General

Is it appropriate for the GBCA to undertake this project or would any other organisation be better placed to do it. If yes, which organisation?

The GBCA is the most appropriate organisation to undertake this project at present.

Is the Aust. market ready for LCA as a tool for assessing the environmental impact of materials? If no, in how many years time do you think the market will be ready?

The GBCA should be looking to lead the market rather than waiting for the market to mature. There really will be no perfect time, we would suggest GBCA start small with a limited set of inclusions and then expand the scope of the materials over time as the market becomes more sophisticated.

What do you see as the main barriers to implementing LCA as an assessment methodology for materials in Green Star?

We see the following as the main barriers to implementing LCA:

- Varying levels of knowledge and understanding of LCA within our industry;
- Availability of data;
    - Consistent and bonefide data that allows comparison, not only between materials but also between products or manufacturers;
    - Data transparency and manufacturers willingness to disclose data and product performance
- Establishing a credible reference case which delivers real environmental benefits.

If the GBCA decided to introduce the methodology described in this paper, how much notice would you recommend the GBCA give to the market?

We would recommend around 12-24 months as sufficient time.

The GBCA could also consider temporarily releasing the new materials credit as a beta or pilot version) within the rating tools alongside the existing material(s) credits. A project would then have the flexibility to select from the two approaches and give the GBCA time to road test and refine the method prior to final rollout. This may or may not also include some innovation recognition for those participating in the pilot.

Methodology

The list of inclusions may be expanded in the future, is it appropriate to start with a limited scope of assessment in order to simplify the LCA? Please provide feedback on the list of inclusions and exclusions.

It is appropriate to start small with a limited scope, with a plan to slowly introduce more materials or building elements over time. We suggest that the following materials or elements be considered, in order of priority below:

1. cast in place concrete;
2. reinforcing steel and mesh;
3. windows, curtain walls;
4. flooring and floor finishes;
5. suspended and set ceilings;
6. precast concrete;
7. masonry walls;
8. internal walls and finishes;
9. Cabling; and
10. Pipes.

Cabling and pipes represent relatively small impact elements; we would therefore suggest that floor finishes and ceilings be considered more of a priority than these elements.

Table 1. in Section 7 of the discussion paper proposes that the standard practice or reference case involve defining material quantities. We believe it is more appropriate for the GBCA to define standard materials and standard inclusions. We suggest that the quantities defined in the standard practice or reference case be derived directly from the proposed building bill of quantities at contract price stage. This approach also has parallels with the energy modelling method used in the GBCA's Public Sector Pilot and Industrial tools.

In summary the reference case would be modelled based on the proposed building and constructed assuming a GBCA defined standard set of materials and inclusions. This model would then be compared against the same as-built building constructed using an as-built set of inclusions and materials.

Are there additional materials which should be addressed by the inclusions and exclusions?

Yes, see above.

Boundary Definition

Is the use of a cradle to constructed, sealed and serviced building approach appropriate?

This is an appropriate boundary definition considering that operational targets are driven through building standards, NABERS Energy and Green Star energy credits and that maintenance and end of life impacts are typically small, for the main structural elements of a building, which represent more than 80% of a building's embodied impacts.

Is it practical to make qualified assumptions about the origin and the distances that material must be transported in a green star submission, i.e. at a tender stage when some of the specific materials are unknown?

It is practical to make assumptions for materials such as cast in place concrete where transport distances are governed by the time limitations of getting concrete from the batching plant to site. Locally sourced steel is available from a limited number of manufacturers and therefore another material where it is relatively easy to make transport mode and distance assumptions.

Facade elements (windows and curtain walls) typically have a far more complex supply chain, where component parts may be manufactured across a global supply chain and fabricated locally or offshore prior to delivery to site.

Lend Lease leverages the tender process to gather transport distance and transport mode data for key trade packages such as concrete supply and placement, steel supply and fixing, facade manufacture and installation. We typically only use transport distance and mode assumptions for minor elements or elements which collectively represent <10% of the impact.

We would suggest that the GBCA provide default distance guidance and modes for minor elements and materials. For example, a default distance of 100km on road for minor elements with more accurate transport data used for high volume, high tonnage elements e.g. concrete, reinforcing and facade.

It is important to remember that mode is often more important than trip distance, therefore, any guidance needs to also reference the transport mode(s) to be assumed.

Functional Unit

Is 1m2 of GFA an appropriate unit?

We believe that the proposed functional unit, 1m2 GFA is appropriate for the assessment of base building elements. Similarly a functional unit of 1m2 NLA could be considered if applied to a fitout space.

Are there constraints to using this unit?

There are constraints when you are looking at floor space utilisation or floor space efficiency, in this case a measure of "number of building occupants" may be more appropriate. Lend Lease does not however, advocate this as an appropriate functional unit given the intent of the materials credit.

If there are constraints or reservations about the proposed functional unit, what are the alternatives?
We believe that the proposed functional unit is appropriate given the intended scope and intent of the proposed credit.

Environmental Impact Categories

Is it appropriate to limit the number of environmental impact categories to six?

We believe that the majority of key environmental impacts are encapsulated within the proposed categories. GHG impacts are a good proxy for energy use and most other environmental impact categories with the exception of water footprint and land transformation. We would therefore advocate a mix of impact categories that include GHG, Water Use and Land use as a minimum.

If more categories are to be included, which categories do you recommend be included? What method should be applied to determining the impact categories the LCA will take into account?

The product category rules (PCR) that relate to the materials used in buildings should be used as a guide – (PCR for building products ISO 21930). The parameters which the PCR deems to be declared in the EPD should help define a minimum set of relevant impact categories. This will also help to maintain consistency with data that are publicly available now and in the future.

The impact categories recommended for use by the BP LCI should also be used as a guide.

If fewer categories are to be included which categories do you recommend be removed?

We would recommend the following be removed if fewer impact categories were to be considered:

- 4) Mineral and fossil fuel depletion (Climate Change addresses this); and
- 6) Human toxicity (As this indicator does not directly address IEQ and because ecotoxicity addresses this to some extent).

If six impact categories are appropriate are the six categories above the most appropriate?

The suggested impact categories are appropriate. These should ideally match the Australian or European PCR or ISO14025 Environmental Impact Categories. Photochemical oxidation, acidification, eutrophication, abiotic depletion, ozone depletion and GWP 100.

Is it appropriate to refer to the AusLCI impact categories? Is there an alternative which should be used? Why?

See comments above.

Environmental Impact Weightings

Is it appropriate to reference the BC LCI weightings? If not, what should be used instead?

Our preference is for no weightings to be applied. Weightings add an element of subjectivity to the LCA and make the results less transparent.

Is it appropriate to have separate credits for each of the environmental categories or should the total score be weighted together and assessed as one credit?

We believe that separate credits for each of the environmental impact categories would be ideal. If a weighting and a single score were to be applied we would recommend that these weightings and the methods behind their development be transparent. Existing weighting and normalising methods such as Ecoindicator 99, Recipe, EcoPoints or TRACI could also be considered.

Baseline – Standard Practice Reference Case

Is it practical to establish a standard practice reference case for low-rise, mid-rise, and high-rise buildings of different classes? If no, what other methods could be used to establish a reference case?

Using a standard practice reference case for each building typology is extremely difficult in practice. This is because there can be a large range of variability between buildings and often this is driven by factors outside of the designer or builders control.

We would suggest a different modelling approach which mirrors the way energy modelling for the Public Buildings Pilot and Industrial Tool are undertaken. In this approach the reference case is the proposed building, modelled assuming a minimum BCA compliance level and then compared to the proposed building with its as built mix of materials and inclusions.

The reference case needs to be based on the proposed building to be constructed, not a hypothetical or similar building typology. In this way a reference case is formulated based on the actual project building and takes into consideration its unique circumstances.

Should the reference case distinguish between new building on a green field site, refurbishment of existing buildings and fitouts? How can an equitable system be developed which acknowledges the advantages of the options from an environmental impact perspective?

The GBCA should consider encouraging refurbishment of existing buildings by simply awarding a bonus or extra point(s) for this initiative. For the materials installed as part of the refurbishment scope the suggested method outlined above would apply.

If the reference case is constructed in a similar manner to that described above, would you be able to provide your interpretation of how this may operate in practice?

We believe that it is extremely difficult to define a reliable standard practice reference case. The GBCA can however, define reference or typical products, materials and standard building inclusions. If the GBCA was to establish a standard practice reference case approach by building typology there will be countless buildings which will either perform better or worse than the reference case before any attempt is made to optimise the design or influence their supply chain.

Building design will not only be a response to low environmental impact it is also a response to tenant requirements, aesthetics, site location, site conditions, planning constraints and budget etc. Because of this it will always be difficult to define a meaningful and reliable reference case for every project.

For example, incorporating inter-tenancy stairs in a structural design will increase band thicknesses and therefore concrete and reinforcing provision in the structure, when compared with a design devoid of this feature. Open floor plates with large cantilevered slabs provide great tenant flexibility and future adaptability, but can increase structural impact over a cellular office space with tighter slender column grid. A double skin facade on a commercial high rise provides protection to external blind systems, improved acoustic performance and the ability to operate mixed mode spaces where wind conditions would otherwise make this difficult, however, they have a significant increase in embodied impact due to the additional materials required.

A reference case established on buildings exhibiting any one or combination of these features will set an unreasonably high or low benchmark for comparison. It is for this reason that measurement should be based on

a project which is in the same external influences, market drivers, location and unique architectural characteristics.

Can LCA methodology in the Green Star Materials category operate without a reference case? If so, how do you see this working?

Yes, but you do need to nominate the appropriate data set to be used for a range of materials along with a clearly defined list of standard inclusions to ensure a consistent reference case method is used.

Is it practical to conduct two iterations of the LCA with different inputs for the project?

Yes, we believe it is important to conduct two iterations, the Baseline or reference case and the As-built model.

How much additional time would it take to do the second iteration of the LCA having completed the first one? Is it 25% more, 50% more, 100% more etc?

Approximately 25% additional time would be required. Ultimately, the original reference model would be adjusted with initiatives and material changes that have been implemented to form the as-built model. Documentation such as EPDs and product LCAs should be used as justification and supporting documentation for material changes in the asbuilt model.

Does the intended content of Table 1 include enough data to determine the input parameters for the standard practice case LCA? If not, what is missing?

Table 1 does not provide sufficient detail to determine the input parameters for a reference case. For example the structural elements need to also consider the concrete types (strength classifications) used in the assembly of columns, beams (bands and edge beams), core, slabs. A standard practice approach would also require the GBCA to define the reinforcing rates, post tensioning, sacrificial formwork rates for all structural elements.

Transport distances also need to define the standard mode. This is often more important than actual transport distances.

Single glazed windows have also been nominated as standard practice, Section J requirements currently make it difficult to get away with anything but double glazed on most elevations.

What would be the best way to determine the rules for the input parameters in Table 1?

We would recommend the GBCA assemble an expert reference panel or committee to develop the appropriate rules and outline the key input parameters. The rules and key input parameters will need to be meaningful and drive the appropriate outcomes while not being overly complex or difficult to administer and audit. Lend Lease would recommend that this reference panel include developers and builders, product manufacturers, as well as LCA practitioners.

Reporting Mechanism

Is it appropriate to nominate ISO14025 as the reporting mechanism?

Yes, this is appropriate for individual products and materials used in building construction and could be applied to a whole of building assessment.

Is there an alternative that is preferred or should be considered?

The GBCA could also consider ISO14024, although we feel that this would be less appropriate than ISO14025 which could be used to provide a score card of impacts for both the reference and as built building assessments.

Allocation of Green Star Points

Is the percentage reduction in impact an appropriate way to awards points for improvement?

Yes, this is the best approach in our opinion; the reduction should be measured against the proposed functional unit of 1m2GFA.

Is it appropriate to have separate credits for each of the environmental categories or should the total score be weighted together and assessed as one credit?

Weighting could be used if the GBCA would like to keep things more concise / tighter. If this is done it needs to be a transparent weighting system. A score card approach would be a good way to summaries all of the impact category +/- rather than a single score.

Data Inventory

Should the Aus LCI Building Product inventory dataset be used in a LCA methodology within Green Star tools?

Yes, Aus LCI data should be used for locally manufactured products where there is available data, in particular, for key materials such as concrete and steel reinforcing.

Should a European LCI be used?

Yes, where the product is not locally sourced or where there is no locally available data.

Are penalties needed?

We don't believe that penalties are required, particularly during the early rollout of the new credit. Recommended or approved data sets should be promoted and penalties could be considered in time, dependent upon how widespread the use of non-approved data sets is.

What data sources would be acceptable for a credible LCA to be conducted?

Data sets which are nationally or internationally recognised and gathered in accordance with ISO14044 principles should be deemed acceptable. Those data sets made available through Software packages such as Simapro and GaBi should be deemed appropriate for use.

Applicable Green Star Rating Tools

Is it appropriate to exclude fitouts based on the lack of an agreed functional unit for fitout items?

Lend Lease believes that 1m2 of NLA could be an appropriate functional unit for commercial buildings. The physical fitout boundary could initially focus on internal walls and partitions, access floors, floor finishes, ceiling grid and fixed joinery.

Other matters for discussion

Will the proposed LCA methodology accommodate existing LCA systems and tools?

Yes, most existing systems and tools are flexible enough to accommodate any range of methods.

What constitutes an LCA practitioner, what qualifications should be required, and should the system ALCAS are developing be referenced?

Yes, we believe there is merit in referencing the ALCAS certified practitioner or equivalent qualification. Qualifications, competencies and experience will be addressed as part of the proposed ALCAS certification scheme.

How much do you estimate it would cost to complete the assessment outlined in this paper? And how does that cost compare to the cost of demonstrating compliance with the current materials category in Green Star?

The cost will ultimately depend on the final method and the number of standard inclusions that is agreed. There is however, an opportunity to streamline the materials category from a compliance perspective. The quantity of documentation and review is likely to decrease however this will be displaced by more detailed calculations and modelling – the final method and approach will dictate how much this is likely to change.

Is the requirement to adhere to international standards necessary?

Where it makes sense to adhere to international or national standards then these should be followed. Where these constrain or make the rollout of an LCA based method more difficult, then they should be carefully adapted to ease the rollout.

> Which are the relevant standards that Green Star related LCAs should adhere to?
>
> We believe that the specific product assessments EPDs would need to comply with ISO14044. The standards for building modelling can however be defined as part of the GBCAs credit with reference to the ISO14025 reporting standard.
>
> Is the requirement to use recognised software necessary?
>
> LCA software is not necessary for cradle to onsite modelling. The software does however provide access to datasets some of which are unavailable outside of the software package and is ideal for conducting robust and more easily auditable assessments. The current packages are expensive therefore allowing only approved software could be a limitation for some. Lend Lease typically use a mix of software and tools to undertake assessments.
>
> Should the GBCA recognise particular softwares?
>
> This is probably not necessary however the following software would be used by most practitioners - GaBi, Simapro and Excel

Which software should be considered and why?

GaBi and Simapro are good for analysing sub assemblies and components however these become very difficult or more complex when using these to model an entire building. GaBi and Simapro are best used to conduct subassembly and component LCAs with the whole building impact calculated within other software packages. For example Lend Lease is currently working to integrate life cycle impact assessments as part of BIM.

The requirements of the Energy category within Green Star rating tools, stipulate that any energy simulation software used are BESTEST compliant. Does equivalent software exist for LCA?

We are not aware of any software certification for LCA. We would suggest that industry recognised LCA software (e.g. PE's GaBi or Pre's Simapro).

Is the requirement for peer review necessary?

We do not believe that it is necessary at first but should be considered once the credit has had time to bed down. If introduced from the beginnings this will add cost and make the process longer. We believe that there is a place for peer review but only once industry knowledge on LCA has had time to mature.

What other requirements are necessary to ensure best practice LCA modelling?

The GBCA should consider LCA training sessions, helping to develop industry tools and guidelines, promoting the sharing of research into standard practice and alerting practitioners to new data sets, EPDs and industry data. Partnerships with key industry players and LCA practitioners through organisations like ALCAS would also be of benefit to assist in the continual improvement of methods and tools over time.