Life Cycle Assessment in Green Star

Discussion Paper 2

greenstar Developed by the Green Building Council of Australia

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1.0	18/09/13	Released for public comment and feedback.

Executive summary

Life cycle assessment (LCA) methodology is used to estimate and compare the overall environmental impact of materials or products during their lifetime.

In 2012, the Green Building Council of Australia (GBCA) released a discussion paper - Life Cycle Assessment in Green Star seeking feedback from industry stakeholders on how LCA could be effectively incorporated into the Green Star rating tools for building design, construction and interior fitouts.

The feedback provided has allowed us to assess stakeholder support for a variety approaches to introducing LCA to the Green Star rating system and has informed the development of two LCA-based draft credits – the 'Materials Life Cycle Impacts' and 'Environmental Product Declarations'. These credits are now available for use by Green Star project teams as 'Innovation Challenges'.

In developing the draft credits we have attempted to strike a workable balance between stakeholder views, the benefits of LCA and the current limits to LCA data availability within the Australian market. We hope that the use of the draft credits as part of the Green Star Innovation Challenges initiative will drive LCA use and data dissemination, as well as deliver documented environmental impact reduction outcomes for individual Green Star projects.

Through this discussion paper we hope to engage industry in a second round of consultation and gain stakeholder feedback on the 'Materials Life Cycle Impacts' and 'Environmental Product Declarations' credits. The paper outlines the rationale that has informed the development of the credits and identifies areas where we seek specific stakeholder discussion and feedback.

Introduction

Based on initial industry feedback received from Green Star users and other industry stakeholders on the incorporation of LCA methodology into the Green Star rating tools, draft credits have been developed as a vehicle by which to introduce LCA methodology and test the approach. The two draft credits - 'Materials Life Cycle Impacts' and 'Environmental Product Declarations' were released in August 2013 and operate as 'Innovation Challenges'.

'Innovation Challenges' are a new initiative that has been introduced to encourage and direct investment in solutions that address a wide range of social, economic and environmental sustainability issues and test new Green Star credits. More information on Innovation Challenges is available at: www.gbca.org.au/green-star/innovation

As feedback and data is provided to us by Green Star project teams that target the 'Materials Life Cycle Impacts' and 'Environmental Product Declarations' credits over time, the guidance and benchmarks for each will evolve and new iterations of the credits will be released.

In addition to this process of refinement through use, we would like to gain initial stakeholder feedback on the credits via this discussion paper. Below are a number of topics and issues about which we seek your further comments and feedback; with criteria and compliance requirements a particular focus.

Please not that several LCA-specific concepts and terms are referenced throughout the paper, and further reading may be necessary. This discussion paper should be read in conjunction with the following documents:

- *Life Cycle Assessment in Green Star Discussion Paper*, August 2012 (download via www.gbca.org.au)
- *Life Cycle Assessment in Green Star Stakeholder Feedback Report*, September 2013 (download via www.gbca.org.au)
- Green Star Environmental Product Declarations Draft Credit (Appendix 1)
- Green Star Materials Life Cycle Impacts Draft Credit (Appendix 2)

Providing your feedback

This paper is intended to generate open discussion and prompt feedback on the approach we've taken to introducing LCA to the Green Star rating system. Feedback prompts on specific issues are included in breakout boxes however general feedback is welcomed on any aspect of the draft credits. You can submit your feedback as a written report, addressed to: tool.development@gbca.org.au. All feedback should be provided by Friday 15 November 2013.

The 'Environmental Product Declarations' credit

The Green Star 'Environmental Product Declarations' draft credit encourages the use of products for which Environmental Product Declarations (EPDs) are publically available. EPDs are defined in ISO 14025, EN 15805 and ISO 21930 as declarations that provide verified environmental impact information to meet market needs. EPDs support organisations in communicating the environmental performance of their products and services in a credible and understandable way.

The generation of EPDs for products and materials for the building market is growing in many parts of Europe and North America, and emerging in Australia and other parts of the world. The Green Star 'Environmental Product Declarations' draft credit aims to increase the demand for, and availability of EPDs by building material and products manufacturers and suppliers in Australia. It is hoped that the use of the credit will result in increased industry capacity to benchmark products and materials using EPDs, and simplify the undertaking of whole-of-building, whole-of-life life cycle assessments.

It is important to note that the draft 'Environmental Product Declarations' credit differentiates between the use of industry wide EPDs and product specific EPDs. While the use of product specific EPDs is prioritised on the basis that product specific data allows for accurate comparisons between product options that are similar (eg: two types of timber flooring), project teams do have the option of using industry wide EPDs.

The draft 'Environmental Product Declarations' credit requires that the EPDs have been issued by schemes that conduct independent audits of the EPD, apply a cradle-to-gate scope at minimum and that the EPD has been peer reviewed by a third party. These requirements have been implemented to ensure reliable and useful data is generated and collated and that industry best practice is encouraged.

The draft 'Environmental Product Declarations' credit does not limit the scope of products and materials for which EPDs can be used and assessed. Instead, initial benchmarks have been set that will allow project teams to demonstrate the amount of products and materials with EPDs that have been used within their Green Star project as a percentage of the project's total contract value.

The initial percentage benchmarks of 4 and 8 per cent of contract value respectively have been deliberately set at relatively low levels in keeping with the as yet limited availability of products and materials for which EPDs are available in the Australian market.

These benchmarks will be tested through the use of the credit as an Innovation Challenge and may be increased over time to accelerate the use of products and materials with EPDs in Green Star projects.

The proposed number of points available for projects using the 'Environmental Product Declarations' credit (a maximum of 2 points) is proportionate to the benefit of achieving the benchmarks as they currently stand, but may also increase in proportion to increases to the benchmarks over time.

Despite the varied manner of presentation for EPDs across the market, we believe that Green Star users and Assessors will be able to review an EPD and quickly and conclusively determine whether it meets the compliance requirements of the credit.

The Green Building Council of Australia seeks your feedback on the following:

- Do you agree that the approach taken within the credit will encourage the use of EPDs by Green Star projects?
- Do you agree with the initial benchmarks and points available: 4% (1 point) and 8% (2 points)?
- Do you agree with the prioritisation of product specific EPDs over industry wide EPDs?
- Do you have any comments or suggestions for improvements to the 'Environmental Product Declarations' credit's compliance requirements?
- After reviewing the requirements for determining the compliance of an EPD with the credit, are you confident that you would be able to quickly and conclusively determine EPDs that are compliant with the credit and those that are not? For examples of EPDs please visit: http://www.environdec.com/en/EPD-Search/ or http://bau-umwelt.de/hp481/Environmental-Product-Declarations-EPD.htm.

The 'Materials Life Cycle Impacts' credit standard practice and actual reference case criteria

The Green Star 'Materials Life Cycle Impacts' draft credit encourages project teams to perform holistic life cycle assessments of their buildings and fitouts and demonstrate that their project performs better in most impact categories than a reference case building.

The credit requires Green Star projects teams to undertake a whole-of-building, whole-of-life (cradle-to-grave) LCA for the building or fitout project undergoing Green Star assessment, and another for a comparable reference case. The results of these LCAs are compared in order to quantify the impact reductions generated by the Green Star project.

A 'Standard Practice Reference Case' is a hypothetical building or interior fitout project that is taken to represent comparable design and construction techniques, building type and use to the Green Star project, but that conforms only to minimum regulatory requirements (or represents a business-as-usual approach to products and materials selection and use).

An 'Actual Reference Case' is a real building or interior fitout project that has been constructed within the past five years that is taken to represent comparable functional and design attributes to the project undergoing Green Star assessment.

Rationale for the Reference Case Criteria

A reference case comparison approach to LCA was first proposed for the credit as part of the Life Cycle Assessment in Green Star Discussion Paper (released August 2012). A reference case compression model was preferred by around 40 per cent of stakeholders who provided feedback.

Some stakeholders suggested that the GBCA should create this reference case in advance of the release of a Green Star LCA based credit, however to facilitate accurate case comparisons the 'Materials Life Cycle Impacts' draft credit requires Green Star project teams to develop their own reference cases.

The criteria for the creation of individual reference cases by project teams have been introduced in order to avoid a lengthy reference case development process by the GBCA, which is not guaranteed to result in workable reference case outcomes.

To ensure the reference case that is created by project teams is appropriate, signed declarations and other documents from the principal architect and engineer for the project are required. These declarations will be used to confirm that the reference case has been developed in accordance with the requirements of the 'Materials Life Cycle Impacts' credit. LCA peer review requirements have been set to provide a further layer of assurance that the reference case and subsequent LCA results are accurate.

As the 'Materials Life Cycle Impacts' credit is used by Green Star project teams and reference data collated, a prescribed reference case will be able to be developed by the GBCA. This will remove the need for project teams to develop individual references cases for each project. Once established, this reference case will evolve over time, in line with new trends in collated data. The GBCA will make collated data publically available in aggregate form.

More on future intentions for the credit can be found in the 'Implementation and review' section of this paper.

The Green Building Council of Australia seeks your feedback on the following:

Do you agree that the requirement for project teams to develop their own reference cases is an adequate and appropriate interim solution until such time as a prescribed reference case can be developed?

Do you have any comments, feedback or suggestions for improvement for the 'Materials Life Cycle Impacts' draft credit's compliance requirements regarding the establishment of a reference case?

The 'Materials Life Cycle Impacts' credit product category rules

Product category rules are a set of requirements and guidelines for developing and publishing LCAs. The following product category rules have been developed for the draft 'Materials Life Cycle Impacts' credit.

Scope

The scope for the LCA undertaken for the 'Materials Life Cycle Impacts' credit is 'whole-of-building'. For the purposes of the 'Materials Life Cycle Impacts' credit the definition of 'whole of building' is as defined by EN 15978, and is essentially taken to encompass all of the materials used within the rated project from 'cradle to grave'.

In the Life Cycle Assessment in Green Star Discussion Paper that was released in August 2012, it was proposed that a simplified scope be adopted, in order to minimise the time and costs associated with targeting the credit. However the feedback that was received from stakeholders indicated that increasing the scope to account for all material inputs would not necessarily represent great increases in effort for project teams and that the industry's general preference was for a scope that delivers a comprehensive life cycle assessment without restrictions.

The Green Building Council of Australia seeks your feedback on the following:

IS the EN 15978 definition of 'whole-of-building' appropriate for use here? If not, what alternative definitions could be used and why?

System Boundary

The system boundary for the LCA undertaken for the 'Materials Life Cycle Impacts' credit is 'whole-of-life'. This boundary has been chosen in an effort to ensure robust LCA results that take into account the impacts of materials and products during building construction, in-use, and at the end of their useful life within a building or fitout. The whole-of-life system boundary is a common feature of existing building LCA frameworks worldwide, and is currently being used in other LCA frameworks, Eg EN 15978.

Current EN 15978 and EN 15804 standards provide a source of definitions and rules regarding the whole of life (cradle-to–grave) life cycle assessment of construction products and materials. EN 15978 includes consideration of the following life cycle stages:

- **Product stage:** the raw material, the manufacturing process and transport
- **Construction stage:** transport to the building and installation
- **Use stage:** the use of the installed product or material, maintenance, repair and replacement
- **End of life stage:** deconstruction and demolition, transport to waste processing, waste processing, re-use and recycling and waste disposal.

The EN 15978 standard also provides rules and clarifications on how these life cycle stages should be represented in LCAs.

As the option preferred by most local stakeholders, EN 15978 and EN 15804 standards have been referenced in the 'Materials Life Cycle Impacts' draft credit. As the credit is used by project teams, the applicability of these standards and the way they are interpreted by LCA practitioners will be evaluated, and where necessary further rules will be set.

As suggested by stakeholders in prior rounds of consultation, a 60 year building lifespan has been adopted for default use within the 'Materials Life Cycle Impacts' credit. Alternative lifespans can be used where they are required by the client or by regulation.

The Green Building Council of Australia seeks your feedback on the following:

Is EN15978 an appropriate reference for building life cycle stages and scenarios?

Do you see a need to determine further rules on maintenance and repair beyond EN 15978?

Is a 60-year lifespan for building an appropriate default lifespan? If not, what alternative would you suggest?

Functional Unit

The functional unit that has been adopted within the 'Materials Life Cycle Impacts' draft credit is one square metre of project area (as relevant to the rating tool under which the project is registered) consistent over the life of the project, eg gross floor area (GFA) or Net Lettable Area (NLA). This unit is an expansion of the unit originally suggested in the Life Cycle Assessment in Green Star Discussion Paper (August 2012) and will help to ensure a variety of building types are accommodated and that the data collated can be categoried by building type if required.

The Green Building Council of Australia seeks your feedback on the following:

- Any aspect of the functional unit adopted.

Impact Categories

The impact categories to be reported by project teams who target points under the 'Materials Life Cycle Impacts' credit are:

- climate change
- mineral fuel and fossil fuel depletion (abiotic depletion)
- eutrophication
- human toxicity

Reductions against these impact categories will determine the number of credit points achieved. These impact categories are well developed and used in existing LCA frameworks, Eg EN 15978, EN 15804 and ISO 21930, and correspond with the primary impact categories the Green Star 'Materials' category seeks to influence. The selection of a limited number of impact categories also aligns with the recommendations of the *Best Practice Guide for Life Cycle Assessment in Australia* (Grant and Peters, 2008).

In line with stakeholder feedback, the following impact categories have not been selected as impact categories within the credit:

- Water footprint: an agreed characterisation method for use in LCA is yet to be developed for water footprint. In addition, the Green Star 'Water' category contains the potable water credit which we believe accounts for operational water use sufficiently.
- Respiratory effects: this impact category is largely captured under the human toxicity impact category which has been incorporated within the draft 'Materials Life Cycle Impacts' credit.

- Indoor environment quality: an agreed characterisation method is yet to be developed for use in LCA for indoor environment quality. At present, the Green Star 'Indoor Environmental Quality' category is a superior method of evaluating indoor environment quality.
- Ozone depletion: this impact category is sufficiently addressed in Green Star rating tools through the application of the 'Refrigerants Impact', 'Greenhouse Gas Emissions' and 'Insulant ODP' credits.
- Nuisance, land transformation, occupation and biodiversity, soil salinisation, eco-toxicity and acidification: an agreed characterisation method for use in LCA is yet to be developed to address these impact categories.

As the understanding of how such impact categories should be accounted for in LCA grows, these impacts may be included in future iterations of the 'Materials Life Cycle Impacts' credit. To facilitate this, the draft credit includes a third criterion - 'Additional Life Cycle Impact Reporting' which encourages reporting of further impact categories.

Based on stakeholder feedback regarding transparency and robustness, and to align with the structure and operation of existing LCA standards such as ISO 14040, no weightings have been assigned to the environmental impact categories assessed in the LCAs undertaken as part of the 'Materials Life Cycle Impacts' draft credit.

The Green Building Council of Australia seeks your opinion on the following:

- Is it clear why the four impacts of climate change, mineral fuel and fossil fuel depletion (abiotic depletion), eutrophication and human toxicity have been selected for the first iteration of the 'Material and Life Cycle Impacts' credit?
- Do you agree that the 'Additional Life Cycle Impact Reporting' criterion is an appropriate and effective way to facilitate and encourage reporting across other impact categories and build the industry's understanding of how LCA should be completed in relation to such categories? If not, what alternatives would you suggest?

Data sources

Data selection for the purpose of the 'Materials Life Cycle Impacts' draft credit follows the method established in EN 15978; whereby an LCA practitioner must satisfy a number of criteria to ensure data suitability, data selection must be reported and subjected to peer review. This approach to data selection has been adopted in order to ensure data quality is maintained and to align the data selection process with the established data selection requirements found in EN 15978.

As use of Australian data is most desirable, the 'Materials Life Cycle Impacts' credit requires project teams to preference the use of Australian data as far as possible, with data from other markets to be adjusted for Australian conditions.

The Green Building Council of Australia seeks your feedback on the following:

- Do you agree with data selection requirements of the 'Materials Life Cycle Impacts' credit? If not, why?

The 'Materials Life Cycle Impacts' credit reference case criteria benchmarking

In order to gain full points under the draft 'Materials Life Cycle Impacts' credit, project teams must be able to demonstrate that a Green Star project achieves a cumulative reduction of 100 per cent on the reference case across the four impact categories. Cumulative reductions lower than 100% are awarded with an appropriate fraction of the available points.

This initial benchmark will be tested as the 'Materials Life Cycle Impacts' credit is used and adjusted as necessary over time. It is acknowledged that as the benchmark increases achieving increasingly marginal reductions in environmental impact will inevitably become more difficult (law of diminishing return). Where this occurs, a descending benchmark may be adopted in favour of the current linear approach to benchmarking.

As the creation of a hypothetical reference case is inherently limited, the 'Materials Life Cycle Impacts' draft credit offers four points for project teams that use a Standard Practice Reference Case, while five points are availanle for those that use an Actual Reference Case. By offering more points, it is hoped that project teams will be encouraged to adopt the Actual Reference Case criterion approach, resulting in more accurate and reliable reference case data and impact reduction documentation.

The Green Building Council of Australia seeks your feedback on the following:

- Do you agree with the initial cumulative reduction benchmark of 100% on the Reference Case across the four impact categories?
- After reviewing the points available for percentage reductions below the highest 100% cumulative reduction benchmark within the draft 'Materials Life Cycle Impacts' credit, do you have any feedback, comments or suggestions for improvement?

LCA Practitioner

Green Star project teams who wish to target the 'Materials Life Cycle Impacts' credit will need to commission suitable LCA practitioners to undertake and peer review the LCAs for their projects. As the integrity of the LCAs conducted rest on the competencies and experience of LCA practitioners, competency requirements have been developed for the 'Materials Life Cycle Impacts' credit.

These competencies require both the LCA practitioner and the peer reviewer to have conducted or peer reviewed at least five LCA studies over the past three years. This requirement is designed to ensure the individuals engaged by Green Star project teams are experienced in the practical intricacies of LCA and are regularly engaged in LCA work.

The LCA practitioner competency accreditation currently under development by the Australian Life Cycle Assessment Society (ALCAS) applicability for determining LCA practitioner competence in relation to the 'Materials Life Cycle Impacts' credit once it is available.

The Green Building Council of Australia seeks your feedback on the following:

- Do you agree with the competency requirements for LCA practitioners that have been adopted for the 'Materials Life Cycle Impacts' credit? Do you have suggestions for improvement?

Implementation and review

The draft 'Materials Life Cycle Impacts' and 'Environmental Product Declarations' credits are now available for project teams to use in a preliminary capacity in the form of Innovation Challenges.

Based on the feedback provided by stakeholders as part of this round of stakeholder review (September - November 2013) the credits may be amended, but will continue to be tested through use as Innovation Challenge on an ongoing basis.

All Green Star projects registered under the Green Star rating tools for Design, As Built and Interiors are able to use the credits to claim Innovation category points. A total of eight unweighted points can be achieved by use of these credits in combination.

As many of the features of the draft credits are at this stage untested in the Australian market and the Green Star context, the first iteration of the credits as Innovation Challenges provides an opportunity for their refinement through user feedback and data collection.

The following indicative timeline outlines our current expectations about the introduction of new iterations of the 'Materials Life Cycle Impacts' and 'Environmental Product Declarations' credits:

- **August 2013:** Draft 'Environmental Product Declaration' and 'Materials Life Cycle Impacts' are released as Innovation Challenges. The credits will remain within the Innovation category based on uptake by Green Star projects.
- **February 2014:** The credits may undergo changes based on stakeholder feedback to this discussion paper and use as Innovation Challenges by Green Star projects.
- **August 2014:** Once sufficient uptake of the credits within the Innovation category is achieved, it is proposed that the 'Environmental Product Declaration' and 'Materials Life Cycle Impacts' credits will become permanent credits within the Green Star 'Materials' category within the new Green Star – Design & As Built rating tool, currently under development. The credits will operate alongside prescriptive credits within the 'Materials' category and provide an alternative compliance pathway for claiming points.
- **2015 - 2016:** When data collated from use of the 'Materials Life Cycle Impacts' credit is sufficient a prescribed reference case will be developed to serve as benchmarking for the credit. The timing for the development of the prescribed reference case will depend upon the uptake of the credit by project teams, but is expected to take place within first two years of the credit's addition to the Materials category.
- **2015 – 2016:** When significant use of EPDs is achieved as a result of the 'Environmental Product Declarations' credit, the credit benchmarking may be evolved based on the data collated. EPDs will also become a valuable data source for conducting whole-of-building whole-of-life LCA as part the 'Materials Life Cycle Impacts' credit going forward.

At all stages of the 'Materials Life Cycle Impacts' and 'Environmental Product Declarations' credits' development we will clearly communicate any proposed changes, and engage in consultation with industry.

The Green Building Council of Australia seeks your feedback on the following:

- Is the proposed process to release future versions of the Materials Life Cycle Impacts and Environmental Product Declarations credits clear?

Appendix 1: 'Environmental Product Declarations' credit

Points available: 2

Aim of Credit

Increase the availability of building or fitout products that have environmental product declarations publicly available.

Credit Criteria

Environmental Product Declaration (EPD)	In order for the compliance requirements to be met, products and materials used in the building or fitout must have a publically available Environmental Product Declaration (EPD).
	
	Up to two points are available. One point is available where 4% of the project contract value complies with the requirements within the credit. Two points are available where 8% of the project contract value complies with the requirements within the credit.
	
	Two options are recognised as follows:
	
	• Products with an industry wide, third-party verified EPD.
	  ○ The EPD is audited by an independent EPD scheme operating in conformance to ISO 14040, ISO 14044, ISO 14025 and/or EN15804 and/or ISO 21930.
	  ○ The product manufacturer is recognised as a participant in the EPD;
	  ○ The EPD is based on a cradle to gate scope at minimum;
	  ○ Cost of products is to be accounted at half (1/2) the actual cost.
	• Products with a product specific, third-party verified, EPD.
	  ○ The EPD is audited by an independent EPD scheme operating in conformance to ISO 14040, ISO 14044, ISO 14025 and/or EN15804 and/or ISO 21930.
	  ○ The EPD is based on a cradle to gate scope at minimum;
	  ○ Cost of products is to be accounted at actual cost.

Compliance Requirements

Environmental Product Declarations - EPD

Environmental Product Declarations (EPD) as defined by ISO 14025 support communication of life cycle environmental performance of products, materials and services in a credible and understandable way.

EPD Schemes

There are several independent EPD schemes operating globally, providing services associated with the release and publishing of EPDs on behalf of participants. EPD schemes can differ, amongst other aspects, in the life cycle stages considered and whether the EPDs are independently verified.

Only EPDs published by schemes that consider a minimum cradle to gate scope and include independent verification are recognised in this credit. Published EPDs shall confirm compliance to listed standards and include the scope considered and by whom the EPD was verified.

Guidance

Standards noted in this credit

Standards for this credit include:

- EN 15804 *Sustainability of Construction Work - Environmental Product Declarations - Core Rules for the Category of Construction Products*.
- ISO 14025 *Environmental labels and declarations - Type III environmental declarations - Principles and procedures*
- ISO 14040 *Environmental management - Life cycle assessment - Principles and framework*
- ISO 14044 *Environmental management - Life cycle assessment - Requirements and guidelines*
- ISO 21930 *Sustainability in building construction - Environmental declaration of building products*

Definitions

Environmental Product Declaration as defined by ISO 14025, is a standardized tool to communicate the environmental performance of a product or system.

Project Contract Value is the dollar value that will be required to complete the works for the entire Green Star rated project, including site works (landscaping, external paving, etc).The following must be excluded when using the contract value for calculations of such Credits:

- Demolition works;
- Consultants, design fees, project management fees;
- Works outside the site area; and
- Buildings or areas within the site that are not being assessed for purposes of Green Star.

Life cycle Assessment (LCA) An evaluation of the environmental effects of a product or activity holistically, by analysing the entire lifecycle. LCA consists of four complimentary components: goal and scope definition, inventory analysis, impact assessment and interpretation. Further definitions are found in ISO 14040 and ISO 14044.

LCA terms, frameworks and standards – it is beyond the scope of the credit to introduce the reader to many LCA terms, frameworks and standards used or referenced within this document. Further reading may be necessary.

Documentation Requirements - Design and As Built

- Short report
- EPD documentation

Short report listing the points claimed, the contract value of EPD products and materials, the project contract value and relevant percentages.

EPD documentation for relevant materials or products highlighting relevant features, including the products names, life cycle scope considered and confirmation the EPD was independently verified.

References

Eurime 2012 ‘Analysis of five approaches to environmental assessment of building components in a whole building contex’, http://www.eurima.org

Appendix 2: 'Materials Life Cycle Impacts' Credit

Points available: 6

Aim of Credit

Assess and reduce the environmental impacts of building materials for the whole building over its entire life cycle.

Credit Criteria

Reference Case - Standard Practice Reference Case	Whole of building, whole of life (cradle-to-grave) life cycle assessment (LCA) is undertaken for the project and for a standard practice reference case. A standard practice reference case is a hypothetical building or fitout created for the project to represent standard contemporary design and construction practices. Up to four points are available in this criterion. These points may be claimed where a reduction against four environmental impacts categories is achieved when compared to the reference case.
Reference Case - Actual Reference Case	Whole of building, whole of life (cradle-to-grave) life cycle assessment (LCA) is undertaken for the project and for an actual reference case project. An actual reference case project is a building or fitout constructed in the last five years and is similar in use and scale to the project. Up to five points are available in this criterion. These points may be claimed where a reduction against four environmental impacts categories is achieved when compared to the reference case.
Additional Life cycle Impact Reporting	Where any points are claimed in one of the above criteria, a further one point is available where the LCA conducted by projects includes reporting of a further five impact categories.

Compliance Requirements

Standard Practice and Actual Reference Case

The following provides guidance to both Reference Case Criteria, unless stated as 'specific' to one of these criteria.

The guidance includes the type of LCA to be applied, specific criterion guidance and LCA practitioner competencies requirements.

Whole of building, whole life product category rules

When conducting an LCA of the project and a reference case the following methodology is to be followed.

Scope	**Whole of Building as defined in EN 15978**
System Boundary	Cradle to grave as defined in EN 15978 including all life cycle stages and scenarios detailed.
Functional Unit	One square metre (m2) project floor area (GDA, GFA, GLAR or GLA) as relevant to Green Star rating tool to which the project is registered. Gross Dwellable Area (GDA) – Green Star – Multi Unit Residential Gross Floor Area (GFA) – Green Star – Education, Green Star - Healthcare and Green Star – Public building Gross Lettable Area – Retail (GLAR) – Green Star - Retail Gross Lettable Area* (GLA) – Green Star - Industrial Net Lettable Area (NLA) – Green Star – Office Design and As Built and Green Star –Interiors.
Service Life	The service life required by the client or through regulations. If no required service life is defined, a default service life of 60 years is to be applied.

Impact Categories

Impact Category	Unit	Characterisation Methods*
Climate change	kgCO2 eq	IPCC
Mineral and fossil fuel depletion (abiotic depletion)	kgSb eq	ML 2 baseline 2001
Eutrophication	kg PO4 eq	CML 2 baseline 2001
Human toxicity	kg 1,4-DB eq	DALY

*based on Grant and Peters, 2008

A further one point is available where the LCA conducted by projects includes reporting of a

	further five impact categories. See 'Additional Life cycle Impact Reporting' guidance.
Data Quality	Selection of data to be based on EN 15978. Data quality to be reported and is subject to peer review. Use of Australian data should take precedent over imported data where available. Where imported data is used this must be adapted for relevance to Australian conditions (for example energy sources, transport distances and modes) and documented to show how the data was adapted.

Benchmarking points

Points are awarded based on a cumulative percent reduction; this is the sum of all impact category reductions between the project and the reference case. Impact categories reductions are unweighted.

Points achieved are to be determined on the basis of the following benchmarks:

- For Standard Practice Reference Case, one point may be claimed for every 25% cumulative reduction, or fraction of, to a maximum of four points (a 100% cumulative reduction). The final score is rounded to include one decimal point.
- For Actual Reference Case, one point may be claimed for every 20% cumulative reduction, or fraction of, to a maximum of five points (a 100% cumulative reduction). The final score is rounded to include one decimal point.
- Where one of the impact categories is increased by more than 5%, **no points may be claimed**.

For example, an 83% cumulative reduction under Standard Practice Reference Case results in 3.3 points, calculated as 0.04X83. The same cumulative reduction under Actual Reference Case results in 4.2 points, calculated as 0.05X83.

Difference benchmarking for the two criteria is aimed at addressing inaccuracies and assumptions inherent in creating a hypothetical reference case, as opposed to the more accurate real world actual reference case.

Standard Practice Reference Case– Specific Guidance

The reference case is to be designed using conventional materials predominant for the building or fitout type deemed compliant to current National Construction Codes (NCC), as detailed in the Building Code of Australia (BCA). Modelled energy consumption must be based on BCA Section J deemed to satisfy (DTS) compliance. Maximum permissible lighting levels in line with BCA must be used. Heating and cooling appliances must comply with efficiencies which meet the latest Minimum Energy Performance Standards (MEPS) and where relevant BCA Section J DTS requirements. Building fabric must also be compliant with BCA Section J DTS requirements. This building or fitout is referred to as the "reference case".

To ensure the reference case is appropriate, projects are required to submit signed declarations from the principal architect and engineer for the project, confirming the reference case was constructed in accordance with the credit criteria. Also confirming the reference case design, technologies and construction are true representation of contemporary practice for the type and function of the project.

Actual Reference Case– Specific Guidance

This criterion of the credit is only available where data for a suitable existing building or fitout is available to projects; this data is the basis for the reference case. This entails an actual building or fitout constructed in the last five years.

The age of the reference case is measured between the project registration for Green Star and the date of occupancy certificate for the reference case. This applies equally in a Design or As Built situation. A Design registration date shall take precedent where a project undergoes both a Design and As Built assessment.

Both the reference case and project must have the same structural requirements, scale, function and location. Where possible the two buildings also have a similar orientation, and season of construction. In relation to scale and in light of the possible difficulty in finding a reference case of exactly the same scale as the project, it is acceptable to adjust data for an existing reference case to represent the scale of the project.

To ensure the reference case is appropriate, projects are required to submit a declaration from the principal architect and engineer for the project, confirming and demonstrating how the reference case meets the credit criteria. In establishing this, as-built drawings and bill of quantity pertaining to the reference case must be provided. Where such documentation is not available points for the Actual Reference Case criterion cannot be claimed.

Documenting LCA results

The results of the LCA are to be presented in accordance with ISO 21930. The LCA report must confirm compliance to the requirements of the credit; the robustness of the result; provide an uncertainty and sensitivity analysis and confirm no impact increases by more than 5% when compared to the reference case score.

Peer Review

The LCA must be peer reviewed by an independent agent as stated in ISO 14044.

LCA Practitioner competencies

The LCA practitioner and peer reviewer, conducting the LCA and peer review on behalf of the project, must be established to undertake LCA work.

For the purpose of this credit and whilst an Australian LCA practitioner accreditation system does not exist, an LCA practitioner is an individual or organisation who have produced or independently peer reviewed at least five LCA studies in the past three years. Projects are require to submit a competencies statement from the practitioners undertaking the LCA and the peer review, referencing five studies and providing documentation to establish when these were completed.

Additional Life cycle Impact Reporting

One point may be claimed where the LCA methodology impact category selection is expanded to account for at least a further five impacts. Selection of these, characterisation methods and units used are to be justified by the LCA practitioner for use in Australia and are subject to peer review.

Relevance to the system should also be considered, but it may be argued impact categories have been selected to test how relevant they are to the system.

Reduction against these impact categories achieved by projects, cannot account for points claimed within this credit.

The Additional Life cycle Impact Reporting criterion is aimed at encouraging development of Australian relevant characterisation methods for impact categories that are underdeveloped in LCA. Reporting against such impact categories may result in incorporation of a wider range of impact categories in future additions of this credit.

Examples of impact categories that are underdeveloped in LCA include; acidification; water footprint; respiratory effects; nuisance and noise; indoor environment quality; land transformation, occupation and biodiversity; ozone depletion; soil salinisation; eco toxicity.

Guidance

Standards noted in this credit

Standards for this credit include:

- EN 15804 *Sustainability of Construction Work - Environmental Product Declarations - Core Rules for the Category of Construction Products.*
- EN 15978 *Sustainability of Construction Works – Assessment of environmental performance of buildings - Calculation method*
- ISO 14040 *Environmental management - Life cycle assessment - Principles and framework*
- ISO 14044 *Environmental management - Life cycle assessment - Requirements and guidelines*
- ISO 21930 *Sustainability in building construction - Environmental declaration of building products*

Definitions

Life Cycle Assessment (LCA) – An evaluation of the environmental effects of a product or activity holistically, by analysing the entire life cycle. The LCA consists of four complimentary components: goal and scope definition, inventory analysis, impact assessment and interpretation. Further definitions can be found in ISO 14040 and ISO 14044.

LCA terms, frameworks and standards – it is beyond the scope of the credit to introduce the reader to many LCA terms, frameworks and standards used or referenced within this document. Further reading may be necessary.

Climate change – measures the greenhouse gas emissions which have been generated by a product or material. Climate Change is also called Global Warming Potential or the Carbon Footprint. Factors are expressed as Global Warming Potential for time horizon 100 years (GWP100), in kg carbon dioxide/kg emission. GWP values found in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) are to be used, expressed in kilograms of carbon dioxide equivalents (kg CO2 eq).

Mineral and fossil fuel depletion (also known as abiotic depletion) – is related to extraction of scarce minerals and fossil fuels. This is generally based on remaining reserves and rate of extraction. This impact is measured in kilograms Antimony equivalents (kg Sb eq).

Eutrophication, or nitrification – quantifies compounds with high nutrient content released into water sources. It is the process by which a body of water acquires a high concentration of nutrients, especially phosphates and nitrates. Eutrophication is a natural, slow-aging process for a water body, but human activity, extraction, processing, manufacturing, construction and maintenance procedures can greatly speed up the process. This impact is measured in kilograms phosphate equivalents (kg PO4 eq).

Human toxicity – provides an indication of the risk to human health. These are based on concentrations tolerable to humans. This toxicity indicator generally excludes the impact on human health from indoor air quality. The indicator is reported in kilograms 1,4 dichlorobenzene equivalents (kg 1,4-DB eq).

Peer review – The ISO 14044 standard requires critical LCA reviews to be performed, this provides an assurance of the credibility of the LCA and therefore the results.

Documentation Requirements - Design and As Built

- Short report
- Reference case documentation
- Peer reviewed LCA report
- LCA practitioner competencies statement

Short report listing the Credit Criteria and points claimed and reference peer reviewed LCA report, architect and engineer statement and reference case documentation.

Reference case documentation as required by Reference Case Criteria one or two.

Peer reviewed LCA report as requirement by the credit criteria.

LCA practitioner competencies statement for both the practitioner undertaking the LCA and the peer reviewer.

References

Athena Sustainable Materials Institute 2013, 'Athena publishes first North American building declaration to EN 15978', http://www.athenasmi.org/

EeBGuide 2013, various document found at http://www.eebguide.eu.

Grant, P. And Peters, G. (2008) 'Best Practice Guide for Life Cycle Assessment in Australia', Australian Life cycle Assessment Society.

Eurime 2012 'Analysis of five approaches to environmental assessment of building components in a whole building contex', thttp://www.eurima.org