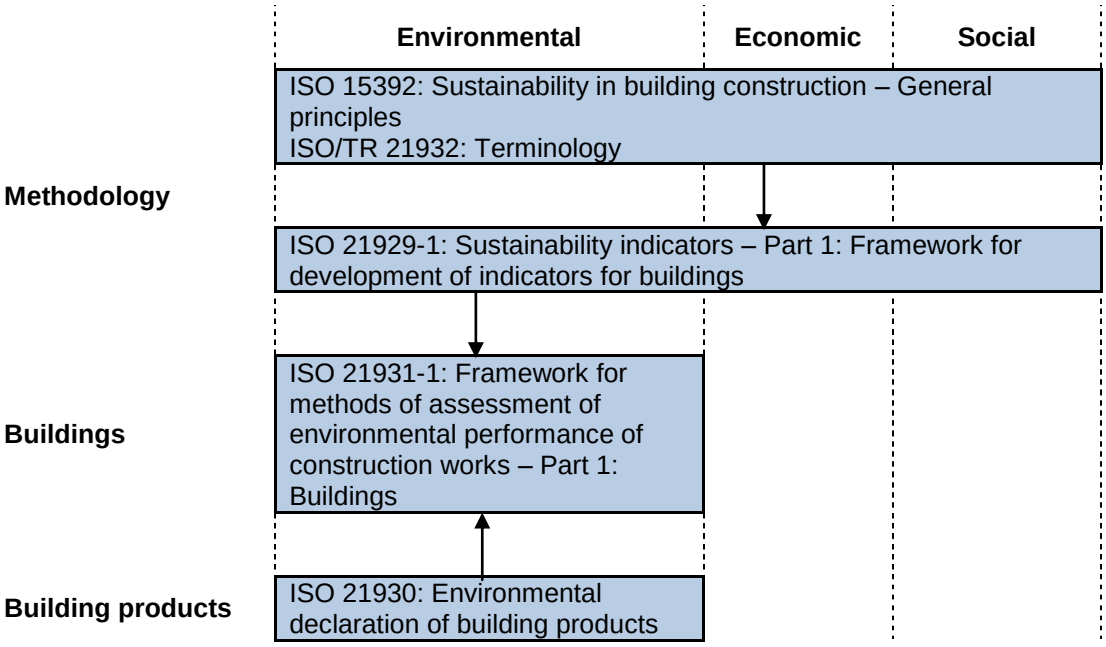


Figure 16. International Standards for Sustainability in Building Construction and Construction Works

European EPD schemes developed as a result of these international standards, incorporating similar requirements but with some differences in PCRs and EPD due to flexibility in interpretation of ISO standards. To avoid these differences becoming barriers to trade, the European Committee for Standardisation (CEN) Technical Committee 350 (TC 350) was tasked with developing standards to harmonise approaches and has produced or is developing:

- EN 15643-1, Sustainability of construction works – Sustainability assessment of buildings – Part 1: General Framework; 2010.
- EN 15643-2, Sustainability of construction works – Assessment of buildings – Part 2: Framework for the assessment of environmental performance; 2011.
- EN 15804, Sustainability of construction works – Environmental Product Declarations – Core rules for the product category of construction products; 2012.
- EN 15978, Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method; 2011.
- CEN/TR 15941, Sustainability of construction works – Environmental Product Declarations – Methodology for selection of generic data.
- EN 15942, Sustainability of construction works – Environmental Product Declarations – Communication formats: business to business; 2011.

The European standard EN 15804 (see Appendix A) which has arisen from this process sets out more detailed requirements than ISO 21930 (2007) on which it is based, and there is a current recommendation being considered by ISO that ISO 21930 should be updated to align more closely with EN 15804. A summary of areas where the two standards differ is provided in Appendix B.

In addition to these published standards, other initiatives include:

- The Joint Research Centre (JRC) published guidance for the International reference Life Cycle Data system (ILCD) – a document that covers methodology and data format with the aim of providing a platform for internationally consistent life cycle inventory (LCI) datasets. LCANZ has provided a recommendation that New Zealand adopts the ILCD format for the NZ LCI.

- The European Commission, through its 7th Framework Programme, has published draft guidance documents called the Energy Efficient Buildings Guide (EeBGuide) for construction products (EC, 2012a) and buildings (EC, 2012b), which provide practical information for developing EPD and building level assessments based on EN 15804 (CEN, 2012).

- An organisation in Australia called National Standards is in the process of developing documents with the aim of these becoming Australian standards for Type I ecolabels, EPD schemes and building design and rating tools for the construction sector. National Standards is not currently accredited by the Accreditation Board for Standards Development Organisations (ABSDO) as a Standards Development Organisation but is in the process of seeking this recognition. The documents National Standards has been developing will be available for public consultation shortly.

- The Building Products Life Cycle Inventory (BP LCI) is an Australian initiative managed by the Building Products Innovation Council (BPIC) to develop LCI data for the construction sector. The Australian Life Cycle Inventory (AusLCI) project is a broader initiative to develop cross sector LCI data. Some trade associations involved in the BP LCI project are preparing data to contribute to AusLCI.
- There are forthcoming international standards for carbon footprinting (ISO 14067) and water footprinting (ISO 14046) which are due for publication in 2013. New Zealand is participating in the development of both of these standards with support from the Ministry of Primary Industries.

A summary of how these standards and other activities relate to each other is provided in Figure 17.

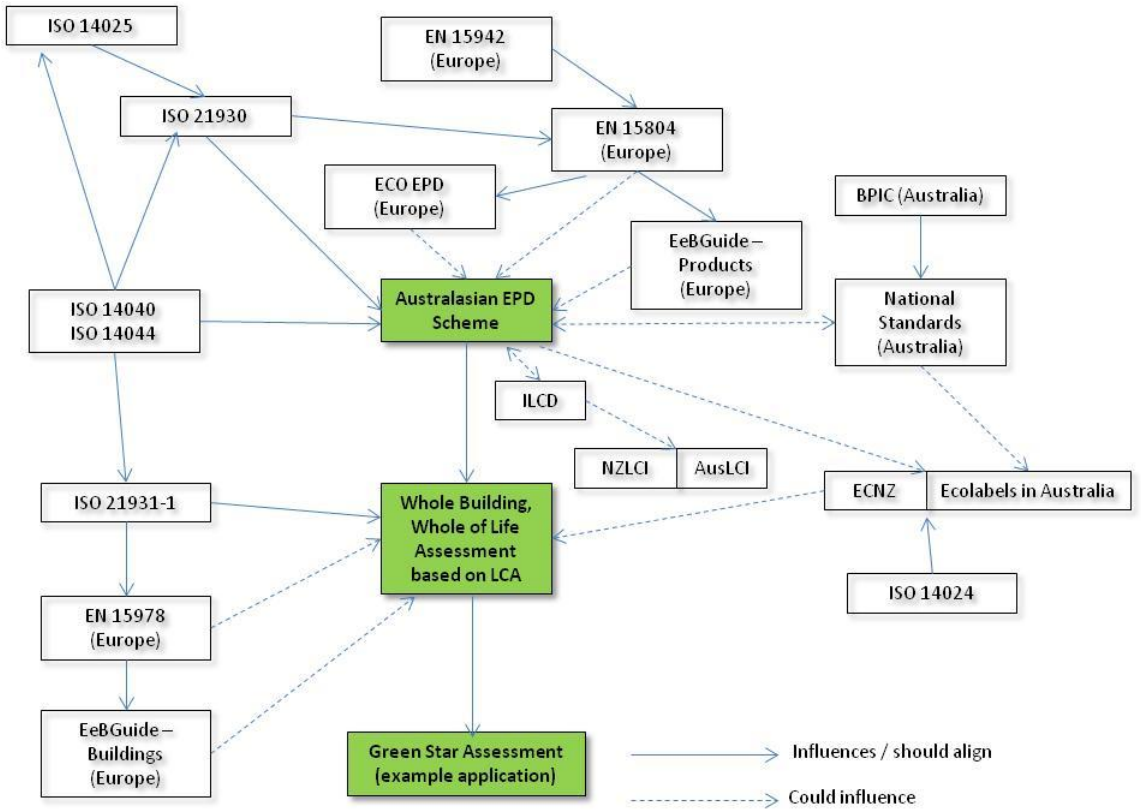


Figure 17. Summary of Standards and Initiatives and how they should or could influence an Australasian EPD Scheme and Whole Building Whole of Life Assessment

Opportunity 6: There are now international standards for assessing the environmental performance of construction products and buildings, as well as guidance and examples of schemes that have been operating internationally. The development of an internationally aligned Australasian EPD scheme together with a whole building whole of life assessment approach based on international standards provides the security sought by the sector that materials and products will be fairly assessed for environmental performance.

5.7 Opportunity 7: Building Information Modelling (BIM)

New Zealand's Construction Productivity Partnership has an objective to improve productivity in the building and construction industry by 20% by 2020, as measured by official productivity statistics produced by Statistics New Zealand. To achieve this, it has developed a research action plan which contains 14 primary drivers, one of which concerns increased use of IT and BIM (Page & Curtis; 2012). The Government is currently looking at how creation of an interoperable platform called GeoBuild can be used to streamline the consenting process, so it is likely that use of BIM will increase in New Zealand.

In a report on use of BIM for buildings with higher environmental performance, McGraw Hill Construction (2010) found that education about how BIM saves time and money in the design and construction process, and the additional ability to use BIM effectively during the operation and maintenance of a building are key factors for driving demand by building owners for use of BIM. Part of the BIM value proposition is its ability to facilitate an integrated design approach.

Tools are already emerging that facilitate various forms of environmental assessment of building designs through BIM, examples of which include Ecospecifier's LCA Design tool and the Autodesk Green Building Studio (Autodesk; 2011). With improved software integration in the future, there is the opportunity to more easily utilise BIM models by linking to data derived from LCA, EPD and other information as a basis for assessing multiple impacts of buildings across the life cycle. This also opens up the possibility for monitoring the performance of buildings after occupation, including using information on operations and maintenance, and comparing this with the original design assessment.

McGraw Hill Construction (2010) report that in the USA, 72% of BIM practitioners rarely or never link LCA to BIM despite 82% stating it is of high or medium importance, indicating a strong want and opportunity in this area. It is also interesting to note that 76% of individuals utilising BIM to deliver greener buildings believe having the facility to calculate credits (in this case, LEED, since the survey was carried out in the USA) within BIM would be of at least medium value.

Opportunity 7: Greater use of BIM in the future, driven by clients, and the integrated design approach that use of BIM can facilitate, provides further opportunities for whole building whole of life assessment. Manufacturers who develop LCAs and EPD for their products will have the quantitative data to make available in BIM in the future leading to opportunities for more rapid, cheaper assessment.

6. KEY STAKEHOLDERS

New Zealand needs to pull its environmental socks up and promote "green growth", says a group of influential business leaders Dominion Post, 11th June 2012 referencing the Pure Advantage report *New Zealand's Position in the Green Race.*

Key stakeholders needed to facilitate development of a New Zealand whole building whole of life assessment framework are set out below.

6.1 The New Zealand Construction Industry

The New Zealand construction industry has asked for a more consistent basis to evaluate materials and products. This basis is whole building whole of life assessment. Manufacturers (that are not already using LCA) can investigate what use of LCA would mean for them and begin to factor it into their forward planning. Those that are already using LCA are well positioned to develop EPD. The design community can help by informing clients about the benefits of buildings achieving higher levels of environmental performance and demanding more robust data and information about building materials and products from manufacturers, in order to help provide a clear market signal.

6.2 LCANZ (& ALCAS)

LCANZ and ALCAS have made a public announcement that they intend to establish an Australasian EPD scheme and are currently reviewing options for this. Models exist (in Europe) that link EPD scheme outputs into whole building whole of life assessment of buildings based on LCA. An EPD scheme established for Australasia should be consistent with international standards and other EPD schemes that operate to these standards.

6.3 NZGBC (& GBCA)

NZGBC consideration of how a whole building whole of life assessment framework could be utilised for evaluating environmental performance of buildings is important. Interest from the GBCA is similarly key due to GBCA's relationship with NZGBC and current considerations on recognition of LCA and EPD. There would be considerable benefits in an aligned approach to whole building whole of life assessment across the Tasman in terms of reach, scale, consistency and cost to develop.

Recognition of EPD and inclusion of LCA as part of a Green Star assessment process would provide important signals to the market, incentivising manufacturers to develop EPD for their materials and products.

6.4 BRANZ & research partners

Research will need to be undertaken to support development of a whole building whole of life assessment framework. With Building Research Levy, support from industry and funding, BRANZ and research partners such as the New Zealand Life Cycle Management Centre (NZLCM Centre) would deliver research outputs in Section 7.8.1 (subject to agreement through the BRANZ levy funding process).

6.5 Other Important Stakeholders

Central and Local Government – This Plan is of interest to Government due to the potential benefits that its implementation can deliver, notably:

- Identification of opportunities to improve resource efficiency and supply chain management, leading to potential cost savings and improved profitability for New Zealand manufacturers.
- Increased capability and understanding of requirements for building environmental assessment using a whole of life approach that aligns with other international initiatives in this area.
- The opportunity for the New Zealand construction sector to demonstrate the environmental performance of its products using robust, quantitative measures that can assist in developing exports.
- The opportunity to take a leadership role in its procurement of buildings (either leased or purchased) by requiring a more robust assessment of life cycle environmental and financial benefits in line with published procurement principles (MBIE, 2012).
- The opportunity to demonstrate and reinforce New Zealand's "clean green" image internationally.

Environmental Choice New Zealand – As New Zealand's Government owned Type I ecolabel scheme, ECNZ would have an opportunity to use sector average EPD data and information, where available, to help inform specifications for construction materials and products. This also means that products obtaining the ECNZ ecolabel would represent environmentally preferable products based on quantified impacts that are reviewed by ECNZ as being below benchmark values for the sector. This provides an alternative option for companies wanting to demonstrate environmental performance but not wanting to publicly disclose using product specific EPD.

Standards New Zealand - As New Zealand's standards development body, Standards New Zealand can provide support and advice to ensure that the development of the whole building whole of life assessment approach is in line with international standards for sustainability of construction materials and products and does not create any issues with respect to freedom of trade with other countries.

Joint Accreditation System of Australia and New Zealand (JAS-ANZ) – in a scheme where LCA based data is used to underpin whole building whole of life assessment, it is envisaged that organisations that are reviewing the underlying method and data (which would be defined by the EPD scheme set up by LCANZ and ALCAS) would require some form of accreditation to perform this function.

Consultancies and organisations offering LCA services – parts of the industry would be seeking support to navigate through the steps proposed in this Plan. There are environmental and sustainability consultancies and other organisations in New Zealand that have the tools and expertise to help manufacturers to engage in this process. LCANZ can provide information on providers of these services. BRANZ also has a role to help the industry become better informed about LCA, EPD and the benefits of whole building whole of life assessment, and can assist manufacturers to develop LCA and EPD on a commercial basis.

7. A PLAN FOR WHOLE BUILDING WHOLE OF LIFE ASSESSMENT FOR NEW ZEALAND

Business models that drive resource productivity will be just as important as those that drive labour productivity McKinsey Quarterly, June 2010.

7.1 Introduction

This section sets out activities needed to develop a whole building whole of life assessment framework for offices in New Zealand. The underlying work to achieve this will facilitate adoption for other building types, such as homes, schools and industrial premises.

Most organisations who responded to the consultation on the draft of this Plan supported the principle of a whole building whole of life assessment framework noting the importance of the details of such a framework. This Plan sets out stages of development and the underlying research that will be important in order to provide the required detail. Research will be undertaken by BRANZ and the NZLCM Centre with oversight and input from construction industry stakeholders.

There are currently parallel discussions about use of LCA in Australia, as recently demonstrated by a GBCA consultation on use of LCA in Green Star. This provides opportunities for information sharing and development of a unified approach to whole building whole of life assessment between New Zealand and Australia (which could leverage off of an Australasian EPD scheme in development).

The Plan has two phases called *Preparation* and *Development,* both of which commence in 2013. Manufacturers and/or sector bodies with little or no experience of LCA are recommended to begin with *Preparation* whilst manufacturers and/or sector bodies already knowledgeable about LCA (or who have completed the *Preparation* phase) can opt to begin with *Development* where they feel that this would benefit their business.

The two phases of the Plan are summarised in the first column of Figure 18 entitled Manufacturers/Importers. This shows two possible routes through a five stage process – Route A for trade associations/sector bodies and Route B for individual manufacturers. These routes are not exclusive meaning there are opportunities through activities and outputs at the sector body level (Route A) to be used by member companies at the individual business level (Route B).

Preparation is broken down into two stages and *Development* into three stages. Manufacturers can therefore assess and decide at which point in this five stage process they can engage with the Plan. Not all manufacturers would need to start at Stage 1. A survey carried out by BRANZ in July 2012 suggests that there are manufacturers who already consider the life cycle of their products and are using LCA tools – these manufacturers should be in a good position to start in the *Development* phase.

Preparation (Stages 1 and 2) is about gaining knowledge and information about LCA, EPD and whole building whole of life assessment, and obtaining a better understanding of data requirements and implications. The *Preparation* phase provides underlying information necessary for manufacturers to decide about proceeding to the *Development* phase (Stage 3 onwards).

A December 2015 completion date has been set for *Development.* At this point, it is envisaged that publicly available data in EPD published by manufacturers and/or in NZ LCI would be incorporated into the first version of the whole building whole of life assessment framework scheduled for finalisation around March 2016. Thus, sector bodies wanting product average data or individual manufacturers wanting product specific data incorporated into the framework would need to have EPD third party verified and published by the end of December 2015, in order to ensure incorporation in the first version of the framework.

It is envisaged that the whole building whole of life assessment framework will then be updated every two to three years, the frequency of updates to be decided and agreed during the forthcoming research process that will underpin this framework.

Aspects of this Plan are already in the process of development, such as the LCANZ/ALCAS Australasian EPD scheme (last column in Figure 18), so this suggested process is designed to build on existing activity rather than "reinvent the wheel". It is also designed to build on international experience and to align with this.

Further information about the proposed five stage process is provided in Sections 7.3 to 7.7 and information on supporting activities is in Section 7.8.

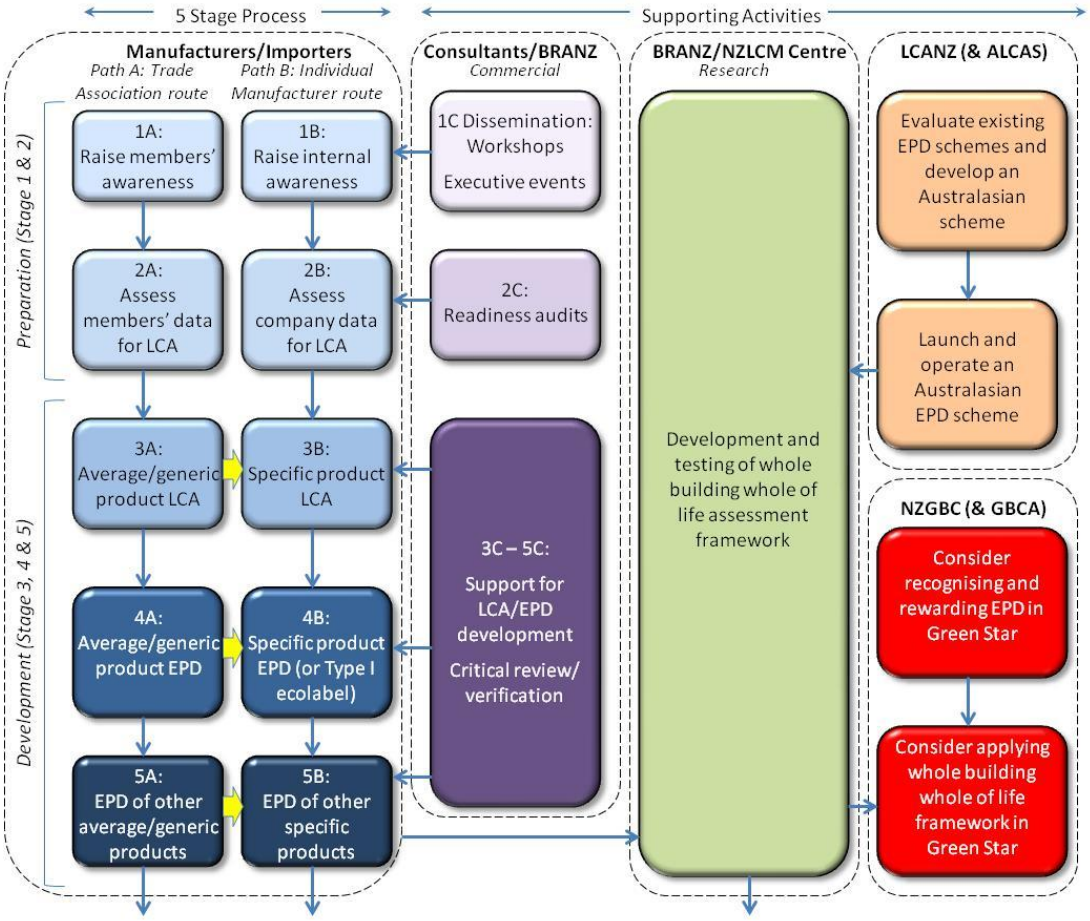


Figure 18. Proposed Approach for development of a Whole Building Whole of Life Assessment Framework for New Zealand

7.2 Costs and Funding

7.2.1 Costs to New Zealand Manufacturers

There are two main costs to manufacturers associated with this Plan - the cost of developing an LCA model for a product or products and the cost of obtaining EPD. These are discussed in more detail in the following sections.

Small or medium sized enterprises (SMEs) represent a large and important proportion of the sector, and are likely to encounter additional barriers that need to be overcome in order to engage in development of LCA and EPD. It is important that this section of the industry is not excluded. Therefore, a research area in this Plan will focus specifically on the needs of this group, developed further in Section 7.8.1.4.

7.2.1.1 Developing an LCA Model

The cost to manufacturers of developing an LCA model will vary depending on a range of factors, for example:

- Industry bodies and trade associations may choose to fund the development of a sector LCA model using data from participating member companies. This model, once developed, may then be used by individual members. The cost of developing such a model is likely to be significantly less than if individual manufacturers each funded the development of their own LCA models.
- Manufacturers with similar products (in terms of contributing materials and processes) will be able to use one LCA model to evaluate a range of their products. Therefore the cost per product will be less than for a manufacturer with very different products, groups of which may require different LCA models.
- Manufacturers who have good data, shorter supply chains and/or good supply chain relations are likely to find the process of obtaining data and developing an LCA model cheaper as much of the data that is needed will already exist or be more easily obtainable.
- Manufacturers may choose to develop their own LCAs (generally requiring licensing of an LCA software tool from a provider and training) or obtain support from external organisations with expertise in LCA. There are various environmental and sustainability consultancies and other organisations in New Zealand that can provide this support. BRANZ also intends to provide support to manufacturers as illustrated in Figure 18. The choice of whether to develop internal capability or engage external support will depend on the cost and time for training and development of an LCA model versus the costs of consultancy support. Investing in internal capability is likely to be more cost effective where manufacturers want to actively use LCA as a decision support tool to help inform company strategy on sustainability, investment decisions and research & development.
- Development of an LCA model for a product is generally a one-off cost. Once an LCA model has been developed for a product, it can be quickly and easily updated in future years, meaning the costs of updates are likely to be minimal in comparison with the initial development cost.
- The process of looking at products through an “LCA lens”, using the right data and engaging staff in the process, can lead to identification of opportunities for financial savings and improved resource efficiency and environmental management (Section 5). Demonstrating an understanding of environmental impacts of products through use of LCA can help with communication to clients, demonstrate commitment and integrity

and enhance reputation, all of which are more difficult to value but can nevertheless be significant.

This cost to develop an LCA model is normally more significant than the cost of publishing an EPD, and is highly dependent on the factors outlined above.

7.2.1.2 Publishing an EPD

The details of an Australasian EPD scheme are not currently available but it is useful to look at an example of an international EPD scheme to better understand the potential costs involved with publishing EPD.

Fees charged by an EPD scheme usually include registration (which typically reduces if more EPD are registered), the cost of third party verification of the EPD and may include an annual membership cost to be part of the scheme. Manufacturers may also want to provision for support to assist with drafting an EPD and development of evidence for the third party verification process.

Based on fees in euros cited by the International EPD System (www.environdec.com), some example costs converted into New Zealand dollars are provided below[7]. **These should not be taken as indicative of a future Australasian scheme**. The costs below exclude verification which is incurred before a draft EPD becomes final and is estimated at typically 2-3 days of work for a verifier:

- A manufacturer with less than 250 employees registering one EPD costs about NZ$3000 in the first year, and NZ$1500 each following year whilst a member of the scheme. Registration of four EPD by the same manufacturer costs around NZ$1175 per EPD in the first year and less than an equivalent of NZ$400 per EPD per following year whilst participating in the scheme.
- A manufacturer with more than 250 employees registering one EPD costs about NZ$5500 in the first year, and around NZ$3900 each following year whilst a member of the scheme. Registration of four EPD by the same manufacturer costs less than NZ$1770 per EPD in the first year and less than an equivalent of NZ$1000 per EPD in each following year of participation thereafter.

As with LCA models, the cost of developing EPD may also vary. For example if an LCA model developed at an industry organisation or trade association level is used for the publication of a sector average EPD, use of the underlying and verified LCA model and EPD template by individual members should save cost and time, in comparison with development of individual LCAs as the basis for product specific EPD.

EPD need to be updated periodically, usually every three to five years depending on the rules of the specific scheme. The cost of update should be significantly lower than the initial set up cost as the LCA model and EPD template would already exist. During an update of an EPD, it is envisaged that the following would be required:

- Updating the existing LCA model with more recent data.
- Updating the product environmental impacts in the EPD template, and any new information that needs to be added about the product.
- Verification of the new data and information (which is likely to take less time as only the new data and information should need review).

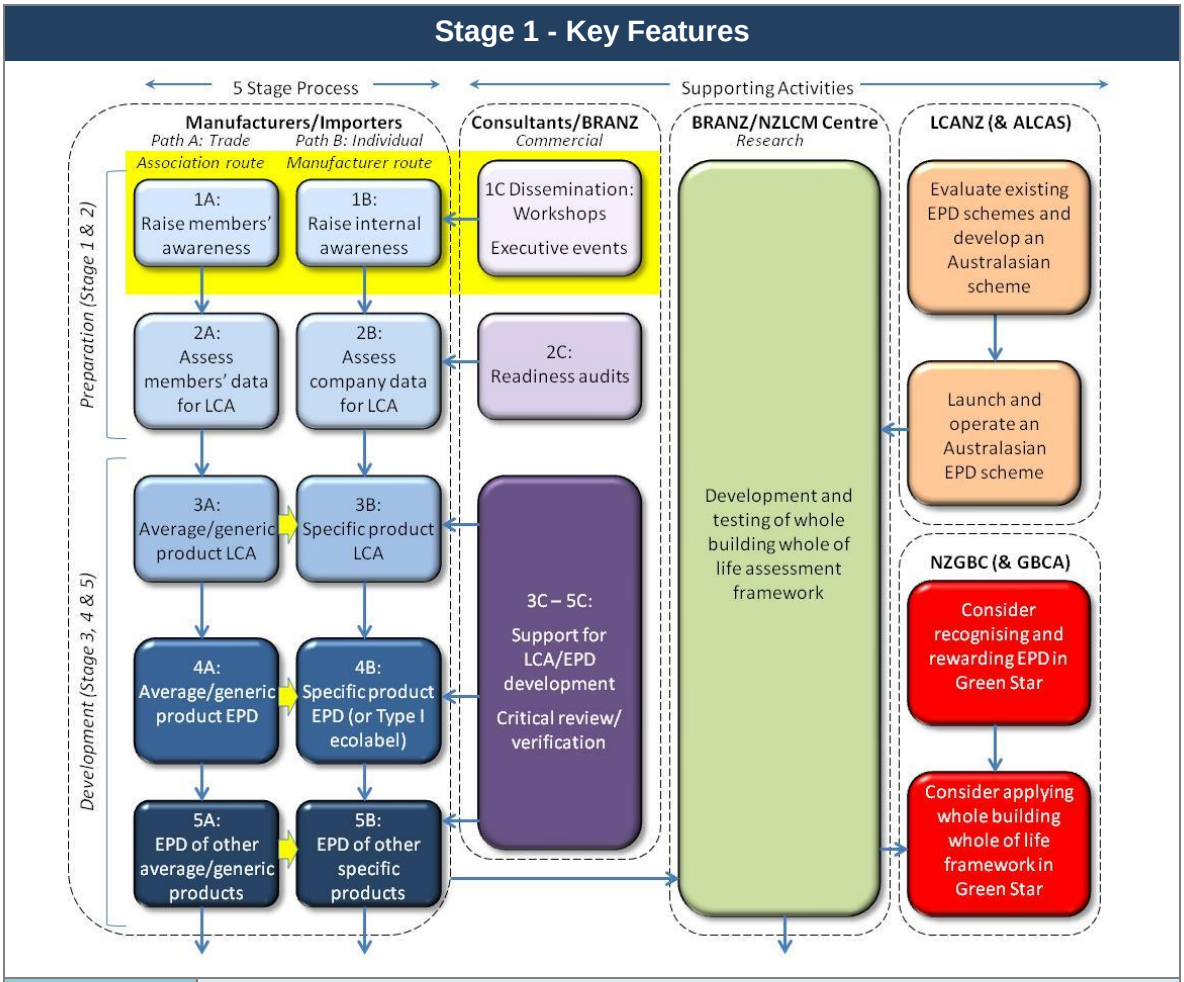
[7] Based on a euro being equivalent to NZ$1.573, the exchange rate quoted on www.ft.com on 20th September 2012.

7.2.2 Funding for Research

BRANZ has applied to the Building Research Levy to fund a three year research programme that will deliver a New Zealand whole building whole of life assessment framework. Funding includes establishment of two doctorate positions with the NZLCM Centre, whose outputs will assist achievement of the research programme aims. Information about the proposed research is set out in Section 7.8.

It is envisaged that the three year research programme will commence around April 2013. Where research aims of this programme meet potential future published aims of Government supported funding, decisions will be taken at the time these become available concerning submitting an application based on alignment.

7.3 Stage 1: Awareness Raising



Who	NZ trade associations (1A), manufacturers (1B), BRANZ/consultants (1C)
When	Preparation (2013)
Why	• To respond to NZ industry feedback that there is a lack of understanding and therefore buy-in from executive management, and training and workshops will help improve knowledge. • To help inform the NZ construction sector about the benefits of LCA, EPD as a communication tool and the "level playing field" to assessment created by a whole building whole of life approach.
Measure of success	• Executives and other key decision makers in manufacturing companies better understand the costs/benefits of a "level playing field" approach, use of LCA and publication of EPD. • Company champions better understand what is involved at a practical level.
Cost to industry	Nominal for workshops and events to cover preparation, travel and venue (if applicable).

Stage 1 is about raising awareness of the benefits of environmental profiling and whole building whole of life assessment amongst New Zealand member organisations, trade associations and manufacturers.

There are two pathways proposed for engaging in this process:

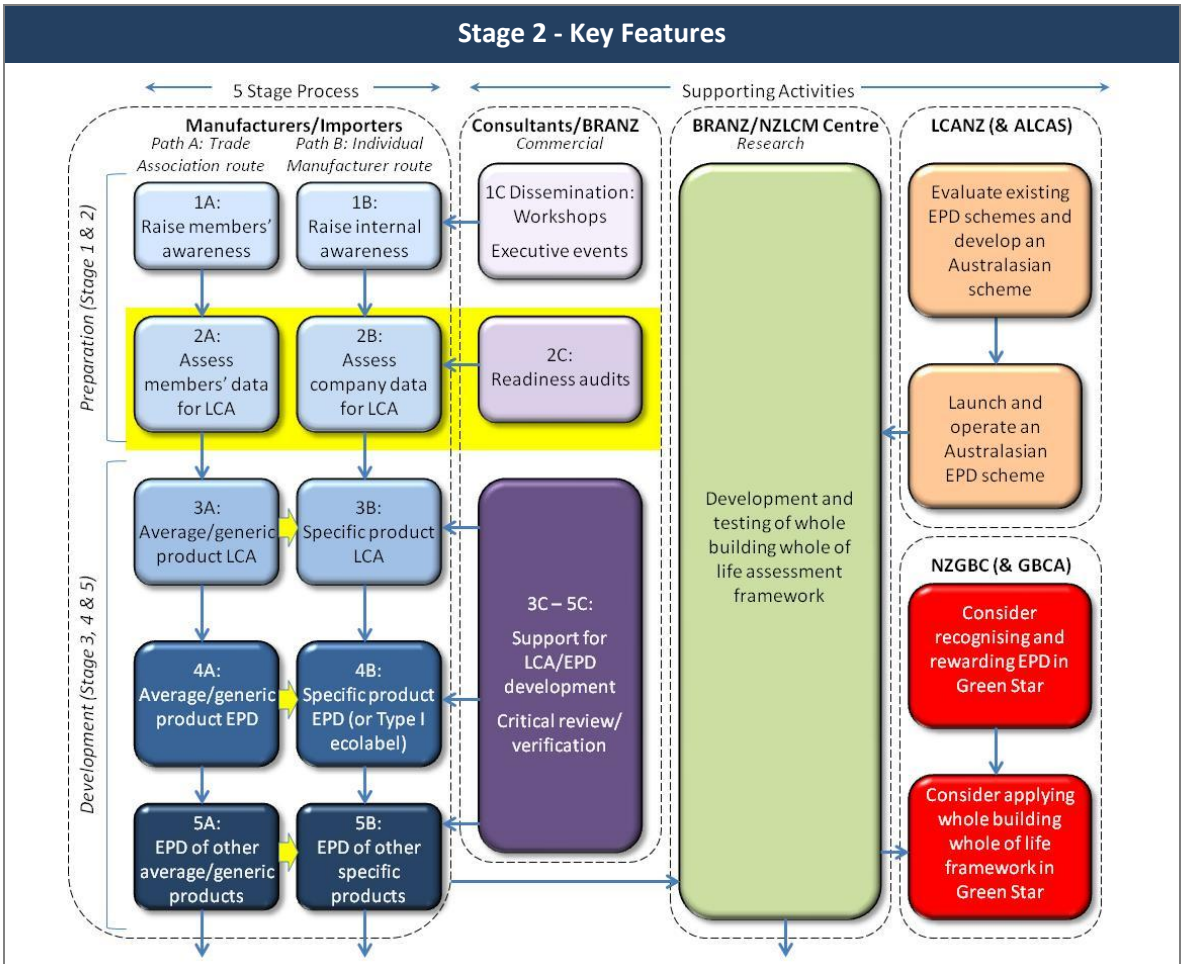
- Pathway A represents awareness raising at the trade association or industry body level.

- Pathway B represents awareness raising at the manufacturer level.

BRANZ proposes to develop and offer two types of awareness raising activities:

- *Executive Events*: These would be aimed at decision makers and would cover the business benefits of LCA, EPD and whole building whole of life environmental assessment.
- *Dissemination Workshops:* These would be aimed at company representatives who have a responsibility for environmental management, products and/or development. They may be conducted through trade associations (Pathway A) or for individual manufacturers (Pathway B). It is envisaged these would have an interactive element so would benefit from smaller group sizes and a workshop format. They will provide a practical understanding of what is involved in undertaking an LCA, publishing an EPD and how this facilitates whole building whole of life assessment, to help participants determine next steps.

7.4 Stage 2: Assess Readiness

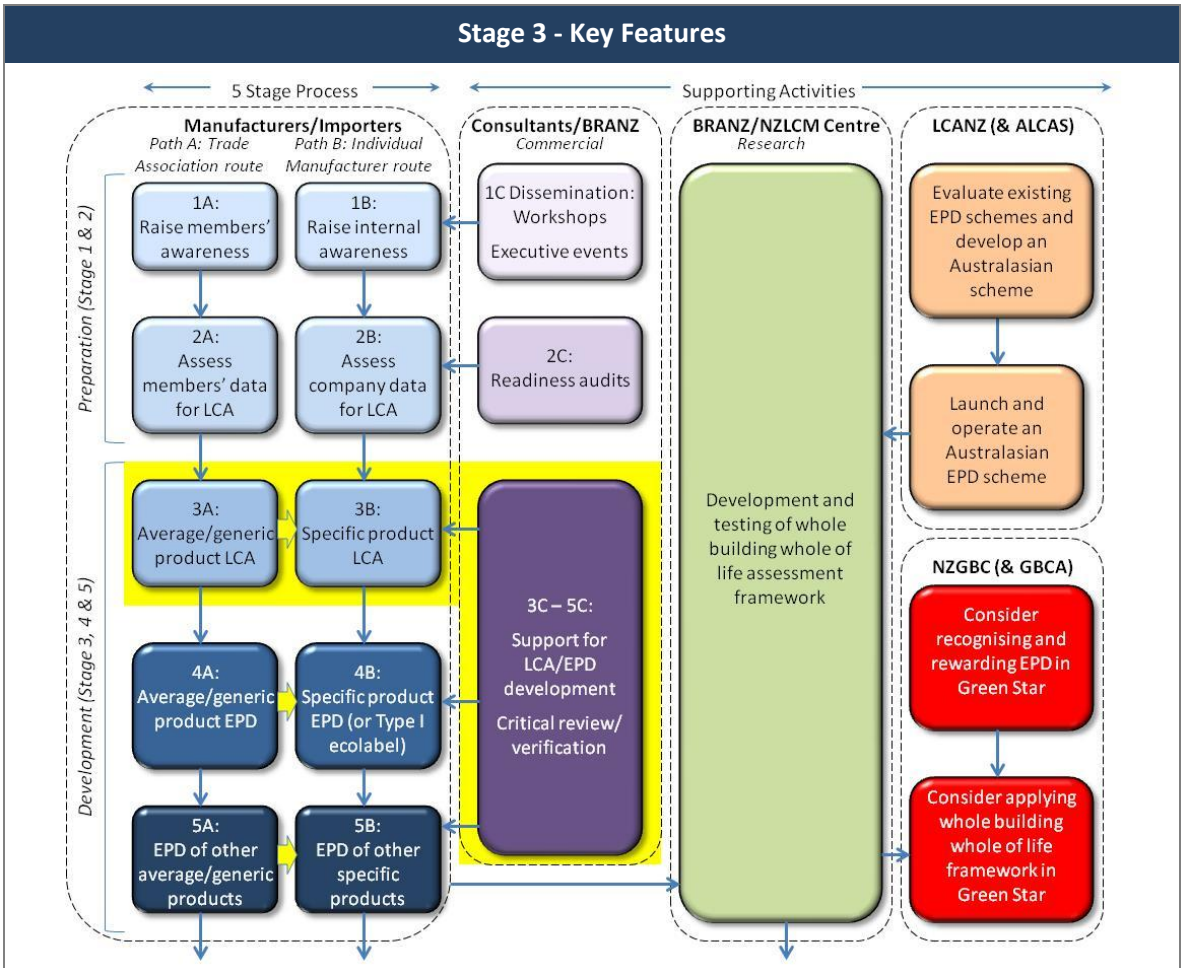


Who	NZ trade associations (2A), manufacturers (2B), BRANZ/consultants (2C)
When	Preparation (2013)
Why	To help manufacturers better understand readiness for LCA and EPD by undertaking a "readiness" audit which focuses on data and information held (scope, extent, quality, format) and suitability for LCA and EPD development.
Measure of success	Manufacturers understand how ready they are for LCA and EPD and the cost of development based on their specific situation (products, data, data quality).
Cost to industry	Nominal cost for an audit to cover time on site, review of information/data and production of a report.

BRANZ proposes to support trade associations assisting their members (Pathway A) and individual manufacturers (Pathway B) who want to better understand their level of preparedness for developing an LCA model and EPD. This support is envisaged as providing an audit and advice service that will look at what data and information are held, format, depth and data quality and assess these against the data needs of an LCA. Where gaps or issues are identified, they will be highlighted together with suggestions to address any issues found. BRANZ envisages a site visit will comprise part of the work. A short report will set out level of readiness and recommendations for next steps.

Environmental and sustainability consultancies, and other organisations with expertise in LCA, may additionally provide this service. LCANZ should be able to provide details (http://www.lcanz.org.nz/).

7.5 Stage 3: LCA Development



Who	NZ trade associations (3A), manufacturers (3B), BRANZ/consultants (3C).
When	Development (2013 – 2015)
Why	• To better understand the environmental impacts of a product or products using an LCA-based model. • To provide a basis for publication of an EPD. • To explore and assess potential benefits.
Measure of success	• LCA modelling carried out to ISO 14040, ISO 14044, ISO 21930 (and EN 15804 standards) and PCRs from an Australasian EPD scheme. • LCA model used as a tool for business planning, assessing alternatives and performance (continuous improvement).
Cost to industry	Dependent on factors set out in Section 7.2.1. Process can lead to identification of cost savings.

Stage 3 involves developing an LCA-based model of a product or products. This may be undertaken at a trade association level (Pathway A) with support and data from individual members in order to generate an average product LCA for similar products or at the manufacturer level (Pathway B) in order to generate a product specific LCA.

A generic LCA model developed at the trade association level may, in turn, be utilised as the basis for individual members to develop their own product specific LCAs.

It is recommended that LCAs carried out at this stage are undertaken in accordance with ISO 14040 (ISO, 2006b), ISO 14044 (ISO, 2006c), ISO 21930 (ISO, 2007) and preferably EN 15804 (CEN, 2012). Relevant PCRs should also be referenced and used. The ILCD (EC, 2010) and EeBGuide (EC, 2012) may also provide useful guidance.

The LCA model will provide an LCI and LCIA and help businesses to understand the environmental impacts of their products across parts or all of the life cycle, depending on the scope of the model. It will also provide the basis for results that would be published in an EPD for businesses that choose to move to Stage 4.

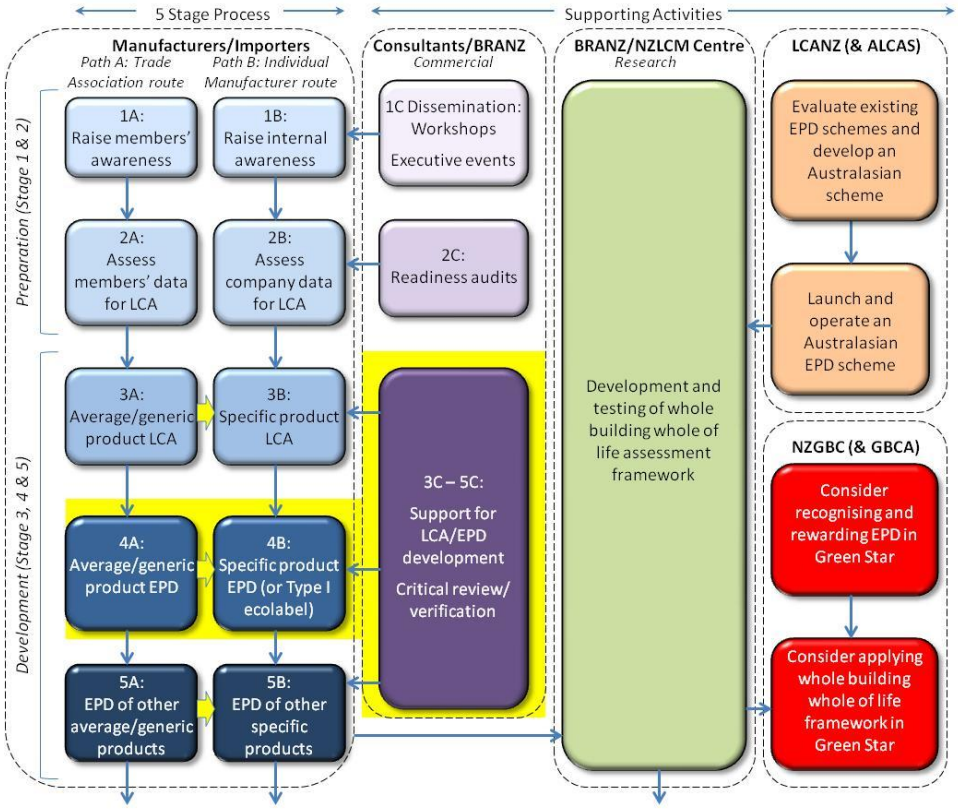
If manufacturers choose to develop their own capability, they may wish to consider purchasing a licence for a proprietary LCA software tool. Examples of commercial softwares include GaBi 5 (www.gabi-software.com/new-zealand/index/) and Simapro 7 (www.lifecycles.com.au/#!SimaPro/c1il2) both of which require training. There is additionally an open source LCA software tool called OpenLCA available at http://www.openlca.org/.

LCA is a tool and like any tool, it can be used appropriately or may be used inappropriately. It is therefore important to understand how to develop LCAs and to appreciate the implications of decisions taken during the process of undertaking an LCA. The NZLCM Centre offers courses in LCA (http://lcm.org.nz/education) which can provide this knowledge.

There are providers available that can help and support manufacturers with LCA development. BRANZ also intends to provide support on a commercial basis to help manufacturers to develop LCA (and EPD), drawing on in-house expertise in LCA, construction, materials and buildings.

Completion of this stage additionally provides trade associations and/or individual manufacturers with the option of submitting LCIs arising from developed LCA models to LCANZ for inclusion in a developing database of New Zealand materials, products and processes called NZ LCI (illustrated in Figure 10 but not in this section). Data submitted for inclusion in NZ LCI should align with the ILCD format (EC, 2010). By making LCIs available, trade associations and/or manufacturers can help ensure that good quality data that are representative of their product(s) are available for use in studies carried out by LCA practitioners.

7.6 Stage 4: Publish an EPD

<table>
<tr><th colspan="2">Stage 4 - Key Features</th></tr>
<tr><td colspan="2"> 
</td></tr>
<tr><td>Who</td><td>Trade associations (4A), manufacturers (4B), BRANZ/consultants (4C).</td></tr>
<tr><td>When</td><td>Development (2013 – 2015)</td></tr>
<tr><td>Why</td><td>• To demonstrate product integrity through public declaration of environmental performance for domestic and export markets.
• To develop benchmarks for a sector (sector average EPD).
• To provide a basis for continuous improvement.
• To input to whole building whole of life assessment providing the level playing field sought by the industry.
• Impacts from sector average EPD can be considered for incorporation into specifications of Type I ecolabel schemes (ECNZ in New Zealand).</td></tr>
<tr><td>Measure of success</td><td>• Published sector average and product specific EPD on the Australasian EPD scheme website.
• Manufacturers have the option of demonstrating a product's impacts are better than sector average impacts by opting for a Type I ecolabel (featuring sector average impacts) as an alternative route.
• Manufacturers have a sound, internationally recognised platform for reporting environmental performance of products, demonstrating benefits over competitor products and yielding opportunities for improved sales.
• Basis for more robust, transparent information/data available to designers.</td></tr>
<tr><td>Cost to industry</td><td>Cost varies and will be dependent on fee structure of Australasian EPD scheme. See Section 7.2.1.</td></tr>
</table>

LCA-based models developed in Stage 3 provide an important basis for EPD development. EPD may be developed to convey sector or product average information and data at the trade association level (Pathway A) or product specific information and data at the manufacturer level (Pathway B).

There may also be opportunities for sector average EPD templates (and the underlying LCA models behind them) to provide the basis for adaptation for development of product specific EPD by individual member companies.

Where a sector average EPD has already been developed, and impacts reported in it have been incorporated into a specification of a Type I ecolabel scheme, manufacturers on Pathway B could have the choice of submitting their product specific data, LCA model and information for review by a Type I ecolabel provider to confirm better environmental performance than the sector average (in addition to other non-LCA criteria set in the specification). This provides a route for recognition of better environmental performance without requiring publication of a product specific EPD where a manufacturer would prefer not to do this.

If a manufacturer chooses this route, it is envisaged that data on the impacts of the product would be submitted by the Type I ecolabel scheme for inclusion in the whole building whole of life assessment, so they are included in the calculation of building impacts but would not be individually reported or published.

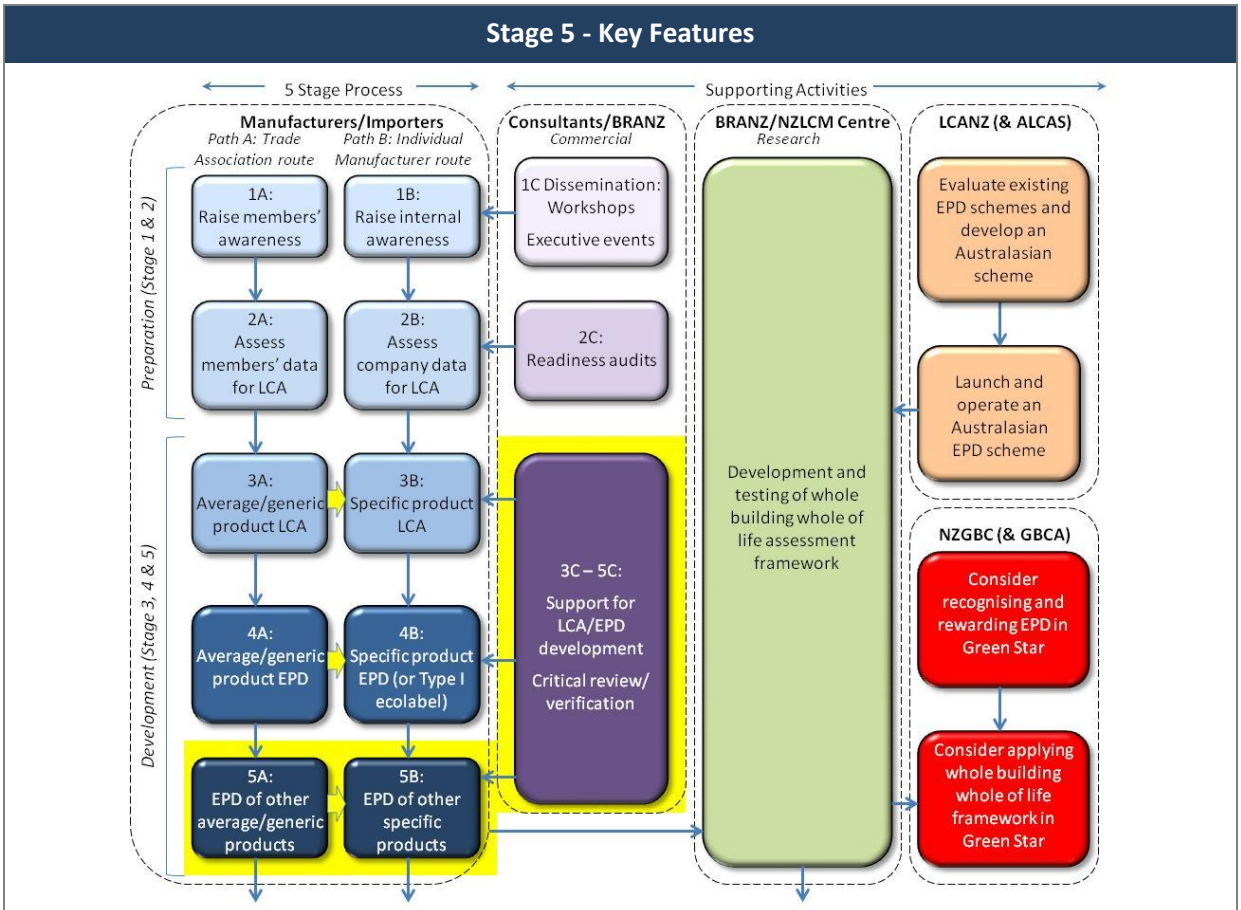
If a manufacturer has an end goal to publish an EPD, then Stages 3 and 4 can be undertaken as one project. LCA models underpinning average or generic product EPD developed at the trade association level may be used by individual member organisations to develop specific EPD for their own products that contribute to the average.

Trade associations and/or manufacturers may additionally choose to submit LCI for inclusion in the developing NZ LCI database of New Zealand materials and processes being overseen by LCANZ (if not already submitted at Stage 3). Figure 10 illustrates this option (which is not illustrated in this section). Data submitted for inclusion in the NZ LCI should align with the ILCD format (EC, 2010).

Consultancies that provide LCA services will also be able to support manufacturers and trade associations with EPD development. BRANZ proposes to assist manufacturers with EPD development at both an individual company and trade association level. This new commercial service would deliver a BRANZ EPD in accordance with the Australasian EPD scheme rules. It is envisaged that this would be an additional service to BRANZ Product Appraisals.

With BRANZ's expertise in LCA, materials, construction and buildings, BRANZ also envisages providing an EPD verification service, subject to EPD scheme rules. This would include review of draft EPD and supporting LCA models to ensure alignment with Australasian EPD scheme requirements and PCRs.

7.7 Stage 5: Other Product EPD



Who	Trade associations (5A), manufacturers (5B), BRANZ/consultants (5C).
When	Development (2013 – 2015) and onwards
Why	• To demonstrate product integrity through public declaration of environmental performance for domestic and export markets. • To develop benchmarks for a sector (sector average EPD). • To provide a basis for continuous improvement. • To input to whole building whole of life assessment providing the level playing field sought by the industry. • Impacts from sector average EPD can be considered for incorporation into specifications of Type I ecolabel schemes such as ECNZ.
Measure of success	• Published sector average and product specific EPD on the Australasian EPD scheme website. • Manufacturers have the option of demonstrating a product's impacts are better than sector average impacts, and can opt for a Type I ecolabel (such as ECNZ) as an alternative to publishing a product specific EPD. • Manufacturers have a sound, internationally recognised platform for reporting environmental performance of products, demonstrating benefits over competitor products and yielding opportunities for improved sales. • Basis for more robust, transparent information/data available to designers.
Cost to industry	See Section 7.2.1. Reduced cost per EPD when more are registered.

Having gone through the process of developing an LCA and EPD, trade associations (working with their members) on Pathway A or individual manufacturers on Pathway B can choose to use/adapt an existing LCA model to consider other similar products or develop LCAs and EPD for other products where this is seen as beneficial to the business.

Where manufacturers register multiple EPD onto an EPD scheme, the cost per EPD is usually less.

7.8 Supporting Activities

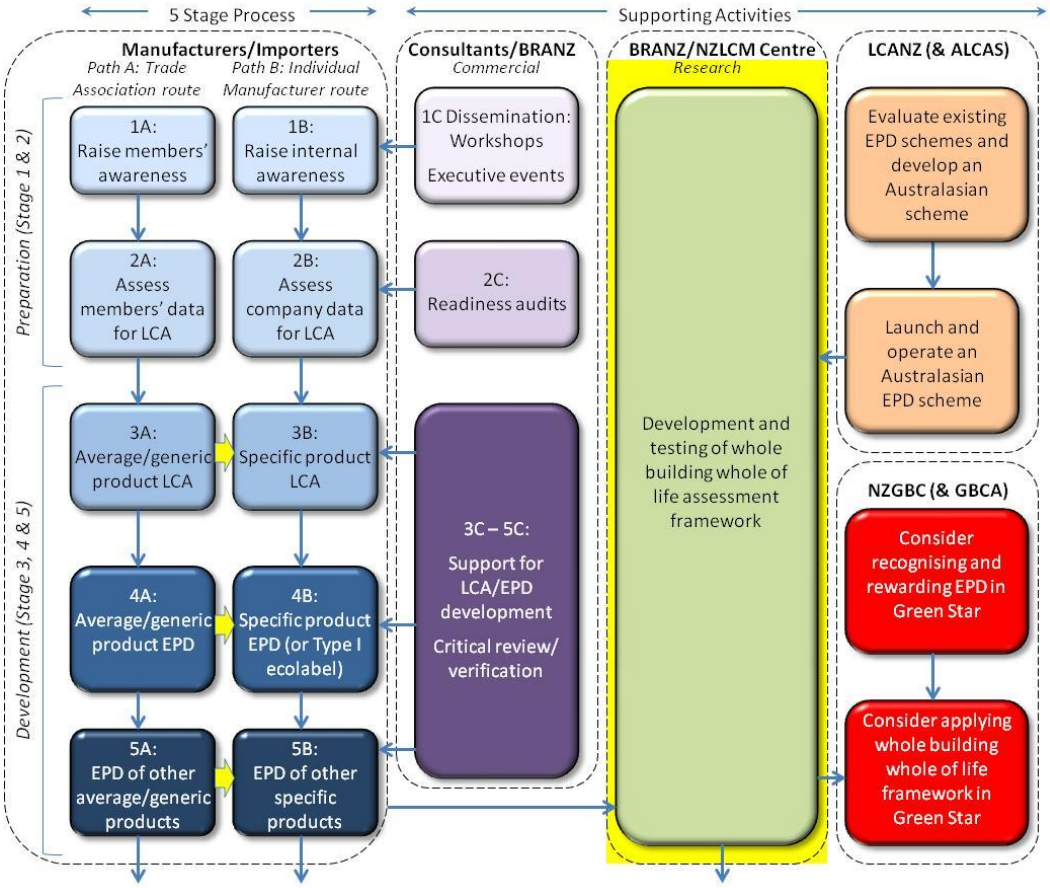
Three supporting activities will assist the establishment of whole building whole of life assessment in New Zealand:

- Research required to develop the supporting framework.
- Establishment of an Australasian EPD scheme that is consistent with international schemes and standards.
- Adoption in tools and schemes that evaluate building environmental performance (such as Green Star).

Further information on these is provided in the following sections.

7.8.1 Research to support Whole Building Whole of Life Assessment

Supporting Activity: Research



Who	BRANZ, NZLCM Centre, industry stakeholders
When	2013 – 2016
Why	• To provide a consistent basis for evaluation of buildings in terms of their life cycle environmental impacts. • To ensure that materials and products, and the contribution they make to the performance of buildings across the life cycle, are fairly represented. • To provide a basis for collection of data to help inform the design process.
Measure of success	• Publication of a whole building whole of life assessment framework for use by the NZ construction industry and suppliers to the industry, such as design tool and rating tool providers. • Delivery of research to address questions in Figure 19. • Participation by the industry through a Programme Committee to oversee the project, and working groups established where necessary.
Cost to industry	• Participation by individuals on the Programme Committee and, where necessary, working groups. • Input of information, experience and data.

The research programme required to support development of a whole building whole of life assessment framework for offices will take three years, commencing April 2013, with delivery of the framework around March 2016.

A review of international building environmental rating tools (Dowdell, 2012) and discussion with the industry has highlighted the following areas for research (Figure 19).

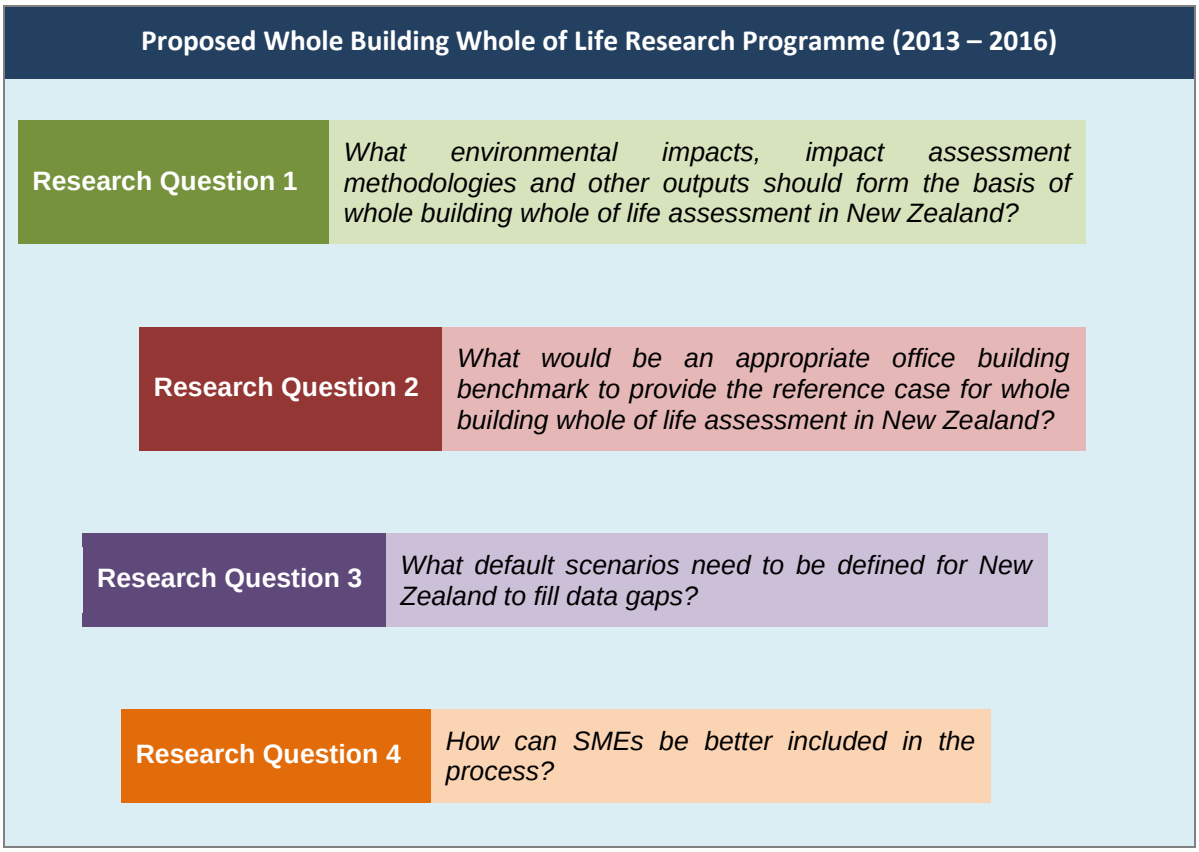


Figure 19. Summary of a Proposed Research Programme to deliver a Whole Building Whole of Life Assessment Framework for New Zealand

BRANZ proposes that a Programme Committee is established to oversee the research, featuring representation from nominated representatives of interested stakeholder groups within New Zealand. It is envisaged that the Programme Committee would consist of industry representatives who can provide technical and other input to the research, support and help to achieve its aims. Current members of the Industry Advisory Group will be invited to participate, and other interested stakeholders can participate (several organisations providing comments to the draft version of this Plan indicated an interest to participate). Progress and findings would be reported regularly to this Committee providing the opportunity for questions, review and comment as the research progresses. Some meetings may be used to discuss specific themes or issues, in order to gain perspectives and collective experience from different parts of the industry to inform a way forward. It is envisaged that there would be two Programme Committee meetings a year, but this may vary depending on the stage of the research.

Programme Committee members will have access to draft reports for comment and will be kept informed of progress on the project between meetings.

Smaller working groups may additionally be established, where necessary, in order to input to and help deliver specific research objectives that arise during the programme.

There is an opportunity for the GBCA (in addition to NZGBC) to review and comment on the proposed research, with the view that the learnings and outputs from the research can be evaluated from an Australian perspective, to explore and facilitate development of an aligned approach between New Zealand and Australia.

The framework that results from the research will be available for use by manufacturers, architects, design and BIM tool providers and other industry professionals.

7.8.1.1 Research Question 1: What environmental impacts, impact assessment methodologies and other outputs should form the basis of whole building whole of life assessment in New Zealand?

Research Question 1 – Key Features	
Output	A report setting out environmental impacts, impact assessment methodologies and other outputs that will underpin a New Zealand whole building whole of life assessment approach.
Envisaged Process	1. Set out impacts, impact methodologies and other outputs referenced in other sources (examples in this section). 2. Discuss their relevance and appropriateness for use in a whole building whole of life assessment, using an interested stakeholder group (featuring representation from manufacturers, design, other industry stakeholders, academia and LCANZ (for EPD scheme)). 3. Develop a draft list of potential impacts, impact methodologies and other outputs. 4. Publish on BRANZ website for comment from wider group of stakeholders. 5. Consider comments received and publish final list.

An output of LCA is the calculation of potential environmental impacts of materials and products across all or part of the life cycle. This is called Life Cycle Impact Assessment (LCIA). Other reported outputs may arise from the LCI such as waste production or water use.

International building environmental rating tools differ with respect to the number of impacts and other outputs used in their whole building whole of life assessment. The following list provides examples of environmental impacts that may be calculated, with different international building environmental rating tools using more or less of these (Dowdell, 2012):

- *Emissions*: global warming, stratospheric ozone depletion, acidification, photochemical oxidant formation, eutrophication.
- *Resources*: depletion of non-renewable energy resources, depletion of mineral resources, water extraction, waste (total/hazardous), depletion of biotic resources, land use, primary energy (renewable/non-renewable).
- *Toxicity*: human toxicity, ecotoxicity to water (freshwater/marine), ecotoxicity to land, radioactivity.

Ideally, potential impacts calculated at a building level should be reported in the EPD of materials and products supporting the assessment, so that the data can be directly used.

There are existing sources of information to draw on for this research including:

- McLaren (2006) developed an overview of environmental issues in New Zealand and LCANZ has developed summaries of a range of environmental impacts.
- BPIC (2010) defined environmental impacts of importance to Australia, many of which are included in the above list.
- ISO 14025 (ISO; 2006a) sets out suggested impact categories (and other metrics) that should be included in an EPD. The list is not exclusive and other impacts may be added. ISO 21929-1 (ISO, 2011b) lists aspects of a building that have an impact and core indicators for consideration at a building level assessment (also included in ISO 21931-1 (ISO, 2010)).
- European standards EN 15942 (CEN, 2011a) and EN 15804 (CEN, 2012) set out minimum requirements for reporting on potential environmental impacts and other outputs in EPD of construction products. EN 15978 (CEN, 2011b) requires these same metrics to be used to calculate the environmental performance of buildings.
- Other sources provide further international examples, including the ILCD and EeBGuide (EC; 2012a, b).

7.8.1.2 Research Question 2: What would be an appropriate office building benchmark to provide the reference case for whole building whole of life assessment in New Zealand?

Research Question 2 - Key Features	
Output	A whole life office building benchmark or benchmarks, expressed as outputs from Research Question 1, on an "impact/area/year" basis.
Envisaged Process	1. Assemble a team with architecture, design, construction management, quantity surveying, materials and LCA experience. 2. Define office building characteristics and building typologies that meet these characteristics. 3. Develop an LCA model of the building(s) including: a. Materials extraction and manufacture of products. b. Transport. c. Construction and assembly. d. Operation, including use of energy and water, maintenance and replacement of materials and products, deconstruction and end of life. 4. Undertake sensitivity analysis and scenario testing to understand impact of alternatives on outputs eg. number of storeys, orientation, presence of underground parking, use of HVAC, climate zone. 5. Define benchmark values (or ranges), and key variables that impact on these values, for use in a whole building whole of life assessment.

BRANZ recommends that initial focus is on office developments due to the strong reported connection between greener office buildings, financial benefits and corporate sustainability (Section 5.5).

Based on a review of international rating tools (Dowdell, 2012) and other considerations, the following building elements are recommended for inclusion:

- *Structure & Enclosure*: sub-structure / foundations, frame, external walls (structural/non-structural), internal walls (structural), roof, windows and doors.

- *Non-structural*: upper floors, internal walls (non-structural), ceilings, wall and floor finishes, HVAC systems, electrical provision (cables, lighting), water and wastewater provision (on-site collection, distribution and use).

Using definitions based on Rawlinsons (2011), Table 3 summarises the proportion of office developments (refurbishments and new) that have undergone a Green Star assessment, based on data provided by NZGBC. It shows that more than three-quarters of assessed offices were between 3 and 15 storeys, had lifts and may or may not include HVAC. The research would need to consider this range of office types in order to understand how variations affect reference impact levels.

Table 3. Summary of Green Star Assessments by Office Type

Office	Definition	% of Office Buildings (based on number)
Low rise (up to 2)	Low rise office, basic services, up to 2 storeys, excluding lifts.	15
Low rise (3 – 5)	Low rise office, basic services, 3 to 5 storeys, including lifts.	30
High rise (6 – 15)	High rise office, full services (including HVAC, lifts and sprinklers), 6 to 15 storeys.	46
High rise (more than 15)	High rise office, full services (including HVAC, lifts and sprinklers), more than 15 storeys.	9

It is envisaged that this research would draw on the following sources:

- Example office building designs meeting New Zealand Building Code requirements.
- Bills of materials.
- Thermal performance simulations for office buildings, including consideration of how these vary with climate zone and building orientation. Water use would also be considered.
- Information about maintenance and replacement schedules using BRANZ/industry knowledge of durability of materials and building elements, and their end of life.
- Information, data, guidance, standards and reports from New Zealand and overseas, that can inform the development and setting of benchmarks.
- Data from LCA databases, where New Zealand specific data are not available.

An office lifetime will need to be established for New Zealand. Reviewed international building environmental rating tools typically use 50 or 60 years.

The work will seek to understand whether there is a need to define benchmarks for different types of office e.g. low rise and high rise or when expressed on an impact/area/year basis, whether they are sufficiently similar that fewer benchmarks will be needed. Furthermore, the work will determine what variables significantly affect benchmark values e.g. climate zone, orientation, number of storeys, underground parking, HVAC, through use of scenario testing and sensitivity analysis. This is to ensure that the reference building is relevant and provides a suitable benchmark for comparison.

The underlying benchmark office building model will use data from EPD of local products where available. Other sources of data will be investigated to fill data gaps including use of commercial databases. It is anticipated that as more New Zealand specific EPD (or ISO 21930 compliant LCA) become available, use of commercial databases will reduce with time.

The model will also feature a process for reflecting data quality used in the assessment so this can be tracked with future updates.

It is envisaged that supporting products data would need to be updated periodically as more EPD become available. This should not be time intensive, costly or difficult.

Establishment of an office building benchmark would be usable by architects and designers as a basis for comparison of designs. Further work may be needed to normalise and weight impacts to provide an output that is meaningful for architects and designers, which is not included in this research. This may be carried out in design tools in order to produce outputs that are easier to use. The outputs of this research would provide a sound basis for adaptation, incorporation or development of tools in the market to specifically address designer needs.

7.8.1.3 Research Question 3: What default scenarios need to be defined for New Zealand to fill data gaps?

Research Question 3 - Key Features	
Output	Default scenarios to support whole building whole of life assessment.
Envisaged Process	1. Identify what default scenarios need definition in the life cycle, for example: a. Transport within New Zealand – modes and distances. b. Construction and installation – practices and wastes. c. Maintenance - practices. d. Replacement of materials and products to maintain functional performance – frequency of replacement, all or part of a building element. e. Deconstruction – practices and wastes. f. End of life – transport and fate. 2. Review standards and guidance to inform scenario setting. 3. Investigate basis for default scenarios, with supporting assumptions and information. 4. Test with sensitivity analysis. 5. Report on findings and provide default values.

Default scenarios are based on informed assumptions about standard New Zealand practices and technologies in order to provide values or information for use where project specific data are not available at the time of an assessment. For example, if undertaking an assessment during early design, it is unlikely that the source of materials will be known. In this case, default scenarios for transport, which apply a distance and mode of transport, may be used where project specific information is unavailable.

It is envisaged that default scenarios will be used to fill gaps in data or information and will be informed by reference data, research, guidance, standards, codes of practice and legal limits, in addition to input, knowledge and experience of industry professionals.

For example, the New Zealand Building Code has a mandatory requirement for durability of construction products and materials. Clause B2 (DBH; 1998) defines this further as follows:

Section B2.3.1. Clause B2 Durability of the New Zealand Building Code

Building elements must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the *specified intended life* of the *building*, if stated, or:

(a) The life of the building, being not less than 50 years, if:

  (i) Those *building elements* (including floors, walls, and fixings) provide structural stability to the building, or

  (ii) Those *building elements* are difficult to access or replace, or

  (iii) Failure of those *building elements* to comply with the *building code* would go undetected during both normal use and maintenance of the *building*.

(b) 15 years if:

  (i) Those *building elements* (including the *building* envelope, exposed plumbing in the subfloor space, and in-built chimneys and flues) are moderately difficult to access or replace, or

  (ii) Failure of those *building* elements to comply with the *building code* would go undetected during normal use of the *building*, but would be easily detected during normal maintenance.

(c) 5 years if:

  (i) The *building elements* (including services, linings, renewable protective coatings, and *fixtures*) are easy to access and replace, and

  (ii) Failure of those *building elements* to comply with the *building code* would be easily detected during normal use of the *building*.

Individual *building elements* which are components of a *building* system and are difficult to access or replace must either:

(a) All have the same durability, or

(b) Be installed in a manner that permits the replacement of *building elements* of lesser durability without removing *building elements* that have greater durability and are not specifically designed for removal and replacement.

Acceptable solutions that meet durability requirements are provided within the New Zealand Building Code (such as NZS3101 for concrete and NZS3604 for timber) or products can undergo independent testing and assessment, such as BRANZ Product Appraisals to demonstrate that Building Code requirements have been met. Both of these are geared to meeting New Zealand Building Code requirements.

Default scenarios for expected lifetime of constructions making up different building elements will require definition and could be based on the New Zealand Building Code. Based on this, a building element defined as having an expected 15 year life will be expected to begin to deteriorate in terms of meeting a level of desired performance after this time. Therefore, and to avoid this, the element (or parts of it) would need replacing at appropriate intervals during the life of a building, incurring the environmental impact of production, transport and installation of the new element (or parts), and transport and disposal of the replaced element

(or parts) at these times. The exact basis for these scenarios would be defined as part of the research.

Similarly, maintenance requirements will need definition. Section 2.5 of Clause E2 of the New Zealand Building Code (DBH, 2011) requires that maintenance is carried out to cladding systems to achieve durability requirements and notes that the extent and nature of the maintenance that is needed is dependent on the type of cladding or components used, their position on a building, the geographical location of the building and its specific site conditions.

Defining the maintenance requirements for different forms of construction, and the expected lifetimes for these constructions, provides an opportunity for manufacturers to design for more durable or lower maintenance products, which could then be potentially submitted for independent testing and opinion. Greater durability and/or lower maintenance requirements should provide lower environmental impacts across the life of a building in comparison with products that are not as durable and/or require more maintenance. Focus would be on building elements with a minimum 15 year and 5 year performance requirement.

Default scenarios will be tested with sensitivity analysis where ranges of data are found. Alternative scenarios will be assessed where there is ambiguity of information to understand significance. Where environmental impacts associated with default scenarios are potentially significant, then key variables will be highlighted to guide selection of project specific criteria.

7.8.1.4 Research Question 4: How can SMEs be better included in the process?

Research Question 4 - Key Features	
Output	Processes and guidance to help SMEs to develop LCAs of their products.
Envisaged Process	1. Identify SMEs in the NZ construction sector, their activities, level of readiness and needs. 2. Review templates, tools and guidance available internationally to help SMEs engage in LCA. 3. Identify options to assist NZ SMEs and review with SME stakeholders. 4. Develop processes and guidance to help SMEs, and test with case studies.

Around 42% of manufacturing firms (including those that manufacture construction products) in New Zealand have 49 employees or less and about three in every four construction sector companies have 49 employees or less (Figure 20), based on figures for 2010. SMEs therefore make an important contribution to the sector in New Zealand.

This research would focus on SMEs and seek to understand who they are, their roles within the sector and their attitudes and readiness for LCA and EPD. The work will capture what templates, tools and guidance have been produced either internationally for SMEs or for other sectors within New Zealand and assess applicability and usefulness. Based on these findings, processes and/or guidance will be developed with the aim of obtaining better engagement from SMEs and it is envisaged that case studies will be generated.

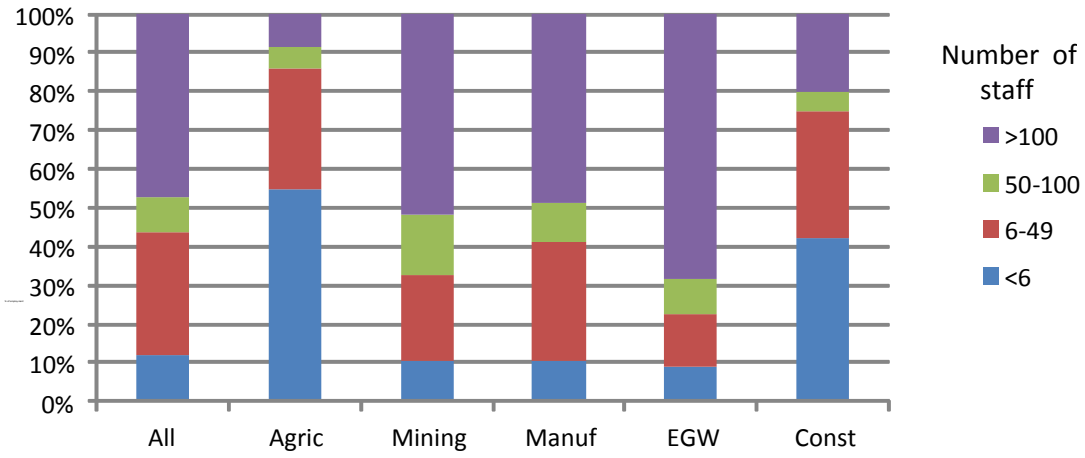
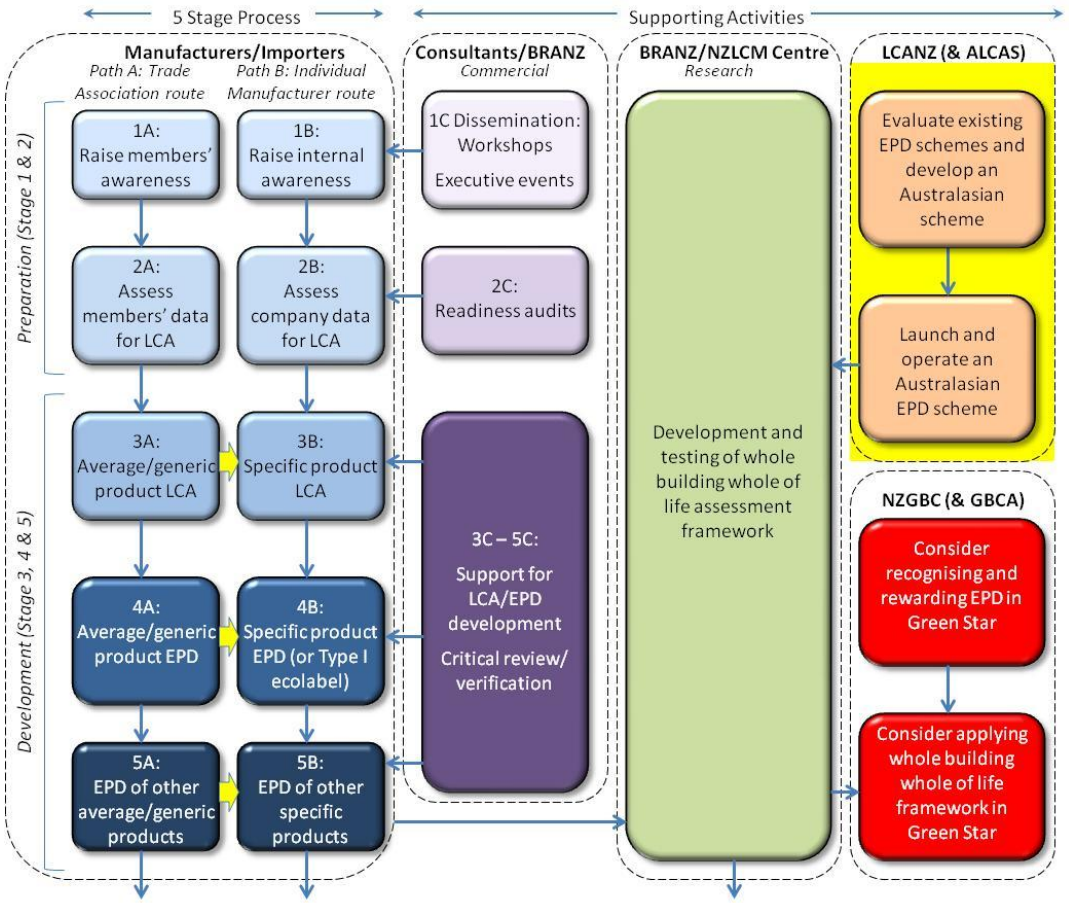


Figure 20. Comparison of Manufacturing, Construction and Other Sector Firms by Number of Employees (from Page, 2011)

7.8.2 Establishment of an Australasian EPD Scheme

Supporting Activity: Australasian EPD Scheme



Who	LCANZ / ALCAS
When	Anticipated 2013 launch.
Why	• To provide a local resource and hub for New Zealand and Australian manufacturers that want to develop EPD. • To have a scheme aligned with international schemes and standards. • To ensure that it is locally relevant. • To provide a mechanism and format for recognition of the environmental performance of New Zealand and Australian made products domestically and overseas.
Measure of success	• EPD scheme in operation during 2013. • Mutual recognition and alignment with other EPD schemes. • EPD published on the scheme by New Zealand and Australian manufacturers.
Cost to industry	There will be a cost to register and for verification of draft EPD. These are yet to be established. Example costs for an international scheme are provided in Section 7.2.1.2.

LCANZ and ALCAS are in the process of considering potential options for an Australasian EPD scheme by assessing examples of schemes that currently operate internationally. Basing an Australasian scheme on an existing scheme has the advantage that it should not "reinvent the wheel", should be aligned and consistent with international developments, should have access to existing PCRs (for adaptation to Australasian conditions, where necessary) and can use existing governance structures and processes. In this way, PCRs for EPD developed under an Australasian EPD scheme should be better aligned with PCRs used internationally.

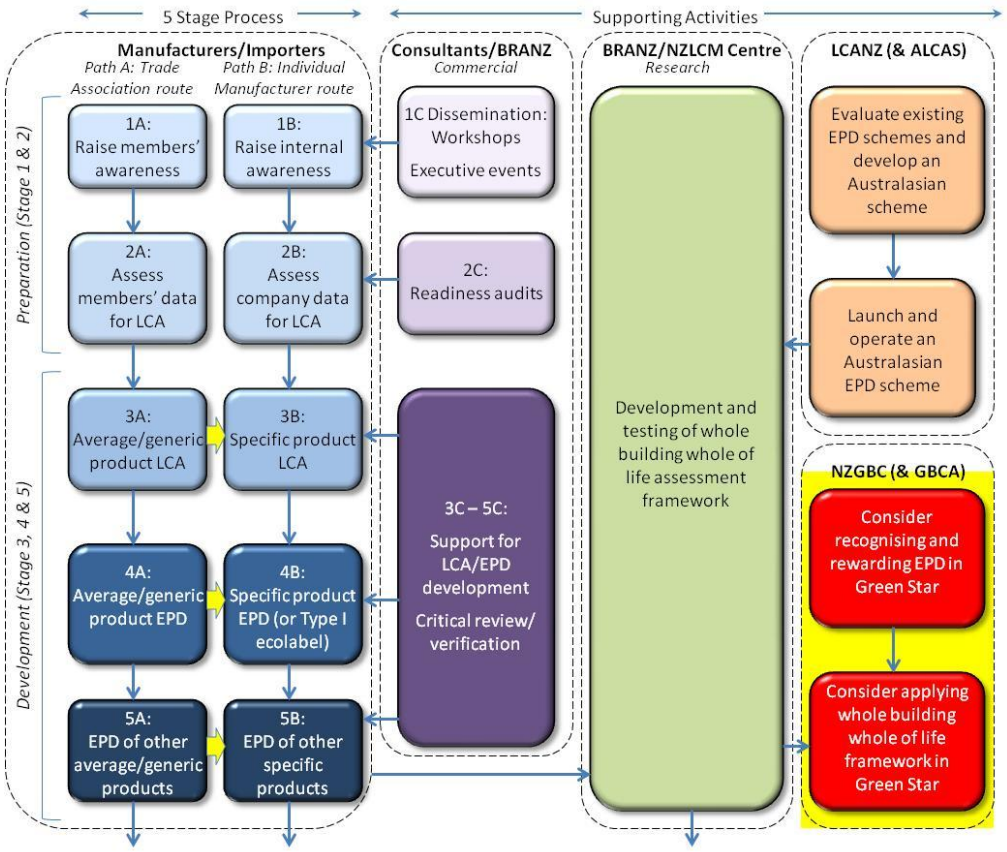
It is envisaged that LCANZ and ALCAS would have joint responsibility for the scheme, and would jointly operate it either directly or potentially through assigned representatives. The aim is to have a scheme in place during 2013.

The scheme will provide a process for publication of EPD including:

- Overarching rules and process for development of EPD and PCRs.
- Ensuring PCRs are developed that are aligned with international PCRs (where they exist) but are locally relevant, based on input from interested stakeholders within the industry and LCA practitioners.
- Development of new PCRs including consultation with interested parties within the industry and LCA practitioners.
- Review of new PCRs and sign off by an expert panel featuring representation by the industry and LCA community.
- Independent review of draft EPD to ensure they have been developed in accordance with relevant PCRs and international standards.
- Publication of PCRs and EPD on a website.
- Alignment with international standards and other EPD schemes (such as ECO).

7.8.3 Adoption in Tools/Schemes that evaluate Building Environmental Performance

Supporting Activity: Framework in Rating Tools and Schemes eg. Green Star



Who	NZGBC / GBCA
When	For consideration throughout research process
Why	• Recognition and incorporation into Green Star provides an important driver. • Assessment process incorporates more materials and evaluates how they contribute to building environmental performance. • Assessment based on calculated environmental impacts rather than proxy, consensus based measures of performance. • Opportunities to link to design process and with BIM in the future.
Measure of success	• NZGBC and GBCA participate as members of Programme Committee overseeing research. • Consider findings of research throughout project and possible implications in Green Star. • Consider a recognition process for EPD in Green Star, providing a further incentive to manufacturers to develop EPD (2013 - 14). • Consider recognising whole building whole of life assessment based on research outcomes in this Plan, due around March 2016.
Cost to industry	No direct cost.

Recognition and use of whole building whole of life assessment in schemes and tools that evaluate building environmental performance is an important driver to facilitate take up and use, providing an incentive for manufacturers to be more transparent with respect to the environmental performance of their products and providing a sound platform to help inform design decisions. In New Zealand and Australia, Green Star is the main rating tool used to assess the environmental performance of offices (and other building types).

By engaging in the three year research process for the whole building whole of life assessment framework, NZGBC and GBCA would have an opportunity to assess and consider how the framework could be incorporated into the process for rating the environmental performance of buildings.

In the short term (2013-14), development of a basis in which Green Star recognises and rewards EPD published by trade associations and/or individual manufacturers would be favourable, followed by consideration of how the whole building whole of life assessment framework can be considered in Green Star in the mid-term (2015 – 2017).

7.8.3.1 Short Term: EPD Recognition in Green Star

Currently, points available for materials in Green Star (Office) are as follows:

- MAT 3: Applied coatings (1 point).
- MAT 4: PVC (3 points).
- MAT 5: Insulation (1 point).
- MAT 6: Timber (3 points).
- MAT 7: Concrete (3 points).
- MAT 8: Steel (3 points).
- MAT 9: Floor coverings (2 points).

Using timber (MAT 6), concrete (MAT 7) and steel (MAT 8) as examples, points are currently awarded for ecolabel certification (ECNZ or an ecolabel on the GBCA Framework) or specified alternative pathways such as:

- Concrete: Up to 2 points if up to 20% of all aggregate used is from recycled sources plus a further point if 20% of in-situ concrete (or 15% for precast) contains cement substitute material sourced locally.
- Steel: Up to 3 points if up to 90% of steel used has a post consumer recycled content of at least 50% or is reused.
- Timber: Up to 2 points if 90% of timber by volume is reused or from post consumer recycled sources plus a further point where it is demonstrated that 90% of the timber does not exceed the minimum treatment classification required under the New Zealand Building Code for the application to which it is being used.

The issue with these examples is that it is difficult to establish equivalency as the criteria do not reflect impacts. As a result, there is no way of comparing the environmental benefits of using recycled aggregate in concrete or using steel with a high recycled content, for example.

EPD provide a robust, transparent, consistent input to calculation of whole building whole of life impacts. It is therefore important that an investment by manufacturers in EPD development and publication is incentivised and rewarded. Published LCAs may also be recognised, although to a lesser degree than EPD as LCA reports vary considerably in terms

of underlying methodology, how they are set out and what they report, meaning it is more difficult to understand the basis by which results have been obtained.

BRANZ's research of international building environmental rating tools shows that EPD are increasingly being recognised (Dowdell; 2012). Examples are as follows:

- LEED, which was developed by the United States Green Building Council (USGBC) and is used not just in the US but increasingly elsewhere (such as China), has introduced a number of pilot credits that recognise EPD and a life cycle perspective.
- BREEAM, developed by the Building Research Establishment (BRE) in the UK has used an environmental profiling approach since the late 1990s and more recently has incorporated an "uplift" where an EPD is provided for products or materials in a building element.
- HQE in France and DGNB in Germany base their environmental profiling activity on EPD and LCA outputs, meaning the impacts of individual or average products are reflected in the overall building level assessment process.

Adoption of an approach in Green Star that rewards development of EPD would provide an important driver. Pilot Credit 61 in LEED uses an interesting approach for recognising EPD by providing an innovation (pilot) credit for their development. The credit works by applying higher weightings to costs of products with EPD. Achieving a threshold cost value through use of enough products with EPD gains an additional point in the assessment. If a similar approach was to be adopted in New Zealand, consideration would need to be given to:

- How such a credit could be incorporated into Green Star and the number of points that could be gained.
- Whether users would have the choice to demonstrate compliance either for non-structural or structure & enclosure materials (as is the case in LEED).
- Which products used in building elements listed in Section 7.8.1.2 would be included.
- What weightings would be used to recognise different levels of disclosure. LEED uses weightings set out in Table 4.
- What threshold value or values would be set for the weighted cost relative to total cost of non-structural or structure and enclosure materials. In LEED, this is 20%.

Table 5 provides an example calculation, based on weightings in Table 4.

Table 4. Potential Compliance Pathway for recognition of EPD and LCA, based on approach in LEED Pilot Credit 61

EPD Pathway	Requirement	Weight (applied to cost)
Product Specific Declaration (LCA)	Products with a publically available, critically reviewed LCA compliant with ISO 21930	50%
Industry Wide (Generic) EPD	Third party certified EPD, where the manufacturer is explicitly recognised as a participant by the Australasian EPD scheme (or equivalent).	100%
Product Specific Declaration (EPD)	Third party certified EPD based on the Australasian EPD scheme (or equivalent).	200%

Table 5. Example Points Allocation for Structure & Enclosure (based on Table 4)

Material		Element	Pathway	Estimated / Actual Cost (NZ$ 000)	Weighting % (Table 4)	Weighted Cost (NZ$ 000)
1	Steel (rebar)	Structure & foundations	Generic EPD	100	100	100
2	Steel (structural)	Structure	Specific LCA	400	50	200
3	Ready mixed concrete (supplier 1)	Structure & foundations	Specific EPD	200	200	400
4	Ready mixed concrete (supplier 2)	Structure & foundations	Generic EPD	800	100	800
5	Timber	External walls (facade)	Specific LCA	400	50	200
6	Insulation	External walls	Specific EPD	750	200	1500
7	Aluminium	Roof	Specific EPD	450	200	900
8	Windows	External walls	Generic EPD	300	100	300
Total Structure & Enclosure Products with EPD or LCA					**Weighted:**	**4400**
Total Structure & Enclosure Products					**Actual/Estimated (Total):**	**15000**
% Weighted Total Structure & Enclosure Products with EPD or LCA:						**29**

Earlier notice of additional recognition of EPD in Green Star would be preferable. This would also mean that manufacturers who are early adopters of EPD could obtain more immediate benefits through recognition in Green Star.

7.8.3.2 Mid Term: Consideration of how to apply the Framework in Green Star

As the research underpinning the development of a whole building whole of life assessment framework produces outputs, NZGBC and GBCA would have the opportunity to consider how these outputs may be utilised in Green Star, with the following potential benefits:

- A common understanding between manufacturers, architects/designers and rating tool providers concerning which environmental impacts are of importance and how they are calculated.
- Evaluation of buildings based on their calculated impacts, taking into account all relevant and significant processes in the life cycle, rather than using consensus driven proxy measures of performance.
- Greater objectivity.
- A data rich process drawing together questions currently covered in parts of the material section (MAT), energy (ENE), water (WAT) and emissions (EMI).
- A thorough assessment of products, in which use of higher quality data eg. product specific EPD, is rewarded.
- Future opportunities to directly draw underlying data from BIM, reducing the time and cost of assessment.

Specific issues that would need consideration would include:

- How the whole building whole of life assessment framework could be recognised in Green Star, in particular, would it be embedded into Green Star directly or would Green Star recognise the results of other tools and applications that use the framework.
- What questions within the current version of Green Star would be covered by application of the whole building whole of life assessment framework.
- The basis for assignment of points in Green Star.

8. SUMMARY OF HOW THIS PLAN RESPONDS TO NEW ZEALAND CONSTRUCTION INDUSTRY RECOMMENDATIONS

When you are being asked to make the business case for sustainability – perhaps ask them to make the business case for being un-sustainable Ray C Anderson, Interface (28 July 1934 – 8 August 2011)

This Plan has been developed to address recommendations made by the New Zealand construction industry in 2010.

Table 6 reproduces Table 1 in Section 3.2 but with an additional column that summarises how this Plan addresses the issues raised.

Table 6. Summary of how this Plan addresses Industry Recommendations

Issue	Designers Workshop	Manufacturers Workshop	How issues raised are addressed in this Plan
Governance	A credible authoritative body or process needs to oversee implementation.	Establish a credible body or mechanism.	A Programme Committee of key stakeholders is proposed to oversee research set out in this Plan, which would be delivered by BRANZ, NZLCM Centre and other partners. LCANZ and ALCAS are currently evaluating examples of international EPD schemes with a view to basing an Australasian scheme on one of these. Governance arrangements would be in accordance with the chosen EPD scheme model and overseen by LCANZ and ALCAS or their representatives.
Methodology	The methodological approach needs to be robust enough to ensure unbiased fair comparison, yet flexible to encompass different applications.	Examine the different options for establishing an LCA approach for New Zealand recognising lessons learnt from international experience.	Different options examined (Dowdell, 2012) and used to inform the development of this proposal. PCRs in the Australasian EPD scheme would align with international schemes and standards (in particular, ISO 21930 and ideally, EN 15804). PCRs provide detailed rules for material and product groups and provide better consistency. EPD may cover all of the life cycle or part of the life cycle where the product can be used in different ways or contributes to the performance of a designed building (such as thermal performance). Where EPD cover part of the life cycle, the rest of the life cycle is modelled in the whole building whole of life assessment.
Suggested Actions to address Barriers	Green Star should be developed to incorporate LCA data, to encourage a consistent and robust approach to materials sustainability assessment in New Zealand using LCA.	Consult with industry groups and improve knowledge using training, coaching and workshops. Encourage the development of a working group to champion the LCA agenda.	Industry events aimed at two levels – CEOs and environmental/product/sales managers. Environmental impacts reported in EPD are a public declaration and provide an input to whole building whole of life assessment. Impacts reported in EPD are consistent, transparent and freely available, providing a useful resource for design tools. NZGBC (and GBCA) invited to a Programme Committee to consider development of the framework and its application in evaluating environmental performance of buildings.
	Further design tools will be needed to maximise data uptake by practitioners. A ‘one tool suits all’ approach is unlikely to be appropriate.	Develop a business case for the New Zealand building sector and promote case studies illustrating industry lessons from use of LCA.	Benefits of developing EPD and using these as the basis of whole building whole of life assessment provided in this Plan. Case studies of companies that have undertaken LCA and EPD, setting out their needs and the benefits they obtained are provided. EPD provide more consistent data which can provide the basis for design tools.

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APPENDIX A ABOUT EPD AND HOW THEY CONTRIBUTE TO WHOLE BUILDING WHOLE OF LIFE ASSESSMENT

A1. Overview of EPD

EPD (or environmental profiles) are an independently verified public declaration of environmental performance of products for all or parts of the life cycle, examples of which are provided in Figure 21.

Figure 21. Examples of EPD

EPD are generally voluntary (with some exceptions – Sections 5.3 and 5.5.2) and may be produced for specific materials and products or an average of the same or similar products within a sector (e.g. at a trade association level). EPD for the same or similar products must be developed in accordance with specific rules for the product category (called PCRs) to ensure that there is consistency and comparability when calculating potential impacts of materials or products within a product category. Examples of PCRs are shown in Figure 22 (taken from www.bau-umwelt.de/hp478/Product-Category-Rules-PCR.htm)

The overall goal of EPD, according to ISO 21930 (ISO, 2007) "is to encourage the demand for, and supply of, building products that cause less stress on the environment through communication of verifiable and accurate information on environmental aspects of those building products that is not misleading, thereby stimulating the potential for market-driven, continuous environmental improvement".

Figure 22. Example PCRs

There are several EPD schemes globally including, for example, the IBU scheme (http://bau-umwelt.de/hp481/Environmental-Product-Declarations-EPD.htm) in Germany and the International EPD System (www.environdec.com/) in Sweden. They operate in compliance with the international standard on EPD – ISO 14025 (ISO; 2006a).

In September 2011, national EPD scheme providers in Finland, France, Germany, Great Britain, Italy, the Netherlands, Norway, Poland, Portugal, Sweden and Spain signed a Memorandum of Understanding to establish a European EPD Platform, called "ECO", with the aim of developing better alignment between different schemes. Although in general there is an issue of disparity between PCRs of different EPD schemes, Subramanian *et al.* (2012) found good alignment between the IBU and International EPD System schemes, when reviewing their respective PCRs for wood particleboard.

Jaques *et al*. (2011) developed two draft New Zealand EPD based on PCRs in the IBU EPD scheme, demonstrating that it is possible to develop EPD in New Zealand. These were for GIB plasterboard and Greenstuf insulation. No Australasian EPD scheme currently exists although a scheme is in the process of development by ALCAS and LCANZ.

An EPD by itself does not provide an indication that a product is environmentally preferable but does when compared, for example:

- A product specific EPD is compared with a sector average EPD for the same or similar products (demonstrating better environmental performance compared to the sector).
- An updated product specific EPD (or average product EPD) is compared with an older version (demonstrating continuous improvement at a manufacturer or sector level).
- A product specific EPD from a manufacturer within a sector compared to another manufacturer with a competing product in the sector (demonstrating better

environmental performance of one product over another meeting the same function(s) within a sector).

- A product specific EPD in a sector compared with an alternative product in another sector provided the EPD are on a life cycle basis (demonstrating environmental performance between products from different sectors). Where the EPD is not full life cycle, this assessment is carried out at the building level in the whole building whole of life assessment so each product can be considered in the context of the building in which both are proposed for use.

EPD provide the following information:

- Robust data and information about the environmental impact of a product or material across part or all of its life cycle.
- Transparency of reporting on issues such as environment, health & safety, durability, requirements for use and appropriate recycling or disposal methods.
- Third party verification that the data have been produced following appropriate rules and International Standards (ISO 14040 (ISO, 2006b) and 14044 (ISO, 2006c)).
- A document that meets the requirements of international standards in terms of its content and format (ISO 14025 (ISO, 2006a), ISO 21930 (ISO, 2007) and preferably, EN 15804 (CEN, 2012)).
- A basis for measuring continuous improvement for companies that publish them. Companies using EPD for public reporting will be more motivated to demonstrate improvement in the environmental impacts associated with their products in future updates.
- An opportunity for the companies that develop them to inform the development of PCRs (where these do not already exist).
- An important building block towards whole building whole of life assessment.

A2. How EPD can underpin Whole Building Whole of Life Assessment

In order for materials and products to be compared on a “level playing field”, their potential impacts must be considered across the life cycle of a building. However, given that materials and products used in construction of buildings are frequently used in combination with other materials and products to form elements or assemblies, it is not necessarily possible (or worthwhile) to account for the contribution individual materials or products make to the operational (e.g. thermal) performance of a building separately. For example, wall insulation alone does not define the thermal resistance (or R value) of an external wall in which it is contained, which may also comprise plasterboard, studwork, building paper, bricks and render, each with their own R values that contribute to the overall R value of the wall.

The R value of the external wall is one determinant of the energy required to heat and cool a building to maintain thermal comfort, other factors being presence of windows and doors (number, size, type and location), size and shape of the building and inclusion of other passive design features and the climate zone in which a building is located.

The potential impacts of supplying energy to heat and cool the building are further dependent on what source or sources of energy are used, including incorporation of any on-site renewables.

Two buildings identical with respect to the amount and type of materials used can perform very differently based on the design. Design is therefore a key parameter as it determines the amount and type of materials used.

For example, insulation performance may be modelled generically according to its thermal resistance but actual performance in a designed building can only be modelled using specialist software (for example EnergyPlus or DesignBuilder) which more accurately simulate the many variables that contribute to thermal performance of a building envelope.

It is for this reason that the international standard on environmental declaration of building products – ISO 21930 (ISO, 2007) allows a modular approach to reporting of the environmental impacts of construction materials and products within EPD. In cases where it is difficult to define a functional unit (or quantified performance unit) in an EPD for a material or product, due to the complexities of how it is used in combination with other products, then it is sufficient to define a declared unit which is a "quantity of a building product for use as a reference unit in an EPD, based on LCA, for the expression of environmental information needed in information modules" (ISO, 2007). Information modules represent part(s) of the life cycle of a material or product and are used where the function and the reference scenario for the whole life cycle, on the building level, cannot be stated. Declared units in information modules are typically in units of mass (kg) or volume (m^3), for example.

Whilst an EPD using a declared unit (or information module) cannot be used for comparison with alternative products with declared units, it provides transparent, consistent, independently reviewed data and information to support a whole building whole of life assessment, in which the contribution the material or product makes to the overall performance of a building is calculated. The material or product is therefore considered across the life cycle at the building level.

It is important that an EPD clearly articulates which parts of the life cycle of a material or product are represented with data and information. ISO 21930 (ISO, 2006a) sets out the elements of the life cycle and mandatory and optional reporting requirements according to the type of EPD being developed (Figure 23). This framework has been developed further in recently published European standards to provide greater transparency – EN 15804 (CEN, 2012) and EN 15978 (CEN, 2011a), which provide core rules for construction products and assessment of the environmental performance of buildings respectively. Figure 24 summarises the relation between product LCA (EPD) and building level LCA, using a modular approach, based on the draft EeBGuide (EC, 2012b).

Figure 25 provides an illustration of how this works. It shows example extract pages from a published EPD for the Kalzip©® standing seam aluminium roofing system (ECO, 2011) and how data and information from this would feed into a building level assessment.

Existing frameworks used in New Zealand could provide a basis for populating with environmental impact data from EPD, such as Rawlinsons (2011) or the construction classification and coding system – Co-ordinated Building Information (CBI; 2011).

Figure 23. Mandatory and Optional Elements and Information Modules in Declared Units and Functional Units (from ISO 21930: 2007)

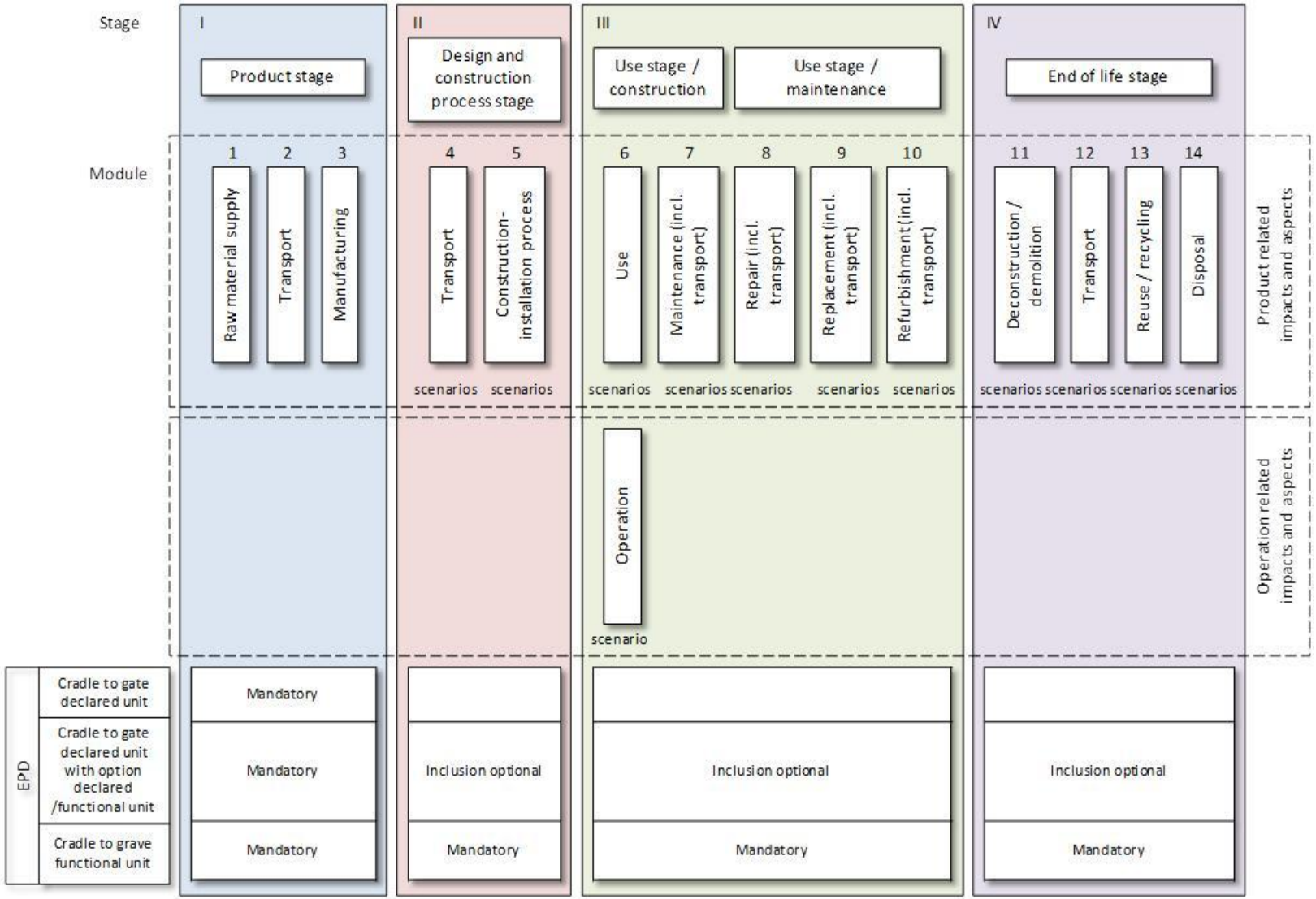


Figure 24. Relationship between Product LCA (EPD) and Building Level LCA based on the draft EeBGuide (EC, 2012b)

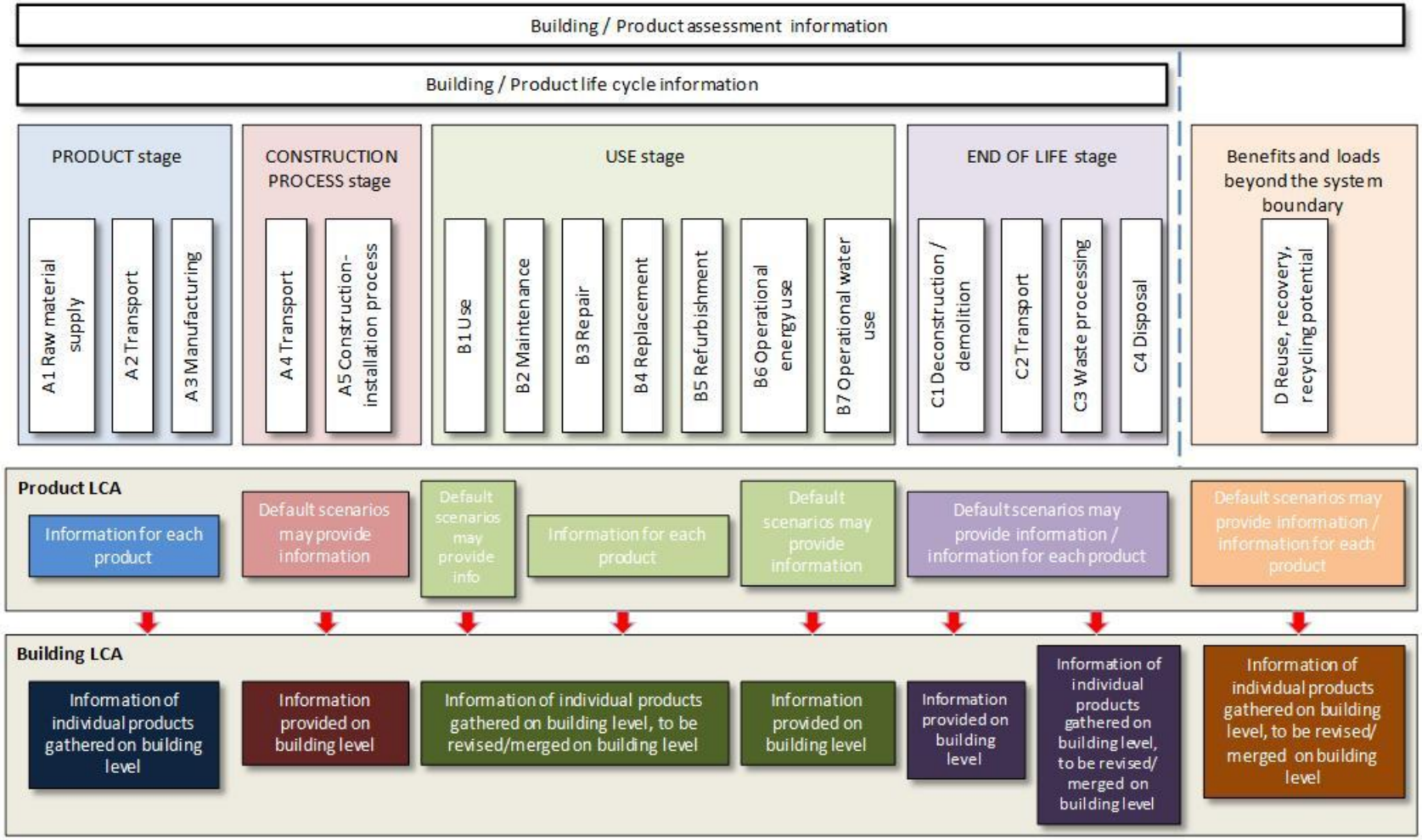
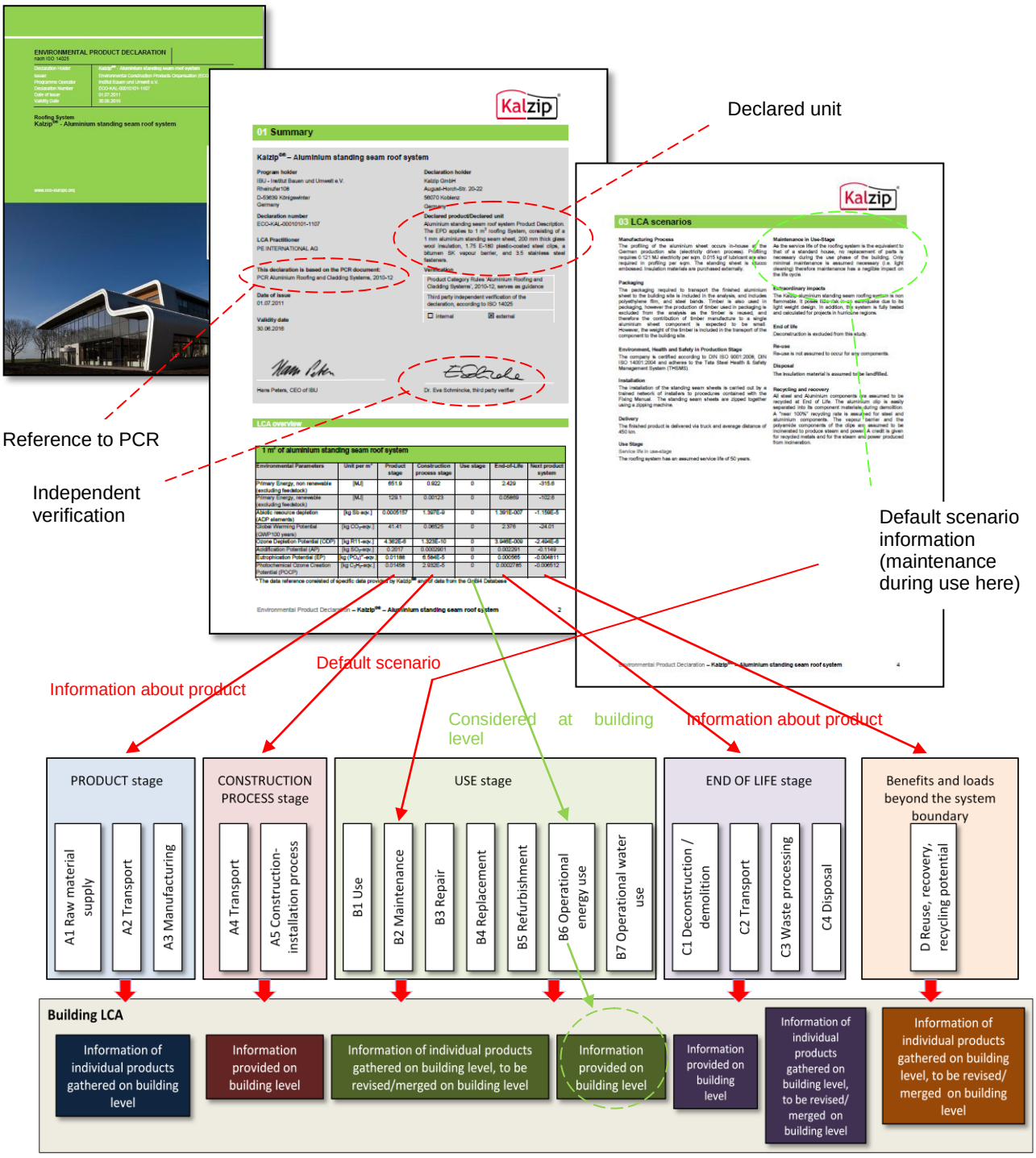


Figure 25. Example of how Data from EPD input to Building Level Assessment



APPENDIX B SUMMARY OF DIFFERENCES BETWEEN ISO 21930 AND EN 15804

Examples where EN 15804 currently differs (in terms of detail required) from ISO 21930 are:

- Declaration of data on recycling, reuse and recovery at end of life or as a result of replacement of products and materials during the life of the building. This is important, as there are different approaches and assumptions that can be used to take account of reuse, recovery and recycling which can affect the results of an LCA. Requiring this to be separately reported helps with transparency.

- Additional technical and functional performance information about a product or material is required by EN 15804, as well as additional information about emissions of dangerous substances to indoor air, soil and water during use of the product or material, not covered in the LCA.

- Verifiable reference service life information needs to be declared, taking into account European product standards and ISO 15686-1 (2011a), -2 (2012), -7 (2006c) and -8 (2008).

- It follows the “polluter pays principle” where all processes are assigned to the product or material that generates them. For example, production of a cleaning agent used for the maintenance of a product is declared in that product’s information module (see Appendix A).

- It sets specific boundaries for secondary materials and energy recovered from secondary fuels in which the system boundary is set where the outputs of the previous system reach an end-of-waste state (i.e. the previous system takes the environmental impacts of processing until a waste is usable).

- Allocation of co-products should be avoided by sub-division where possible. Where this is not possible, allocation should be based on physical properties (e.g. mass, volume) where the difference in revenue from co-products is low (less than 25%) and in all other cases, based on economic values. A common position on the definition of the most appropriate allocation rule needs to be defined with other relevant sectors.

- More detailed parameters describing environmental impacts, resource use, waste categories and output flows to be reported, including methods and units.