

cradle to grave

principles of LCA

LCA is a useful tool for determining the overall environmental impact of a building. Janine Strachan explains.

Life cycle assessment (LCA) can be used as a decision-making tool for the assessment of building products when considering the overall environmental impact of a building. But what does it mean?

LCA is a scientific method used to compile and evaluate the environmental impacts of a material, product or service throughout its entire life cycle.

There are five commonly accepted stages in an LCA approach: production, construction, operation, maintenance, and end-of-life. (See box at right.)

In addition, the terms 'cradle-to-grave' and 'cradle-to-cradle' systems are often used. 'Cradle' refers to the extraction and processing stage of raw or recycled materials. 'Grave' refers to the material or product when it is no longer deemed

to have value at the end of its life cycle and is disposed of. Finally, where the material is deemed to have value at the end-of-life and can be reprocessed or reused it is referred to as going back to the 'cradle'.

What can LCA be used for?

LCA is used to formulate and review information that will allow the user to evaluate the environmental impact of materials or products, or compare materials and products intended for the same use.

LCA can be used to identify where improvements can be made throughout the life cycle stages to reduce its environmental impact. For example, an LCA study could be undertaken to measure the environmental impact of alternative materials used in a flooring system.

There are a number of LCA-based software tools being developed that are linked to thermal performance modelling of buildings (such as AccuRate) which will provide a 'whole-

of-house' LCA. These can be used as a decision-making tool for builders, designers and consumers.

Information provided in an LCA can allow designers and builders to make informed choices on, but not limited to, material selection, suitability of materials in particular climates, durability and recyclability and its influence on design. It is important to understand that the strength of LCA in the housing sector is measuring the environmental performance of a single material (or products or the home) through all the LCA stages.

And while the interpretation of the LCA results can provide a comparison of or benchmark against products in a specific house these results can differ

The five LCA stages

- **Production** Extracting raw materials, transport of materials to production plant and the manufacturing process.
- **Construction** Transport of product and construction workforce to site, installation and application of materials/products.
- **Operation** Influence of the material/product on the heating and cooling operations of the building.
- **Maintenance** Maintain a product to ensure quality is retained for the intended lifespan of the building. This stage could include renovation projects.
- **End-of-life** Ability to reuse or recycle material or product at the building's end-of-life, or the generation of waste to landfill.

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BUILDING PRODUCTS LIFE CYCLE INVENTORY

The Building Products Life Cycle Inventory website is under development. Please contact BPIC for urgent inquiries about the Building Products Life Cycle Inventory.

Life Cycle Inventory

Life Cycle Assessment

The Building Products Innovation Council developed the Building Products Life Cycle Inventory (BP LCI) to serve the national interest in improving the impact of the built environment. It is a freely available service developed and maintained by the building industry. It provides a nationally consistent and scientifically reliable method and database for conducting Life Cycle Assessment of building products.

LCI NEWS

- Building Industry Seminar2 09_2011 (5378 KB)
- New Toolkit for building material life cycle resources Jan2011 (178 KB)
- BP LCI EcoTools Workshop Presentation (10285 KB)

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because of changing LCA parameters or location. (See examples below).

While comparisons of different products based on embodied energy are important, this makes up only the production stage of an LCA and therefore does not give the complete picture of a product's environmental impact.

Results of an LCA could be used to demonstrate or communicate how much carbon dioxide emissions are released during the life of the home as a measure of the home's carbon footprint, but it is certainly not limited to reporting on a single element.

Where do you start?

An LCA study consists of four phases: goal and scope definition, life cycle inventory analysis (LCI), life cycle impact assessment (LCIA), and interpretation. The detail of each will vary depending on the information available and information sought by the client.

Different parameters equal different results

Example 1: Compare two identically designed brick veneer houses, one located in Melbourne and the other in Brisbane. The homes are constructed using the same material, which has been sourced from the same plants midway between each location. While the LCA should demonstrate close to identical results through the production, construction, maintenance and end-of-life stages they have the potential to vary the results of the operational stage, through a varied heating and cooling load as a direct influence of climate, design and material selection.

Example 2: Compare two adjacent and identically designed houses that achieve five stars. One is clad with fibre cement sheeting with an insulated timber frame, and the other uses a brick veneer wall. When performing a whole-of-house, whole-of-life LCA the houses may achieve different LCA results throughout the five LCA stages – production, construction, operation, maintenance and end-of-life.

The setting of a *goal and scope definition* is usually undertaken with guidance from an LCA practitioner, to ensure that the International Standards Organisation standards 14040 and 14044 are adhered to, and to ensure the client understands the type of information that will be reviewed and presented in the LCA report.

The strength and rigour of an LCA is dependent upon the accuracy and relevance of detail provided in the *LCI phase*. Here, the energy, water and material flow into and out of the environment are quantified using a unit of measure for the material. This ensures data is collected and presented in a consistent manner. Inputs include the use of raw materials, water, transport fuel and process fuel consumed by all supply chain operations. Outputs relate to the discharge of substances including emissions to air and land, discharge to water, creation of product, co-products, by-products and wastes. This data can be generated by a manufacturer or collectively for an industry, and input into a database for use in LCA studies.

It's rare that a product or option scores better than others in all of the categories

The *LCIA phase* is aimed at evaluating the contribution to environmental impact categories such as ozone depletion, acidification, eutrophication, resource depletion, habitat destruction, human toxicity and climate change. The first step is termed characterisation, where impact potentials are calculated based on the LCI results.

It's rare that a product or option scores better than others in all of the categories, so making decisions based on the LCA results may involve tradeoffs. To make tradeoffs, a decision needs to be made as to how important each category is compared to the others.

Some systems will then include steps for normalisation and weighting, but these are both voluntary. Where this is not provided, builders can make their own decisions about what environmental impacts are of most

importance to the project, such as reducing embodied energy, water consumption or maintenance.

The *interpretation phase* is a systematic technique to identify, quantify, check, and evaluate information from the results of the LCI and LCIA phases; determine the level of confidence in the final results; and communicate them in a fair, complete, and consistent manner.

Australian LCI data

An important component of a rigorous LCA relies on the ability for LCA practitioners to access local data, and until now Australian building product data has not been readily available. However, the Building Products Innovation Council (BPIC) has recently released its building products life cycle inventory (BPLCI). This provides two fundamental building blocks for building product LCA work:

1. Methodology – the recommended methods for measuring and reporting the environmental impact of building products and using this data for LCA of building products.
2. Database – the information required to conduct LCA of building products.

It is anticipated that the BPLCI will be used by LCA practitioners performing LCAs, incorporated into LCA software tools, incorporated in building design tools, and be used for environmental assessment by the operators of third party environmental accreditation schemes.

The database currently contains around 150 common building products, and this is likely to grow as more manufacturers and suppliers become familiar with the inventory and its purpose.

Ultimately, an LCA study provides information that can be of value to a manufacturer, designer or builder – information that can help identify areas of improvement in the environmental performance of a material, product or home.

LCAs can be a valuable resource which, when performed as a whole-of-life, whole-of-house LCA can provide the industry with information for strategies to reduce a home's overall environmental impact.

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