

# BEDP ENVIRONMENT DESIGN GUIDE

## Strategies and Resources for Material Selection

**Andrew Walker-Morison, Tim Grant & Scott McAlister**

**Centre for Design, RMIT University**

### Summary of

## Actions Towards Sustainable Outcomes

### Environmental Issues/Principal Impacts

- The careful selection of building materials and their use in design has the potential to reduce life-cycle environmental impacts significantly.
- There is no such thing as a 'sustainable material' if the broader supply chain and the supporting systems for it do not meet sustainability principles. It is more accurate to talk about environmentally preferable materials, and the implementation of sustainability principles.

### Basic Strategies

*In many design situations, boundaries and constraints limit the application of cutting EDGe actions. In these circumstances, designers should at least consider the following:*

- Australia's greenhouse gas emissions are currently dominated by the operational energy use of construction. The first priority should be to improve operational energy efficiency. This can be aided by the appropriate specification of materials.
- Firstly, the selection of materials should be prioritised at a whole-of-building (system) level on the basis of building life-cycle (e.g. design for durability, flexibility and disassembly)
- Secondly, detailed consideration should be given to optimising the performance of individual products and materials (e.g. specifying products that have credible and verified claims to environmentally-preferable performance such as 'certified' timber).

### Cutting EDGe Strategies

- Design with end-of-life considerations uppermost in mind: can the product as specified and as assembled be reused or, at least, recycled to a high value? If not, it is not sustainable.
- Educate yourself and your colleagues about issues and options, and understand areas where principal impacts occur (allocate resources appropriately such as allowing staff time to evaluate options).
- Demand credible information from suppliers that assesses environmental impacts over the full life-cycle (this should preferably be independently verified or reviewed by a credible body).
- Design for appropriate durability and to minimise material 'churn' (need for refits or renovation). Design for the building design life, with appropriate detailing allowing for flexibility.

### Synergies and References

*BEDP Environment Design Guide:*

- Gen 21 Waste Minimisation and Resource Recovery
- Gen 22 Life Cycle Energy Analysis
- Gen 51 Life Cycle Assessment – Application in Buildings
- Gen 58 Embodied Water of Construction
- Gen 66 Design for Adaptability – An Introduction to the Principles and Basic Strategies
- Des 30 Specifying for Waste Minimisation
- Des 31 Design for Disassembly – Themes and Principles
- Des 35 Building Materials Selection – Greenhouse Strategies
- Pro 16 Durability of Building Materials – An Introduction
- Pro 22 Waste Minimisation – A Guide for Materials Selection
- Cas 18 Fairweather Homes



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*This note follows on from Pro 7. It outlines Australian and international responses to materials sustainability, reviews what a sustainable material is, and the role of design. It reviews recent research quantifying benefits from specific materials strategies, major materials impact areas in buildings, and looks at practical ways forwards, both for strategies and resources.*

### 1.0 Introduction

As outlined in Environment Design Guide note Pro 7, there are a range of impacts associated with the use of building materials. The question arising is what practical strategies exist to reduce these impacts or, preferably, which aim for remediation or net benefit? This note:

- reviews selected policy and tool development initiatives internationally and in Australia
- reviews what may define a sustainable material
- reviews the value of design in reducing impacts
- reviews data on where major impacts occur
- suggests practical strategies and further resources to assist in reducing impacts associated with building materials on projects.

#### 1.1 Background

This note draws in part on research undertaken for the Commonwealth Government through the Department of the Environment and Heritage (now the Department of Environment and Water Resources) to 'Investigate Measures for Improving the Environmental Sustainability of Building Materials' (DEH, 2006). The report is now available for public review.

### 2.0 International Approaches to Fostering Sustainable Materials

#### 2.1 United Kingdom

Building materials are an important focus of international research and policy development. Pertinent examples include the UK Government's decision in December 2006 to implement a voluntary 'Code for Sustainable Homes'. This Code includes a measure of the carbon intensity of materials production and disposal, as well as building operational performance. The Code "signal(s) the future direction of the Building Regulations" and that "a probable future development regarding the environmental

impact of materials is to reward resource efficiency, as well as the use of resources that are more sustainable" (Department of Communities and Local Government, 2006, p 5, 10).

#### 2.2 European Union

In the EU a number of current policy initiatives have the potential to impact on future building materials' policy and regulation. These include the Construction Product Directive that aims to achieve EU harmonisation for Environmental Product Declarations (EPD's) ISO-compliant life-cycle assessment scorecards. Also of interest are REACH (Registration, Evaluation and Authorisation of Chemicals) and the EU Restriction of Hazardous Substances (RoHS), that may well provide a policy blueprint for aspects of building product reporting in the future. RoHS Directive (RoHS 2002/95/EC [2006]) restricts the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment. Materials initially targeted under RoHS are lead, mercury, cadmium, chromium VI, PBB and PBDE, which are fire retardants used in many plastics. REACH was passed as a legislative instrument in December 2005. REACH reverses the burden of proof for the risk classification of new chemicals so that any manufacturer of greater than 10 tonnes of a new substance must demonstrate that it will not have adverse effects under a completely revised assessment process. While RoHS does not currently apply to construction materials and REACH has yet to come into effect, they are indicators of a potential future direction for international legislators and may mark a new trend in addressing pollutant toxicity issues<sup>1</sup>.

#### 2.3 International Standards Organisation

The International Standards Organisation (ISO), which is largely driven by EU members, has recently finalised Standard 21930: Environmental Declaration of Building Products. This standard sets out the principles and requirements for conducting Type III (LCA-report card) environmental declarations of building

<sup>1</sup> Additional information: <http://www.rohs.gov.uk/> [http://ec.europa.eu/environment/chemicals/reach/reach\\_intro.htm](http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm)

products. This complements the ISO 14025 (Type I) environmental labelling standard, of which Good Environmental Choice Australia is an example (refer Resources).

Building rating schemes are proving to be major drivers of change internationally. Leading examples are the UK Building Research Establishment Environmental Assessment Method (BREEAM) system that has a reference guide, *The Green Guide to Specification* that advises on the environmental impacts of generic building assemblies. In the USA the US Green Building Council has under development its *LCA into LEED* program, which aims to bring quantitative science to the Leadership in Energy and Environmental Design (LEED) rating tool through the use of LCA.

As yet, there does not appear to be any global regulatory requirements to report on, or meet a set level of environmental performance with regards to building products.

### 3.0 Australian Trends and Responses

Australian government bodies are developing a range of policies and tools, often with different focuses. At a local government level examples from Victoria include the City of Port Phillip (Sustainable Design Scorecard), and Moreland City Council (STEPS).

Statutory bodies have also looked at the issue with VicUrban (the Victorian Government's sustainable urban development agency) making its Eco-Selector (a guide to best practice materials selection) mandatory at its new greenfield residential development, Aurora. A number of state governments have mandated the use of the Green Building Council of Australia's (GBCA) Green Star, which includes credits for the use of selected materials and strategies.

At a Federal level there are no specific voluntary or guideline requirements for materials selection in the Commonwealth Procurement Guidelines and Best Practice Guidance. The Australian Greenhouse Office provides broad guidelines, however benchmarks or pass/fail standards are not quantified. The Green Star rating tool is driving extensive change in the consideration, selection and specification of building materials in the commercial sector, with rapid growth in demand for tools, accreditation and training.

#### 3.1 Australian Life Cycle Inventory and the Building Assemblies and Materials Scorecard

Other important initiatives in Australia at the time of writing include the development, led by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) of a national inventory of Life Cycle Data (AusLCI). This will make standardisation

and use of LCA's much easier and consistent in the future, although this project is anticipated to take 2-3 years to complete.

Another important initiative is the development of an Assemblies and Materials Scorecard, similar in intent to the UK Green Guide to Specification. Led by RMIT, project partners include the GBCA, VicUrban, and a number of local governments with funding from the Victorian Government's Sustainability Victoria. The project will establish a method and reporting framework to assess the environmental performance of building assemblies. This will potentially form a more quantitative assessment basis for rating tools such as Green Star<sup>2</sup>.

## 4.0 Towards Sustainability; Practical Strategies

When seeking to improve sustainability of building materials, the questions faced by most specifiers include:

- What *is* a sustainable material anyway?
- Do design and specification decisions make a difference, and how much?
- How do I prioritise – where are the major impacts in terms of building materials?
- How do I evaluate between 'apples and oranges' (i.e. materials that have quite different environmental characteristics)?
- What is a practical approach for materials selection?
- How do I find credible information on building products' environmental performance?

Today there is another question to add to this list, namely: how do I ensure I achieve points under the rating tools I am using? This last question falls outside the scope of this paper but is referred to in part in 'Enabling resources' at the end of this paper.

### 4.1 What is a Sustainable Material Anyway?

The following table expands upon the principles and criteria identified in *Environment Design Guide* note Pro 7, and provides guidance about the characteristics of materials made and used sustainably. The key message is that sustainability describes a system not a material or product. A material or product's 'sustainability' can only be assessed in the context of its use over many cycles. We may create outstanding *environmentally preferable* materials, but if we do not use them in a way that supports their use in line with sustainability principles (if wastes cannot become food for future materials for example), we fail.

In short there are no sustainable materials, only materials used sustainably.

<sup>2</sup> For additional information contact the Centre for Design at RMIT or Sustainability Victoria.

| Actions                                                                                                                                                                                                                                                         | Goal                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| <b>Dematerialise and increase resource productivity</b><br>(e.g. reduce material use and mass; as well as net volumes).                                                                                                                                         | Zero waste and emissions                           |
| Establish, and minimise adverse sustainability impacts of use – <b>take-back, upgrade, reuse</b> , and recycling programs for material and products.                                                                                                            | Closed loop material use                           |
| Substitute, and ultimately eliminate, use of <b>toxic, persistent, and bio-accumulative</b> inputs and materials (e.g., mutagens, teratogens, carcinogens, endorphins, and endocrine disrupters).                                                               | Zero toxic, persistent, and bioaccumulative inputs |
| Minimise <b>embodied energy</b> (through material and process selection).<br>Convert to renewable and sustainable energy and material sources.                                                                                                                  | 100% renewable and sustainable energy              |
| <b>Optimise LCA</b> criteria base (including potential of global warming, acidification, ozone depletion, eutrophication, photochemical oxidant (smog), aquatic eco-toxicity, human toxicity, terrestrial eco-toxicity, and so forth.                           | Zero on all fronts                                 |
| <b>Redesign products</b> and processes to:<br>1. Reflect biomimicry approaches.<br>2. Use sustainably generated inputs within sustainable processes and transport systems.<br>3. Pivot on a service business model.<br>4. Replenish natural and social systems. | 100% for all measures                              |

**Table 1. Principles, criteria and goals for sustainable materials**

Adapted from DEH and Waage et al.

| Resource Effectiveness of Buildings                  |                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Current status                                       | Not typically quantified                                                                                                                                                                                                                                                                                                                             |
| Preferred future                                     | Resource performance reported at design stages and at all other supply chain nodes                                                                                                                                                                                                                                                                   |
| Eco-preferred examples                               | Swinburne University Atrium re-development (refer DEH report for more details)                                                                                                                                                                                                                                                                       |
| Resource acquisition is low-impact/restorative       |                                                                                                                                                                                                                                                                                                                                                      |
| Current status                                       | Resource extraction from natural systems delivering typically virgin materials, and becoming landfill at end of life                                                                                                                                                                                                                                 |
| Preferred future                                     | Minimal extraction from natural environments; most resources from reuse and recovery – resource stewardship model                                                                                                                                                                                                                                    |
| Eco-preferred examples                               | <ul style="list-style-type: none"> <li>Company level: Simms Metal</li> <li>Product level: FSC-certified and recycled wood products</li> <li>High-recycled content (e.g. Electric Arc Furnace steel)</li> <li>Triple-blend lime-incorporating masonry mortars (to facilitate reuse)</li> <li>Reusable partitions</li> <li>Interface carpet</li> </ul> |
| Product and process toxicity to natural environments |                                                                                                                                                                                                                                                                                                                                                      |
| Current status                                       | Wide range of constituents of varying levels of toxicity, persistency and cumulative potential                                                                                                                                                                                                                                                       |
| Preferred future                                     | Non-toxic (nutrient only) or entirely segregated from natural environments                                                                                                                                                                                                                                                                           |
| Eco-preferred examples                               | Range of certified products particularly MBDC (McDonough Braungart Design Chemistry) certified design and production processes e.g. Think Chair (Refer Table 6)                                                                                                                                                                                      |
| Energy inputs                                        |                                                                                                                                                                                                                                                                                                                                                      |
| Current status                                       | High energy inputs, fossil-fuel and greenhouse intensive                                                                                                                                                                                                                                                                                             |
| Preferred future                                     | Minimal energy inputs over the life-cycle, inputs from renewable sources                                                                                                                                                                                                                                                                             |
| Eco-preferred examples                               | Renewable energy inputs for technologies such as: <ul style="list-style-type: none"> <li>High supplementary cements</li> <li>Hi-smelt steel</li> </ul>                                                                                                                                                                                               |

**Table 2. Future focus – some characteristics of a sustainable materials supply chain**

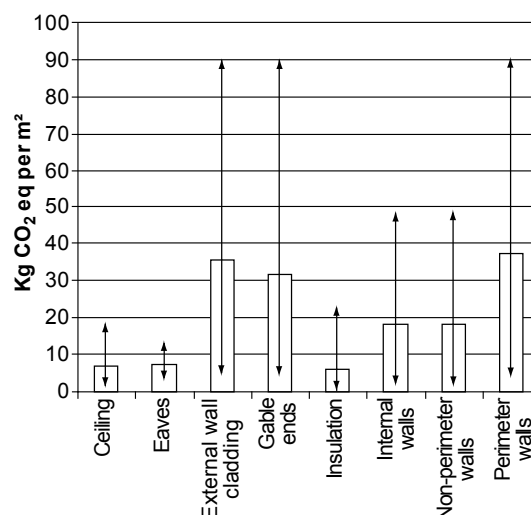
## 4.2 Do Design and Specification Decisions make a Difference?

Design strategies can make a profound difference to sustainable outcomes. Recent EU research has shown that embodied energy in conventional buildings can be reduced by approximately 10-15% through relatively simple means (Thormark, 2006). A study by the same author suggested that 45-50% of embodied energy can be recovered if energy recovery systems are used (Thormark, 2002). Work by RMIT shown in Figure 1, indicates that in Australia the greenhouse gas impacts of alternate ways of delivering equivalent building element performance may vary significantly depending on the system selected. The task for the specifier remains to identify preferable systems; this is the purpose of tools such as the Building Assemblies and Materials Scorecard and LCA Design.

In the case study of an atrium infill roof at Swinburne University (Architects: DesignInc), the mass of structure required to support a roof was able to be reduced by 40% with the use of new lightweight membrane technologies.

Design for disassembly will typically be a crucial strategy for reducing impacts. Recent Dutch research on the life-cycle impacts associated with materials for internal walls in commercial buildings showed impacts may be reduced by more than 80% through design for disassembly. This can also deliver significant economic benefits (Durmisevic, 2006). Another example in the *Environment Design Guide*, Cas 18: Fairweather Homes, reviews an Australian design series that is comprehensively designed for disassembly, minimizing environmental loads, and maximising operational energy efficiency.

The DEH research reviewed options to improve the environmental performance of building materials use. Strategies reviewed are listed below including the benefit obtained from their use across all building types nationally, for greenhouse gas emissions.



**Figure 1. Mean Value for Global Warming Potential and the Highest and Lowest Value within the Range for Residential Assemblages**

Interpretation: the arrows plot the range of greenhouse intensity of different systems analysed for each application. Thus for external claddings the greenhouse intensity ranged from less than 10 kg CO<sub>2</sub> equivalent, to over 90 kg CO<sub>2</sub> equivalent, depending on the system selected. The top of the shaded bar shows the median performance for assemblies assessed for this application.

## 4.3 Setting Priorities – Reviewing Major Impact Areas

When it comes to setting priorities there is still comparatively little data available on where major materials impacts occur in buildings. Table 4 and 5 provide some guidance on materials impact drawing on a range of published studies, and highlight how the priority varies under different systems.

| Item                             | Description                                                                                                                                                                        | Materials Specific Reduction (greenhouse gas) | Total Sectoral Reduction in 2055 |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------|
| Inert anode aluminium            | In-development advanced smelting technology                                                                                                                                        | 30%                                           | 1%                               |
| Hi-smelt steel                   | Pre-commercialisation advanced smelting technology.                                                                                                                                | 30%                                           | 7%                               |
| High supplementary concretes     | Increased use of supplementary materials: fly-ash, slag.                                                                                                                           | 25%                                           | 2%                               |
| Process energy efficiency        | According to Australian and international studies (ABARE and IEA) manufacturing process efficiencies of up to 30% should be achievable over coming decades in relevant industries. | varies 20-30% typically                       | 13%                              |
| Improvement in energy generation | Projected improvement to 2055 on the basis of reduction of greenhouse intensity of electricity                                                                                     | 40%                                           | 18%                              |
| Combined house reduction         | New separate house size reduction to 240m <sup>2</sup> , and multi-residential stabilise at 150m <sup>2</sup>                                                                      | N/A                                           | 16%                              |
| Combination all measures         |                                                                                                                                                                                    |                                               | 45%                              |

**Table 3. Quantified Technology and Other Options to Reduce Greenhouse Emissions**

| Study description                                                                                                                                                                     | Order of Impacts by Building Element                                                                                                                                                                                 | Order of Impacts by Material                                                                                                                                                                                                                                             | Source/<br>Further Information                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Embodied energy.<br>Residential semi-detached, timber framed with external brick veneer, concrete ground floor slab, timber first floor, timber windows, two-storey, 86m <sup>2</sup> | <ol style="list-style-type: none"> <li>1. Structure</li> <li>2. Sub structure</li> <li>3. Fitments</li> <li>4. Roof</li> <li>5. Finishes/external works</li> <li>6. Finishes</li> <li>7. Windows/services</li> </ol> | <ol style="list-style-type: none"> <li>1. Ceramics (brick)</li> <li>2. Timber</li> <li>3. Steel</li> <li>4. Concrete</li> <li>5. Other metals</li> <li>6. Plastic</li> <li>7. Carpet</li> <li>8. Fibreglass batts</li> <li>9. Plasterboard</li> <li>10. Glass</li> </ol> | <a href="http://buildlca.rmit.edu.au/">http://buildlca.rmit.edu.au/</a> |

**Table 4. Residential Buildings – Overview of impacts by order of embodied energy (1 highest impact)**

| Study description                                                                                                                                                | Order of Impacts by Building Element                                                                                                                                                                                                                                                                                                      | Order of Impacts by Material                                                                      | Source/<br>Further Information                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Embodied energy, base building construction only. Medium sized Australian office building, concrete frame construction, aluminium- framed curtain wall cladding. | <ol style="list-style-type: none"> <li>1. Structure</li> <li>2. Services</li> <li>3. Sub-structure</li> <li>4. Finishes</li> <li>5. Windows</li> <li>6. Roof</li> </ol>                                                                                                                                                                   | <ol style="list-style-type: none"> <li>1. Steel</li> <li>2. Concrete</li> <li>3. Other</li> </ol> | <a href="http://buildlca.rmit.edu.au/">http://buildlca.rmit.edu.au/</a> |
| Full LCA (single score). Of a small sample of UK commercial buildings over a 60 year life-cycle, excluding furniture.                                            | <ol style="list-style-type: none"> <li>1. Floor finishes</li> <li>2. Upper floor structure</li> <li>3. Footings</li> <li>4. Floor surfaces (raised floors)</li> <li>5. External walls (high-mass type)</li> <li>6. Roof</li> <li>7. Windows and curtain walling</li> <li>8. Internal walls and partitioning/suspended ceilings</li> </ol> | N/A                                                                                               | <a href="http://www.bre.co.uk">http://www.bre.co.uk</a>                 |
| Embodied energy<br>Full life-cycle<br>Over 40 years                                                                                                              | <ol style="list-style-type: none"> <li>1. Furniture</li> <li>2. Upper floor structure</li> <li>3. Floor finishes</li> <li>4. External walls</li> <li>5. Wall finishes</li> <li>6. Electrical</li> <li>7. Substructure</li> <li>8. Internal walls</li> <li>9. Columns</li> <li>10. Plumbing</li> </ol>                                     | N/A                                                                                               | (Treloar 1999)                                                          |

**Table 5. Commercial Buildings – Overview of impacts by order by embodied energy and LCA (1 highest impact)**

#### 4.4 How to Compare ‘Apples and Oranges’: a Thorny Issue

Often specifiers will be asked to choose between quite different options; such as a timber window of unknown provenance vs. a window of virgin aluminium. Resolving this with confidence requires a detailed knowledge of products and how they are put together, the anticipated life-cycle and end of life options (e.g. disposal or recycling), and the ability to model the options. At present only LCA can offer this quantitative comparison, however this is not practical for most projects due to complexity and cost.

Initiatives such as the Building Assemblies and Materials Scorecard (currently under development, led

by RMIT Centre for Design), and software packages such as LCA Design are designed to assist in this regard (Tucker, 2003). In the meantime, specifiers must use more limited but still useful qualitative approaches in conjunction with research and available tools and guides.

#### 4.5 A Practical Approach

The following outlines a practical approach to materials selection and specification that will deliver environmental benefits. While this approach identifies the questions to ask, answering these questions will depend on the project at hand, and the use of tools and guides identified in ‘Resources’.

#### 4.5.1 At a Building Level

Design for system-wide benefits.

Ensure that full life-cycle energy performance is taken into account. The first priority should be to reduce operational energy loads. However this does not have to be done at the expense of embodied energy impacts. This includes strategies to:

- (i) Reduce the amount of materials required in initial and ongoing construction (refurbishment) at a whole-of-building level, over the life-cycle of the building through:
  - Minimising building area
  - Designing for system-wide benefits (e.g. circulating air and other services under a raised floor in office buildings may allow for floor-to-floor heights to be reduced, and deliver savings of structural materials)
  - Design for disassembly to be integrated into the building (proprietary office partition systems that allow for minimal waste relocation)
  - Factoring for a probable, actual design life (which includes an allowance for 'churn')
  - Design for durability appropriate to the design life (e.g. if the application is a retail fitout with a churn every 18-months, design for 20 year durability would be wasteful. High value items such as quality chairs and fittings will have resale value, whereas poor quality items may not).
- (ii) Maximise conservation efforts for the high-impact applications, as per the tabular summaries given above.
- (iii) Identify early in the design key benchmarks (e.g. Green Star). If a project needs to obtain credits in certain areas for materials these should be addressed in regular holistic design reviews to avoid unwelcome surprises.
- (iv) Seek cross-disciplinary input and external expertise, particularly from facilities managers. Materials selection and detail design decisions drive many down-stream environmental impacts, from operational energy efficiency to churn rates. Consulting other parties, such as engineers, owners, and facilities managers (who understand churn issues particularly well) will ensure the best-possible information is available during design. (For example, design air conditioning duct work with additional capacity and flexible ducts to allow for future replanning of an office tenancy).

#### 4.5.2 At an Element and Product Level

- (i) Start by designing with the end of life in mind. If it's not reusable or recyclable to a high value, then it is not sustainable. If this design approach is used it will require the design team to think 'upward', from the construction of building elements, to the whole building.

- (ii) Optimise environmental performance at a product level, across the products/materials life-cycle. Product information and certification services are powerful and useful at this level. For example, specification of timber from FSC Australian sources compared to illegally logged Indonesian rainforests.

#### 4.5.3 At a Practice Level

Demand information from suppliers about the sustainability of their products. This sends powerful messages through the supply chain, and creates incentive for suppliers to differentiate their products on the basis of environmental performance.

For example corporate credentials such as

- triple bottom line reporting (including greenhouse reporting)
- and products credentials. This could include questions such as:
- service life expectancy including durability
  - maintenance requirements including reparability
  - reusability and recyclability: does the supplier offer a take-back option?
  - embodied greenhouse or embodied energy
  - recycled content (including whether after use (post consumer) or factory waste (pre-consumer))
  - location of manufacture
  - constituent materials by percentage
  - if there is renewable (plant or animal product) content, does this come with environmentally preferable accreditation, such as Forest Stewardship Certified for wood products
  - presence of Persistent Organic Pollutants or known carcinogens. Quiz suppliers on what Materials Safety Data Sheets (MSDS) terms mean.
  - Water, both embodied and required for maintenance if applicable (for example dry cleaning some floor coverings can make significant reductions in the quantity of water required over life).

Finally, educate yourself and your colleagues. Building materials' sustainability was not taught in detail at universities when the majority of practitioners were educated. There is a steep learning curve, and examples of best practice continually evolve. Investment in education, and research and development in the sustainable materials area can now be seen as mandatory for design professionals. Only with this knowledge can they offer their clients best-practice outcomes.

#### 4.6 Finding Credible Information

Sourcing credible information remains a key challenge for Australian specifiers. In this regard Australia is not alone; the challenge is global. In response to this, initiatives such as ISO 14020 standards series were developed. These standards fall into three categories:

Type 1 Third party verifications against identified pass/fail criteria such as Good Environmental Choice – Australia (GECA).

Type 2 Self certification by a company.

Type 3 Third-party verified report card using established LCA criteria such as the Dutch MRPI (not yet seen in Australia).

There are also a range of other approaches that are not ISO compliant, and do not neatly fall into any category, such as Ecospecifier and MBDC. Table 6 outlines some useful resources and provides some commentary as to their process approach.

## 5.0 Conclusion

At the time of writing, cutting-edge science makes strong arguments for Australia to reduce greenhouse emissions by 60–90% over the coming decades. With building materials likely to be contributing 3–5% of these embodied energy impacts, and at least 10–20% of operational energy impacts, materials clearly have a big role to play in a sustainable future for greenhouse gas emissions alone. Which raises the question – are such targets achievable?

As we have seen, the selection of preferable products has the potential to reduce key environmental impacts

for many building material applications by 15–50%. Technologies to reduce the environmental impacts of producing high-impact materials by 15–30% are available, or close to commercialisation.

Design for disassembly alone may offer the potential to reduce impacts in some applications by up to 80%. Reducing building size has the potential to reduce impacts by at least 15%. Individually the influence of these strategies is significant; and in combination, they have the potential to radically reduce impacts.

Their implementation will require a fundamental reorganisation of supply chains, business models, and performance metrics, and it is here the challenge clearly lies. The opportunity for specifiers and designers is that the power for driving these changes is substantially in their hands. The challenge for rating tool developers and policy makers, is to provide the missing link by developing methods that more clearly measure and communicate the options, opportunities, and achievements for innovative design teams and product suppliers.

| Resource description                                                                                                                                                           | Advantage                                                                                                                                                                                                     | Disadvantage                                                                                                                                                                                                                                               | Further Information                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <b>Ecospecifier</b><br>A database of self-described environmentally preferable products.<br>(membership based with some products in public domain)                             | This is an extensive database that is easy to use, and provides data on products that may achieve Green Star points. It provides extensive qualitative and quantitative discussion to assist decision-making. | The criteria for listing is not always transparent. It requires evaluation of options by specifier and is not an ISO compliant process (the verification is based on supplier undertakings and expert review, and is not recognised by Green Star rating). | <a href="http://www.ecospecifier.org">http://www.ecospecifier.org</a>                                                             |
| <b>Good Environmental Choice Australia (GECA)</b><br>A free access to certified product lists and standards.                                                                   | This provides an ISO-14025 compliant assurance that products meet standards. These standards are available for review. GECA labelled products are recognised by Green Star.                                   | This resource does not typically assist with side-by-side product comparison, for as a Type I system it, is a non-descriptive pass/fail standard.                                                                                                          | <a href="http://www.aela.org.au">http://www.aela.org.au</a>                                                                       |
| <b>BuildLCA</b><br>Free access                                                                                                                                                 | Excellent context from a number of case study buildings, these overview LCA and provide useful case-studies for overview analysis.                                                                            | This does not give product-level information, but detailed information on embodied energy only. Some links and data are now out of date.                                                                                                                   | <a href="http://buildlca.rmit.edu.au/">http://buildlca.rmit.edu.au/</a>                                                           |
| <b>Environmental Building News</b><br>Membership based                                                                                                                         | An excellent information source on environment and materials related issues, with extensive discussions and checklists, case-studies, and product and specification data.                                     | From the USA.                                                                                                                                                                                                                                              | <a href="http://www.buildinggreen.com">http://www.buildinggreen.com</a><br>in particular, the article What Makes a Product Green? |
| <b>Building Assembly and Materials Scorecard (BAMS)</b>                                                                                                                        | This system will provide LCA-based analysis of different assemblies, made using common generic materials.                                                                                                     | Stage 1 is due for completion at the end of 2007.                                                                                                                                                                                                          | <a href="http://www.cfd.rmit.edu.au">http://www.cfd.rmit.edu.au</a>                                                               |
| <b>MBDC Cradle to Cradle Certification</b><br>A certification scheme (not ISO compliant) that uses cradle-to-cradle criteria developed by McDonough Braungart Design Chemistry | A well-regarded methodological approach to environmentally preferable design using systems thinking, MBDC is recognised by LEED in the USA. Some MBDC rated products are available in Australia.              | This certification is not currently recognised by Green Star, and only a limited number of products are available in Australia. There is limited review or external transparency.                                                                          | <a href="http://www.mbdc.com">http://www.mbdc.com</a>                                                                             |
| <b>Green Guide to Specification</b><br>For purchase.                                                                                                                           | LCA-based checklists on the comparative performance of common building assemblies, and these provide data on where relative impacts occur.                                                                    | Being a UK resource and data, many assemblies are not relevant to Australia. It is for commercial building types only.                                                                                                                                     | <a href="http://www.bre.co.uk">http://www.bre.co.uk</a>                                                                           |

**Table 6. Enabling Resources**

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## Biographies

**Andrew Walker-Morison** (BArch [Hons]) is a former architect, and for four years managed the Sustainable Materials Programme at RMIT's Centre for Design. Andrew was the RMIT manager for commercialisation of 'Ecospecifier' for the Centre, developed the Building Assembly and Materials Scorecard initiative, and is currently involved in a wide range of research and commercial activities related to materials and the built environment.

**Tim Grant** (BAppSci, MEng) is Assistant Director of the Centre for Design and has worked in Life Cycle Assessment for over 10 years. He is the President of the Australian LCA Society and an Adjunct research fellow with CSIRO Marine and Atmospheric Research.

**Scott McAlister** (BSci, PGrad, DipSci) is a life-cycle assessment researcher at the Centre for Design and analyst for the DEH Scoping Study.

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