Green Building Rating Systems and How They Relate to Wood

Forestry Innovation Investment

Publication Date: January 2010

background paper prepared for:

Forestry Innovation Investment

Original report submitted by:

Light House Sustainable Building Centre

Publication Date: January 2010

Executive Summary

This study examines the world's major green building rating and certification systems in order to evaluate their relationships with wood and to gain a better understanding of what opportunities may be available for promoting wood as a green building product.

The research questions comprise the following:

1. In what ways does wood relate to green building rating systems?
2. How important or influential wood is in each of the systems?
3. How are lifecycle impacts and carbon footprint dealt with?
4. Is using wood an advantage or disadvantage in terms of the number of points/credits that could be earned compared to other competing products?

The report begins with a description of the methodology and the ways that wood and wood products relate to the green building rating systems.

The report then summarizes the prevalence of wood-related credits in each of the rating systems assuming that all else is equal. A comparison is then conducted on two hypothetical projects to assess how rating systems treat wood compared to non-wood competitors. The projects comprise:

1. High intensity wood: a theoretical project in which wood is specified wherever possible (ignoring considerations of cost and complexity),
2. Low intensity wood: a theoretical project in which other products are used in lieu of wood (concrete, steel, plastic, etc also ignoring considerations of cost and complexity).

The details on each rating system and their specific wood-related credits are located in the appendices.

Eleven rating systems were analyzed, including: BREEAM, Built Green™, CASBEE®, Green Globes™, Green Star, LEED®, the Living Building Challenge, NAHB Model Green Home Guidelines, and the SB Tool. With all the various applications, a total of 18 systems were included in the study. The rating systems were selected based on the following considerations:

1. The rating system targets projects in market areas of interest to Forest Innovations Investment
2. The system is administered by a market neutral third party
3. The system is holistic in its inclusion of environmental issues and addresses material selection and occupant health as well as energy, water, etc.

It is recognized that rating systems are constantly evolving and new systems entering the market. It is expected that the review process initiated by this study

will be undertaken periodically by the Wood Industry to maintain an ongoing understanding of the relationship between the rating systems and wood.

Green building rating systems are evolving rapidly but are still mostly voluntary and directed to leadership projects. They are generally unregulated and non-standardized. With the growing awareness of the impacts of buildings on carbon emissions, resource depletion and eco-system degradation, the implementation of national and international building regulations is accelerating. Although the long-term future of rating systems is unknown, they are the providing strategic direction to industry today. It is important for the Wood Industry to keep abreast of rating systems and their development.

The selected green building systems were evaluated to determine: (1) in what ways does wood relate to green buildings, (2) how important or influential wood is in each of the systems, and (3) whether using wood is an advantage or disadvantage in terms of the number of points/credits that could be earned compared to using other competing products.

It was found that wood relates to green buildings in the following categories:

1. **Certified wood** – different forest certification standard are accepted by the various rating systems.
2. **Recycled / reused / salvaged materials** – recycled content in wood products and reused or salvaged wood and wood products.
3. **Local sourcing of materials** – local manufacturing and harvesting.
4. **Building techniques and skills** – specific building techniques that can leverage wood to gain green building points/credits.
5. **Waste minimization** - points/credits are given for diverting a certain amount of waste or minimizing wasted woodcuts.
6. **Lifecycle impacts** – embodied energy and lifecycle carbon.
7. **Indoor air quality** – no added urea-formaldehyde in wood products and low-VOC finishes.

The prevalence of wood in each of the rating systems varied from below 10% (SB Tool, LEED® NC US, and BREEAM Code for Sustainable Homes) to over 25% of the total available points (Built Green™ Canada). The rating systems for commercial buildings had the least spread (10%) with between 8% and 18% of the credits relating to wood. This increased in the rating systems for multi-family residential buildings with a spread of 18% (between 10% and 28%) of the credits relating to wood. The spread of credits applicable to wood (14%) was between 9% and 23% for the single-detached home rating systems.

The analysis further shows that the intensity of wood used in a project did not have a large impact on the number of total credits/points that can be achieved. In most rating systems using more wood was a slight advantage (especially in the single-detached homes), but only marginally. One consideration is only 6 of the 18 applications reviewed (and only 1 North American system) made any

recognition of Life Cycle benefits of wood (a factor that may position wood favourably against competitors such as concrete or steel).

There were also other key areas where wood may have further advantages that are currently not being adequately considered in most of the ratings systems:

1. **Acoustics** – Acoustical performance is rarely addressed in rating systems. Wood panel products and products containing wood fibre are particularly useful in sound abatement and control strategies.
2. **New products in traditional applications -** Wood fibre insulation has made headway into European markets for its thermal performance, low carbon footprint and its healthfulness when compared to glass fibre batt and urethane foams and boards.
3. **Thermal mass** - Researchers in Europe have identified wood as material of choice in the development of passive buildings. Current rating systems do not directly reference passive design strategies. Awareness and adoption of the principles of passive design are only now taking root in North America – an area in which wood has an advantage.
4. **Efficiency:** unlike other competitors, wood offers combined benefits of thermal mass, structural integrity, weather resistance, insulative properties yet is relatively lightweight. Dematerialization and material efficiency is not referenced in rating systems.

The study unearthed a great deal of information on how wood and wood products relate to green building rating and certification systems. Detailed analysis is laid out in the Appendix. As such, there are the following recommendations for effective promotion of wood and wood products:

1. **Building techniques and skills** – there is an opportunity to train building professionals in the techniques and skills needed to leverage wood and wood products into more green building points. Easy-to-use design guides, structural sizing charts, code interpretations, credit application “cheat-sheets” will be useful for the rating systems that focus on single-detached homes AND to grow the use of wood in non-residential buildings in the North American Market.
2. **Understand, quantify and promote lifecycle analysis (LCA) as a separate credit from local content** – some rating systems use local content credits with the intent of reducing the embodied energy and/or lifecycle emissions, when in fact a LCA approach is both more appropriate and more beneficial to wood and wood-based products. Particular reference should be given to structural systems which currently do not comprise a significant portion of green considerations for rating systems.
3. **Ensure wood product manufacturers are aware of opportunities** – There are many opportunities to promote wood-based products that have recycled content and/or use low-VOC and low/no added formaldehyde. Quantitative information about the criteria necessary to achieve specific credits need to be developed to assist sales reps in communicating the merits and applicability of their products. Manufacturers may not be aware of these

opportunities or may not know the specific standards that they need to adhere to, depending on their market(s).

4. **Proactively support new wood technologies and products** - Design approaches such as passive design, philosophies such as dematerialization, and products such as wood fibre insulation have the potential to push the green building industry to greater environmental achievements. These strategies help to position wood as a consideration within the energy and atmosphere categories. At the same time mainstream issues such as acoustics, which is an important consideration in occupant well-being, are ignored.

In summary, wood has the potential to significantly contribute to the environmental performance of a building. Given that rating systems are evolving quickly, there are opportunities to inform the development process to best communicate and evaluate the environmental benefits of wood.

To most effectively accomplish this role, a number of items require more research in order to evaluate their impacts on wood and wood products, and to better formulate a strategy for promoting more wood in the rating systems themselves.

1. **Research lifecycle assessment tools, processes** – Evaluation of the various LCA tools and methodologies for their ease of use, applicability and rigour in their treatment of wood products and assemblies was beyond the scope of the research. Given the LCA advantages of wood, it would be advantageous to proactively develop and promote appropriate LCA methodology in advance of market demand for carbon disclosure.

   As part of this research, it is important to also look at the coming version of LEED 3.0 and how LCA is incorporated.

2. **Evaluate the realities of using certified wood products** – When comparing the hypothetic buildings of ‘More’ and ‘Less’ wood, it was assumed that any credits that are wood related would be achieved, without evaluating whether the cost, complexity of regulatory implications. Industry feedback indicates that some certified products are more difficult to specify than others (certified heavy timbers), some strategies more technically difficult or costly to achieve (e.g. structural sizing of wood in non-residential buildings) and some are challenged with regulatory constraints (e.g. use of wood in non-combustible construction).

   Practical information that addresses these items will aid further uptake. This is an important dynamic for understanding if competing wood products are favoured by the building industry when building green.

3. **Regionally-specific waste management strategies** – Many of the rating and certification systems specify a certain percentage of waste that needs to be diverted to gain credits. It is unclear whether using wood makes these targets more difficult or easier to achieve. This information is also determined by regional waste diversion infrastructure.

   It would be important to know the range of waste diversion options and fees to aid construction professionals and in order to develop a training program for promoting building techniques and skills for using wood.

4. **Salvaged wood and the pine beetle** –wood that has been salvaged from mountain pine beetle (MPB) damaged forests should be admissible under salvaged materials credits. It is therefore important to understand the procedures for applicable rating systems to accept MPB wood as salvaged material in future versions or through regional priority credits.
5. **Influencing new systems in development** –China is developing labelling standards for green buildings. With the upcoming conference in Copenhagen (Fall 2009), other carbon reporting systems in FII target markets will be rolled out. Further, existing rating systems are frequently updated – LEED (US and Canada) is slated for update in the short term. The window of opportunity to develop accessible and practical information for specifiers in a manner that places the wood industry ahead of the curve is now. Further research is also necessary to develop and the to communicate the carbon-specific information that will aid specifiers use wood effectively in these systems.
6. **Valuation of cost and/or degree of difficulty** - This study did not examine how difficult it is to achieve the specific wood-related credits. This is important for understanding the specific barriers to using wood in the various green building rating systems. The weighting of credits in some systems do not adequately reflect the degree of difficulty or the economic impacts of accomplishment. For example, the number of credits allocated to construction waste management do not always account for the cost for diverting wood waste as opposed to sending to landfill. Research is necessary to quantify the impacts of shifting industry practice to design for disassembly, to design to coordinating dimensions or to pre-fabricate in order to reduce off-cuts and wastage during construction are not recognized.

Overall, it is important to promote the larger picture and the culture of wood use. While wood and wood products can be promoted through the rating systems on a prescriptive point-by-point basis, which may be important to specific wood industries, in the long-run it is critical that **low carbon life cycle** and the **overall performance of wood** be quantified and recognized in the rating systems and the industry in general.

The development and distribution of tools to assist with this process such as LCA calculators will be critical. This can be accomplished by emphasizing the long-term environmental benefits of using a renewable resource that has low-embodied energy and a small lifecycle carbon footprint.

Table of Contents

A. Introduction

The purpose of this study is to provide Forest Innovations Investment (FII) with information about the world's most widely used green building rating systems and how they incorporate and reflect wood and wood products. The intention is to equip FII with the data sufficient to target its marketing and advocacy efforts to the needs of the rapidly emerging green building industry and to present wood and wood products to their best advantages.

The scope of the project was limited to investigations relating to the use of structural and specialty wood products (dimensional lumber, panel products, cladding, insulation, structural and engineered wood products, specialties and finishes). The project does not address the references to wood stoves and biofuels.

The first section begins with a description of the methodology and the ways that the environmental merits of wood and wood products are captured by green building rating systems. The next section summarizes the prevalence of wood-related credits in each of the rating systems and the degree to which life-cycle assessment is recognized. To determine the extent to which the use of wood aids or hinders success with rating systems, there follows a comparison of two theoretical project scenarios the first with as much wood in the project as possible, the second with no wood, to see if wood is at a disadvantage to competing products. The details on each rating system and their specific wood-related credits are located in the appendices.

The study is positioned as a first foray into gauging the relationship between rating systems and wood. Further work is necessary to better assess wood's contribution to green buildings – particularly in terms of the quantification of wood's environmental benefits in a way that enables specifiers to more readily turn to wood as a means to achieve credits. It is also recognized that rating systems are constantly evolving and new systems entering the market. Also, with the Copenhagen Climate Change Summit in December 2009, global policy priorities are shifting to greater awareness of the value of low carbon solutions in the fight against climate change. It is therefore expected that the review process initiated by this study will be undertaken periodically by the Wood Industry to maintain an ongoing understanding of the relationship between the rating systems and wood.

B. Methodology

Major green building rating systems from around the world were identified and examined. The rating systems were selected based on the following considerations:

1. The rating system targets projects in market areas of interest to Forest Innovations Investment
2. The system is administered by a market neutral third party
3. Rating systems generally categorize the environmental attributes of a building under the following categories:
    - Site and neighbourhood
    - Energy efficiency and renewable energy systems
    - Toxicity, pollution and health
    - Materials and waste
    - Water conservation
    - Design process and innovation

    Some rating systems only address certain categories (such as energy and indoor air quality). Only systems that are holistic in the inclusion of environmental issues and addresses material selection and occupant health as well as energy, water, etc were included.

Specific credits or guidelines that relate to wood and competing wood products (steel, concrete) were documented. The wood-related credits were also noted for their "theme", which describes the way in which the credit actually relates to wood and/or wood products. The specific language and credits for each system can be found in the Appendix.

The following eleven green building rating systems were examined:

1. BREEAM, UK
    a. Offices
    b. Multi-family residential
    c. Eco-homes
2. Built Green ™ Canada
    a. Low-rise
    b. Multi-family residential
3. Built Green® Colorado, USA
    a. Multi-family residential
4. Built Green ™ Washington, USA
    a. Low-rise

    b. Multi-family residential
5. CASBEE® (for Homes), Japan
6. Green Globes™, North America
7. Green Star, Australia and South Africa
8. LEED® North America
    a. LEED® NC (Canada)
    b. LEED® NC (US)
    c. LEED® CI (Canada)
    d. LEED® for Homes (Canada)
9. Living Building Challenge, North America
10. NAHB Model Green Home Buildings Guidelines, USA
11. SB Tool, North America

In some of FII's target markets no rating systems yet exist (e.g. China). Other green building certification systems were examined and excluded from the analysis due to lack of data and/or out of scope or they no references to material specification generally and wood in particular, including:

1. R2000 (Canada)
2. Passivhaus[1] (Austria, Germany, Switzerland)
3. German Sustainable Building Certification (Germany)
4. Earth Advantage (US)
5. Maison Qualite (France)

[1] Minergie, the European rating system based on PassivHaus principles is about to release a comprehensive sustainability system but this was not available at time of writing. Also, the CMHC Equilibrium initiative is being rolled out at time of writing – this too is very much aligned with PassivHaus energy standards. However, administration by CMHC is limited to a small number of homes enrolled through a rigorous admissions process. It is however, a tool to watch for the future.

Table 1: Summary of Study Methodology and Assumptions

Research question	Methodology & Assumptions
1. How does wood relate to the rating system in question?	Documented all credits that have any relationship to wood and wood products. Credits were counted as relating to wood if they mention: wood or wood-products directly (e.g. forest certification) or some factor that affects wood products (e.g. low-VOC paints and adhesives), or a direct substitute to wood (e.g. bamboo floors) Developed "themes" to categorize the various relationships with wood.
2. How important is wood in each of the rating systems?	Once all of the wood-related credits were identified, the credits were summed and divided by the total number of credits available, giving the percentage of credits that relate to wood and/or wood products. This was compared against the other rating systems. Any credit or category that related to wood was counted, regardless of how it related or how difficult or costly it was to achieve.
3. How are lifecycle impact and carbon footprint dealt with?	Qualitative observation and recording of lifecycle methodology.
4. How does wood fair against substitute products/materials?	Two hypothetical cases were created for each rating system. The first, called "More Wood", assumed that every possible material choice was wood or wood based (e.g. wood framing instead of steel, or wood floors instead of carpet). It was also assumed that when wood was used, the most sustainable possible option was available (ie. FSC-certified). The second case, called "Less Wood", assumed that every possible material choice was not wood or wood-based if there was a common substitute (e.g. vinyl windows instead of wood, or ICFs instead of wood framing). It was also assumed that when a substitute was used, the most sustainable possible option was available (ie. fly-ash concrete) • To keep all other factors constant, the exercise assumed that all other credits were taken, despite the fact that this may be impossible in practice. • Both cases assume that such uses of wood are permissible under relevant codes and regulations.

C. Study Findings

This section summarizes the findings of the research and the answers to the research questions, according to the following subsections:

1. Wood in Green Buildings (how does wood relate to green buildings?)
2. Prevalence of Wood (how important is wood?)
3. Wood v. Competing Products (how does wood fare and are the lifecycle impacts considered?)

1. Wood in Green Buildings

Wood is an abundant, affordable and, when compared to competitive materials such as steel and concrete, an environmental benign natural resource. For the purposes of this study, wood's inherent environmental merits include:

- Its low carbon life cycle based on the ability of trees to absorb and store carbon
- Its material efficiencies related to its combined thermal mass, water resistance, structural integrity and finish quality.
- Clean wood waste is easily recycleable.

Yet when it comes to defining environmental impacts, the global forestry industry is not without its controversies. However, for the purposes of this study, it is assumed that the reader is aware of issues related to the use of endangered species, impacts of forest management practices, features of (un)healthy forests and forestry economies, etc.

When sourced from local sustainably managed forests, wood can offer substantial additional benefits:

- Support for local economies
- Contribution to carbon neutral/positive building
- Habitat restoration and eco-system well-being

There are various roles that wood and wood products play in the design and construction of green buildings. These relationships are set out in detail in the Appendices.

While green building rating systems have made headway as a means to declaring a building's environmental performance, they are numerous, unregulated and not standardized. It is also important to note that while rating systems are evolving quickly, so are building regulations and standards.

With the growing awareness of the impacts of buildings on carbon emissions, resource depletion and eco-system degradation, the implementation of national and international building regulations is accelerating. Although the long-term

future of rating systems is unknown, they are the providing strategic direction to industry today[2]. There is no question that builders will increasingly be held accountable for their building's performance during construction and operation. Sooner or later, international building standards will start to align around energy performance, materials, water, etc. The EU is already some way along this process and Germany is already finalizing an environmental product declaration (EPD) scheme.

Generally, green building ratings systems reference wood products directly and indirectly in the following ways:

1. **Certified wood** – most rating systems give credits for wood if it has been certified as being from a sustainably managed forest and the certification comes from a respected 3rd party verifier[3]. Different rating systems allow for different certification schemes. Some rating systems are more inclusive than others. However, rating systems generally do not require commensurate chain of custody certification standards for other materials.
2. **Recycled / reused / salvaged materials** – many rating systems give credits for recycled content, which is relevant for some wood products. However, some rating systems give explicit recognition to other products such HVFA concrete. Some rating systems do allow salvaged wood to count for recycled content.
3. **Local sourcing of materials** – most rating systems give credits for using local materials, but for different reasons. In some of the cases it is to support the local economy, while others do so to reduce environmental impacts from transportation. The key here is that some rating systems do not look at the whole embodied energy or lifecycle impacts which is important when developing a full carbon footprint of a building (and where wood has an advantage). Instead, they simply place a travel distance limit for the sourcing of materials. A more rigorous approach would be to have separate credits for local resources and embodied energy, as they do in Japan's CASBEE.
4. **Building techniques & skills** – the rating systems that focus on low-rise residential homes tend to less performance based and more prescriptive than those for commercial buildings. They frequently prescribe certain building techniques (e.g. advanced framing) that reference wood. These techniques do not necessarily have an impact on the wood industry directly, although very prescriptive techniques might drive builders to other forms of construction.
5. **Waste minimization** - many of the rating systems give credits for diverting a certain amount of construction waste, or for minimizing wasted woodcuts. There are opportunities to teach builders how to earn points by implementing job site protocols that would leverage their use of wood in green building credits. Wood waste is of particular interest to regional bodies such as Metro Vancouver (which has been working for some time on a wood waste diversion strategy).

---

[2] Life Cycle Assessment Tools, John Carmody and Wayne Trusty appearing in Implications, Vol. 05 Issue 03, A Newsletter by InformeDesign. A Web site for design and human behavior research www.informedesign.umn.edu

[3] Examples include Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), Canadian Standards Association (CSA), International Standards Organization (ISO), etc.

6. **Lifecycle impacts** – Calculating lifecycle impacts is complex and time consuming given the limited availability and capability of LCA software systems. Qualitative solutions are open to wide interpretation and are generally not robust. At this time, only a few of the rating systems quantitatively and holistically address lifecycle impacts of materials and of those, there is sometimes little follow-through from the calculation to the building project itself. This is unfortunate as wood products frequently present favourable lifecycle performance relative to concrete and steel.
7. **Indoor air quality** – most rating systems demand that all wood adhesives, resins, engineered and composite products contain no added urea-formaldehyde and have strict limits on VOC content. While many products (such as carpets), have created clear guidance to specifiers about their toxicity, information about wood products (particularly panel products such as plywood and MDF) can be less straightforward, compounded by challenging tracking and quality control systems.
8. **References to competitive materials** – there are a few instances where points are given for using material substitutes for wood. For example, Built Green™ gives extra credit for using insulated concrete forms (ICFs) in the exterior walls, which may lead builders to forgo using wood structural systems (framing, structural insulated panels (SIPS), cross-laminated panels (X-Lam), etc).

There are also a few areas where the environmental benefits of wood are not adequately accounted for, or where there are scope gaps in the rating systems. These areas present opportunities for wood advocates to undertake further research and to specifically promote their green building qualities:

1. **Acoustics** - While acoustics is an important part of any building seeking higher standards in indoor environmental quality, most rating systems ignore acoustical performance completely[4]. This is unfortunate, because early post occupancy studies of green buildings show that acoustical performance tends to be below expectation[5]. Moreover, wood panel products and products containing wood fibre are particularly useful in sound abatement and control strategies.
2. **Resistance to new products in traditional applications.** Wood fibre insulation has made headway into European markets for its thermal performance, low carbon footprint, ease of installation and its healthfulness when compared to glass fibre batt and urethane foams and boards. These factors are generally not included in rating systems. Also, ratings systems do not reference material performance in fire (specifically toxicity) – a consideration which would put wood fibre insulation at an advantage compared to, for example, polyisocyanurate board.
3. **Thermal performance:** researchers in Europe have identified wood as material of choice in the development of passive buildings. The thermal qualities of wood (mass and resistance) are beginning to be incorporated in small buildings through the use of structural wood panels. This enables wood to be considered in the context of the energy and atmosphere sections of rating systems.

[4] Of the rating systems reviewed, only Green Globes explicitly refers to acoustical performance.
[5] Metro Vancouver POE study of 5 commercial buildings, completed by Keen Engineering, 2003.

Although rating systems take note of issues related to the site they do not, as yet, directly reference passive design strategies (building orientation, internal layout, etc). Awareness and adoption of the principles of passive design are only now taking root in North America – an area in which wood has an advantage.

4. **Efficiency:** unlike other competitors, wood offers a combination of benefits including thermal mass, structural integrity, weather resistance, insulative properties yet is relatively lightweight. Concrete offers mass and structural integrity but is heavy. Steel offers structural integrity but little thermal resistance. Material efficiency is not referenced in rating systems but particularly important when the overall carbon footprint of a building is calculated.

2. Prevalence of Wood in Rating Systems

Each rating system has a certain percentage of credits that relate to wood. This relationship is usually determined by:

- The amount or extent of wood used as a proportion of the total project measured by cost, volume, etc
- The ability of a wood product or wood-based material (e.g. waste wood) to contribute to the accomplishment of a particular credit, or
- In some cases the ability of certain "environmentally enhanced"[6] wood products to contribute to energy efficiency, indoor air quality, operations & maintenance and other performance related credits.

The proportion of credits allocated to material selection in general and wood in particular varies widely. The following tables show the percentage of each rating system that is related to wood and wood products.

Built Green™ Canada for single-family homes allocates the greatest portion of credits to wood-related strategies (28%). SB Tool for commercial buildings allocates the least (8%).

The rating systems for commercial buildings had the least spread (10%) with between 8% and 18% of the credits relating to wood. This increased in the rating systems for multi-family residential buildings with a spread of 18% (between 10% and 28%) of the credits relating to wood. The spread of credits applicable to wood (14%) was between 9% and 23% for the single-detached home rating systems.

[6] "Environmentally enhanced" refers to products that not only leverage the fact that they are made of wood but embody additional qualities such as low-toxicity, made using certified materials/processes (rapidly renewable, etc).

Figure 1: Proportion of credits related to wood: commercial buildings

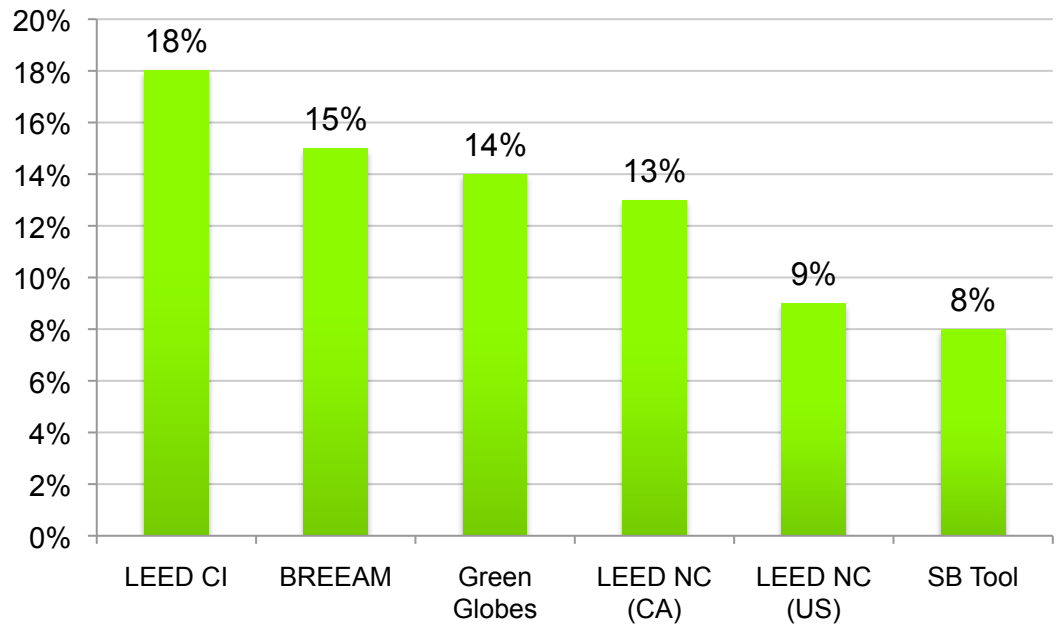


Figure 2: Proportion of credits related to wood: multi-family residential buildings

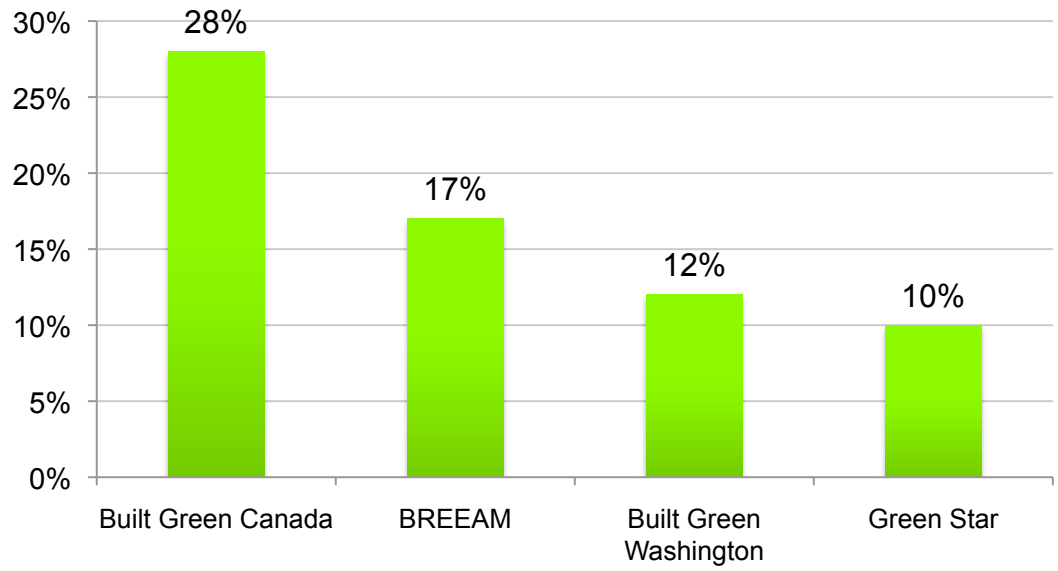
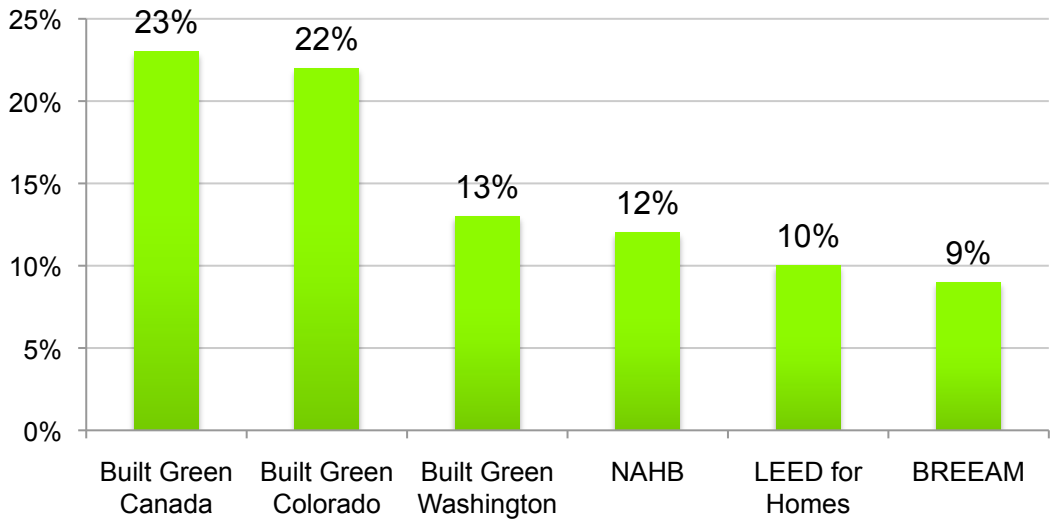


Figure 3: Proportion of credits related to wood: single-family residential buildings



The variations between the rating systems are often due to the materials categories having different weights within the rating systems and local building practices (e.g. UK homes are typically constructed using cavity-wall masonry and therefore BREEAM Eco-home does not reference wood to any great degree). However, a complete analysis of each rating system to determine why it does or does not favour wood is beyond the scope of this research. See Recommendations and Further Research.

3. Consideration of Life Cycle Impacts

A life-cycle assessment (LCA)[7] describes and analyses, in a quantitative way, all the important environmental aspects of a product system or technology. The scope of the calculation is the result of an iterative procedure of data collection and scope definition, followed by analysis and interpretation[8].

Wood's primary environmental benefit is its ability to positively impact the carbon footprint of a building on a life cycle basis. Moreover, there is a

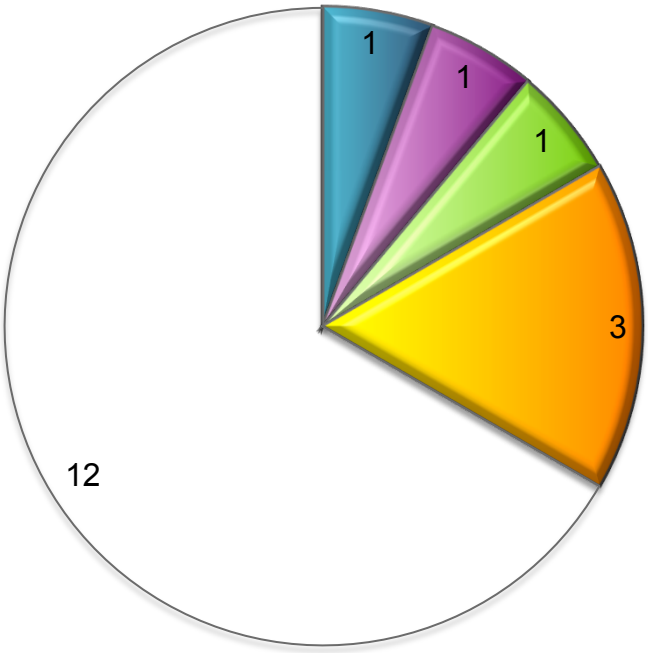
[7] The principles and framework for life cycle assessment (LCA) are set out under ISO 14040:2006 including: definition of the goal and scope of the LCA, the life cycle inventory analysis (LCI) phase, the life cycle impact assessment (LCIA) phase, the life cycle interpretation phase, reporting and critical review of the LCA, limitations of the LCA, the relationship between the LCA phases, and conditions for use of value choices and optional elements.

[8] European Commission Joint Research Centre http://lca.jrc.ec.europa.eu/lcainfohub/index.vm

substantial amount of research work being done to develop robust LCA data[9] to better communicate the LCA benefits of wood.

The rating systems were reviewed to determine the extent to which life cycle impacts are recognized, if at all.

Figure 4: Proportion of rating systems that reference and/or give credit for life cycle analysis



- Gives points for LCA assessment, but does not specify methodology: Green Globes
- Offers points for LCA methods that examine embodied energy, lifecycle GHGs, and lifecycle costs: SB Tool
- Uses rules of thumb that depend on the major building elements that are related to lifecycle CO2: CASBEE
- Calculations from the UK Green Guide: BREEAM Offices, MF, Eco-home
- Not addressed

1. Built Green Canada
2. Built Green Canada MF
3. Built Green (WA)
4. Built Green (WA) MF
5. Built Green Colorado
6. Green Star
7. LEED NC Canada
8. LEED NC US
9. LEED CI
10. LEED for Homes
11. Living Building Challenge
12. NAHB Model Guidelines

[9] University College London, CORRIM, Athena Sustainable Materials Institute are leading the way in the development and testing of LCA datasets and wood's role in the carbon-based assessment of buildings.

Table 2: Summary of inclusion of LCA in leading green building rating systems

Rating System	LCA reference
BREEAM Offices	Yes. Calculations from the UK Green Guide
BREEAM Multi-residential	Yes. Calculations from the UK Green Guide
BREEAM Eco-homes	Yes. Calculations from the UK Green Guide
Built Green ™ Canada	No.
Built Green ™ Canada Multi-family	No.
Built Green ™ Washington	No.
Built Green ™ Washington Multi-family	No.
Built Green® Colorado	No.
CASBEE® for Homes	Yes. Uses rules of thumb that depend on the major building elements that are related to lifecycle CO_2
Green Globes™	Yes. Gives points for LCA assessment, but does not specify methodology
Green Star	No.
LEED® NC Canada	No.
LEED® NC US	No.
LEED® CI	No.
LEED® for Homes	No.
Living Building Challenge	No.
NAHB Model Guidelines	No.
SB Tool	Yes. Offers points for LCA methods that examine embodied energy, lifecycle GHGs, and lifecycle costs

4. Wood vs. Competing Products

To understand the extent to which the use of wood aids or hinders the achievement of credits for each of the rating systems, a comparison was conducted on two theoretical projects in which the intensity of wood in each project was changed but all other considerations were held constant. The two project scenarios comprise:

1. High intensity wood: in which wood is specified wherever possible

2. Low intensity wood: in which other products are used in lieu of wood (concrete, steel, plastic, etc)

In both situations all considerations of cost, complexity and regulations were discounted. Also, it was assumed in that where wood was specified, that it embodied all the possible environmental enhancements reasonably available (e.g. that where applicable, wood products were formaldehyde-free, locally sourced, certified, etc).

The results summarized below set out the extent to which the use of wood positively or negatively impacts the total credits achievable for each rating system. Where there is a range of credits, the results present the average. Ranges of credits achievable occur due to the integrated nature of the rating system, the various trade offs or due to the adoption of a cluster of options.

Figure 5: Comparison of rating systems showing the extent to which the use of wood positively or negatively impacts the rating system score

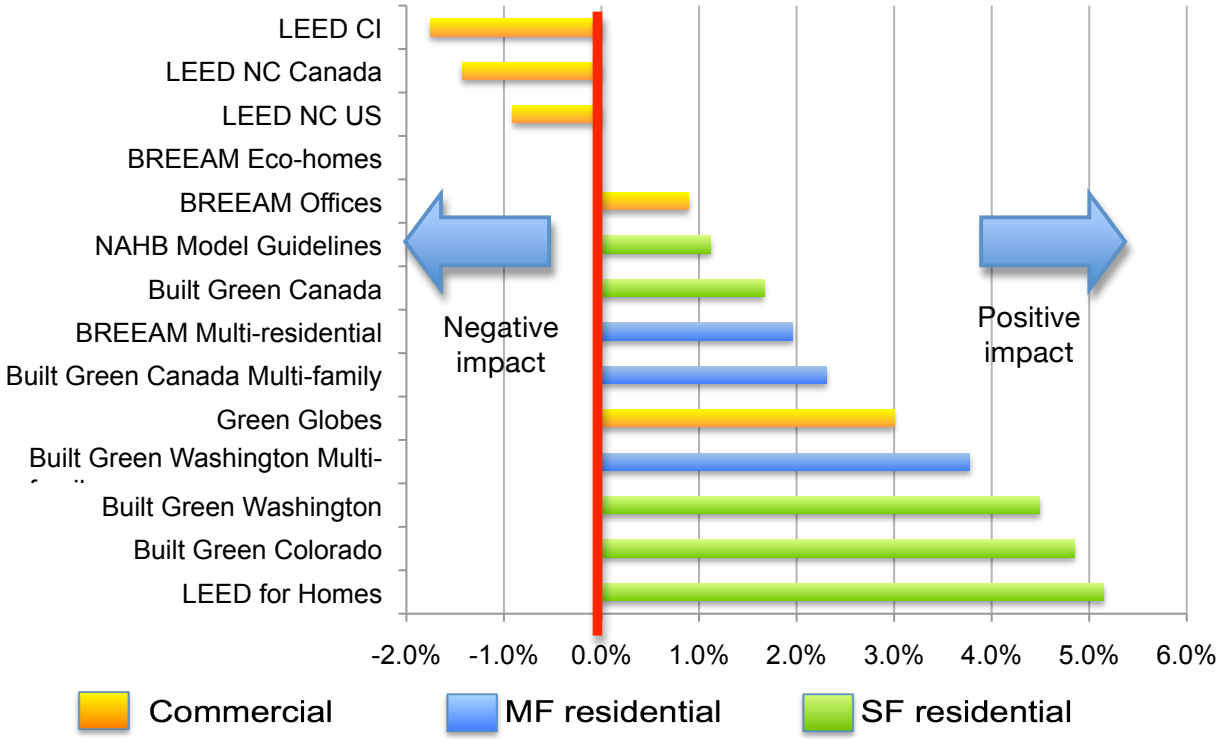


Table 3: Summary of rating system analysis data

	Total Credits in System	Total Wood Related Credits	Wood Related Credits Achieved	
			High intensity	Low intensity
BREEAM Offices	112	14	10 - 14	8 - 13
BREEAM Multi-residential	112	14	8 - 14	6 - 13
BREEAM Eco-homes	95	25	1 - 25	1 – 25
Built Green ™ Canada	420	98	70	63
Built Green ™ Canada Multi-family	433	122	94	84
Built Green ™ Washington	1335	174	115	55
Built Green ™ Washington Multi-family	1748	217	133	67
Built Green® Colorado	681	148	99	66
CASBEE® for Homes	n/a			
Green Globes™	1000	155	85 - 155	85 - 155
Green Star	n/a			
LEED® NC Canada	70	10	7	8
LEED® NC US	110	10	7	8
LEED® CI	57	11	8	9
LEED® for Homes	136	13	13	13
Living Building Challenge	n/a			
NAHB Model Guidelines	896	110	107	97
SB Tool	n/a			

The analysis found that wood and wood products often gained or lost points for the following reasons:

1. **Indoor environmental quality** – points are often awarded when natural or low-VOC carpet is installed. Some systems balanced this by also awarding points if zero carpet is installed (e.g. wood floors), but others do not.
2. **Competing products were stipulated or given advantage** – some rating systems give points when using non-wood products such as above-grade ICFs

and recycled-content steel studs. Points are given for using flyash in concrete and calculated such that a lot of concrete needs to used to gain the points.

3. **Building technique & skills** – many of the rating systems for single-detached residential homes give points for advanced framing and/or optimal engineering. Depending on the number of points given, this was often a significant advantage for wood.
4. **Product certification** – the various rating systems treat forest certification differently, with some calling for a percentage of certified wood based on value, and others simply giving credits when certain building systems use certified wood (i.e. flooring, internal wall framing, panels, etc). No similar "chain of custody" standard is referenced for steel or concrete.
5. **Lifecycle considerations** – Only a few of the rating systems gave consideration to the lifecycle of the materials. Previous research has indicated that wood usually fairs better than its competitors on a lifecycle basis.[10] A detailed review of how wood fares in the rating systems that currently use lifecycle analysis is beyond the scope of this research.

D. Conclusions and Recommendations

Wood's primary environmental benefits are:

- Its low carbon life cycle based on the ability of trees to absorb and store carbon
- Its material efficiencies related to its combined thermal mass, water resistance, structural integrity and finish quality.
- Clean wood waste is easily recycleable

There are a host of additional benefits afforded by wood products that are sourced, manufactured and installed following environmentally responsible practices and which embody enhanced merits such as low-toxicity, energy efficiency, etc.

Rating systems are evolving rapidly but are still largely voluntary and directed to leadership projects. They are still largely unregulated and non-standardized. With the growing awareness of the impacts of buildings on carbon emissions, resource depletion and eco-system degradation, the implementation of national and international building regulations is accelerating. Although the long-term future of rating systems is unknown, they are the providing strategic direction to industry today.

If it is assumed that Europe is the harbinger of future market direction, then it may be anticipated that increased attention will be paid to the carbon inputs into a building and that progressive manufacturers will be starting to provide carbon information related to their products in the future[11].

[10] Conversation with Forestry Investment Innovation, August 2009.
[11] UN Timber Committee "Forest Sector and the Green Economy" http://timber.unece.org/index.php?id=201

While wood is variously represented by the world's most prevalent green building rating systems, its primary benefits are either undervalued or ignored. Wood products make a significant contribution to rating systems when they can leverage environmentally enhanced features (product certification, low-toxicity, etc).

Currently, rating systems dedicated to home building are most favourably disposed to the use for wood while rating systems dedicated to commercial building are at best indifferent to the prevalence of wood. As the wood industry ramps up production of environmentally enhanced products, there will be more opportunities to contribute to rating system success.

However, substantial shifts in industry practice will be necessary before the calculation and reporting of LCA and material efficiency benefits of wood industry become commonplace.

This study unearthed a great deal of information on how wood and wood products relate to green building rating and certification systems. As such, there are the following recommendations for effective promotion of wood and wood products:

1. **Building techniques and skills** – there is an opportunity to train building professionals in the techniques and skills needed to leverage wood and wood products into more green building points. Easy-to-use design guides, structural sizing charts, code interpretations, credit application "cheat-sheets" will be useful for the rating systems that focus on single-detached homes AND to grow the use of wood in non-residential buildings in the North American Market.
2. **Understand, quantify and promote lifecycle analysis (LCA) as a separate credit from local content** – some rating systems use local content credits with the intent of reducing the embodied energy and/or lifecycle emissions, when in fact a LCA approach is both more appropriate and more beneficial to wood and wood-based products. Particular reference should be given to structural systems which currently do not comprise a significant portion of green considerations for rating systems.
3. **Ensure wood product manufacturers are aware of opportunities** – There are many opportunities to promote wood-based products that have recycled content and/or use low-VOC and low/no added formaldehyde. Quantitative information about the criteria necessary to achieve specific credits need to be developed to assist sales reps in communicating the merits and applicability of their products. Manufacturers may not be aware of these opportunities or may not know the specific standards that they need to adhere to, depending on their market(s).
4. **Proactively support new wood technologies and products** - Design approaches such as passive design, philosophies such as dematerialization, and products such as wood fibre insulation have the potential to push the green building industry to greater environmental achievements. These strategies help to position wood as a consideration within the energy and atmosphere

categories. At the same time mainstream issues such as acoustics, which is an important consideration in occupant well-being, are ignored.

In summary, wood has the potential to significantly contribute to the environmental performance of a building. Given that rating systems are evolving quickly, there are opportunities to inform the development process to best communicate and evaluate the environmental benefits of wood.

To most effectively accomplish this role, a number of items require more research in order to evaluate their impacts on wood and wood products, and to better formulate a strategy for promoting more wood in the rating systems themselves.

1. **Research lifecycle assessment tools, processes** – Evaluation of the various LCA tools and methodologies for their ease of use, applicability and rigour in their treatment of wood products and assemblies was beyond the scope of the research. Given the LCA advantages of wood, it would be advantageous to proactively develop and promote appropriate LCA methodology in advance of market demand for carbon disclosure. As part of this research, it is important to also look at the coming version of LEED 3.0 and how LCA is incorporated.
2. **Evaluate the realities of using certified wood products** – When comparing the hypothetic buildings of 'More' and 'Less' wood, it was assumed that any credits that are wood related would be achieved, without evaluating whether the cost, complexity of regulatory implications. Industry feedback indicates that some certified products are more difficult to specify than others (certified heavy timbers), some strategies more technically difficult or costly to achieve (e.g. structural sizing of wood in non-residential buildings) and some are challenged with regulatory constraints (e.g. use of wood in non-combustible construction). Practical information that addresses these items will aid further uptake. This is an important dynamic for understanding if competing wood products are favoured by the building industry when building green.
3. **Regionally-specific waste management strategies** – Many of the rating and certification systems specify a certain percentage of waste that needs to be diverted to gain credits. It is unclear whether using wood makes these targets more difficult or easier to achieve. This information is also determined by regional waste diversion infrastructure. It is important to know the range of waste diversion options and fees to aid construction professionals and in order to develop a training program for promoting building techniques and skills for using wood.
4. **Salvaged wood and the pine beetle** –wood that has been salvaged from mountain pine beetle (MPB) damaged forests should be admissible under salvaged materials credits. It is therefore important to understand the procedures for applicable rating systems to accept MPB wood as salvaged material in future versions or through regional priority credits.
5. **Influencing new systems in development** –China is developing labelling standards for green buildings. With the upcoming conference in Copenhagen

(Fall 2009), other carbon reporting systems in FII target markets will be rolled out. Further, existing rating systems are frequently updated – LEED (US and Canada) is slated for update in the short term. The window of opportunity to develop accessible and practical information for specifiers in a manner that places the wood industry ahead of the curve is now. Further research is also necessary to develop and the to communicate the carbon-specific information that will aid specifiers use wood effectively in these systems.

6. **Valuation of cost and/or degree of difficulty** - This study did not examine how difficult it is to achieve the specific wood-related credits. This is important for understanding the specific barriers to using wood in the various green building rating systems. The weighting of credits in some systems do not adequately reflect the degree of difficulty or the economic impacts of accomplishment. For example, the number of credits allocated to construction waste management do not always account for the cost for diverting wood waste as opposed to sending to landfill. Research is necessary to quantify the impacts of shifting industry practice to design for disassembly, to design to coordinating dimensions or to pre-fabricate in order to reduce off-cuts and wastage during construction are not recognized.

Having read this overview of green building rating systems and their relationship to wood, the next step for the Wood Industry and its advocates is to consider and weigh the relative importance of the recommendations presented and to:

1. Align and compare with industry strategic plans (which recommendations fit best with industry priorities and current activities - short, medium and long term)
2. Create assessment and weighting criteria with which to prioritize the proposed recommendations (which recommendations to undertake first)
3. Develop an action plan and pinpoint areas requiring deeper understanding (supply chain issues, market actors and drivers, etc)
4. Identify funds and resources
5. Forge strategic partnerships and liaisons to work together and align plans (such as with the sealants and coatings sector, the insulation industry, etc)
6. Develop metrics for success

Appendix 1 - Summary of Rating Systems by Theme

Rating System	BREEAM		
	Offices	**Multi-residential**	**Eco-homes**
Building Types	Commercial	Multi-family residential	Low-rise residential and single detached
Market location	UK	UK	UK
Issues pertaining to wood			
Certified wood	In all three of the BREEAM rating systems, points are awarded for timber that is responsibly sourced. In each case the highest number of points (3) are awarded for the following certifications: FSC, CSA, SFI w/ Chain of Custody certificate, PERC, Reused materials, and schemes compliant with BES6001:2008 (Excellent and Very Good) performance ratings.		
	• MAT 5 – Responsible Sourcing of Materials (3 credits) • MAN 3 – Construction Site Impacts (4 credits)	• MAT 5 – Responsible Sourcing of Materials • MAT 8 – Responsible Sourcing of Materials: Finishing Elements • MAN 3 – Construction Site Impacts	• MAT 2 – Responsible Sourcing of Materials • MAT 3 - Responsible Sourcing of Materials: Finishing Elements • MAN 3 – Construction Site Impacts
Recycled content	Offers 1 credit for having over 25% of recycled aggregates - WST 2 – Recycled Aggregates.	All reused or salvaged materials (i.e. timber) get the same credits as the Certified wood credits	All reused or salvaged materials (i.e. timber) get the same credits as the Certified wood credits
Local sourcing of materials	n/a	n/a	n/a
Building techniques	n/a	n/a	n/a
Site protocols & waste	Credits given for waste generated per 100m3 of floor space. (Up to 4 credits) - WST 1 – Construction Site Waste Management	Credits given for waste generated per 100m3 of floor space. (Up to 4 credits) - WST 1 – Construction Site Waste Management	Credit given when there is a commitment and strategy to monitor, sort and recycle construction waste on site - MAN 3 Construction Site Impacts
Lifecycle impacts	The goal is to encourage the use of with a low environmental impact over the full life cycle of the building. Credits are achieved depending on the Green Guide ratings for the specification. The Insulation credits require both a Green Guide Rating and responsible sourcing of wood-based products.		
	• MAT 1 – Materials Specification (Major Building Elements) • MAT 6 - Insulation	• MAT 1 – Materials Specification (Major Building Elements) • MAT 6 – Insulation	• MAT 1 – Environmental Impact of Materials
Carbon & global warming	• Points are awarded to buildings that are designed to minimise the CO2 emissions associated with their operational energy consumption. Appropriate modelling assessment and software is required. In Eco-homes, credit can also being gained by using insulation materials with low global warming potential, such as (if not blown): mineral fibre, cellulose insulation, glass fibre, wood fibre board, cork, wool, cellular glass flax, etc.		
	• ENE 1 - Reduction of CO2 Emissions (15 credits)	• ENE 1 - Reduction of CO2 emissions (15 credits)	• ENE 1 - Dwelling Emission Rate • POL 1 – Insulant GWP
Indoor air quality	• HEA 9 – Volatile Organic Compounds	• HEA 9 – Volatile Organic Compounds	n/a

Competitive Materials	n/a	n/a	n/a

Rating System	Built Green ™	
	Built Green ™ Canada	**Built Green ™ Canada**
Building Types	Detached homes	Multi-family residential
Market location	Alberta & BC	Alberta & BC
Issues pertaining to wood		
Certified wood	Points awarded for using third-party certified wood in the decks/veranda and the framing in the roof, floor, and walls. Accepted standards are FSC, SFI, and CAN/CSA Z809-02.	
	• Building Materials 2-13, 2-16, 2-17, 2-18 • Exterior & Interior Finishes 3-3, 3-6, 3-22, 3-25	• Building Materials 2-16, 2-17 • Exterior & Interior Finishes 3-4, 3-15, 3-25, 3-28
Recycled /reclaimed content	Points are awarded for having recycled content in a variety of products (gypsum, sheathing, insulation, doors, window frames, etc)	
	• Building Materials 2-25, 2-26, 2-27, 2-30 • Exterior & Interior Finishes 3-5, 3-8, 3-10, 3-11, 3-13, 3-18, 3-28 • Waste Management 6-8	• Building Materials 2-25, 2-27 • Exterior & Interior Finishes 3-1, 3-3, 3-5, 3-7. 3-8, 3-9, 3-11, 3-14, 3-16, 3-19, 3-23 • Waste Management 5-5
Local sourcing of materials	Points for up to five local products (within 800km) and separate points for local countertop materials.	
	• Business Practice 8-1 • Exterior & Interior Finishes 3-27	• Business Practice 7-1
Building techniques	Points given for building techniques that reduce wood usage, mostly in the framing.	
	• Building Materials 2-7 to 2-12	• Building Materials 2-8, 2-9, 2-15
Site protocols & waste	Using engineering durable form systems and reusable bracing for framing.	
	• Waste Management 6-5, 6-9	• Waste Management 5-8, 5-9
Lifecycle impacts	n/a	n/a
Carbon & global warming	n/a	n/a
Indoor air quality	Industry Standard ANSI A208.1-1999 sets a 0.20 ppm limit for formaldehyde emissions. Built Green requires a 10% better level of performance at 0.18 ppm. Points are also awarded for using hard surface flooring.	Low formaldehyde (phenol) and formaldehyde-free binders (PMDI) are available and becoming more common. FSC certified OSB is becoming more common. The referenced standard is ANSI A208.2 – 1994 concentration 0.3 ppm).
	• Indoor air quality 4-10 to 4-18, • Indoor air quality 4-23, 4-27	• Indoor Air Quality 4-11 to 4-20, • Indoor Air Quality 4-27, 4-28

Competitive Materials	Points are awarded for replacing wood with alternative products, such as wood studs with ICFs or recycled steel studs or replacing lumber with engineered products (floors, beams, headers, studs, etc).	
	• Building Materials 2-2, 2-4 • Building Materials 2-19 to 2-24 • Building Materials 2-32 • Exterior & Interior Finishes 3-4, 3-12, 3-24	• Building Materials 2-1, 2-7 • Building Materials 2-18 to 2-22, 2-26 • Exterior & Interior Finishes 3-2, 3-24

Rating System	Built Green ™	
	Built Green ™ Washington	**Built Green ™ Washington**
Building Types	Detached residential	Multi-family residential
Market location	King & Snohomish County	King & Snohomish County
Issues pertaining to wood		
Certified wood	Requires that wood be certified to FSC standard. No other certification schemes are accepted.	
	• Materials Efficiency 5-37, 5-39 to 5-44, 5-66, 5-67, 5-86, 5-87, 5-88b&c, 5-90, 5-91b&c, 5-93, 5-102	• Materials Efficiency 5-44 to 5-49, 5-72, 5-73, 5-82, 5-83, 5-88, 5-89, 5-94b-e, 5-96, 5-97, 5-98b-e, 5-100, 5-112, 5-113
Recycled /reclaimed content	Mainly points are awarded for salvaged/reclaimed materials, and some points are available for using recycled content in concrete.	
	• Materials Efficiency 5-32, 5-33, 5-36, 5-53, 5-54, 5-63, 5-65	• Materials Efficiency 5-13a-k, 5-14, 5-38, 5-59, 5-60, 5-71, 5-108, 5-114
Local sourcing of materials	Points awarded for using local and regional materials and products. A "local" material is manufactured in Pierce, King, or Snohomish county in Washington. A "regional" material is produced within a 500 mile radius of the project.	
	• Materials Efficiency 5-31, 5-88a, 5-91a	• Materials Efficiency 5-36, 5-37, 5-58, 5-61, 5-93, 5-94a, 5-98a
Building techniques	Points given for building techniques that reduce wood usage, mostly in the framing.	
	• Energy Efficiency 3-4, 3-8, 3-17, 3-18 • Materials Efficiency 5-10, 5-51	• Energy Efficiency 3-5, 3-9, 3-10, 3-17, 3-18 • Materials Efficiency 5-56
Site protocols & waste	Points given for 85% recycling rates for both wood scraps and for concrete/asphalt/masonry materials	
	• Materials Efficiency 5-10, 5-15, 5-18, 5-30	• Materials Efficiency 5-16, 5-17, 5-20
Lifecycle impacts	n/a	n/a
Carbon & global warming	n/a	n/a
Indoor air quality	Checklist states that products must have zero Urea Formaldehyde.	
	• Health & Indoor Quality 4-14, 4-22, 4-25, 4-26, 4-28 • Materials Efficiency 5-89, 5-92	• Health & Indoor Quality 4-15 to 4-23 • Materials Efficiency 5-95, 5-98f,
Competitive Materials	Points for SIPs, ICFs, engineered products, finger-jointed products, and avoiding vinyl flooring and windows.	
	• Materials Efficiency 5-45, 5-47 to 5-50, 5-83, 5-84, 5-85,	• Materials Efficiency 5-51 to 5-55, 5-63, 5-84, 5-90 to 5-92

Rating System	Built Green® Colorado	CASBEE®
Building Types	Detached residential	Detached residential
Market location	Colorado	Japan
Issues pertaining to wood		
Certified wood	Points are awarded when specific building elements and/or assemblies use third-party certified wood. FSC and SFI are listed as references, but it is unclear if CSA is acceptable.	Points are awarded depending on the percentage of the materials used for the specified building system, Accepted third-party certification systems include: FSC, SFI, ATFS, PEFC, and SGEC. The wood and wood products should have a certification mark on them in conjunction with CoC certification

	• Material Resource Efficiency – 117, 118, 125, 127, 134, 135, 137, 144, 149, 159	• LRH2 Using Resources Sparingly and Reducing Waste:
		  • 1.1 Building frames
		  • 1.3 Exterior materials
		  • 1.4 Interior materials
		  • 1.5 Materials for the external area

Recycled /reclaimed content	Points are awarded when specific building elements (flooring, structural, etc) have recycled content or have been reclaimed/salvaged.	Points are awarded for efforts to use materials that have been recycled, however the same points are given if the materials are renewable (ie. From a sustainable forest)

	• Material Resource Efficiency - 123, 124, 136, 147, 157, 161, 162	• LRH2 Using Resources Sparingly and Reducing Waste:
		  • 1.1 Building frames
		  • 1.3 Exterior materials
		  • 1.4 Interior materials
		  • 1.5 Materials for the external area

Local sourcing of materials	The only local content credit asks that 50% of the façade material is regionally produced (within 500 mile radius)	The goal is to preserve the environment of mountain forests by utilizing wood resources of the region.
	• Material Resource Efficiency - 145	• QH3 Creating a Richer Townscape and Ecosystem - 4. Utilizing Regional Resources and Inheriting the Regional Housing Culture
Building techniques	Points given for building techniques that reduce wood usage, mostly in the framing	n/a
	• Material Resource Efficiency – 27, 28, 119, 120	

Site protocols & waste	n/a	Points are awarded for efforts to reducing waste and increasing recycling, both at the construction stage and by purchasing materials from companies with ISO 140001 certification.
		• LRH2 Using Resources Sparingly and Reducing Waste:
		  • 2.1 Production stage (members for building frames)
		  • 2.2 Production stage (other members)

Rating System	Built Green® Colorado	CASBEE®
Lifecycle impacts	n/a	Various point levels achieved for different lifespan of materials before large-scale replacement/repair is needed.
		• QH2 Ensuring a Long Service Life - 1.1. Building frames QH2 Ensuring a Long Service Life - 1.2 Exterior wall materials
Carbon & global warming	n/a	CASBEE® has developed a method for calculating lifecycle CO2 emissions (emissions produced from all processes of the house from construction to occupancy, renovation, demolition, and disposal) based on the scoring of other CASBEE® criteria and building systems that have large CO2 impacts LRH3 Consideration of the Global, Local, and Surrounding Environment - 1. Consideration of Global Warming
Indoor air quality	Points are given for specific building elements and/or assemblies that have low VOC and low/no added formaldehyde.	Must satisfy the requirements of Grade 1,2, or 3 in Section 6-1, "Countermeasure against Formaldehyde (Interior, Ceiling Plenum, etc.)," of the Japan Housing Performance Indication Standards. The areas include interior finish (except pillars or other axis materials, crown moldings, window sills, skirtings, fitted framing, paints used partially, and adhesives) and base materials used in the ceiling plenum or other spaces
	• Material Resource Efficiency – 77, 78, 81, 83, 84, 136, 155, 156, 157	• QH1 – Comfortable, Healthy and Safe Indoor Environment - 2.1 Counter measures against chemical contaminants
Competitive Materials	Points are awarded for ICFs, various flooring (bamboo, cork, natural carpet) and durable roofing materials.	n/a
	• Material Resource Efficiency -79, 113, 146, 148, 150, 151, 152, 153	

Rating System	Green Globes™	Green Star
Building Types	Commercial	Multi-family residential
Market location	Canada	Australia, New Zealand, South Africa
Issues pertaining to wood		
Certified wood	To conserve resources and minimize the energy and environmental impact of extracting and processing non-renewable materials	Points awarded for FSC certified timber, flooring, joinery, and internal walls
	E.2 – Minimal Consumption of Resources: • Use lumber and timber panel products which originate from certified and sustainable sources (CSA, FSC, or SFI) and avoid use of tropical hardwoods.	• Materials – 7, 11, 12, 14
Recycled /reclaimed content	To conserve resources and minimize the energy and environmental impact of extracting and processing non-renewable materials	Single credit for recycled-content & re-used products and materials. Concrete, steel and timber is excluded.
	E.2 – Minimal Consumption of Resources: • Specify used building materials and components. • Specify materials with recycled content	• Materials - 3
Local sourcing of materials	To conserve resources and minimize the energy and environmental impact of extracting and processing non-renewable materials	n/a
	E.2 – Minimal Consumption of Resources: • Specify locally manufactured materials that have been selected based on a LCA.	
Building techniques	n/a	n/a
Waste minimization	n/a	n/a
Lifecycle impacts	To select materials with the lowest life cycle environmental burden and embodied energy:	n/a
	E.1 – Low Impact Systems & Materials - Select materials that reflect the results of a "best run" life cycle assessment for the following: • Foundation and floor assembly and materials • Column and beam or post and beam combinations, and walls • Roof assemblies • Other envelope assembly materials (cladding, windows, etc.)	
Carbon & global warming	n/a	n/a
Indoor air	To minimize contaminants in the indoor air thereby helping to ensure occupant wellbeing and comfort - Use interior materials, including paints,	Points awarded for finishes with low-VOC and wood products with low or

quality	sealants, adhesives, carpets and composite wood products that are low-VOC emitting, non-toxic, and chemically inert (i.e. contain concentrations of VOC as per Environmental Choice Program limits).	no added formaldehyde.
	• G.2 – Control of Indoor Pollutants	• IEQ – 8, 9
Competitive Materials	n/a	Has specific credits for timber, concrete and steel, but these points are not counted against if the product is not used.
		• Materials – 4, 5

	LEED NC (US and Canada)	LEED CI
Building Types	New Construction and Major Renovations, large projects, high rises, multi unit residential	Commercial Interiors and Tenant Improvements, large projects, high rises, multi unit residential
Market location	US and Canada	US and Canada
Issues pertaining to wood		
Certified wood	LEED-NC and LEED-CI both award a credit for projects in which a minimum of 50% by value of all wood-based materials are certified in accordance with FSC principals and criteria.	
	• MR 7 – Certified Wood (1 credit)	• MR 7 – Certified Wood (1 credit)
Recycled /reclaimed content	LEED-NC and LEED-CI both award credits for reuse of materials (5-10% by value of all building materials, not limited to wood). LEED-NC Canada awards up to 2 credits for use of recycled content materials (Canada: 7.5-15%, US: 10-20% by value post consumer content, not limited to wood. Post industrial counts as one half the value of post consumer). LEED-CI awards a credit for use of a minimum of 30% salvaged furniture and furnishings, as well as up to 2 credits for use of recycled content materials and products (10-20% by value post consumer content, not limited to wood. Pre consumer counts as one half the value of post consumer).	
	• MR 3.1 – Resource Reuse 5% (1 credit) • MR 3.2 – Resource Reuse 10% (1 credit) • Canada: MR 4.1 – Recycled Content 7.5% (1 credit) • Canada: MR 4.2 – Recycled Content 15% (1 credit) • US: MR 4 – Recycled Content 10-20% (1-2 credits)	• MR 3.1 – Resource Reuse 5% (1 credit) • MR 3.2 – Resource Reuse 10% (1 credit) • MR 3.3 – Resource Reuse 30% Furniture and Furnishings (1 credit) • MR 4.1 – Recycled Content 10% (1 credit) • MR 4.2 – Recycled Content 20% (1 credit)
Local sourcing of materials	LEED-NC (Canada) and LEED-CI both award up to 2 credits for use of regionally manufactured or extracted materials (10-20% by value of all building products and materials extracted or produced within 800km, OR within 2,400km and shipped via train/water, OR combination. Not limited to wood products). LEED-NC US offers up to 4 credits for 'Regional Priority' credits that are determined on a regional basis.	
	• Canada: MR 5.1 - Regional Materials - 10% Extracted & Manufactured Regionally (1 credit) • Canada: MR 5.2 - Regional Materials - 20% Extracted & Manufactured Regionally (1 credit) • US: RP 1 – Regional Priority (1-4 credits)	• MR 5.1 Regional Materials - 10% Extracted & Manufactured Regionally (1 credit) • MR 5.2 Regional Materials - 20% Extracted & Manufactured Regionally (1 credit)
Building techniques	n/a	
Site protocols & waste	n/a	
Lifecycle impacts	n/a	
Carbon & global warming	n/a	

	LEED NC (US and Canada)	LEED CI
Indoor air quality	LEED-NC (Canada) and LEED-CI both award a credit for reducing indoor air contaminants, by requiring that composite wood or agrifibre products, and laminate adhesives have no added urea-formaldehyde resins. LEED-NC (Canada) offers a further credit for paints and coatings that have limited volatile organic compounds. LEED-CI offers a further credit for systems and furniture that meets specific emissions standards. LEED-NC (US) offers credits for reducing indoor air contaminants by requiring that composite wood or agrifibre product have no added urea-formaldehyde resins, and that all flooring systems meet emissions standards.	
	• Canada: EQ 4.1 - Low Emitting Materials - Paints & Coatings (1 credit) • Canada: EQ 4.4 - Low Emitting Materials - Composite Wood and Laminate Adhesives (1 credit) • US: IEQ 4.3 – Low Emitting Materials – Flooring Systems (1 credit) • US: IEQ 4.4 – Low Emitting Materials – Composite Wood and Agrifibre Products (1 credit)	• EQ 4.4 - Low Emitting Materials - Composite Wood & Laminate Adhesives (1 credit) • EQ 4.4 - Low Emitting Materials - Systems, Furniture & Seating (1 credit)
Competitive Materials	LEED-NC (Canada) and LEED-CI include additional credits for a minimum 5% by value of total plant-based materials being made from a rapidly renewable plant (with a ten-year or shorter harvesting cycle).	
	• Canada: MR 6 – Rapidly renewable materials (1 credit)	• MR 6 – Rapidly renewable materials (1 credit)

Rating System	LEED	
	LEED for Homes (Canada)	**LEED for Homes (US)**
Building Types	New Construction and Major Renovations, single family homes	New Construction and Major Renovations, single family homes
Market location	Canada	US
Issues pertaining to wood		
Certified wood	LEED for Homes requires that projects utilizing tropical wood for framing use only FSC-certified wood, and awards a credit for use of 50% by value certified wood for all other materials and products.	
	• MR 2.1 - Environmentally Preferable Products (Prerequisite) • MR 7 – Certified Wood (1 credit)	
Recycled /reclaimed content	LEED for Homes awards credits for reuse of materials and recycled content materials in framing. Products must contain 25% post consumer content with pre consumer / post industrial counted at half the rate.	
	MR 2.2 – Environmentally Preferable Products (up to 8 points)	
Local sourcing of materials	LEED for Homes awards credits for use of regional framing materials. Products must extracted, processed and manufactured within 800km (if trucked) or 2,400km (if shipped by rail).	
	• MR 2.2 – Environmentally Preferable Products (up to 8 points)	
Building techniques	Offers points for advanced framing techniques	
	MR 1 - Material-Efficient Framing	
Site protocols & waste	n/a	
Lifecycle impacts	n/a	
Carbon & global warming	n/a	
Indoor air quality	n/a	
	n/a	
Competitive Materials	n/a	

Rating System	Living Building Challenge
Building Types	New Construction and Major Renovations, large projects, high rises, multi unit residential
Market location	Cascadia region, US and Canada
Issues pertaining to wood	
Certified wood	All wood must be certified FSC or be salvaged or be reused onsite timber.
	• Prerequisite 7 – Responsible Industry
Recycled /reclaimed content	All wood must be certified FSC or be salvaged or be reused onsite timber.
	• Prerequisite 7 – Responsible Industry
Local sourcing of materials	Assemblies and materials must be sourced within specified distances, between 250-3,000 miles.
	• Prerequisite 8 – Appropriate Materials/Services Radius
Building techniques	n/a
Site protocols & waste	Construction Waste must be diverted from landfills to the following levels: Metals (90%), all wood products (80%), concrete (80%)
	• Prerequisite 9 - Leadership in Construction Waste
Lifecycle impacts	n/a
Carbon & global warming	The project must account for the embodied carbon footprint of its construction through a one-time carbon offset tied to the building's square footage and general construction type.
	• Prerequisite 6 – Construction Carbon Footprint
Indoor air quality	All interior materials, finishes, paints and adhesives must comply with All interior finishes, paints and adhesives must comply with SCAQMD 2007/2008 standards.
	• Prerequisite T13 – Healthy Air: Source Control
Competitive Materials	n/a

	NAHB	SB Tool
Building Types	New Construction and Major Renovations, single family homes	All
Market location	US	Worldwide
Issues pertaining to wood		
Certified wood	All wood must be certified by credible third party certification sources including Sustainable Forestry Initiative, American Tree Farm, Canadian Standards Association, FSC, Program for Endorsement of Forest Certification Systems. Further credits are available for materials manufactured from renewable resources or agricultural by-products, as well as for termite resistant materials where necessary.	The percentage, by cost, of bio-based products used in the building, including wood and agricultural products that are certified by a recognized certification agency.
	• Resource Efficiency 2.2.8 – Termite resistant materials (7 credits) • Resource Efficiency 2.6.1 - Renewable Resources (3 credits) • Resource Efficiency 2.6.2 - Certified Wood (4 credits)	• B4.7 - Use of bio-based products obtained from sustainable sources
Recycled /reclaimed content		• To reduce the use of virgin materials, where functionally appropriate, in order to minimize the direct consumption of natural resources. The percent of interior floor, wall or ceiling surfaces that consist of non-virgin materials • To encourage the re-use in the project of suitable existing materials from the site or from off-site sources. Also to encourage the use of recycled materials. The percentage, by cost, of the materials, products, and furnishings in the project that are salvaged and refurbished or reused or come from off-site recycled sources.
	• Resource Efficiency 2.3.2 – Reuse salvaged materials (5 credits) • Resource Efficiency 2.4.1 – Use recycled content materials (3 credits)	• B4.3 - Minimal use of virgin materials • B4.5 - Re-use of salvaged materials. • B4.6 - Use of recycled materials from off-site sources
Local sourcing of materials		To encourage the procurement of high-weight materials such as aggregate, sand, concrete, masonry, steel and glass, from sources within the greater urban region.
	• Resource Efficiency 2.8.1 – Use Local Indigenous materials (5 credits)	• B4.9 - Use of materials that are locally produced
Building techniques	Use of advanced framing techniques and resource efficiency is encouraged	n/a
	• Resource Efficiency 2.1.2 – Advanced Framing (8 credits) • Resource Efficiency 2.1.3 – Minimize Material Cuts (6 credits) • Resource Efficiency 2.1.4 – Framing Plan (7 credits) • Resource Efficiency 2.1.5 – Materials Require no additional Finish (4 credits) • Resource Efficiency 2.1.6a – Pre-cut or Pre-assembled methods (3	

	NAHB	SB Tool
	credits per floor) • Resource Efficiency 2.1.6b – Panelized wall framing (6 credits) • Resource Efficiency 2.1.6c – Panelized roof system (6 credits) • Resource Efficiency 2.1.6d – Modular construction (7 credits) • Energy Efficiency 3.3 – Increase R-Value of envelope using SIPS/ICFs/Advanced Framing	
Site protocols & waste		n/a
Lifecycle impacts		To minimize the embodied primary energy used in the building, annualized over the estimated lifespan of the building. Estimate of embodied primary energy used for structure, envelope (excl. glazing), and major interior components, as determined by a program designed to estimate embodied energy and emissions through Life Cycle Analysis; also, estimate of lifespan
	• Resource Efficiency 2.8.2 – Use Life Cycle Assessment Tool (8 credits) • Global Impact 7.11 – Product Manufacturer Operations ISO Compliance (3 credits)	• B1.1 - Annualized non-renewable primary energy embodied in construction materials • F2.1 - Minimization of life-cycle cost
Carbon & global warming		• C1.1 - Annualized GHG emissions embodied in construction materials.
Indoor air quality	All particleboard, fibreboard and hardwood plywood substrates certified low formaldehyde. Wood composites and agrifibre panels no added urea formaldehyde resins or third party certified.	
	• IEQ 5.1.5 – Formaldehyde Emissions (6 credits)	• D1.3 - Off-gassing of pollutants from interior finish materials.
Competitive Materials		
		• B4.8 - Use of cement supplementing materials in concrete.

Appendix 2 – Detailed Breakdown of Each System

This section goes into each green building rating system and details the data and calculations that were summarized in Appendix 1.

Appendix 2 describes each rating system in two parts. The first part identifies the system by its name, location, market scope, building type, and the organization that administers it. A general description of the system then follows and contains:

- The weighting of the different categories within the system (e.g. energy, water, IAQ, etc.),
- The number of credits/points needed to achieve the various levels of distinction (e.g. LEED Silver, Gold, Platinum),
- Calculations for the prevalence of wood-related credits,
- The number of credits achieved using wood products versus using non-wood products.

The second part of the description is given in tables and contains the specific credit title and ID number, the number of credits/points available, a description of how the credit relates to wood, steel and concrete, and the credit's implications for wood and wood-related products.

BREEAM

Name(s):	Building Research Establishment's Environmental Assessment Method (BEEAM)
Location:	United Kingdom
Market Scope:	All of UK
Building Types:	BREEM for Offices, Multi-family Residential, ecoHomes
Organization:	Building Research Establishment (BRE)

BREEAM (Building Research Establishment's (BRE) Environmental Assessment Method) offers credits in ten categories according to performance. These credits are then added together to produce a single overall score on a scale of Pass, Good, Very Good, Excellent and Outstanding.

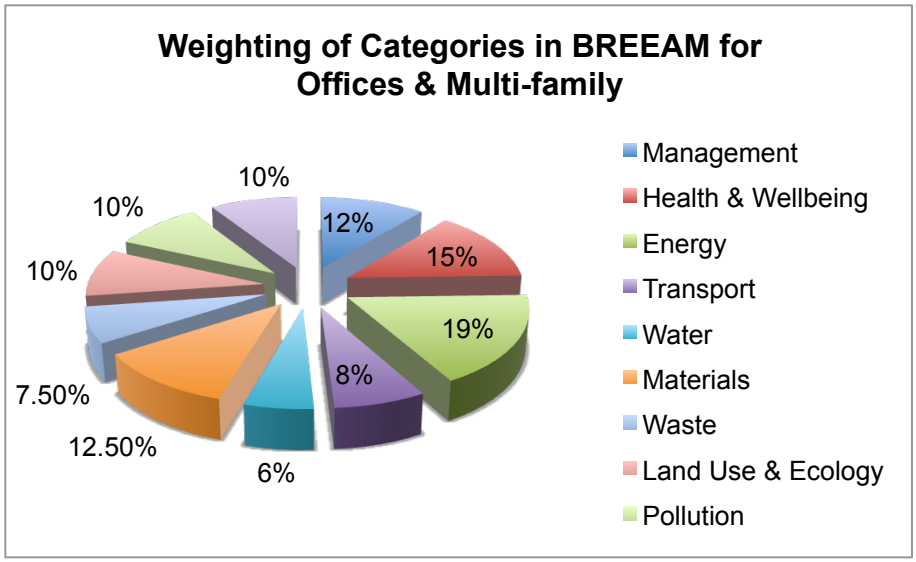
There are a variety of BREAM schemes, each with their own manual of technical standards, definition of scope, rating and scoring information and technical checklists:

- BREEAM Courts
- BREEAM Education
- BREEAM Industrial
- BREEAM Healthcare
- BREEAM Prisons
- BREEAM Multi-residential
- BREEAM Offices
- BREEAM Retail

The BREEAM standard, regardless of which scheme is used (with the exception of ecohomes, which is discussed on the next page), evaluates buildings in 10 categories of sustainability:

1. Management
2. Health & Wellbeing
3. Energy
4. Transport
5. Water
6. Materials
7. Waste
8. Land Use & Eocology
9. Pollution
10. Innovation

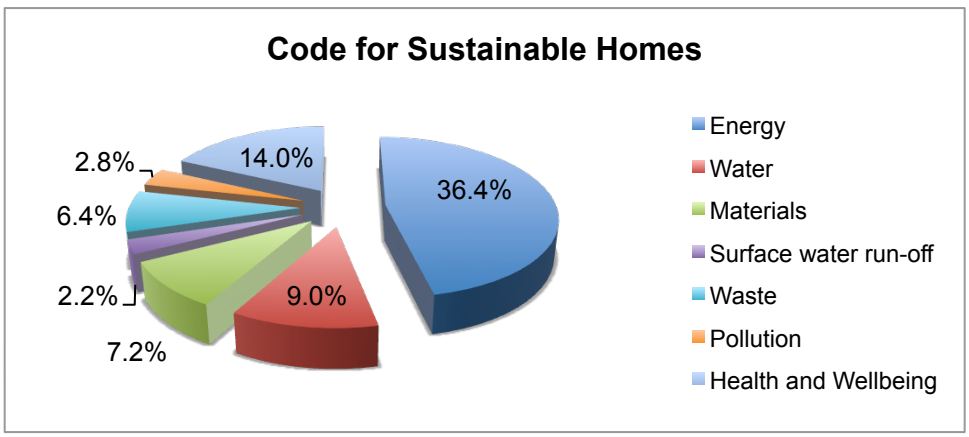
The different sections are weighted as follows:



BREEAM buildings are rated based on their scores, which are calculated by the sum of the credits achieved in each category, multiplied by the weighting given to each category. Buildings are rated as follows:

BREEAM Rating	% score
Unclassified	< 30
Pass	≥ 30
Good	≥ 45
Very Good	≥ 55
Excellent	≥ 70
Outstanding	≥ 85

BREEAM Ecohomes is a slightly different system that was developed alongside UK's Code for Sustainable Homes, which has now taken over as the dominant scheme. This system focused on greening low-rise residential homes. Instead of ten categories, the Code only has eight:



Prevalence of Wood

The following sections look at how many credits relate to wood. The credits are multiplied by the weighting of each category in order to evaluate how much influence wood and wood products have on the BREEAM rating systems.

BREEAM Offices

Wood-related credits are found in the categories of Management (10%), Health & Wellbeing (7%), and Materials (75%).

Prevalence of Wood - BREEAM for Offices

	Total credits available	Credits that relate to wood	Percent related to wood	Weight of category	Prevalence of wood overall
Management	10	1	10%	12%	4.8%
Health & Wellbeing	14	1	7%	15%	1.1%
Energy	21	0	0%	19%	0.0%
Transport	10	0	0%	8%	0.0%
Water	6	0	0%	6%	0.0%
Materials	12	9	75%	12.50%	9.4%
Waste	7	0	0%	7.50%	0.0%
Land Use & Ecology	10	0	0%	10%	0.0%
Pollution	12	0	0%	10%	0.0%
Innovation	10	0	0%	10%	0.0%
Total	112	14			11.6%

Overall, wood-related credits account for about 12% of all available credits.

BREEAM Multi-residential

Wood-related credits are in the categories of Management (10%), Health & Wellbeing (7%), and Materials (92%).

Prevalence of Wood - BREEAM Multi-residential

	Total credits available	Credits that relate to wood	Percent related to wood	Weight of category	Prevalence of wood overall
Management	10	1	10%	12%	4.8%
Health & Wellbeing	14	1	7%	15%	1.1%
Energy	21	0	0%	19%	0.0%
Transport	10	0	0%	8%	0.0%

Prevalence of Wood - BREEAM Multi-residential					
Water	6	0	0%	6%	0.0%
Materials	12	11	92%	12.5%	11.5%
Waste	7	0	0%	7.5%	0.0%
Land Use & Ecology	10	0	0%	10%	0.0%
Pollution	12	0	0%	10%	0.0%
Total	112	14			13.7%

Overall, wood-related credits account for about 14% of all available credits.

BREEAM Code for Sustainable Homes

Wood-related credits are in the categories of Materials (100%), Pollution (25%) and Management (11%).

Prevalence of Wood - BREEAM Code for Sustainable Homes					
	Total credits available	Credits that relate to wood	Percent related to wood	Weight of category	Prevalence of wood overall
Energy	29	0	0%	36.4%	0.0%
Water	6	0	0%	9.0%	0.0%
Materials	24	24	100%	7.2%	7.2%
Surface water run-off	4	0	0%	2.2%	0.0%
Waste	7	0	0%	6.4%	0.0%
Pollution	4	1	25%	2.8%	0.7%
Health and Wellbeing	12	0	0%	14.0%	0.0%
Management	9	1	11%	10.0%	1.1%
Ecology	9	0	0%	12.0%	0.0%
Total	95	26	27%		9.0%

Overall, wood-related credits account for about 9% of all the total score.

Wood vs. Competing Products

This section compares two hypothetical buildings for each rating system to determine if using wood and wood-products is a disadvantage or an advantage in the BREEAM rating systems.

Each of these systems relies on the UK Green Guide to assess how many points various materials can receive. The Green Guide is the materials lifecycle analysis guide that is used to achieve points in that category. An assessment of how wood is treated in the Green Guide is beyond the scope of the research (see the “Further Research” section of this report for more details

BREEAM Offices

BREEAM for Offices	Total Credits	Total Wood-Related Credits	More Wood	Less Wood
Management	10	1	1	1
Health & Wellbeing	14	1	1	1
Materials	12	9	0-9	0-9
Total	36	14	5-14	5-14

In the Management category, credit Man 3 offers 1 point if 80% of the wood used on-site is responsibly sourced. It was assumed that this point can be achieved regardless of the amount of wood on site (i.e. more or less wood).

The Materials category depends on the Green Guide ratings. Please refer to the next section for more details on each of these credits.

BREEAM Multi-residential

The Multi-residential application is identical to BREEAM for Office in how it treats wood use.

BREEAM Multi-residential	Total Credits	Total Wood-Related Credits	More Wood	Less Wood
Management	10	1	1	1
Health & Wellbeing	14	1	1	1
Materials	12	9	0-9	0-9
Total	36	11	2-11	2-11

BREEAM Code for Sustainable Homes

It is possible to score just as many points using substitutes for wood as long as they are rated equally in the Green Guide. An analysis of which substitutes compare equally to wood is beyond the scope of this report.

BREEAM Code for Sustainable Homes	Total Credits	Wood-related credits	More Wood	Less Wood
Materials	24	24	0 - 24	0 - 24
Pollution	4	1	1	1
Total	28	25	1-25	1-25

The next section details the specific credits that can be earned.

Specific Credits - BREEAM Offices[12]

Issue ID & Title	# Credits	Description(s) relating to wood, steel and concrete	Implications for Wood
Management			
MAN 3 – Construction Site Impacts	4	1 credit where at least 80% of site timber is responsibly sourced and 100% is legally sourced. Site timber is considered to be timber used to facilitate construction, including formwork, site hoardings and other temporary site timber used for the purpose of facilitating construction. It does not cover structural timber and timber used for fit-out items.	• Forest certification – timber - requires a copy of the certification document or Chain of Custody (CoC) certificate(s)
Health & Wellbeing			
HEA 9 – Volatile Organic Compounds	1	Products (where specified) have been tested and meet the relevant standards – *See table below* – wood panels, timber structures, glued laminated timber, wood flooring, laminated wood flooring, flooring adhesives, decorative paints and varnishes	• Low or no formaldehyde and/or VOCs
Materials			
MAT 1 – Materials Specification (Major Building Elements)	4	To recognise and encourage the use of construction materials with a low environmental impact over the full life cycle of the building – Credits are achieved depending on the Green Guide ratings for the specification. Exemplary level (extra credit) can be achieved as follows: • Where assessing four or more applicable building elements, the building achieves at least two points additional to the total points required to achieve maximum credits under the standard BREEAM criteria. • Where assessing fewer than four applicable building elements, the building achieves at least one point additional to the total points required to achieve maximum credits under the standard BREEAM criteria.	• Lifecycle environmental impact • How does wood fair under the UK's Green Guide?

[12] BREEAM Offices 2008 Assessor Manual,

Issue ID & Title	# Credits	Description(s) relating to wood, steel and concrete	Implications for Wood
MAT 5 – Responsible Sourcing of Materials	3	Up to 3 credits are available when 80% of the *applicable materials* comprising each of the following building elements are responsibly sourced: Structural Frame, Ground floor, Upper floors, Roof, External & Internal walls, Foundation/substructure, Staircase. Applicable materials include - Brick (including clay tiles and other ceramics), Resin-based composites and materials, including GRP and polymeric render, **Concrete**, Glass, Plastics and rubbers, **Metals (steel, aluminium** etc.), Dressed or building stone including slate, **Timber, timber composite and wood panels (including glulam, plywood, OSB, MDF, chipboard and cement bonded particleboard).** Plasterboard and plaster, Bituminous materials, such as roofing membranes and asphalt, **Other mineral-based materials, including fibre cement and calcium silicate,** P**roducts with recycled content** Exemplary level criteria can achieve an innovation credit where, in addition to the above criteria, 95% of the applicable materials have been responsibly sourced.	• Forest certification – all wood and wood-based products - Highest points achieved with FSC, CSA, SFI with CoC, PEFC, reused materials, schemes compliant with BES6001:2008.
MAT 6 - Insulation	2	Credit 1 – Embodied Impact – credit calculated using Green Guide score combined with Insulation Index Calculator Credit 2 – Responsible Sourcing - At least 80% of the thermal insulation used in the building elements must be responsibly sourced.	▪ Insulation – wood based = Green Guide score + insulation from either recycled source or from certified wood. • How does wood-based insulation fair in the Green Guide?
Waste			
WST 1 – Construction Site Waste Management	4	Credits given for waste generated per 100m^3 of floor space. 1 credit for 13.0-16.6m^3, 2 credits for 9.2-12.9 m^3 and 3 credits if there is less than 9.2 m^3 of waste. One credit is also available when at least 75% by weight or 65% by volume of non-hazardous construction waste has been diverted from landfill and either: a. Reused on site (in-situ or for new applications) b. Reused on other sites c. Salvaged/reclaimed for reuse d. Returned to the supplier via a 'take-back' scheme e. Recovered from site by an approved waste management contractor and recycled. Exemplary level can be achieved at 90% by weight (80% volume) has been diverted.	• Does using wood make it easier or more difficult to achieve waste diversion targets?

Issue ID & Title	# Credits	Description(s) relating to wood, steel and concrete	Implications for Wood
WST 2 – Recycled Aggregates	1	To encourage the use of recycle & secondary aggregates, thereby reducing demand for virgin material. The following demonstrates compliance: Where the amount of recycled and secondary aggregate specified is over 25% of the total high-grade aggregate uses for the building. Such aggregates can be EITHER: • Obtained on site, OR • Obtained from waste processing site(s) within a 30km radius of the site; the source will be principally from construction, demolition and excavation waste (CD&E) – this includes road planings, OR • Secondary aggregates obtained from a non-construction post-consumer or post-industrial by-product source.	• Competes with wood

Specific Credits - BREEAM Multi-Residential[13]

Issue ID & Title	# Credits	Description(s) relating to wood, steel, and concrete	Implications for wood
Management			
MAN 3 – Construction Site Impacts	4	+1 credit available where evidence provided demonstrates that at least 80% of site timber is responsibly sourced and 100% is legally sourced.	• Forest certification – timber - requires a copy of the certification document or Chain of Custody (CoC) certificate(s)
Health & Wellbeing			

[13] BREEAM Multi-residential 2008 Assessor Manual

Issue ID & Title	# Credits	Description(s) relating to wood, steel, and concrete	Implications for wood
HEA 9 – Volatile Organic Compounds	1	Same as HEA 9 in BREEAM for Offices	• Low or no formaldehyde and/or VOCs
Materials			
MAT 1 – Materials Specification (major building elements)	6	Up to six credits are available, determined by the Green Guide to Specification ratings for the major building/finishing elements – external walls, windows, roof, upper floor slab, internal walls, and floor finishes. The Green Guide rating for the specifications for the following building elements must be determined and entered in to the BREEAM assessor's Mat 1 Calculator	• Lifecycle environmental impact – major building and finishing elements • How does wood fair under the UK's Green Guide?
MAT 5 – Responsible sourcing of materials: Basic building elements	3	Up to 3 credits are available where evidence demonstrates that 80% of the *applicable materials* comprising each of the following building elements are responsibly sourced: Structural Frame, Ground floor, Upper floors, including separating floors, Roof, External walls, Internal walls, Foundation/substructure, Staircase Applicable materials include - Brick (including clay tiles and other ceramics), Resin-based composites and materials, including GRP and polymeric render, **Concrete**, Glass, Plastics and rubbers, **Metals (steel, aluminium** etc.), Dressed or building stone including slate, **Timber, timber composite and wood panels (including glulam, plywood, OSB, MDF, chipboard and cement bonded particleboard).** Plasterboard and plaster, Bituminous materials, such as roofing membranes and asphalt, **Other mineral-based materials, including fibre cement and calcium silicate,** P**roducts with recycled content** Any non-certified timber used in the development comes from a legal source and is not included on the CITES list (see definition for legally sourced timber). Exemplary level criteria can achieve an innovation credit where, in addition to the above criteria, 95% of the applicable materials have been responsibly sourced. EMS requirements - All wood products can only use the Timber Certification route. Where an Environmental management scheme is used to assess products made from recycled timber, 100% of the timber content must be recycled or sourced from one of the recognised timber certification schemes. A timber product with 50% recycled timber and 50% legally sourced timber will not comply with the criteria and will not be awarded any points. Using an EMS for new timber does not demonstrate timber certification and therefore does not qualify for points.	• Forest certification – all wood and wood-based products - Highest points achieved with FSC, CSA, SFI with CoC, PEFC, reused materials, schemes compliant with BES6001:2008.

Issue ID & Title	# Credits	Description(s) relating to wood, steel, and concrete	Implications for wood
MAT 6 - Insulation	2	To recognise and encourage the use of thermal insulation that has a low embodied environmental performance relative to its thermal properties and has been responsibly sourced. Where evidence provided demonstrates that thermal insulation products used in the building have a low embodied impact relative to their thermal properties, determined by the Green Guide to Specification ratings. Where evidence provided demonstrates that thermal insulation products used in the building have been responsibly sourced.	• Insulation – wood based = Green Guide score + insulation from either recycled source or from certified wood. • How does wood-based insulation fair in the Green Guide?
MAT 8 – Responsible Sourcing of Materials: Finishing Elements	2	Up to 2 credits are available where evidence provided demonstrates that 80% of the assessed materials in the following finishing elements are responsibly sourced: • Stairs (including handrails, balustrades, banisters, other guarding rails but excluding staircase) • Window (including sub-frames, frames, boards and sills) • External and internal door (including sub-frames, frames, linings anddoor) • Skirting (including architrave, skirting board and rails) • Panelling (including any other trim) • Furniture (including fitted kitchen, bedroom and bathroom) • Facias (soffit boards, bargeboards, gutter boards, others) • Any other significant use. Exemplary innovation credit at 95% of applicable materials are responsible sourced	• Forest certification – all wood and wood-based products - Highest points achieved with FSC, CSA, SFI with CoC, PEFC, reused materials, schemes compliant with BES6001:2008.
Waste			
WST 1 – Construction Site Waste Management	4	Same as Credit WST 1 in BREEAM for Offices	• Does using wood make it easier or more difficult to achieve waste diversion targets?

Specific Credits - BREEAM Code for Sustainable Homes[14]

Issue ID & Title	# Credits	Description(s) relating to wood, steel and concrete	Implications for wood
Materials			
MAT 1 – Environmental Impact of Materials	15	To encourage the use of materials with lower environmental impacts over their lifecycle. There is a mandatory requirement with no available credits to achieve a Green Guide rating of between A+ and D for at least three of the following five elements of the building envelope: • Roof • External Walls • Internal Walls (including separating walls) • Upper and Ground Floors (including separating floors) • Windows Between 1 - 15 credits are available depending on the Green Guide ratings and relative distributions of different materials across the five main elements of the building envelope.	• Wood and wood products = 'A' Green Guide rating • How does wood fair in the Green Guide for Housing Specification?
MAT 2 – Responsible Sourcing of Materials: Basic Building Elements	6	To recognise and encourage the specification of responsibly sourced materials for the basic building elements. Where 80% of the *assessed materials* in the following *Building Elements* are responsibly sourced: a) Frame b) Ground floor c) Upper floors (including separating fl oors) d) Roof e) External walls f) Internal walls (including separating walls) g) Foundation/substructure (excluding sub-base materials) h) Staircase	• Forest certification – FSC, CSA, and SFI with Chain of Custody certificate get the most points – all major building elements.

[14] Code for Sustainable Homes, Technical guide, May 2009, Version 2

Issue ID & Title	# Credits	Description(s) relating to wood, steel and concrete	Implications for wood
MAT 3 - Responsible Sourcing of Materials: Finishing Elements	3	To recognise and encourage the specification of responsibly sourced materials for the finishing elements. Where 80% of the assessed materials in the following Finishing Elements are responsibly sourced: a) Stair b) Window c) External & internal door d) Skirting e) Panelling f) Furniture g) Fascias h) Any other significant use Additionally, 100% of any timber in these elements must be legally sourced	• Forest certification – FSC, CSA, and SFI with Chain of Custody certificate get the most points – finishing elements.
Pollution			
POL 1 – Insulant GWP	1	To reduce global warming from blowing agent emissions that arise from the manufacture, installation, use and disposal of foamed thermal and acoustic insulating materials. Credits are awarded where all insulating materials in the elements of the dwelling listed below only use substances that have a GWP < 5 (manufacture AND installation): • Roofs: including loft access • Walls: internal and external including lintels and all acoustic insulation • Floors: including ground and upper fl oors • Hot water cylinder: pipe insulation and other thermal stores • Cold water storage tanks: where provided • External doors Typical insulants that inherently have a **GWP of less than 5** (and a zero ODP) will include insulation materials (if not blown) such as: mineral fibre, **cellulose insulation**, glass fibre**, wood fibre board**, cork, wool, cellular glass flax, nitrile rubber, recycled newspaper and jute	• Wood products – insulation – global warming potential • How is global warming potential evaluated?
Management			

Issue ID & Title	# Credits	Description(s) relating to wood, steel and concrete	Implications for wood
Man 3 – Construction Site Impacts	2	To recognise and encourage construction sites managed in a manner that mitigates environmental impacts. Credits are awarded where there is a commitment and strategy to operate site management procedures on site as follows: Where there are procedures that cover 2 or more of the following items (1 credit): • Monitor, report and set targets for CO2 production or energy use arising from site activities • Monitor and report CO2 or energy use arising from commercial transport to and from site • Monitor, report and set targets for water consumption from site activities • Adopt best practice policies in respect of air (dust) pollution arising from site activities • Adopt best practice policies in respect of water (ground and surface) pollution occurring on the site • 80% of site timber is reclaimed, re-used or responsibly sourced Where there are procedures that cover 4 or more of the items listed above (2 points)	• Forest certification – timber, OR • Reclaimed/Reused - timber

References

Responsible Sourcing of Materials[15]

Tier Level	Issue Assessed	Points per element	Evidence/measure assessed	Examples of compliant schemes
1	Legality & responsible sourcing	3	Certification scheme	FSC, CSA, SFI with CoC, PEFC, Reused Materials, Schemes compliant with BES6001:2008 (or similar) Excellent and Very Good Performance ratings.
2	Legality & responsible sourcing	2	Certification scheme	Schemes compliant with BES6001:2008 (or similar) Good and Pass Performance ratings.
3	Legality & responsible sourcing	1.5	Certification scheme/ EMS	Timber: MTCC, Verified, SGS, TFT Other materials: Certified EMS for Key Process and Supply Chain Recycled Materials with certified EMS for Key Processes
4	Legality & responsible sourcing	1	Certification scheme/ EMS	Certified EMS for key process stage

Note:

- When any timber is used, evidence must be provided that it is legally sourced.
- Where new in situ concrete (not existing concrete) is used, certifcation of the manufacture of the cement as the primary process, extraction of the aggregate and limestone used to make the cement as well as supply chain processes to be provided.

[15] BREEAM Offices 2008 Assessor Manual, p 164

VOC Criteria by Product Type (HEA 9)[16]

Product	**European Standard**	**Emission level required**
Wood Panels Particleboard, Fibreboard including MDF, OSB, Cement-bonded particleboard, Plywood, Solid wood panel and acoustic board	BS EN 13986:2002	Formaldehyde E1 (Testing req 1– see below) Verify that regulated wood preservatives are absent and of the minimum content.
Timber Structures Glued laminated timber	BS EN 14080:2005	Formaldehyde E1 (Testing req 1)
Wood flooring e.g. parquet flooring	BS EN 14342:2005	Formaldehyde E1 (Testing req 1) Verify that regulated wood preservatives are absent and of the minimum content.
Resilient, textile and laminated floor coverings Vinyl/linoleum, Cork and rubber, Carpet, Laminated wood flooring	BS EN 14041:2004	Formaldehyde E1 (Testing req 1) Verify that regulated preservatives are absent and of the minimum content.
Suspended ceiling tiles	BS EN 13964:2004	Formaldehyde E1 (Testing req 1) No asbestos.
Flooring adhesives	BS EN 139991:2007	Verify that carcinogenic or sensitising volatile substances are absent (Testing req. 2-4).
Wall-coverings Finished wallpapers, Wall vinyl's and plastic wall coverings, Wallpapers for subsequent decoration, Heavy duty wall-coverings, Textile wall-coverings	BS EN 233:1999 BS EN 234:1989 BS EN 259:2001 BS EN 266:1992	Formaldehyde (testing req. 5) and Vinyl chloride monomer (VCM)(testing req. 5) release should be low and within the BS EN standard for the material. Verify that the migration of heavy metals(5) and other toxic substances are within the BS EN standard for the material
Adhesive for hanging flexible wall coverings	BS 3046:1981	No harmful substances and preservatives used should be of minimum toxicity.

[16] BREEAM Offices 2008 Assessor Manual, p 76

Product	**European Standard**	**Emission level required**
Decorative paints and varnishes	BS EN 13300:2001 referred to the criteria of Decorative Paint Directive 2004/42/CE	VOC (organic solvent) content (testing req. 6), requirement for Phase 2. Fungal and algal resistant.
Testing requirements 1. BS EN 717-1:2004 2. BS EN 13999-2:2007 - Volatile Organic Compounds (VOCs) 3. BS EN 13999-3:2007 - Volatile aldehydes 4. BS EN 13999-4:2007 - Volatile diisocyanates 5. BS EN 12149:1997 6. BS EN ISO 11890-2:2006		

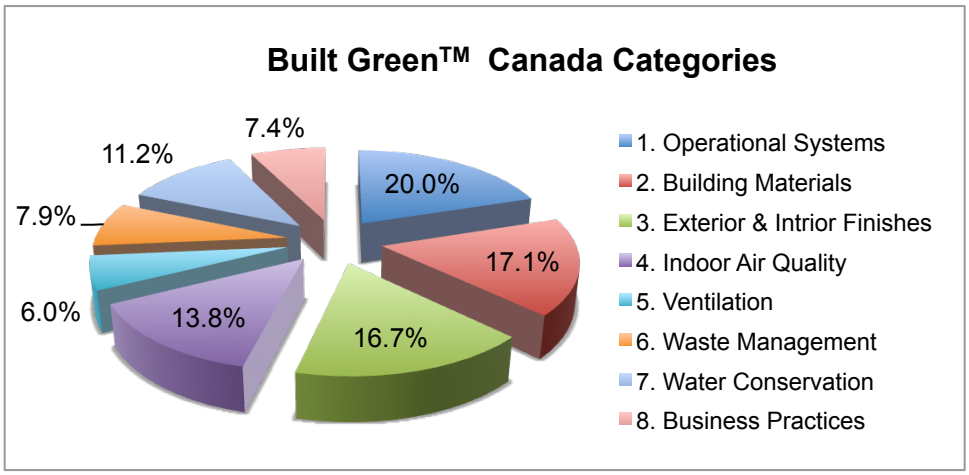
Built Green™ Canada

Name(s): Built Green™, Built Green™ Multi-family residential
Location: Canada
Market Scope: British Columbia & Alberta
Building Types: Single-detached, Multi-family residential
Organization: Built Green™ Canada

Built Green™ is owned and managed by the Built Green™ Society of Canada. Membership in Built Green™ is open to all members of participating Home Builders' Associations (HBA's) including builders, renovators, product suppliers or manufacturers, service providers, community developers and municipalities.

Currently Built Green™ offers certification for new single-family homes and row homes and offers a pilot in multi-story residential. Built Green™ is in the process of developing standards for communities and renovations.

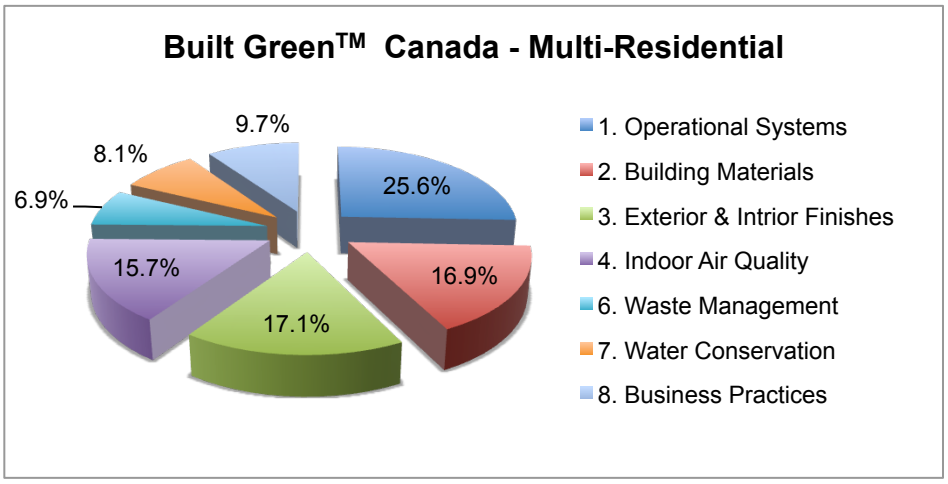
There are 433 available points over eight categories in the Built Green™ system:



Certification levels depend on the number of points achieved:

Certification Level	Points
Bronze	76
Silver	90
Gold	100
Platinum	120

The Built Green™ Multi-residential pilot is slightly different with 420 points in seven categories:



Certification levels for the multi-residential system depend on the number of points achieved:

Certification Level	Points
Bronze	75
Silver	80
Gold	85
Platinum	150

Prevalence of Wood

Of all the points available in this rating system, 23% of them are related to wood.

Built Green™ - AB & BC

	Total Points	Related to Wood	% Related to Wood
1. Operational Systems	84	0	0%
2. Building Materials	72	37	51%
3. Exterior & Interior Finishes	70	39	56%
4. Indoor Air Quality	58	21	36%
5. Ventilation	25	0	0%
6. Waste Management	33	1	3%
7. Water Conservation	47	0	0%
8. Business Practices	31	0	0%
Total	420	98	23%

This increases to 28% in the multi-residential system, due to the higher number of wood-related points in the "Exterior and Interior Finishes" category.

Built Green™ - AB & BC - Multi-residential

	Total Points	Related to Wood	% Related to Wood
1. Operational Systems	111	0	0%
2. Building Materials	73	38	52%
3. Exterior & Interior Finishes	74	56	76%
4. Indoor Air Quality	68	25	37%
6. Waste Management	30	3	10%
7. Water Conservation	35	0	0%
8. Business Practices	42	0	0%
Total	433	122	28%

Wood vs. Competing Products

When comparing hypothetical buildings with More Wood and Less Wood, there are some differences in the total points achieved, but the differences are not great. In the case of low-rise residential homes, those with More Wood can score up to 70 points out of 98 wood-related points, whereas homes with Less Wood can score up to 63 points, which is a difference of 7 points or 7.1% of the total wood-related points.

Built Green™ - AB & BC

	Total Points	Wood-Related Points	More Wood	Less Wood
Building Materials	72	37	26	18
Exterior & Interior Finishes	70	39	28	30
Indoor Air Quality	58	21	15	14
Waste Management	30	1	1	1
Total	230	98	70	63

In the multi-family version, the difference is 10 points, or 8.2% of wood-related points.

Built Green™ - AB & BC - Multifamily

	Total Points	Wood-Related Points	More Wood	Less Wood
Building Materials	73	38	31	25
Exterior & Interior Finishes	74	56	43	41
Indoor Air Quality	68	25	19	17
Waste Management	30	3	1	1
Total	245	122	94	84

Specific Credits - Built Green™ Canada[17]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
2. Building Materials			
2-2	3	Insulated Concrete Form (ICF) system used for main house walls.	• Competing product to wood • Do ICFs prevent achieving points for 2-7 to 2-12?
2-4	1	Steel studding made from a minimum of 75% recycled steel is used to replace a minimum of 15% of wood studs in the home.	• Competing product to wood
2-5	1 or 2	Exterior and interior wall stud spacing at 19.2” on-centre (1 point) or 24" on-centre (2 points).	• Building technique & skills
2-7	1	Install manufactured insulated rim/band joist, or build on-site built header wrap detail for continuous air barrier. Rim and band joists can either be insulated on site or can be pre-manufactured (often insulated with a foamed insulation).	• Building technique & skills
2-8	1	Elimination of headers at non-bearing interior and exterior walls. It is not necessary to use the additional wood involved in header construction if the opening is less than 4' wide and is non-load bearing. For more details on Optimum Value Engineering framing principles see www.buildingscience.com.	• Building technique & skills
2-9	1	Use of header hangers instead of jack studs. Using metal header hangers instead of jack studs allows for savings in wood use. For more details on Optimum Value Engineering framing principles see www.buildingscience.com.	• Building technique & skills
2-10	1	Elimination of cripples on hung windows. For hung window openings, cripples are only necessary for siding or gypsum board attachment. For more details on Optimum Value Engineering framing principles see www.buildingscience.com.	• Building technique & skills
2-11	1	Elimination of double plates, using single plates with connectors by lining up roof framing with wall and floor framing. Stack framing principles might allow for reduced wood usage. For more details on Optimum Value Engineering framing principles see www.buildingscience.com.	• Building technique & skills
2-12	1	Use of two stud corner framing with drywall clips or scrap lumber for drywall backing instead of studs. Drywall clips can be used instead of a third corner stud allowing for reduced wood usage. For more details on Optimum Value Engineering framing principles see www.buildingscience.com.	• Building technique & skills

[17] Built Green™ Canada Checklist 2009

2-13	1 or 2	Deck or veranda surfaces (1 point) and/or structure (1 point) made from a third-party certified sustainably harvested wood source. Wood must come from a sustainably harvested source with certification from Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), or Canadian Standards Association's Sustainable Forest Management Standard (CAN/CSA-Z809-02).	• Forest certification – deck & balcony
2-14	1 or 2	Deck or veranda surfaces (1 point) and/or structure (1 point) made from a third-party certified sustainable concrete. Concrete produced from aggregates derived from a pit or quarry with a valid reclamation plan approved by Materials and Resources Canada or the governing provincial body.	• Certified sustainable concrete competes with forest certification
2-15	4 or 6	Structural insulated panel system used for at least 75% of roof (4 points) and/or 75% of walls (6 points). Reduces thermal migration and controls air leakage – keeps heating and cooling costs to a minimum compared to a conventionally framed wall.	• Wood product - SIPs • Do SIPS prevent achieving points for 2-7 to 2-12?
2-16	1	Dimensional lumber from a third-party certified sustainably harvested source used for floor framing. Saves old growth forests by using trees from second-generation forests.	• Forest certification – floor framing
2-17	2	Dimensional lumber from a third-party certified sustainably harvested source used for wall framing. Saves old growth forests by using trees from second-generation forests.	• Forest certification – wall framing
2-18	1	Dimensional lumber from a third-party certified sustainably harvested source used for roof framing. Saves old growth forests by using trees from second-generation forests.	• Forest certification – roof framing
2-19	2	Use manufactured wood products for floor systems instead of dimensional lumber. Engineered wood floor systems save old growth forests by using components from second-generation forests and the use of recycled materials.	• Engineered products – floor systems
2-20	2	Reduce dimensional lumber use by using engineered product for all load bearing beams & columns. Engineered products include wood products, concrete and recycled steel.	• Engineered products – beams & columns
2-21	1	Reduce dimensional lumber use by using engineered products for all exterior window and door headers. Engineered products include wood products, concrete and recycled steel.	• Engineered products – headers
2-22	1	Finger-jointed plate material and/or engineered plate material used for all framing plates. Use of recycled materials saves old growth forests.	• Engineered products – plate material
2-23	1	Reduce dimensional lumber use by using engineered stud material for 10% of structural stud wall framing. Use of engineered lumber products saves old growth forests by using components from second-generation forests and the use of recycled materials.	• Engineered products – framing
2-24	1 or 2	Finger-jointed studs for 90% of non-structural (1 point) and/or 90% of structural (1 point) wall framing. Use of recycled materials saves old growth forests.	• Recycled materials - finger-jointed studs
2-26	2	Recycled content exterior wall sheathing (minimum 50% pre- or post-consumer).	• Recycled content (OSB)
2-27	1 or 2	Use rain screen system separating cladding from the wall sheathing with a drainage plane (2 point), 60% or more recycled content (additional 1 point). Use of recycled content polypropylene, steel or aluminium rain screen strapping may replace the traditional use of wood strapping on rain screen systems.	• Wood strapping is replaced with recycled content steel/aluminium for rain screen systems

2-30	1 or 2	All insulation used in home is certified by a third-party to contain a minimum recycled content: 40% (1 point) or 50% (2 points).	• Recycled content insulation – wood fibre
2-32	2	Replace exterior wood sheathing with insulating sheathing and structurally required metal bracing. Using less materials when possible saves the forest reserves, reduces thermal migration and controls air leakage and keeps heating and cooling costs to a minimum compared to a conventional wall.	• Competes with wood
3. Exterior & Interior Finishes			
3-1	1	Exterior doors with a minimum of 15% recycled and/or recovered content. Recycled or recovered content ensures we keep our landfill use to a minimum. Not including overhead garage doors (see 2-33).	• Recycled /recovered content
3-2	1	Interior doors with a minimum of 15% recycled and/or recovered content.	• Recycled /recovered content
3-3	2	Interior doors made from third-party certified sustainably harvested wood. Uses trees from forests managed sustainably that prevent clear cutting and replant trees in areas from which they've been harvested.	• Forest certification - doors
3-4	1	All exterior doors manufactured from fiberglass. Fiberglass doors insulate better than steel skinned or wood doors, have a longer lifespan, do not warp, twist or crack, and therefore reduce landfill use.	• Competes with wood
3-5	1	Exterior window frames contain a minimum of 10% recycled content. Reusing materials such as plastics reduces landfill usage and may not be biodegradable.	• Recycled /recovered content
3-6	2	Exterior window frames made from third-party certified sustainably harvested wood. Uses trees from forests managed sustainably that prevent clear cutting and replant trees in areas from which they've been harvested.	• Forest certification – window frames
3-7	4	Natural cementitious stone/stucco/brick or fiber cement siding – complete or combination thereof for 100% of exterior cladding. Strong, long lasting, fireproof material.	• Competes with wood
3-8	1 or 2	Recycled or reclaimed exterior cladding material. 1/3 of exterior (1 point), 2/3 or more of home (2 points). Recycled brick blocks etc, intent is to replace siding materials, primarily exterior finish materials.	• Recycled /recovered content
3-9	2	Fiber cement fascia and soffit. Fiber cement fascia and soffit, made with recycled content from sawmill waste and Portland cement, is a strong, long lasting and fireproof material.	• Recycled /recovered content
3-10	1	Recycled and/or recovered-content fascia and soffit (minimum 50% pre- or post-consumer). Recycled and/or recovered-content fascia and soffit reduces the amount of new material used in production by gluing up mill scraps into large pieces, which conserves natural resources and reduces landfill usage.	• Recycled /recovered content

3-11	4	Recycled and/or recovered-content siding (minimum 50% pre- or post-consumer). Recycled and/or recovered-content siding reduces the amount of new material used in production by gluing up mill scraps into large pieces, which conserves natural resources and reduces landfill usage.	• Recycled /recovered content
3-12	1	Exterior trim materials are made from alternatives to solid lumber. Trim materials manufactured from OSB uses a laminating process to make larger pieces from smaller pieces or strands of wood. The process saves old growth forests by using trees from forests managed sustainably that prevents clear cutting and replant trees in areas from which they've been harvested.	• Wood products
3-13	3	Exterior trim materials have recycled and/or recovered-content (minimum 50%). Recycled and/or recovered-content trim materials reduce the amount of new material used in production by gluing up mill scraps into large pieces, which conserves natural resources and reduces landfill usage.	• Recycled /recovered content
3-18	6	Domestic wood from reused/recovered or re-milled sources, 500 ft² minimum for flooring or all cabinets or all millwork. Reused, recovered or re-milled sources eliminate the need for new resources, saving energy, transportation costs, and forestry from depletion.	• Recycled /recovered content
3-22	3	Bamboo, cork or hardwood flooring used in home, minimum of 300 ft² installed. Products must be third-party certified from sustainably managed forests or certified sustainable sources. Cork flooring comes from stripping the bark off cork oak, which regenerates itself. The cork tiles are moisture, rot and mould resistant, providing a floor that can last over 30 years. Bamboo flooring is a good use of natural resources because it is fast growing, durable and flexible. All hard floorings promote better indoor air quality by not trapping contaminates.	• Competes with wood
3-24	1 - 2	MDF and/or finger jointed casing and baseboard used throughout home (1 point), and all jambs (1 point) Medium Density Fiberboard (MDF) casing is created from sawdust and glues, utilizing all wood waste to create usable product.	• Wood products
3-25	2 or 4	Solid hardwood trim from third-party certified sustainably harvested sources approved for millwork and/or cabinets (2 points per application – maximum of 4 points). This process saves old growth forests by using trees from forests managed sustainably, that prevent clear cutting and replant trees in areas from which they've been harvested.	• Forest Certification - trim
3-27	2	Domestically sourced natural granite, stone or recycled glass (30% of content) countertops in 100% of the kitchen. Natural product is more durable, easy to clean and maintain, resistant to heat and scoring. By quarrying and sourcing in Canada, the environmental cost of shipping is greatly reduced. Foreign stone cut or polished in Canada is not acceptable.	• Local content – granite, stone, recycled glass

3-28	1	Natural granite, stone, recycled glass or concrete countertops for all other countertop areas. Natural product is more durable, easy to clean and maintain, resistant to heat and scoring.	• Competes with wood
3-29	2	100% agricultural waste or 100% recycled wood particle board used for shelving. Products such as wheat board are made from agricultural waste.	• Recycled /recovered content
Indoor Air Quality			
4-10	2	All insulation in the home is third-party certified or certified with low or zero formaldehyde. Formaldehyde is colourless gaseous organic compound, water soluble, with a characteristic pungent and stifling smell. Products with low formaldehyde emission levels will improve indoor air quality of homes and long term owner health.	• Low or no formaldehyde - wood-based insulation
4-11	3	Low formaldehyde sub floor sheathing (less than 0.18 ppm). Formaldehyde is colourless gaseous organic compound, water soluble, with a characteristic pungent and stifling smell. Products with low formaldehyde emission levels will improve indoor air quality of homes and long term owner health. Industry Standard ANSI A208.1-1999 sets a 0.20 ppm limit. Built Green™ requires a 10% better level of performance at 0.18 ppm. Products using Phenol Formaldehyde, or PMDI or MDI will meet this standard without testing.	• Low or no formaldehyde – sub-floor sheathing
4-12	1	Low formaldehyde underlayment is used in home (less than 0.18 ppm). Low formaldehyde (phenol) and formaldehyde-free binders (PMDI) are available and becoming more common. FSC certified OSB is becoming more common, reducing environmental impacts on air, water, social quality.	• Low or no formaldehyde – underlayment
4-13	1 or 2	Low formaldehyde particle board/MDF (less than 0.18 ppm) = 1 point, or zero formaldehyde particle board/MDF (2 points) used for cabinets. Urea formaldehyde-free fiberboard can be used in the same way as conventional fiberboard, but with the added caution of greater potential for water damage.	• Low or no formaldehyde - particleboard for cabinets
4-14	1 or 2	Low formaldehyde particle board/MDF (less than 0.18 ppm) = 1 point, or zero formaldehyde particle board/MDF (2 points) for shelving. Urea formaldehyde-free fiberboard can be used in the same way as conventional fiberboard, but with the added caution of greater potential for water damage.	• Low or no formaldehyde - particleboard for shelving
4-16	2	Water-based urethane finishes used on all site-finished wood floors. Water-based epoxy finish (generally referred to as epoxy-modified finish) differs from its solvent-based counterpart in that the epoxy resin is itself the catalyst for an acrylic or urethane resin.	• Water-based finishes for wood floors (when finished on-site)
4-17	2	All wood or laminate flooring in home is factory finished. Installing a pre-finished floor eliminates the time, the dust and the odours associated with the on-site sanding and finishing of an unfinished product.	• Points for wood or laminate floors having factory finish

4-18	3	Water-based lacquer or paints are used on all site built and installed millwork, including doors, casing and baseboards. (less then 200 grams/litre of VOC's) Water based interior finish products reduces VOC off-gassing which improves indoor air quality.	• Water-based finishes for all millwork
4-23	2	All vinyl flooring in home is replaced by hard surface flooring. Hard surface flooring is generally more durable and improves the Indoor Air Quality within a building. Carpets collect dust, dust mites and other allergens which when disturbed become airborne particulates, directly affecting the health of the occupants.	• Wood or laminate floors can replace vinyl
4-27	4	All carpet in home is replaced by hard surface flooring. Hard surface flooring is generally more durable and improves the Indoor Air Quality within a building. Carpets collect dust, dust mites and other allergens which when disturbed become airborne particulates- directly affecting the health of the occupants.	• Wood or laminate floors can replace carpet
6. Waste Management			
6-7	1	Metal or engineered durable form systems used for concrete foundation walls. The use of metal forming systems reduces the requirement of lumber, a limited resource.	• Competes with wood
6-8	1 or 2	Concrete used in home has a minimum supplementary cementing material of 25% (1 point) or 40% (2 points) within the scope of proper engineering practices. For every one ton of Portland cement generated, eighth tenths of a ton of carbon dioxide is produced. Supplementary cementations products include fly ash, blast furnace slag as well as metakaolin.	• Implications for concrete – wood not impacted
6-9	1	Reusable bracing is used for framing. The use of reusable bracing for framing reduces the requirement of lumber, a limited resource.	• Building technique and skills
8. Business Practice			
8-1	1 - 5	Products used for home are manufactured within 800 km (1 point for each product - maximum of 5). Products made closer to the location of use will have less embodied energy. Basically this means that the shorter the transportation distance the less energy used in moving the product. Less energy used means fewer emissions.	• Uses geographic distance as a proxy for embodied energy, Wood may fair better if lifecycle analysis was used instead.

Specific Credits - Built Green™ Canada – Multi-Unit Residential Buildings[18]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implication
2. Building Materials			
2-1	2 - 4	Insulated Concrete Forming system (ICF's) used below grade (2 pts.) and/or above grade (2 pts.). Insulating Concrete Forms (ICFs) are hollow building elements made of plastic foam that are assembled, often like building blocks, into the shape of a building's exterior walls. The ICFs are filled with reinforced concrete to create structural walls. Unlike traditional forms, the ICFs are left in place to provide insulation and a surface for finishes.	• Competing product to wood • Do ICFs prevent achieving points for 2-7 to 2-12?
2-7	1	Steel studs made from a recycled steel (min. 75%) is used to replace wood studs (min.15%). Recycling steel reduces landfill waste and saves on wood consumption.	• Competing product to wood
2-8	1 - 7	"Use Optimum Value Engineering (OVE) to reduce wood use in framing: - Exterior and interior wall stud spacing at 24"" on-center (2 points) or 19.2" on-center (1 pt.). - Elimination of headers at non-bearing interior and exterior walls. (1 pt.) - Use of header hangers instead of jack studs. (1 pt.) - Elimination of cripples on hung windows. (1 pt.) - Elimination of double plates, use single plates with connectors by lining up roof framing with wall & floor framing (1 pt.) - Use of two stud corner framing with drywall clips or scrap lumber for drywall backing instead of studs. (1 pt.)" For more details on Optimum Value Engineering (OVE) framing principles see www.buildingscience .com.	• Building technique & skills
2-9	2	Walls and roof designed as 24" module to reduce waste. A 24" module takes into account the size of sheets of OSB or plywood, stud spacing, carpet size etc.	• Building technique & skills
2-10	1	Use of insulated headers (either manufactured or site built open insulated single headers) with minimum insulation value of R10. Headers can either be insulated on site or can be a pre-manufactured product (often insulated with a foamed plastic).	• Building technique & skills, or • Wood-product if manufactured

[18] Built Green™ Canada Multi Checklist 2007

2-11	2	Install manufactured insulated rim/band joist or build on site by setting back joists to allow rigid insulation filler of a minimum R10. Rim and band joists can either be insulated on site or can be pre-manufactured (often insulated with a foamed plastic).	• Building technique & skills, or • Wood-product if manufactured
2-12	2 – 5	Structural insulated panel system (SIPS) used for walls (3 pts.) and/or for roofs (2 pts.). Reduces thermal migration and controls air leakage – Keeps heating and cooling costs to a minimum compared to a conventionally framed wall.	• Wood product - SIP
2-13	1 or 2	All insulation used in the project is certified by a third party to contain a minimum recycled content: 40% (1 pt.) or 50% (2 pts.). Recycled content means less landfill waste and raw material use. Also, according the the North American Insulation Manufacturer's Association, insulation with recycled content takes less energy to produce than using all raw materials.	• Recycled content – wood-based insulation
2-15	2	Replace exterior wood sheathing with installed insulating sheathing. Using less materials when not required saves the forest reserves, reduces thermal migration and controls air leakage; it also keeps heating and cooling costs to a minimum compared to a conventional wall.	• Competes with wood
2-16	1 - 3	Deck (1pt.),balcony surfaces (1pt.), and/or veranda structure (1 pt.) made from a third-party certified sustainable harvested wood source or third-party certified sustainable concrete. The issue of sustainable forest management (SFM) is considered to be of such importance by the Canadian forest industry that, in 1993, a group of 22 organizations representing virtually all of the industry came together to form the Canadian Sustainable Forestry Certification Coalition. The coalition regroups several different certification standards that each have their strengths and weaknesses. For more information, see www.sfms.com. Concrete produced from aggregates derived from a pit or quarry with a valid reclamation plan approved by Materials and Resources Canada or the governing provincial body.	• Forest certification – deck & balcony
2-17	1 - 4	Dimensional lumber from a third-party certified sustainable harvested source used for floor framing (1 pt.), wall framing (2 pts.), and/or roof framing (1 pt.). Saves old growth forests by using trees from a second generation forest.	• Forest certification – dimensional lumber
2-18	1	Environmentally engineered flooring system (ie. Uses reclaimed/recycled/rapidly renewable wood waste, flyash concrete (1pt-30%), recycled steel (1pt-90%)). Use of Engineered floor system saves old growth forest by using components from second generation forests and the use of recycled materials.	• Wood products– engineered flooring systems
2-19	2	Environmentally engineered products for all load bearing beams (ie. Uses reclaimed/recycled/rapidly renewable wood waste, flyash concrete, recycled steel). Engineered products include wood products, concrete and recycled steel.	• Wood products – engineered beams

2-20	1	Environmentally engineered products for all exterior window and door headers. Engineered products include wood products, concrete and recycled steel.	• Wood products – engineered headers
2-21	1	Engineered stud material for 10% of stud wall framing. Use of Engineered lumber products saves old growth forest by using components from second generation forests and recycled materials.	• Wood products – engineered framing
2-22	1	Engineered plate material and/or finger-jointed plate material. Use of recycled materials saves old growth forest.	• Wood products – engineered plate material
2-23	2	Finger-jointed studs for 90% of non-structural stud wall framing. Use of recycled materials saves old growth forest.	• Wood products – finger-jointed studs
2-25	2	Recycled content exterior wall sheathing (min. 50% pre or post consumer). Recycled content reduces landfill waste and the use of new materials.	• Recycled content – sheathing
2-26	2	Replace exterior wood sheathing (if applicable) and use external rigid insulation as sheathing or installed insulating sheathing (2pts.) Using this system replaces the need for use of additional OSB product, saving the forest reserves, reduces thermal migration and controls air leakage; it also keeps heating and cooling costs to a minimum compared to a conventional wall.	• Competes with wood
2-27	2	100% Recycled content rainscreen attachment system. Use of recycled content polypropelene, steel or aluminium rainscreen strapping may replace the traditional use of treated wood strapping on rainscreen systems.	• Competes with wood
3. Exterior & Interior Finishes			
3-1	1	Exterior doors with a minimum of 15% recycled and/or recovered content. Recycled or recovered content ensures we keep our landfill use to a minimum.	• Recycled content –doors
3-2	1	All exterior doors manufactured from fiberglass. Fiberglass doors insulate better than steel skinned or wood doors, have a longer lifespan, do not warp, twist or crack, and therefore reduce landfill use.	• Competes with wood
3-3	1	Exterior window frames contain a minimum of 10% recycled content. Reusing materials such as plastics reduces landfill usage, which may not be biodegradable.	• Recycled content – window frames
3-4	2	Exterior window frames are made from third-party certified sustainable harvested wood. Uses trees from a forest managed system that prevents clear cutting trees, and replants trees to replace from which they've been harvested.	• Forest certification – window frames

3-5	1 – 2	Concrete used in home has a minimum supplementary cementing material of 25% (1 pt.) and/or 40% (2 pts.) is within the scope of proper engineering practices. For every one tonne of Portland cement generated, eighth tenths of a ton of carbon dioxide is produced. Supplementary cementitious products include fly ash, blast furnace slag as well as metakaolin.	• Concrete credit
3-6	4	Natural cementitious stone/stucco/brick or fiber cement siding – complete or combination thereof for 100% of exterior cladding. Battens are included in cladding. Strong, long lasting, fireproof material.	• Wood product – fibre cement • Others compete with wood
3-7	1 – 5	Exterior trim and finish is made of recycled content (50% min., pre or post consumer) material, durable and fire rated; trim (1 pt.) and/or wall finish (4 pts.). Fiber cement fascia and soffit, made with recycled content from sawmill waste and Portland cement, is a strong, long lasting and fireproof material.	• Recycled content – fibre cement – exterior trim and finish
3-8	3 – 4	Exterior trim (3 pts.) and /or siding materials (4 pts.) have recycled and/or recovered-content (min. 50% pre- or post-consumer). Recycled and/or recovered-content trim materials reduce the amount of new material used in production by gluing up miss scraps into large pieces, which conserves natural resources and reduces landfill usage.	• Recycled /recovered content – exterior trim and/ or siding
3-9	1	Exterior trim materials are manufactured from OSB . Trim materials manufactured from OSB uses a laminating process to make larger pieces from smaller pieces or strands of wood. The process saves old growth forests by using trees from forest managed systems that prevents clear cutting trees, and replants trees in areas from which they have been harvested.	• Wood product – OSB - trim
3-10	1 – 2	All exterior trim is clad with pre-finished metal (1 pt. over top wood backings, 2 pts. without wood backings). Trim clad with pre-finished metal is a durable long lasting product that requires no maintenance, reduces waste in landfills due to long life of product.	• Competes with wood – pre-finished metal (durability)
3-11	1,2,3, or 5	Deck or balcony surfaces made from recycled materials: 50% (1 pt.), 75% (2 pts.), 100% (3 pts.), and/or from low maintenance materials (2 pts.) (Deck surfaces should not need maintenance of any kind, including painting, for a minimum of 5 years). Substituting recycled material outdoors avoids the use of pressure treated and high mildew resistant wood that may otherwise be harvested from disappearing old growth or rain forests. Material which lasts longer and reduces landfill usage tends to require little to no maintenance, saving replacement costs and reducing energy spent.	• Recycled materials – deck & balcony

3-14	1 – 3	Interior doors made with recycled and/or recovered content (min.15%-1 pt.) and/or from third-party certified sustainable harvested sources (2 pts.). Recycled or recovered content ensures we keep our landfill use to a minimum.	• Recycled / recovered content - doors
3-15	2	Interior doors made from third-party certified sustainable harvested sources. Uses trees from a forest managed system that prevents clear cutting trees, and replants trees to replace from which they have been harvested.	• Forest certification - doors
3-16	6	Domestic wood from reused/recovered or remilled sources – 500 square foot minimum for flooring or all cabinets or all millwork. Reused, recovered or re-milled sources eliminate the need for new resources, saves energy, transportation costs, and forestry from depletion.	• Reused, recovered, remilled wood
3-19	1	100% recycled or recovered content underlayment or use of concrete finishes to enable the flooring to remain concrete. Concrete finishes such as stamped or stained concrete etc.	• Recycled / recovered content - underlayment
3-21	3	Bamboo, cork or hardwood flooring used in home (min. 300 square feet installed). Products must be third-party certified to be from managed forests or from certified sustainable sources. Cork flooring comes from stripping the bark off cork oak, which regenerates itself. The cork tiles are moisture, rot and mold resistant, providing a floor that can last over 30 years. Bamboo flooring is a good use of natural resources because it is fast growing, durable and flexible.	• Forest certification – floors • Others compete with wood
3-23	1	MDF casing and baseboard used throughout the project. MDF casing is created from sawdust and glues, utilizing all wood waste to create usable product.	• Wood products – MDF – casings & baseboards
3-24	1	Finger-jointed casings, baseboards and jambs used throughout the project. Finger-jointed casing and baseboards maximize wood usage, buy using small pieces of wood glued together to create longer pieces. The process saves old growth forests by using trees from forest managed systems that prevents clear cutting trees, and replants trees in areas from which they have been harvested.	• Wood-products – finger-jointed casings, baseboards, jambs
3-25	2 – 4	Solid hardwood trim from third party certified sustainable harvested sources approved for millwork (2 pts.) and/or cabinets (2 pts.). This process saves old growth forests by using trees from forest managed systems that prevents clear cutting trees, and replants trees in areas from which they have been harvested.	• Forest certification – trim
3-28	2	100% agricultural waste or 100% recycled wood particle board used for shelving. Products such as wheat board are made from agricultural waste.	• Recycled / recovered content – particle board - shelving
4. Indoor Air Quality			

4-11	2	All insulation in the project is third-party certified or certified with low or zero formaldehyde. Formaldehyde may cause eye, nose, and throat irritation, headaches, loss of coordination, nausea, damage to liver, kidney, and central nervous system.	• Low or zero formaldehyde - insulation
4-12	3	Low formaldehyde sub floor sheathing. Formaldehyde is colourless gaseous organic compound, water soluble, with a characteristic pungent and stifling smell. Building materials low in or free of formaldehyde glues are used in the floor underlayment, cabinetry and elsewhere to protect the indoor air quality.	• Low formaldehyde – sub-floor sheathing
4-13	1	Low formaldehyde underlayment is used in the project. (ANSI A208.1 – 1993 concentration 0.3 ppm). Low formaldehyde (phenol) and formaldehyde-free binders (PMDI) are available and becoming more common. FSC certified OSB is becoming more common, reducing environmental impacts on air, water, social quality.	• Low formaldehyde - underlayment
4-14	1	Low formaldehyde particle board/MDF used for cabinets (ANSI A208.2 – 1994 concentration 0.3 ppm). Urea formaldehyde-free fibreboard can be used in the same way as conventional fibreboard, but with the added caution of greater potential for water damage.	• Low formaldehyde – MDF - cabinets
4-15	1	Low formaldehyde particle board/MDF used for shelving (ANSI A208.2 – 1994 concentration 0.3 ppm).	• Low formaldehyde – MDF - shelving
4-16	2 – 4	Zero formaldehyde particle board/MDF used for cabinets (2 pts.) and/or for shelving (2 pts.). Cabinets made from formaldehyde free particleboard or MDF eliminate the Volatile Organic Compounds (VOC) that offgas into the home, resulting in healthier indoor air quality.	• Zero formaldehyde - MDF - cabinets and/or shelving.
4-18	2	Water-based urethane finishes used on all site-finished wood floors. Water-Based Epoxy: Generally referred to as “epoxy-modified finish,” water-based epoxy finish differs from its solvent-based counterpart in that the epoxy resin is itself the catalyst for an acrylic or urethane resin.	• Low VOCs - wood products – floors
4-19	2	All wood or laminate flooring in the project is factory finished. Installing a pre-finished floor eliminates the time, the dust and the odours associated with the on-site sanding and finishing of an unfinished product.	• Wood product – floors – factory finish
4-20	3	Water-based Lacquer or paints are used on all site built and installed millwork, including doors, casing and baseboards. Water based interior finish products reduces VOC off-gassing which improves indoor air quality.	• Low VOC – wood & wood products – millwork, doors, casings, etc
4-27	2	All vinyl flooring in units are replaced by hard surface flooring. See detail below.	• Wood product - floors

4-28	4	All carpet in units are replaced by hard surface flooring. Hard surface flooring is generally more durable and improves the IAQ within a building. Carpets collect dust, dust mites and other allergens which when disturbed become airborne particulates, directly affecting the health of the occupants.	• Wood product - floors
5. Waste Management			
5-5	1 - 3	Use of recycled materials derived from local construction sites (1 pt. for each different product used, max of 3 pts.). Products recycled from the construction site, such as mulched wood cut offs or mulched gypsum are often useable as either clay/ soil water retention additives or for organic burning.	• Building technique and skills - Recycled materials from local construction sites
5-8	1	Metal or engineered durable form systems used for concrete foundation walls. The use of metal forming systems reduces the requirement of lumber, a limited resource.	• Competes with wood
5-9	1	Reusable bracing is used for framing. The use of reusable bracing for framing reduces the requirement of lumber, a limited resource.	• Competes with wood
7. Business Practice			
7-1	1 - 5	Products used for the project are manufactured within 800 km. (1 pt. for each product to a max. of 5 products). Products made closer to the location of use will have less embodied energy. Basically this means that the shorter the transportation distance the less energy used in moving the product. Less energy used means fewer emissions.	• Local content – does wood fair better with true embodied energy instead of distance criteria?

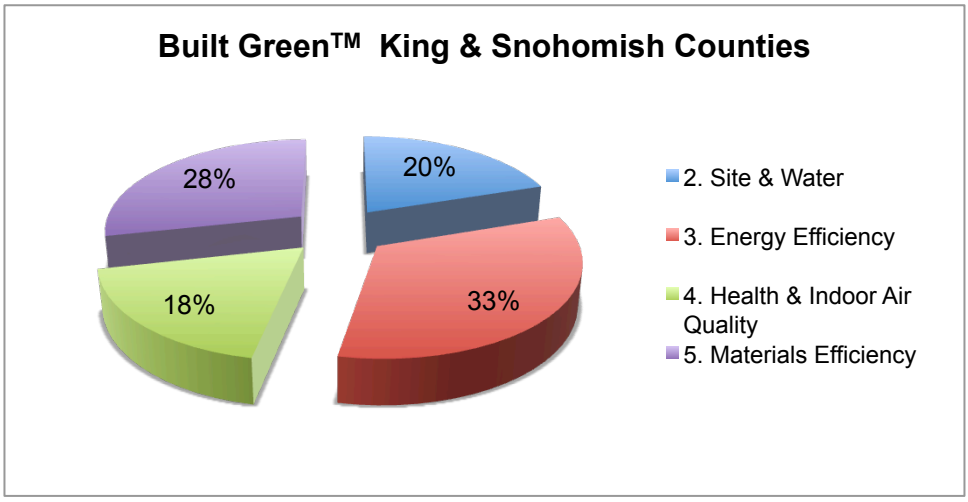
Built Green™ Washington (King and Snohomish County)

Name(s): Built Green™ Washington, Built Green™ Multi-family residential
Location(s): Program runs in most counties, Washington State, USA
Market Scope: Washington State, USA
Building Types: Single-detached, Multi-family residential
Organization: Built Green™ Washington, Master Builders Association of King and Snohomish Counties

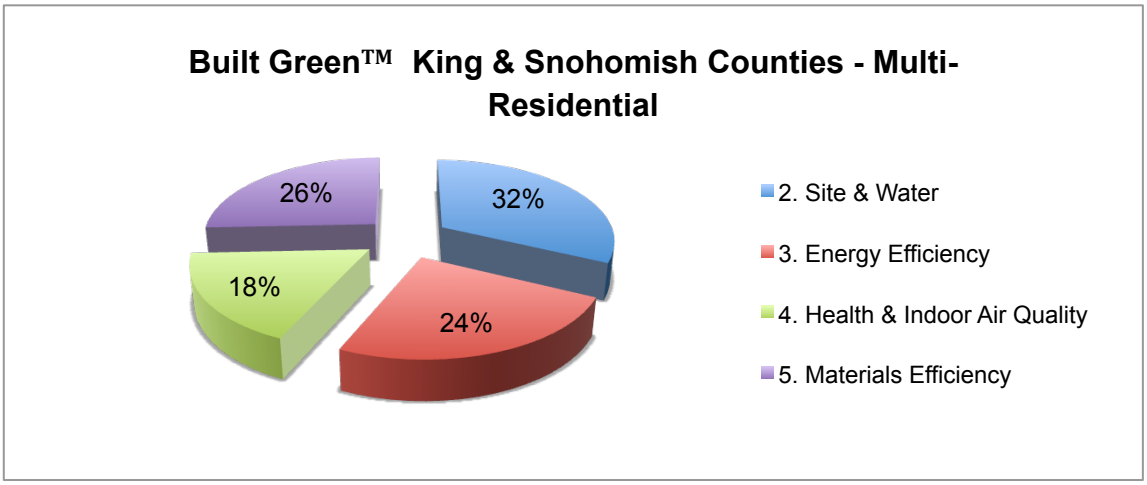
Built Green™ Washington is a non-profit cooperative representing local Built Green™ programs throughout the state of Washington, some of which have been active since 1996. Each local Built Green program sets its own criteria for certification. The Built Green™ for the Seattle area was used for evaluation in this case.

For the Seattle area, Built Green™ is a residential building program of the Master Builders Association of King and Snohomish Counties, developed in partnership with King County, Snohomish County, and other agencies in Washington State.

The Built Green™ program for King and Snohomish Counties has 1,335 available points and is divided into the following categories:



The Multi-family residential checklist is slightly different, but the materials section, which is most relevant to wood and wood products, is weighted the same at 18%:



Once certified, a building will receive one to five stars depending on performance. The number of points needed for each category also depends on the size of the house. Smaller homes will have an advantage since larger homes have to achieve higher levels of performance in the areas of energy and materials.

Prevalence of Wood

There are 174 points that are related to wood and/or wood products. This accounts for 13.0% of total points available.

Built Green™ – Washington

1. Build to Green Codes	Total Points Required	Related to Wood Required	% Related to Wood Required
2. Site & Water	266	3	1.1%
3. Energy Efficiency	443	23	5.2%
4. Health & Indoor Air Quality	246	35	14.2%
5. Materials Efficiency	380	113	29.7%
Total	1,335	174	13.0%

In the case of the multi-family rating system, there are 217 points that are related to wood and/or wood products. This is 12.4% of all the points available.

Built Green™ - Washington - Multi-family

1. Build to Green Codes	Total Points Required	Related to Wood Required	% Related to Wood Required
2. Site & Water	562	3	0.5%
3. Energy Efficiency	428	18	4.2%
4. Health & Indoor Air Quality	309	28	9.1%
5. Materials Efficiency	449	171	38.1%
Total	1,748	220	12.6%

Wood vs. Competing Products

Similarly to Built Green™ Canada, when comparing hypothetical buildings with More and Less Wood, there are some differences in the total points achieved, but the differences are not great when considered against the entire rating system.

Built Green™ – Washington

	Total Points	Wood-Related Points	More Wood	Less Wood
Site & Water	266	3	3	3
Energy Efficiency	443	23	23	13
Health & Indoor Air Quality	246	35	24	19
Materials Efficiency	380	113	65	20
Total	1335	174	115	55

In this case, using Less Wood results in 60 fewer points, which accounts for 34% of the wood-related points, but only 4.5% of the total points available in the rating system.

Built Green™ - Washington - Multi-family

	Total Points	Wood-Related Points	More Wood	Less Wood
Site & Water	562	3	3	3
Energy Efficiency	428	18	18	18
Health & Indoor Air Quality	309	25	8	4
Materials Efficiency	449	171	104	42
Total	1748	217	133	67

In the multi-family developments, using Less Wood results in 66 fewer points, which accounts for 49.6% of the wood-related points, but only 3.8% of the total points available in the systems.

Specific Credits - Built Green™ Washington[19]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for wood
Site & Water			
2-32	3	Use non- or low-toxic outdoor lumber for outdoor landscaping (e.g. least-toxic treated wood). (ALL outdoor applications for 5-Star)	• Wood & wood products – non-toxic treated wood
Energy Efficiency			
3-4	5	Install dense packed cellulose, wet-blown cellulose, blown-in foam, soy-based foam, or fiberglass BIBs as insulation	• Wood products - insulation
3-8	3	Use Airtight Drywall Approach for framed structures	• Building technique and skill
3-9	3	If using Structural Insulated Panels or Insulated Concrete Forms for building envelope, fix potential leak areas along ceiling and attic to ensure airtight building method	• Building technique and skill
3-16	2	Use Insulated Exterior Sheathing	• Wood products - sheathing
3-17	5	Use advanced wall framing—24 in OC, w/double top plate	• Building technique and skill
3-18	5	Innovative Stick Framing to Reduce Thermal Bridging, by Methods Such as Double Wall Framing and Horizontal Wall Furring	• Building technique and skill
Health & Indoor Quality			
4-14	15	No carpet in home	• Wood product – floors
4-22	3	Use urea-formaldehyde-free insulation or GreenGuard certified product	• Wood product - insulation - no formaldehyde
4-23	4	Do not use fiberglass insulation	• Wood product - insulation

[19] Single-Family/Townhome New Construction Checklist, 2007

4-25	3	Use Plywood and Composites of Exterior Grade or With No Added Urea Formaldehyde (For Interior Use)	• Wood product – composites – no formaldehyde
4-26	5	Install Cabinets Made with No Added Urea Formaldehyde Board and Low-Toxic Finish	• Wood product – cabinets – no formaldehyde, low-VOC finish
4-28	5	Use Only Shelving, Window Trims, Door Trim, Base Moulding, etc., With No Added Urea Formaldehyde	• Wood products – shelves, trim, door, base, etc – no formaldehyde
Materials Efficiency			
5-2	5 - 9	Design and Build for Deconstruction Concept	• Is using wood easier for achieving this credit?
5-10	1	Sell or Give Away Wood Scraps, Lumber, and Land Clearing Debris	• Building technique & skill
5-15	5	Recycle Clean Scrap Wood and Broken Pallets by Source Separation, 85% Minimum Recycling Rate	• Is using wood easier for achieving this credit?
5-18	2	Recycle Concrete/Asphalt Rubble, Masonry Materials, or Porcelain by Source Separation, 85% Minimum Recycling Rate	• Concrete credit
5-30	1	Install Materials with Longer Life Cycles	• Is using wood easier for achieving this credit?
5-31	1 - 3	Install Locally Produced Materials	• Local products
5-32	1 – 8	Use Building Salvaged Lumber, Minimum 200 Board Feet	• Salvaged lumber
5-33	2 - 3	Use Urban or Forest Salvaged Lumber, Minimum 250 Board Feet	• Salvaged lumber
5-36	1 – 10	Bonus Points: Reuse Salvaged Materials	• Salvaged wood products
5-37	3	Use No Endangered Wood Species	• Forest certification
5-38	2	Use Environmentally Preferable Products with Third-Party Certification, such as SCS, Greenguard, Green Seal, and Floor Score (Not Applicable to Carpet)	• Wood products – certification
5-39	7	Use Dimensional Lumber that is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 1 Requirements Outlined in the Handbook, 50% Minimum	• Forest certification – lumber - FSC

5-40	1	Use Dimensional Lumber that is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 2 Requirements Outlined in the Handbook	• Forest certification – lumber – FSC
5-41	5	Use Sheathing That Is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 1 Requirements Outlined in the Handbook, 50% Minimum	• Forest certification – Sheathing
5-42	1	Use Sheathing That Is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 2 Requirements Outlined in the Handbook	• Forest certification – Sheathing
5-43	5	Use Beams That Are Third-Party Certified Sustainably Harvested Wood that Meets the Tier 1 Requirements Outlined in the Handbook, 50% Minimum	• Forest certification – Beams – FSC
5-44	1	Use Beams That Are Third-Party Certified Sustainably Harvested Wood that Meets the Tier 2 Requirements Outlined in the Handbook	• Forest certification – Beams – FSC
5-45	1	Use Factory Framed Wall Panels (Panelized Wall Construction)	• Wood products – panels
5-47	3	Use Engineered Structural Products and Use No Dimensional 2xs Larger Than 2x8, and No 4xs Larger Than 4x8	• Wood products – engineered lumber
5-48	4	Use Structural Insulated Panels (SIPs)	• Wood products – SIPs
5-49	3	Use Insulated Concrete Forms (ICFs)	• Competes with wood
5-50	2-3	Use Finger-Jointed Studs	• Wood product – finger-jointed studs
5-51	5	Use Advanced System Framing With Double Top Plate	• Building technique and skills
5-53	6	Use Flyash or Blast Furnace Slag For 25% by Weight of Cementitious Materials for All Concrete (20% for Flat Work)	• Concrete credit
5-54	2	Use Recycled Concrete, Asphalt, or Glass Cullet For Base or Fill	• Concrete credit
5-57	4	No Vinyl Flooring	• Wood product - flooring
5-65	1-5	Use Locally Salvaged Wood Flooring	• Recycled content - salvaged wood
5-66	5	Use Flooring that is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 1 Requirements Outlined in the Handbook, 50% Minimum	• Forest certification – floors - FSC
5-67	1	Use Flooring that is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 2 Requirements Outlined in the Handbook	• Forest certification – floors - FSC
5-83	3	Use Wood/Composite or Fiberglass Windows	• Wood product - composites

5-84	4	No Vinyl Windows	• Wood product - windows
5-85	1	Use Finger-Jointed Wood Windows	• Wood product - windows
5-86	5	Use Wood Windows that are Third-Party Certified Sustainably Harvested Wood that Meets the Tier 1 Requirements Outlined in the Handbook	• Forest certification – windows – FSC
5-87	1	Use Wood Windows that are Third-Party Certified Sustainably Harvested Wood that Meets the Tier 2 Requirements Outlined in the Handbook	• Forest certification – windows - FSC
5-88a	1	Use Regional Trim Products, 50% Minimum	• Local content – trim
5-88b	3	Use Trim That Is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 1 Requirements Outlined in the Handbook, 50% Minimum	• Forest certification – trim – FSC
5-88c	1	Use Trim that is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 2 Requirements Outlined in the Handbook, 50% Minimum	• Forest certification – trim – FSC
5-89	3	Use Finger-Jointed or MDF Trim With No Added Urea Formaldehyde, 90% Minimum	• Wood products – trim - finger-jointed or MDF + no formaldehyde
5-90	1	Use Wood Veneers that are Third-Party Certified Sustainably Harvested Wood that Meets the Tier 1 Requirements Outlined in the Handbook, 50% Minimum	• Forest certification – veneers - FSC
5-91a	2	Use Regional Products, 90% Minimum	• Local products
5-91b	3	Use Wood that is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 1 Requirements Outlined in the Handbook, 50% Minimum	• Forest certification – floors - FSC
5-91c	1	Use Wood that is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 2 Requirements Outlined in the Handbook, 50% Minimum	• Forest certification – floors - FSC
5-92	2-3	Use Cabinet Casework and Shelving Constructed of Agricultural Fiber With No Added Urea Formaldehyde	• Competes with wood
5-93	1	Use Countertops That Are Salvaged, Recycled, or Third-Party Certified Sustainably Harvested Wood that Meets the Tier 1 Requirements Outlined in the Handbook	• Forest certification – floors - FSC
5-102	3	Use 100% Recycled Content HDPE, Salvaged Lumber or Lumber that is Third-Party Certified Sustainably Harvested Wood that Meets the Tier 1 Requirements Outlined in the Handbook for Decking and Porches	• Forest certification – floors - FSC
5-103	4	Use No Pressure Treated Lumber	• Wood product - lumber

Specific Credits - Built Green™ Washington – Multi-Family Residential Buildings[20]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
Site & Water			
2-38	3	Use non-toxic or low-toxic outdoor materials for landscaping (e.g. plastic, least-toxic treated wood)	• Wood & wood products – non-toxic treated wood
Energy Efficiency			
3-5	5	Use dense packed cellulose (over 2.5 lbs/inch) or wet blown cellulose or blown in foam	• Wood products - insulation
3-9	3	Airtight drywall approach for framed structures	• Building technique and skill
3-10	3	Use airtight building method, such as SIP or ICF	• Building technique and skill
3-17	2	Use insulated exterior sheathing	• Wood products - sheathing
3-18	5	Use advanced wall framing - 24-inch OC, with double top plate	• Building technique and skill
Health & Indoor Quality			
4-15	5	Use an alternative to fiberglass insulation	• Wood product – insulation
4-16	3	Use urea formaldehyde-free insulation or Greenguard certified product	• Wood product - insulation - no formaldehyde
4-18	3	Use plywood and composites of exterior grade with no added urea formaldehyde (for interior use)	• Wood product – composites – no formaldehyde

[20] Built Green Project Checklist Multi-Family 2008 Extended Pilot MASTER

4-19	5	Use only shelving, window trim, door trim, base moulding, etc., with no added urea formaldehyde	• Wood products – shelves, trim, door, base, etc – no formaldehyde
4-20	5	Install cabinets made with board with no added urea formaldehyde and low-toxic finish	• Wood product – cabinets – no formaldehyde, low-VOC finish
4-21	1	Use pre-finished flooring	• Wood product flooring
4-23	3	Use ceramic tile flooring	• Competes with wood
4-43	3	In wood-framed structures, use low-toxic mould-inhibitor product	• Wood products – framing – mould inhibitor
Materials Efficiency			
5-11	1	Sell or give away wood scraps, lumber and land clearing debris	• Building technique & skill
5-13	Re-use materials:		
5-13a	1	Doors	• Reused wood
5-13b	1	Flooring	• Re-used flooring
5-13c	1	Windows	• Re-used windows
5-13g	1	Cabinets	• Re-used cabinets
5-13h	1	Siding	• Re-used siding
5-13i	1	Decking	• Re-used decking
5-13j	1	Trim	• Re-used trim
5-13k	2	framing lumber	• Re-used framing lumber
5-14	1-10	Bonus points for reuse of salvaged materials.	• Salvaged wood and wood products
5-16	2	Recycle metal scraps by source separation, 90% minimum recycling rate	• Metal credit
5-17	5	Recycle clean scrap wood and broken pallets by source separation, 90% minimum recycling rate	• Recycle wood
5-20	2	Recycle concrete/asphalt rubble, masonry materials, or porcelain by source separation, 90% minimum recycling rate	• Concrete credit
5-36	1	Install locally/regionally produced materials	• Local products

5-37	10	Install locally/regionally produced materials, minimum 5 materials used in all units	• Local products
5-38	5	Use salvaged lumber, minimum of 1,000 board feet	• Salvaged lumber
5-41	3	Use no endangered wood species	•
5-42	2	Use environmentally preferable products with third-party certifications	• Wood products – certification
5-44	10	Use dimensional lumber that is third-party certified sustainably harvested wood that meets the Tier 1 requirements outlined in the Handbook, 50% minimum	• Forest certification – lumber - FSC
5-45	6	Use dimensional lumber that is third-party certified sustainably harvested wood that meets the Tier 2 requirements outlined in the Handbook, 50% minimum	• Forest certification – lumber – FSC
5-46	7	Use sheathing that is third-party certified sustainably harvested wood that meets the Tier 1 requirements outlined in the Handbook, 50% minimum.	• Forest certification – Sheathing
5-47	4	Use sheathing that is third-party certified sustainably harvested wood that meets the Tier 2 requirements outlined in the Handbook, 50% minimum.	• Forest certification – Sheathing
5-48	5	Use beams that are third-party certified sustainably harvested wood that meets the Tier 1 requirements outlined in the Handbook, 50% minimum.	• Forest certification – Beams – FSC
5-49	3	Use beams that are third-party certified sustainably harvested wood that meets the Tier 2 requirements outlined in the Handbook, 50% minimum.	• Forest certification – Beams – FSC
5-51	3	Use engineered structural products and use no 2xs larger than 2x8, and no 4xs larger than 4x8	• Wood products – engineered lumber
5-52	1	For interior walls, use steel studs with minimum 50% recycled content	• Competes with wood
5-53	4	Use structural insulated panels (SIPs)	• Wood products – SIPs
5-54	2	Use insulated concrete forms (ICFs)	• Competes with wood
5-55	1	Use finger-jointed framing material (e.g. studs)	• Wood product – finger-jointed studs
5-56	5	Use advanced system framing with double top plate	• Building technique and skills
5-58	3 or 6	Use regionally produced flyash or blast furnace slag for 25% by weight of cementitious materials for all concrete (20% for flat work), if available	• Concrete credit
5-59	2	Use recycled concrete, asphalt, or glass cullet for base or fill	• Concrete credit
5-60	1	Use recycled content sub-floor	• Recycled content - flooring
5-61	2	Use domestically-grown wood interior doors	• Local wood - doors
5-63	4	No vinyl flooring	• Wood product - flooring

5-71	1 or 3 or 5	If using wood flooring, use locally salvaged wood flooring on 25%, 50% or 90%+ of total flooring	• Recycled content - salvaged wood
5-72	5	Use flooring that is third-party certified sustainably harvested wood that meets the Tier 1 requirements outlined in the Handbook, 50% minimum	• Forest certification – floors - FSC
5-73	3	Use flooring that is third-party certified sustainably harvested wood that meets the Tier 2 requirements outlined in the Handbook, 50% minimum	• Forest certification – floors - FSC
5-82	2	Use recycled content sheathing (OSB does not apply)	• Wood product - composites
5-83	3	Use exterior cladding with reclaimed or recycled material on at least 20% of solid wall surface	• Wood products - recycled content - cladding
5-84	4	No vinyl siding or exterior trim	• Local content – trim
5-88	5	Use wood siding that is third-party certified sustainably harvested wood that meets the Tier 1 requirements outlined in the Handbook on at least 20% of solid wall surface	• Forest certification – siding – FSC
5-89	3	Use wood siding that is third-party certified sustainably harvested wood that meets the Tier 2 requirements outlined in the Handbook on at least 20% of solid wall surface	• Forest certification – siding - FSC
5-90	3	Use wood, composite, or fiberglass windows	• Wood product - windows
5-91	4	No vinyl windows	• Wood product - windows
5-92	1	Use finger-jointed wood windows	• Wood products – windows – finger-jointed
5-93	2	Use regionally produced windows	• Local products - windows
5-94	If using wood trim:		
5-94a	1	Use regional products, 50% minimum	• Local products - trim
5-94b	3	Use domestic hardwood trim that is third-party certified sustainably harvested wood that meets the Tier 1 requirements outlined in the Handbook, 50% minimum	• Forest certification – trim - FSC
5-94c	2	Use domestic hardwood trim that is third-party certified sustainably harvested wood that meets the Tier 2 requirements outlined in the Handbook, 50% minimum	• Forest certification – trim - FSC
5-94d	3	Use third-party certified sustainably harvested wood that meets the Tier 1 requirements outlined in the Handbook, 50% minimum	• Forest certification – wood - FSC

5-94e	2	Use third-party certified sustainably harvested wood that meets the Tier 2 requirements outlined in the Handbook, 50% minimum	• Forest certification – wood - FSC
5-95	3	Use finger-jointed or MDF trim with no added urea formaldehyde, 90% minimum	• Wood products – trim - finger-jointed or zero formaldehyde MDF
5-96	1	Use wood veneers that are third-party certified sustainably harvested woods that meets the Tier 1 requirements outlined in the Handbook, 50% minimum	• Forest certification – veneers- FSC
5-97	1	Use wood veneers that are third-party certified sustainably harvested woods that meets the Tier 2 requirements outlined in the Handbook, 75% minimum	• Forest certification – veneers- FSC
5-98	For cabinets:		
5-98a	2	Use regional products, 90% minimum	• Local products – cabinets
5-98b	2	Use domestic hardwood that is third-party certified sustainably harvested wood that meets the Tier 1 requirements outlined in the Handbook, 50% minimum	• Forest certification – cabinets – FSC
5-98c	1	Use domestic hardwood that is third-party certified sustainably harvested wood that meets the Tier 2 requirements outlined in the Handbook, 50% minimum	• Forest certification – cabinets – FSC
5-98d	2	Use third-party certified sustainably harvested wood that meets the Tier 1 requirements outlined in the Handbook, 50% minimum	• Forest certification – wood - FSC
5-98e	1	Use third-party certified sustainably harvested wood that meets the Tier 2 requirements outlined in the Handbook, 50% minimum	• Forest certification – wood - FSC
5-98f	2 or 3	Use cabinet casework and shelving constructed of agricultural fiber (“strawboard” or “wheatboard”) with no added urea formaldehyde for 50% or 90% of all casework	• Competes with wood
5-99	1	Use resource efficient countertop material in lobby/reception areas	• Competes with wood
5-100	4	Use countertops that are salvaged, recycled, or third-party certified sustainably harvested wood with a chain of custody in all units	• Forest certification or salvaged – countertops - FSC
5-108	2	All insulation to have a minimum of 40% recycled content	• Wood product – insulation
5-111	2	Use reclaimed or salvaged material for landscaping walls	• Salvaged wood
5-112	3	Use 100% recycled content HDPE, salvaged lumber, or lumber that is third-party certified sustainably harvested wood that meets the Tier 1 requirements outlined in the Handbook for decking and porches	• Forest certification – decking - FSC
5-113	2	Use 100% recycled content HDPE, salvaged lumber, or lumber that is third-party certified sustainably harvested wood that meets the Tier 2 requirements outlined in the Handbook for decking and porches	• Forest certification – decking - FSC

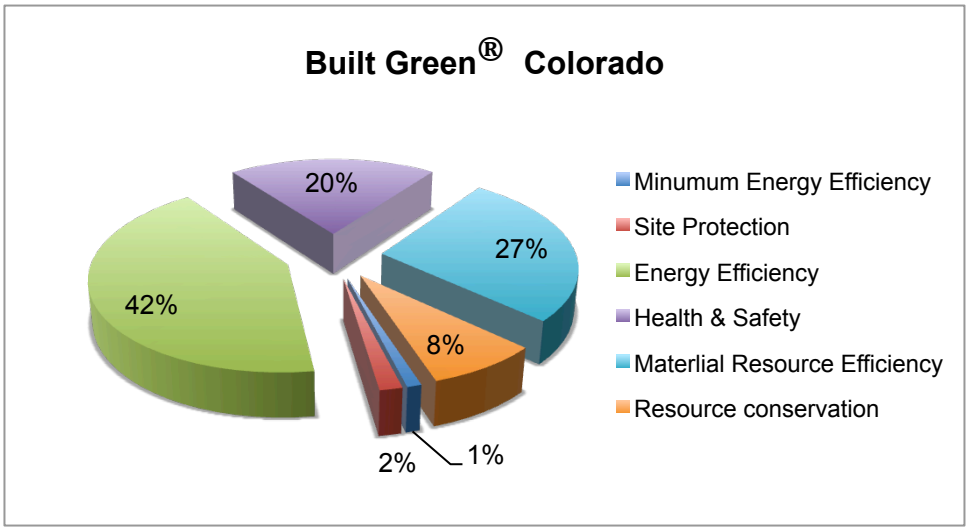
5-114	2	Use recycled content lumber for decking (e.g. Trex)	• Recycled content – decking
5-115	4	If lumber is used, use no pressure treated lumber	• Wood product – lumber – not pressure treated
5-116	1	If using pressure-treated lumber, use CAB	

Built Green® Colorado

Name(s): Built Green® Colorado
Location(s): Colorado, USA
Market Scope: Colorado, USA
Building Types: Single-detached residential
Organization: Built Green® Colorado, Home Builders Association of Metro Denver

Introduced in 1995, Built Green® Colorado is a voluntary industry-driven program of the Home Builders Association of Metro Denver and is offered to builders across the state.

To achieve the Built Green® distinction, homes must be designed and constructed based on a checklist of more than 180 features in 22 categories, 8 of which are required. The 22 categories can be summed into the following themes:



Prevalence of Wood

Built Green® Colorado has 148 credits that are related to wood and/or wood products. This accounts for 21.7% of the total points available.

Built Green® - Colorado

	Total Points	Related to Wood	% Related to Wood
Minimum Energy Efficiency	7	0	0.0%
Site Protection	11	0	0.0%
Energy Efficiency	288	8	2.8%
Health & Safety	136	21	15.4%
Material Resource Efficiency	184	119	64.7%
Resource conservation	55	0	0.0%
Total	681	148	21.7%

Wood vs. Competing Products

When comparing the two hypothetical buildings, More Wood fairs better than Less, with 99 total wood-related points instead of 66.

Built Green® - Colorado

	Total Points	Wood Related Points	More Wood	Less Wood
Energy Efficiency	288	8	8	8
Health & Safety	136	21	18	14
Material Resource Efficiency	184	119	73	44
Total	681	148	99	66

This difference of 33 points accounts for a 22.3% difference within the wood-related points, but only 4.8% of the total points available across all categories.

Specific Credits - Built Green® Colorado

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
VI. Energy Efficiency – Foundation Systems			
19	5	Rigid insulation forms that provide permanent insulation to the foundation (ICFs)	• Concrete credit
VII. Energy Efficiency – Thermal Envelope			
27	Varies	Raised heels of 6" or more on trusses to provide for full-height insulation over top wall plate. (choose only one) - 6" – 3 pts, 8" – 4 pts, 10" – 5 pts	• Building technique & skills
28	3	Advanced Rim Joist Insulation. This item can be achieved by one of the following: See Guide for diagrams and further descriptions • Using an engineered, SIP-like product for rim section • Installing an inch or more of rigid foam on the exterior face of the rim joist, integrated with the drainage plane • Using a combination of rigid foam sealed with spray foam • Using high-density spray foam insulation on the interior bays of the floor joists.	• Building technique & skills • Wood product - SIPs
XII. Health & Safety – Improved Indoor Air Quality			
74	2	All carpet throughout the home meets one of the following criteria: • Carpet must comply with the Carpet and Rug Institute's (CRI's) Green Label Plus program (low VOC carpet and pad), OR • No carpets installed in 100% of home (i.e. hard-surfaced flooring)	• Wood product – flooring
77	2	OSB produced with non-formaldehyde based adhesives used for sub floor	• Wood product – OSB sub-floor – no formaldehyde
78	2	OSB produced with non-formaldehyde based adhesives used for sheathing	• Wood product – OSB sheathing – no formaldehyde
79	3	Ceramic tile installed with low toxic adhesives	• Competes with wood
81	4	Cabinet finish coat done with water based finishes containing VOC content of less than 250 grams per liter	• Wood products – cabinets – low formaldehyde
82	3	Water-based urethane finishes on wood floors	• Wood products – flooring – low VOCs

83	3	Water-based lacquer finishes on woodwork	• Wood products – woodwork – low VOCs
84	2	All panel ends, edges and cuts of any particle board must be sealed with impermeable water-based sealer prior to painting	• Wood product – particle board – low VOCs
XVIII. Material Resource Efficiency: Framing			
113	10	Reinforced cementitious foam-formed above grade walls (ICFs, or insulated concrete forms)	• Competes with wood
114	7	Structural insulated panels (SIPs) used for 75% or more of walls	• Wood product – SIPs – walls
115	7	Structural insulated panels (SIPs) used for 75% or more of roof	• Wood product – SIPs – roof
116	5	Engineered alternative wall systems as approved by local code	• Wood product – engineered wall systems
117	Varies	Dimensional or engineered lumber from third-party certified sustainably-harvested sources used for 100% the following: • Floor framing – 2 pts • Wall framing – 2 pts • Roof framing – 2 pts	• Forest certification – framing – floor, wall, roof – FSC
118	Varies	Engineered alternative replaces large dimension solid lumber (2x10 or greater) in 90% or more of the following areas: • Floor systems (i.e. trusses, joists) – 2 pts • Roof structure (i.e. trusses, joists) – 2 pts	• Forest certification – lumber – floor, roof – FSC
119	3	Reduced framing package includes ALL of the following: • 24. O.C. on all studs at interior non-bearing walls • 3-stud exterior corners capable of being insulated • No headers in non-bearing interior walls	• Building technique & skills

120	Varies	Advanced framing techniques (OVE, optimum value engineering) employed to reduce/conserve structural framing and lumber. Points awarded according to components listed below: • Roof trusses, wall studs, floor framing spaced 24" on center (stacked framing) – 4 pts • Aligning all door and window openings with stud spacing – 1 pt • Single top plates – 1 pt • Ladder-backed framing or alternate at all partition wall connections – 1 pt • 2 stud exterior wall corners utilizing drywall clips or alternate means of fastening (NO California corners) – 2 pts • Headers – no headers on non-bearing walls; for bearing walls, insulate and size for actual load conditions – 2 pts	• Building technique & skills
121	Varies	Engineered lumber products used for the following: • ≥ 50% beams – 2 pts • ALL load-bearing window and door headers – 1 pt • ALL plate and rim joist material – 2 pts • ≥ 10% of stud wall framing – 1 pt	• Wood products – engineered lumber
122	Varies	Finger-jointed material used for the following: • Plate material – 2 pts • Stud material for 90% of wall framing – 2 pts	• Wood products – finger jointed plates & studs
123	1	Recycled-content sheathing where sheer corners and sheer walls are not required (minimum 50% post consumer content by weight) OSB does NOT qualify for this point 1 Product literature	• Wood products – sheathing – recycled content
124	Varies	Non-structural elements of decking materials with the following - Choose only one: • ≥ 50% or greater recycled content by weight – 3 pts • ≥ 80% or greater recycled content by weight – 4 pts • Add points for ≥ 25% post-consumer recycled material – 1 pt • Add points if product is 100% recyclable (≥ 50% of decking material must be from post-consumer recycled sources to take this point) – 1 pt	• Wood products – decking – recycled content
125	3	All decking materials made from third-party certified sustainably-harvested lumber	• Forest certification – decking - FSC
XIX. Material Resource Efficiency: Sub-floor			
126	3	Natural cork or 100% recycled or recovered content underlayment	• Competes with wood
127	1	Plywood or Oriented Strand Board (OSB) made from sustainably harvested sources for sub-flooring	• Forest certification – plywood & OSB

XX. Material Resource Efficiency: Roofing			
128	6	Minimum 40-year roofing material, including concrete, slate, clay or metal Cannot combine points with any other roofing material	• Competes with wood
130	Varies	Recycled-content roofing material with Class-A fire rating, with =/>50% post consumer content • Cannot combine points with any other roofing material • 40-year roofing material – 4 pts • 50-year roofing material – 6 pts	• Competes with wood
XXII. Material Resource Efficiency: Windows & Doors			
134	2	Window frames made from third-party certified sustainably harvested wood	• Forest certification – windows
135	2	Tropical hardwoods, if used anywhere in the home, are from third party certified sustainably harvested wood	• Forest certification – tropical wood
136	4	Doors in home must use non-urea formaldehyde based binders, and constitute one or all of the following: (1 pt per door, max 4 pts) • Recycled content doors (≥ 25% post consumer) • Recovered content doors (e.g. agri-fiber, re-milled wood products) • Reclaimed/reused doors	• Wood product – doors – recycled content + no formaldehyde
137	4	Doors made from third-party certified sustainably harvested wood (1 pt per door, max 4 pts)	• Forest certification – doors
XXIII. Material Resource Efficiency: Exterior Wall Finishes			
140	2	Fiber cement fascia and soffits	• Wood product – fascia – fibre cement
141	3	Natural or treated engineered wood siding is 100% from third-party certified sustainably harvested sources on 50% or more of exterior wall area, with proper drainage plane installation, natural wood siding (not treated engineered wood) must be primed on all six (6) sides of the material, and maintains a minimum ¼" air gap between the siding material and the sheathing and drainage plane material.	• Wood product – engineered siding
142	3	Fiber cement siding on 50% or more of exterior wall area with proper drainage plane installation and/or manufacturer's specifications regarding drainage plane. See Guide to the Built Green Checklist for proper drainage plane installation	• Wood product – siding – fibre cement
143	1	Recycled and/or recovered-content siding (minimum 40% pre- or post-consumer) on 50% or more of exterior wall area	• Wood product – siding – recycled content

144	2	Fascia, soffits or trim for 100% of application from: (choose only one) • Recycled and/or recovered-content materials (minimum 40% pre- or post-consumer) • Treated engineered wood from 100% third party certified sustainably harvested sources (note: OSB, natural wood and MDF can take these points)	• Wood product – fascia, trim – recycled OR forest certification
145	1	50% of façade material is regionally produced (within 500 mile radius)	• Local content
XXIV. Material Resource Efficiency: Interior Finish Floor			
146	Varies	Natural fiber carpet (e.g. wool, sisal, etc.) made with non-SB latex backing • ≥ 25% of carpeted floor area – 2 pts • ≥ 50% of carpeted floor area – 4 pts	• Competes with wood
147	Varies	Domestic wood flooring from reused/recovered or re-milled sources • ≥ 25% of hard surface floor area – 3 pts • ≥ 50% of hard surface floor area – 6 pts	• Wood product – flooring – reused/recovered
148	Varies	Natural linoleum in place of any vinyl sheet flooring or vinyl composition tile, with low toxic adhesives or backing • ≥ 10% of hard surface floor area – 2 pts • ≥ 25% of hard surface floor area – 4 pts	• Competes with wood
149	Varies	Wood flooring made from third-party certified sustainably harvested sources • ≥ 25% of hard surface floor area – 3 pts • ≥ 50% of hard surface floor area – 6 pts	• Forest certification – flooring - FSC
150	Varies	Bamboo in place of hardwood • ≥ 25% of hard surface floor area – 3 pts • ≥ 50% of hard surface floor area – 6 pts	• Competes with wood
151	Varies	Cork flooring in place of hardwood or tile • ≥ 10% of hard surface floor area – 2 pts • ≥ 25% of hard surface floor area – 4 pts	• Competes with wood
152	Varies	100% of carpet pad in house is made from the following: (choose only one) • Recycled content textile, carpet, carpet cushion or tire waste (rebond still qualifies) – 1 pt • Natural fiber (wool felt, etc.) or 100% post consumer recycled content carpet pad – 2 pts	• Competes with wood
153	Varies	Recycled-content carpet, ≥ 25% post consumer recycled content • ≥ 50% of carpeted floor area – 1 pt • 100% of carpeted floor area – 2 pts	• Competes with wood

XXV. Material Resource Efficiency: Cabinetry & Trim			
155	Varies	Cabinets and drawer boxes are made from materials that contain no added urea-formaldehyde resins and are made from the following: • Agri-fiber material – 4 pts • SCS or CPA/EPP Certified Composition wood used in cabinets (i.e., particle/fiber board, MDF) – 3 pts SCS = "Scientific Certification Systems" CPA/EPP = "Composite Panel Association's "Environmentally Preferable Product"	• Wood product – cabinets – no formaldehyde
156	Varies	Shelving and/or Countertops are made from materials that contain no added urea-formaldehyde resins and are made from the following: • Agri-fiber material – 3 pts • SCS or CPA/EPP Certified Composition wood used in shelving and/or countertop underlayment (i.e., particle/fiber board, MDF) – 2 pts SCS = "Scientific Certification Systems" CPA/EPP = "Composite Panel Association's "Environmentally Preferable Product"	• Wood product – shelving/countertops – no formaldehyde
157	4	Cabinet frames, doors and drawer fronts with low-VOC finishes (≤ 250 grams/liter), made from one or all of the following: (choose only one) • 100% reclaimed or salvaged wood • 100% agri-fiber composite material (w/ no added urea-formaldehyde resins) • 100% bamboo or other rapidly renewable resource • Third-party certified sustainably harvested sources	• Wood product – cabinets, frames, doors, drawers – low VOC + forest certification OR reclaimed/salvaged OR competing wood product
158	Varies	Trim made from the following materials: • SCS Certified Composition wood used for trim (i.e. fiber board/MDF) – 2 pts • Finger-jointed trim – 1 pt	Wood product – trim – composites and/or finger-jointed
159	2	Solid hardwood trim from third-party certified sustainably harvested sources	Forest certification - hardwood
XXVI. Material Resource Efficiency: Materials Reduction & Reuse			
161	5	Specify salvaged, reclaimed or refurbished materials for 5% of structural materials	• Salvaged wood – structural
162	5	Specify salvaged, reclaimed or refurbished materials for 5% of finish materials, not including flooring • Cannot combine with #147 "domestic wood flooring from reused/recovered …"	• Salvaged wood – finish materials

CASBEE®

Name(s): The Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)® for Home

Location(s): Japan

Market Scope: All of Japan

Building Types: Single-detached residential

Organization: Japan GreenBuild Council (JaGBC) & Japan Sustainable Building Consortium (JSBC)

CASBEE® (the Comprehensive Assessment System for Building Environmental Efficiency) was developed by a committee set up under the initiative of the Ministry of Land, Infrastructure and Transport (MLIT) in 2001. Since 2002, various categories of CASBEE® has been sequentially developed including:

- CASBEE® for New Construction
- CASBEE® for Existing Building
- CASBEE® for Renovation
- CASBEE® for HI (Heat Island)
- CASBEE® for Urban Development
- CASBEE® for Home (Detached House)

CASBEE® for Home (Detached House)

CASBEE® for Home (Detached House) evaluates the general environmental performance from two viewpoints: (1) the environmental quality of the house itself (symbolized by "Q" for quality) and, (2) the environmental load imposed by the house on the external environment (symbolized by "L" for load). Q and L each have three assessment categories:

1. Evaluation of the level of environmental quality (Q):
    - Q1 Comfortable, Healthy and Safe Indoor Environment
    - Q2 Ensuring a Long Service Life
    - Q3 Creating a Richer Townscape and Ecosystem

2. Evaluation of efforts to reduce the environmental load (L) by load reduction (LR):
    - LR1 Conserving Energy and Water
    - LR2 Using Resources Sparingly and Reducing Waste
    - LR3 Consideration of the Global, Local, and Surrounding Environment

Each of Q and L's three categories is subdivided into one to three stages ("medium-level item," "minor item," and "detailed item," respectively). A total of 54 individual assessment items are allocated to these categories and are evaluated by assigning 1 to 5 points per item. The result is summed up for each subdivision to identify which efforts in which category are excellent or poor.

CASBEE® is designed so that a house that has a higher Q and a lower L will receive a better evaluation. This relationship is shown in the following:

Index of environmental efficiency in CASBEE® for Home (BEE_H):

$$\mathbf{BEE_H = Q_H/L_H}$$

The greater the slope, the better the ranking:

Table 4 - CASBEE® for Homes rating levels[21]

Rank	Assessment	BEE Value	Ranking in Stars
S	Excellent	3.0 or higher	☆☆☆☆☆
A	Very good	1.5 of higher, but less than 3.0	☆☆☆☆
B+	Good	1.0 or higher, but less than 1.5	☆☆☆
B-	Fairly poor	0.5 or higher but less than 1.0	☆☆
C	Poor	Less than 0.5	☆

An interesting aspect of the BEE value is the correlation between the environmental quality (Q) and environmental load (L). If Q is doubled and L is halved, the BEE value will be quadrupled. For example, assuming that the environmental load is reduced by reducing heating or cooling energy, if this means that the occupants have to withstand cold or hot temperatures, it will represent a decrease in environmental quality. A good assessment will not then be achieved. On the other hand, if energy consumption is successfully reduced without reducing the level of comfort, or the level of comfort is increased without increasing energy consumption, a higher evaluation will be given. Therefore achieving both a reduction in energy consumption and an improvement in the level of comfort will result in the highest evaluation. [22]

Prevalence of Wood

The CASEE® system is designed to produce a slope of a straight line. The greater the slope indicates a higher performing building. In the numerator, which relates to the quality of the house, wood related credits account for 16.5% of the total available score.

[21] CASBEE for Homes Technical Manual, 2007 Edition
[22] CASBEE for Homes Technical Manual, 2007 Edition

CASBEE® for Homes	Weighting	% related to wood	% in whole system
Qh1 - Comfortable, Healthy, Safe Indoor Environment <0.45>	45.00%	9.90%	4.46%
Qh2 Ensuring a Long Service Life <0.30>	30.00%	40.00%	12.00%
Qh3 Creating a Richer Townscape & Ecosystem <0.25>	25.00%	0.00%	0.00%
Total	1		16.46%
LRh1 Conserving Energy and Water <0.35>	35.00%	0.00%	0.00%
LRh2 Using Resources Sparingly and Reducing Waste <0.35>	35.00%	57.90%	20.27%
LRh3 Consideration of the Global, Local, and Surrounding Environment <0.30>	30.00%	33.00%	9.90%
Total	1		30.17%

In the denominator, wood related credits accounts for 30.2% of the total available score.

Wood vs. Competing Products

How wood fairs against competing products cannot be evaluated because calculations for this rating system are done through specialized software. However, there are two important qualitative observations:

1. Wood, steel, and concrete walls/framing are treated equally and separately. The category “LRh2 Using Resources Sparingly and Reducing Waste” is divided into 5 sub-categories, the first of which is “1.1 Building Frames”. This sub-section has separate compliance paths depending on whether wood, steel, or concrete is used. This sub-section accounts for 30% of the LRh1 category.

2. It also seems that subsections 1.3 - 1.5, which account for 50% of the LRh1 category may be easier to achieve using wood products over competing substitutes – see the next section on Specific Credits for detailed language for how wood is treated.

Specific Credits - CASBEE® for Homes[23]

Credit ID & Title	Description(s) relating to wood, steel, or concrete	Implications for Wood
Q_H1 – Comfortable, Healthy and Safe Indoor Environment		
2. Health, Safety, and Security		
2.1 Counter measures against chemical contaminants	Evaluate whether adequate measures are taken to avoid indoor air pollution from chemical contaminants. Levels 3-5 - The building satisfies the requirements of Grade 1,2, or 3 in Section 6-1, "Countermeasure against Formaldehyde (Interior, Ceiling Plenum, etc.)," of the Japan Housing Performance Indication Standards. The areas to be evaluated include interior finish (except pillars or other axis materials, crown mouldings, window sills, skirtings (baseboards), fitted framing, paints used partially, and adhesives) and base materials used in the ceiling plenum or other spaces (except in cases where certain arrangements such as ventilation are made there)	Formaldehyde requirements for wood products.
Q_H2 Ensuring a Long Service Life		
1. Basic Life Performance		
1.1 – Building frames	Evaluate the basic performance of the building frames in terms of assuring a longer service life based on the degree of measures required to extend the period up to when large-scale renovation, such as replacement of materials used in the building frames, becomes necessary. Levels 3-5 - The building satisfies the requirements of Grades 1, 2, or 3 in Section 3-1, "Deterioration Resistance Grades (Building Frames, etc.)," of the Japan Housing Performance Indication Standards. • Grade 3 - Measures required to extend the period up to when large-scale renovation becomes necessary over three generations (about 75-90 years), under normally assumed natural conditions and maintenance, have been implemented. • Grade 2 - Measures required to extend the period up to when large-scale renovation becomes necessary over two generations (about 50-60 years), under normally assumed natural conditions and maintenance, have been implemented. • Grade 1 - Measures specified in the Building Standards Act have been implemented.	Do wood frames prevent achievement of Grade 3 (service life of 75-90 years)?
1.2 Exterior wall materials	Evaluate the basic life performance of the base materials of exterior walls based on their years of durability and renewability. Level 1 - A service life of less than 12 years can be expected. Level 2 - A service life of 12 years to less than 25 years can be expected. Level 3 - A service life of 25 years to less than 50 years can be expected.	Siding is rated at Level 3, and formed cement board at Level 4.

[23] CASBEE® for Home Technical Manual 2007 Edition

	Level 4 - A service life of 50 years to less than 100 years can be expected. Level 5 - (May be selected if the Conditions for adding points are met.)	
1.4 Resistance against natural	Evaluate the strength of the building against natural disasters based on the strength of the building structure against earthquakes, in terms of resistance to collapse and destruction. Levels 3-5 - The building satisfies the requirements of Grade 1 , 2 or 3 in Section 1-1, "Seismic Resistance Grades (Prevention of Collapse of Building Structures)," of the Japan Housing Performance Indication Standards. Grade 3 - The building can withstand 1.5 times the strength of an earthquake (stipulated in Article 88, Clause 3 of the Building Standards Act) that occurs very rarely (once every few hundred years). Grade 2 - The building can withstand 1.25 times the strength of an earthquake that occurs very rarely. Grade 1 - The building can withstand the strength of an earthquake that occurs very rarely .	How does wood-frame construction perform in earthquakes?
Q_H3 Creating a Richer Townscape and Ecosystem		
4. Utilizing Regional Resources and Inheriting the Regional Housing Culture	Evaluate efforts to actively inherit the housing culture that is deeply rooted in the region as well as efforts to preserve the environment of mountain forests by utilizing wood resources of the region. Levels 1-3 – Zero, one or two of Efforts to be evaluated No.1 through 5 have been implemented. Efforts to be evaluated (that relate to wood): • Wood materials produced from local mountain forests are actively used for the structure of the building. • Wood materials produced from local mountain forests are actively used for the interior and exterior materials or external area materials of the building. Classification of Efforts: Utilization of locally produced wood resources Wood from mountain forests has been used in Japan as an environmentally friendly biological material for housing construction since ancient times. However, the environment of mountain forests has been deteriorating because wood resources from these forests are not being properly utilized and are therefore not being renewed as they should be, and also because the forests are not being managed well. In addition to the objectives in "Inheritance of the local housing culture" described above, efforts to restore the mountain forest environment by utilizing wood resources produced in the mountain forests of the region are evaluated in efforts 4 and 5. 4 Efforts to use wood resources produced in the mountain forests of the region for the main frames of the house are evaluated. 5 At the same time, efforts to use wood resources produced in the mountain forests of the region for interior and exterior materials or external area materials are evaluated. *The locality of the "materials supplied by local industries" and the region of "wood resources produced in the region" are defined as the prefecture where the planned area is located and the adjoining prefectures. However, if the municipality in which the planned area is located has formulated measures to facilitate the use of local materials, the definition specified by the municipality is to be applied	This is assessment criterion aids Japan's forest management and wood industries, but excludes foreign wood and wood products.

LR_H2 Using Resources Sparingly and Reducing Waste		
1. Introduction of Materials Useful for Resource Saving and Waste Prevention		
1.1 Building frames	Evaluate efforts related to the introduction and reuse of materials in the building frames that are useful for resource saving (recycled materials, renewable materials) and waste prevention (recyclable materials). The evaluation is conducted using the detailed items in "LRH2.1.1.1 Wooden house," "LRH2.1.1.2 Steel-frame house," or "LRH2.1.1.3 Concrete house", where the detailed items are appropriate for the structure of the house. In the case of a house with a mixed structure, the evaluation is conducted for each of the structures separately, and a weighted average of the assessment levels is obtained according to the respective floor areas. Renewable materials - mean materials that can be used without fear of resource depletion and that fall under either of the following categories. Those materials derived from mineral resources (stone materials, etc.) are not evaluated. • Wood produced from sustainable forests. • Plant-derived natural resources (bamboo, kenaf, etc.) that require a short period to become available. Wood produced from sustainable forests (Formwork is not evaluated.) 1. Thinned wood. 2. Wood produced from a forest under sustainable forestry management (for which the method of verification complies with the "Guidelines for Verification of Legality and Sustainability of Wood and Wood Products" (Forestry Agency of Japan, 2006, described later)). 3. Conifer wood produced in Japan. In addition, wood-based materials such as laminated wood and plywood, which conform with these definitions, can be considered to be produced from sustainable forests. Forest Certification Systems In these systems, third-party organizations assess and certify the level of forest management based on criteria defined by independent forest certification organizations, including: FSC, SFI, ATFS, PEFC, SGEC. A method to verify that wood and wood products have been produced in certified forests by sealing a certification mark on them in conjunction with CoC certification.	Acceptable forest certification systems include FSC, SFI, and CSA (with COC certificates).
1.1.1 Wooden House	Evaluate the extent to which wooden materials produced from sustainable forests are used for the building frames in the case of a wooden house built by such methods as wood framework construction, two-by-four construction, wood panel construction, or wood unit construction. Levels 3 – 5, wood produced form sustainable forests is used for, less than half, more than half, or for the entire building frame. Conditions for adding points - the evaluation can be raised by up to two levels when each of the following conditions are met. However, if the resultant level exceeds Level 5, it is evaluated as Level 5.	Acceptable forest certification systems include FSC, SFI, and CSA (with COC certificates).

	Part 1 The level is raised by 1 in a case where wood whose legality and sustainability are verified according to "(1) Method using forest certification system and chain of custody certification system," "(2) Method using voluntary codes of conduct of industry groups," or "(3) Method using individual operators' own efforts" in the "Guidelines for Verification of Legality and Sustainability of Wood and Wood Products" (Forestry Agency, refer to previous related information) is used for more than half of the building frames. In general, wood whose legality and sustainability is verified by method (1) is the norm from the viewpoint of independence, but verification by methods (2) and (3) may also be permitted considering the current distribution status and the importance of promoting the use of wood and wood products with verified legality. Part 2 The level is raised by 1 or 2, respectively, when reused materials once used in other building structures are used for part of or more than half of the building frames.	
1.1.2 Steel-frame house	This evaluation is conducted according to the proportion of electric steel that is used in the building frames of a steel-frame house of light-gauge or heavy-gauge steel frames, or built by the steel unit construction method. Although iron scrap can be considered as a recycled material because it is included when virgin steel is manufactured, it is not evaluated in this assessment because the percentage is low, at 2-3%. Level 3-4: Electric steel is not used, is used for part, or used for more than half of the building frames. Regarding Levels 4 and 5, the judgment is made according to the proportion (weight) of electric steel used in the building frames. A case in which the proportion is lower than 0.5 is evaluated as Level 4, while case in which the proportion is 0.5 or higher is evaluated as Level 5. Conditions for adding points: When reused materials once used in other building structures are used for part of or more than half of the building frames, the level is raised by 1 or 2, respectively. However, if the resultant level exceeds Level 5, it is evaluated as Level 5.	n/a
1.1.3 Concrete house	Evaluate efforts to save resources in the case of a concrete house with a reinforced-concrete structure or reinforced-concrete box frame structure. Level 3-4 – Neither efforts 1 or 2, or one of the efforts, or both of the efforts have been implemented. Effort 1 - Blended cement (blast-furnace cement or fly-ash cement) or eco-cement is used for the structural concrete. (Use in blinding concrete or exterior wainscots is not evaluated.) Effort 2 - Recycled aggregate or slag aggregate for concrete is used for the structural concrete. (Use in blinding concrete or exterior wainscots is not evaluated.)	n/a

<table>
<tr>
<td></td>
<td>Blended cement (blast-furnace cement or fly-ash cement), eco-cement, and slag aggregate used for concrete are materials designated by the Law Concerning the Promotion of Procurement of Eco-Friendly Goods and
Services by the State and Other Entities (Law on Promoting Green Purchasing).</td>
<td></td>
</tr>
<tr>
<td>1.3 Exterior materials</td>
<td>Evaluate the use of materials that are useful for resource saving (recycled and renewable materials) and waste prevention (recyclable materials) in the exterior materials. The exterior materials evaluated are roofing materials, waterproofing materials, roof sheathing materials, waterproof sheathing materials, exterior wall materials, exterior wall sheathing, and insulation materials. Evaluation is carried out according to the credit ratio, after assessing the introduction of materials that are useful for resource saving (recycled materials, renewable materials) and materials useful for waste prevention (recyclable materials) in the exterior materials.
Efforts concerning surface materials other than insulation materials are evaluated as a "Large-scale effort," while the use of such materials for linear elements such as scantlings and joiners is treated as a "Small-scale effort." The use of small items such as metal fittings, screws, and nails is not treated as an effort. With regard to the extent of efforts concerning insulation materials, overall use of recycled materials is regarded as a "Large-scale effort" and partial use as a "Small-scale effort."

Efforts to be evaluated
<table>
<tr><th colspan="3">Evaluation points</th><th rowspan="2">Effort</th></tr>
<tr><th>Large-scale effort</th><th>Small-scale effort</th><th>No effort</th></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the roofing material (in the case of a sloping roof) or waterproofing material (in the case of a flat roof)</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the roof sheathing material (in the case of a sloping roof) or waterproof sheathing material (in the case of a flat roof)</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the exterior wall material</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the exterior wall sheathing</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the insulation materials</td></tr>
<tr><td colspan="3">[I] Total points =____ point(s)</td><td>[II] Maximum points =____ point(s)
[III] Credit ratio ([I]÷[II])= _____</td></tr>
</table>
[24]

Cases in which the building frame also functions as an exterior material, such as as-cast concrete walls and</td>
<td>Wood produced from sustainable forests (as previously described) counts as “materials that are useful for resource saving (renewable)”.

Waste wood products such as particleboard are considered as “materials that are useful for resource saving (recycled)”.</td>
</tr>
</table>

[24] CASBEE® for Home Technical Manual 2007 Edition

[25]

construction materials used for uncovered structures in traditional houses, are evaluated. Furring strips and wooden laths as well as surface materials such as plywood are included in exterior wall sheathing.

(Reference 1) Examples of Materials Useful for Resource Saving (Recycled Materials)

Name of product	Main applications	Raw materials used
Tiles (recycled materials)	Exterior walls	Ash from incineration of sewage sludge, liquid slag, waste glass, waste ceramics, etc.
Resin construction materials mixed with wood flour (construction materials made from wood flour and thermoplastic resin by mixing and molding)	Battens for holding tiles, eave boards	Waste plastic, wood flour
Recycled plastic	Exterior wall sheathing	Waste plastic
Recycled insulation material (including cellulose fiber)	Insulation material	Waste wood material, PET bottles, used paper
Rock wool	Insulation material	Blast-furnace slag
Glass wool	Insulation material	Recycled glass
Recycled wooden board (particleboard)	Sheathing material	Waste wood material
Recycled wooden board (fiberboard)	Sheathing material	Waste wood material
Ceramic siding material	Surface material for exterior walls	Used paper pulp, blast-furnace slag
Exterior materials other than those listed above made using waste or byproducts from other industries.		

25

Conditions for adding points - When reused materials once used in other building structures are used for part of or more than half of the exterior materials, the level is raised by 1 or 2, respectively. However, if the resultant level exceeds Level 5, it is evaluated as Level 5.

(Reference 2) Definition of Materials Useful for Resource Saving (Renewable Materials) - The term "renewable materials" refers to wood produced from sustainable forests or to plant-derived natural materials that require a short period to become available (e.g., grass or straw for thatched roofs, etc.). Refer to "LRH2.1.1 Building frames" for details.

<table>
<tr>
<td>1.4 Interior materials</td>
<td>
The interior materials evaluated are the finishing and sheathing materials used for floors, interior walls and ceilings. Evaluation is carried out according to the credit ratio, after assessing the introduction of materials that are useful for resource saving (recycled materials, renewable materials) and materials useful for waste prevention (recyclable materials) as interior materials.
With regard to the extent of efforts, the use of such materials for surface materials in a living room is treated as a "Large-scale effort," while the use of such materials for linear elements such as skirtings or baseboards, crown moldings, and scantlings is treated as a "Small-scale effort."
Efforts to be evaluated
<table>
<tr><th colspan="3">Evaluation points</th><th rowspan="2">Effort</th></tr>
<tr><th>Large-scale effort</th><th>Small-scale effort</th><th>No effort</th></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the floor finishing material</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the subfloor material</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the interior wall finish</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the interior wall sheathing material</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the ceiling finish</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Use of material that promotes resource saving or waste reduction for the ceiling sheathing material</td></tr>
<tr><td colspan="3">[I] Total points = ____ point(s)</td><td>[II] Maximum points = ____ point(s)</td><td>[III] Credit ratio ([I] ÷ [II])= ____</td></tr>
</table>
[26]

Conditions for adding points - When reused materials once used in other building structures are used for part of or more than half of the interior work, the level is raised by 1 or 2, respectively.
</td>
<td>
Wood produced from sustainable forests (as previously described) counts as “materials that are useful for resource saving (renewable)”.

Waste wood products such as particleboard are considered as “materials that are useful for resource saving (recycled)”.
</td>
</tr>
</table>

[26] CASBEE® for Home Technical Manual 2007 Edition
[27] CASBEE® for Home Technical Manual 2007 Edition

(Reference 1) Examples of Materials Useful for Resource Saving (Recycled Materials)

Name of product	Main applications	Raw materials used
Tiles (recycled materials)	Interior walls	Ash from incineration of sewage sludge, liquid slag, waste glass, waste ceramics, etc.
Resin construction materials mixed with wood flour (construction materials made from wood flour and thermoplastic resin by mixing and molding)	Interior walls (wainscots)	Waste plastic, wood flour
Recycled wooden board (particleboard)	Sheathing material	Waste wood material
Recycled wooden board (fiberboard)	Sheathing material	Waste wood material
Plasterboard	Sheathing material	Desulfurized plaster
Interior materials other than those listed above made using waste or byproducts from other industries.		

[27]

Definition of Materials Useful for Resource Saving (Renewable Materials)
The term "renewable materials" refers to wood produced from sustainable forests or plant-derived natural materials that require a short period to become available (bamboo flooring, kenaf wallpaper, tatami matting, bamboo laths, etc.). Refer to "LRH2.1.1 Building frames" for details.

1.5 Materials for the external area	Evaluate the introduction of materials for the external area that are useful for resource saving (recycled and renewable materials). Level 3 or 5 = Either none or any of the efforts 1 through 4 have been implemented:	Wood produced from sustainable forests (as previously described) counts as “materials that are useful for resource saving (renewable)”. Waste wood products such as particleboard are considered as “materials that are useful for resource saving (recycled)”.

[28] CASBEE® for Home Technical Manual 2007 Edition

Efforts to be evaluated

No.	Effort	
1	Use of recycled materials	・Application of paving blocks made from waste clay from the ceramic industry or waste glass to corridors or parking lots ・Installation of an outdoor deck made of artificial materials produced from wood powder and thermoplastic resin ・Use of materials for the external area that are made of waste and byproducts from other industries
2	Use of reused materials	・Use of recycled stone for pavement stone ・Use of used bricks for flower beds
3	Use of wood products produced from sustainable forests	・Installation of an outdoor deck made of wood produced from sustainable forests ・Application of wood produced from sustainable forests to the external area
4	Use of natural materials made from plants that quickly become usable as materials and are less likely to be depleted in terms of resources	・Use of bamboo products ・Application of natural materials made from plants that quickly become usable as materials and are less likely to be depleted in terms of resources to the external area

28

2. Reduction of Waste in the Production and Construction Stage		
2.1 Production stage (members for building frames)	Evaluate efforts to reduce waste at the production and processing stages of members for the building frames. The evaluation is targeted at efforts with respect to the corresponding type of construction work, but efforts to reduce waste by the companies concerned are also evaluated. The efforts of pre-cutting factories in the case of wooden construction, steel frame production factories in the case of steel construction, or reinforcing steel processing factories or production factories of prefabricated structure manufacturers in the case of reinforced-concrete construction are assessed, and cases in which ISO 14001 certification has been acquired, or zero emissions have been achieved, are evaluated as Level 5.	Favours framing products from companies with ISO 14001 certification, or other waste reduction schemes.

	<table><tr><td>Level 3</td><td>No instructions have been given on efforts to reduce the generation of byproducts in the structural member production and processing stages or to promote recycling, and no such efforts have been implemented.</td></tr><tr><td>Level 4</td><td>(No corresponding level)</td></tr><tr><td>Level 5</td><td>Instructions have been given by means of design documents, etc. on efforts to reduce the generation of byproducts in the structural member production and processing stages or to promote recycling, or such efforts have actually been implemented.</td></tr></table> [29] Examples of By-product Reduction • Reduction of materials during processing on the basis of each type of construction • Economical cutting from standard-sized materials • Delivery of materials by suppliers using simple packaging and returnable containers Examples of Promotion of By-product Recycling • Thorough separation of by-products • Recycling of wood offcuts into particleboard, material recycling such as manufacturing of artificial wood by wood flour and use of polypropylene (PP) bands • Energy recovery through a cogeneration system using wood offcuts, etc.	
2.2 Production stage (members other	Efforts to reduce waste at the production and processing stages of members other than those for the building frames are evaluated. Materials for which efforts are made to reduce the generation of by-products or promote recycling at the production and processing stages refer to the following two types of materials: • Construction materials obtained from a factory that has acquired ISO 14001 certification. • Construction materials of a manufacturer designated under the "wide-area recycling designation system." In addition, cases such as the factories of prefabricated structure manufacturers that produce members for building frames and other members are evaluated, and cases in which ISO 14001 certification has been acquired, or zero emissions have been achieved, are evaluated as Level 5.	Favours products from companies with ISO 14001 certification, or other waste reduction schemes

[29] CASBEE® for Home Technical Manual 2007 Edition
[30] CASBEE® for Home Technical Manual 2007 Edition

Level 3	Does not satisfy the criterion of Level 4.
Level 4	Instructions have been given by means of design documents, etc. on the use of one or two materials, other than members for the building frames, for which efforts have been made to reduce the generation of byproducts during the production or processing stages or to promote recycling, or such efforts have actually been implemented.
Level 5	Instructions have been given by means of design documents, etc. on the use of three or more materials, other than members for the building frames, for which efforts have been made to reduce the generation of byproducts during the production or processing stages or to promote recycling, or such efforts have actually been implemented.

[30]

LR_H3 Consideration of the Global, Local, and Surrounding Environment		
1. Consideration of Global Warming	Evaluate the level of consideration of global warming in terms of the carbon dioxide emissions produced from all processes of the house from construction to occupancy, renovation, demolition, and disposal (referred to herein as "life cycle CO2").	Does wood impact the amount of CO2 emitted during construction, operation, and demolition and disposal?

Level	Criterion
Level 1 to Level 5	Levels are expressed in life cycle CO_2 emission rates converted to any of the numbers 1 through 5 (down to the first decimal place). Levels 1, 3, and 5 are defined by the following emission rates: Level 1: The life cycle CO_2 emission rate is 125% or higher than that of an ordinary house (reference value). Level 3: The life cycle CO_2 emission rate is equal to that of an ordinary house (reference value). Level 5: The life cycle CO_2 emission rate is 75% or lower than that of an ordinary house (reference value).

[31]

CO2 emitted in the life cycle processes of the house being evaluated, ranging from construction to demolition and disposal, (life cycle CO2) is compared with that of an ordinary house to evaluate the reduction effect of the targeted house. Calculation of life cycle CO2 requires a large amount of time and specialized knowledge, and it is difficult to perform during the execution stage of housing construction. Therefore, the assessment results obtained for other evaluation items (17 items selected from QH2 and LRH1), which have a large impact on life cycle CO2, are used to simplify the calculation process. The specific calculation procedure is shown in detail in Part III.

[31] CASBEE® for Home Technical Manual 2007 Edition
[32] CASBEE® for Home Technical Manual 2007 Edition

Scoring items used in life cycle CO_2 calculation			Utilization in calculation
Q_H2 Ensuring a Long Service Life	1. Basic Life Performance	1.1 Building frames	Used in calculation of CO_2 emissions from "construction" and "renovation, repair, and demolition"
		1.2 Exterior wall materials	
		1.3 Roof materials/flat roof	
	2. Maintenance	2.2.2 Maintenance system	

32

Green Globes™

Name(s): Green Globes™

Location(s): Canada, US

Market Scope: More prevalent in Canada due to adoption by BOMA, but also promoted in the US by the Green Building Initiative – a Portland-based not-for-profit

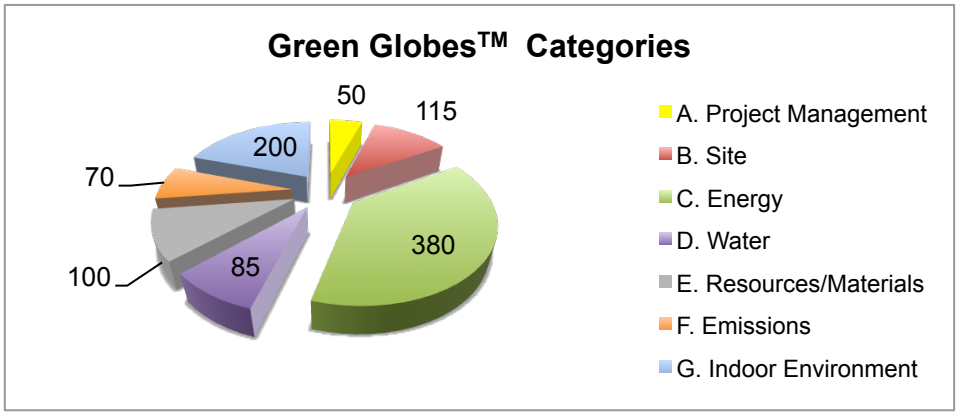
Building Types: Office buildings

Organization: The Green Building Initiative (US)

The Green Globes™ system is used in Canada and the USA. In the USA, Green Globes™ is owned and operated by the Green Building Initiative (GBI). In 2005, GBI became the first green building organization to be accredited as a standards developer by the American National Standards Institute (ANSI), and began the process of establishing Green Globes as an official ANSI standard.

In Canada, the federal government has been using the Green Globes™ suite of tools for several years under the Green Globes™ name and it has been the basis for the Building Owners and Manufacturer's Association of Canada's (BOMA) "Go Green Plus" program.

The Green Globes™ program is a questionnaire-based online tool that consists of approximately150 questions that take between 2 to 3 hours to answer. There are seven categories of differing values as shown in the following figure:



In the Green Globes™ rating system, buildings are given one to five globes, depending on performance levels. A minimum of 35% of the 1000 points need to be reached in order to achieve the lowest certification level.

Prevalence of Wood

The Green Globes™ rating system has 140 points that are related to wood and/or wood products. This accounts for 14% of the total available credits.

Green Globes™	Total Points	Related to Wood	% Related to Wood
A. Project Management	50	10	20.0%
B. Site	115	0	0.0%
C. Energy	380	30	7.9%
D. Water	85	0	0.0%
E. Resources/Materials	100	55	55.0%
F. Emissions	70	0	0.0%
G. Indoor Environment	200	45	22.5%
Total	1000	155	15.5%

Wood vs. Competing Products

Even though there are many categories with wood-related credits, the Resources/Materials category is the only one that might register a difference when comparing two hypothetical buildings with more and less wood.

Green Globes™	**Total Points**	**Total Wood-Related Points**	**More Wood**	**Less Wood**
Project Management	50	10	10	10
Energy	380	30	30	30
Resources/Materials	100	70	0-70	0-70
Indoor Environment	200	45	45	45
Total	1000	155	85-155	85-155

The 70 wood-related points in the Resources/Materials category relate to life cycle environmental burden, embodied energy, recycled content, forest certification and material durability. An analysis of how wood performs in these regards is beyond the scope of this report, however the specific credits are listed in the next section.

Specific Credits - Green Globes™ [33]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
Project Management			
A.2 Environmental Purchasing	10	To select materials, products and equipment that have minimal impact on the environment in terms of resource use, production of waste and energy use. • Apply environmental purchasing criteria or integrate the green aspects of the National Master Specification (NMS). • Specify energy-saving, high-efficiency equipment based on NMS and/or Energuide	• How is wood treated in the "green aspects of the National Master Specification? • Can wood /wood products be shown to have "minimal impact on the environment in terms of resource and energy use and production of waste?
Energy			
C.2 - Reduced Energy Demand – Building Envelope	114 for entire C.2 section, not just envelope	To minimize the energy that is gained or lost through the envelope, prevent condensation and avoid water damage: • Design the building's thermal resistance of the exterior enclosure to meet the Model National Energy Code for Buildings (MNECB) for the walls. • Design the building's thermal resistance of the exterior enclosure to meet the Model National Energy Code for Buildings (MNECB) for the roof. • Design the building to prevent groundwater and/or rain penetration. • Use best air and vapour barrier practices to assure integrity of building envelope with respect to: ▪ Detailing of roof to wall air barrier connections. ▪ Mock-ups and mock-up testing for air and vapour barrier systems. ▪ Field review and testing for air and vapour barrier systems. (Air barrier materials should meet Part 5 of NBC) • Prevent unwanted stack effect by appropriate sealing of the top, bottom and vertical shafts of the building.	• When constructing a continuous air barrier, the trades people require a higher level of skill if using wood framing techniques instead of ICFs or SIPs.
Resources			

[33] Green Globes™ - Design for New Buildings and Retrofits Rating System and Program Summary, 2004

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
E.1 – Low Impact Systems & Materials	40	To select materials with the lowest life cycle environmental burden and embodied energy. Requirements - select materials that reflect the results of a "best run" life cycle assessment for the following: ▪ Foundation and floor assembly and materials ▪ Column and beam or post and beam combinations, and walls ▪ Roof assemblies ▪ Other envelope assembly materials (cladding, windows, etc.)	• Does wood achieve the lowest lifecycle environmental burden and embodied energy?
E.2 – Minimal Consumption of Resources	15	To conserve resources and minimize the energy and environmental impact of extracting and processing non-renewable materials. • Specify used building materials and components. • Specify materials with recycled content. • Specify materials from renewable sources that have been selected based on a life-cycle assessment (LCA) • Specify locally manufactured materials that have been selected based on a LCA. • Use lumber and timber panel products which originate from certified and sustainable sources (certified by the CSA (Canadian Standards Association), the FSC (Forestry Stewardship Council), or the SFI (Sustainable Forestry Initiative)) and avoid use of tropical hardwoods.	• Used materials (salvaged lumber, doors/windows, finishing materials, etc) • Recycled content (OSB, MDF, etc) • Certified wood – CSA, SFI, FSC • Does wood achieve the lowest lifecycle environmental burden and embodied energy?
E.4 – Building Durability, Adaptability and Disassembly	15	To extend the life of a building and its components, and to conserve resources by minimizing the need to replace materials and assemblies. Requirements • Specify durable and low-maintenance building materials and assemblies that can withstand the following: sunlight, temperature and humidity changes; condensation; and wear-and-tear associated with the amount and type of traffic expected. • Implement a building design that promotes building adaptability. • Specify fastening systems that allow for easy disassembly.	• How does wood rate in terms of durability and low-maintenance?
Indoor Environment			

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
G.2 – Control of Indoor Pollutants	45	Objective - To minimize contaminants in the indoor air thereby helping to ensure occupant wellbeing and comfort: • Implement design measures to prevent the growth of fungus, mold, and bacteria on building surfaces and in concealed spaces. • Ensure easy access to the air-handling units for regular inspection and maintenance. • Design a humidification system to avoid the growth of microorganisms. • Implement measures to mitigate pollution at source such as physical isolation of the spaces, separate ventilation, or a combination of isolation and ventilation for areas that generate contaminants. • Design and locate wet cooling towers to avoid the risk of Legionella. • Design a domestic hot water system to minimize the risk of Legionella. • **Use interior materials, including paints, sealants, adhesives, carpets and composite wood products that are low-VOC emitting, non-toxic, and chemically inert (i.e. contain concentrations of VOC as per Environmental Choice Program limits).** • Provide CO monitoring in enclosed parking garages.	• VOCs in wood composite products must follow the Environmental Choice Program

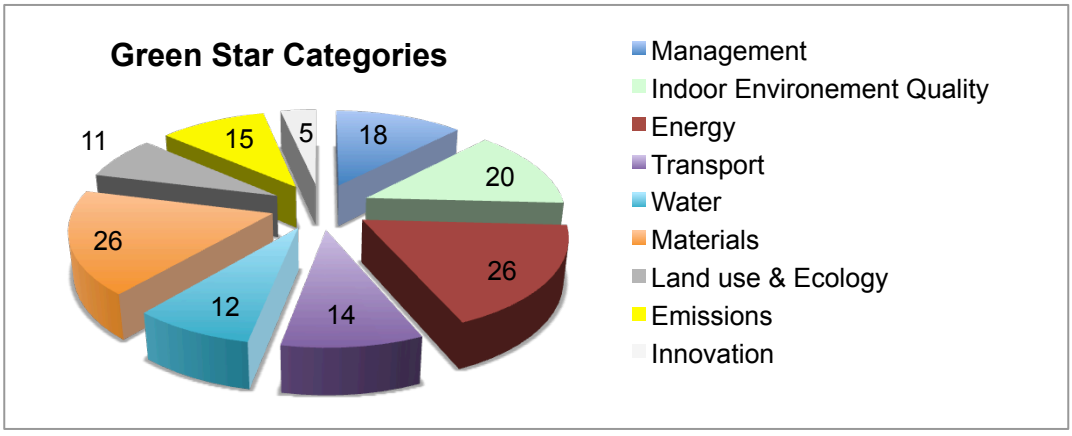
Green Star

Name(s): Green Star Multi-residential
Location(s): Australia (similar versions in New Zealand, South Africa)
Market Scope: All of Australia (New Zealand, South Africa)
Building Types: Multi-residential
Organization: Green Building Council of Australia (New Zealand Green Building Council, Green Building Council of South Africa)

The GBCA launched the Green Star environmental rating system for buildings in 2003. Since then, a variety of Green Star rating tools have been developed:

- Green Star - Multi Unit Residential
- Green Star - Healthcare
- Green Star - Retail Centre
- Green Star - Office Design
- Green Star - Office As Built
- Green Star - Office Interiors

The GBCA released the Green Star - Multi Unit Residential rating tool in July 2009 to promote the design and construction of high-performance green residential developments. While Green Star applies to all areas of Australia, the rated categories are weighted differently across the regions. Regardless of weighting, the credits and categories for Green Star – Multi-residential are divided as follows:



Green Star – Multi-residential ratings are awarded as outlined below:

Certification Rating	Weighted Score	Signifies
4 Star Green Star Certified Rating	45-59	'Best Practice'
5 Star Green Star Certified Rating	60-74	'Australian Excellence'
6 Star Green Star Certified Rating	75-100	'World Leadership'

Prevalence of Wood

There are 15 points out of 147 in the Green Star rating system that relate to wood and/or wood-products.

Green Star	Total Credits	Relate to Wood	% Relate to Wood
Management	18	0	0.0%
Indoor Environment Quality	20	5	25.0%
Energy	26	0	0.0%
Transport	14	0	0.0%
Water	12	0	0.0%
Materials	26	10	38.5%
Land use & Ecology	11	0	0.0%
Emissions	15	0	0.0%
Innovation	5	0	0.0%
Total	147	15	10.2%

This accounts for 10.2% of the total points available.

Wood vs. Competing Products

It is difficult to assess how the two hypothetical buildings of More or Less Wood fair without a more detailed assessment of the rating system and the calculators used within it – which is beyond the scope of the research. This is due to the special materials/products calculators that have been designed specifically for this rating system.

It is interesting to note that specific credits where timber, steel, and concrete compete against each other are not applicable if those materials are not used in the project, thereby levelling the playing field.

Additionally, there are four points that are related to flooring, joinery, and the internal walls, whose credits are awarded based on the environmentally preferred products as calculated by specific Green Star calculators.

Specific Credits - Green Star[34]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
IEQ-8 - Volatile Organic Compounds	4	To encourage and recognize the use of interior finishes and products that minimize the levels of Volatile Organic Compounds present in buildings. "Up to four points are awarded as follows: Paints - One point where at least 95% of all internal painted surfaces meet the Total Volatile Organic Compound (TVOC) Content Limits outlined in Table IEQ-8.1 (in the Technical Manual) or where no paint is used in the project." "Adhesives and Sealants - One point where 95% of all adhesives and sealants meet the TVOC Content Limits outlined in Table IEQ-8.2 (in the Technical Manual) or where no adhesives or sealants are used." "Wall and ceiling coverings - One point where at least 95% of all internal wall and ceiling coverings meet the TVOC Content Limits outlined in Table IEQ-8.4 (in the Technical Manual) or where no wall and ceiling coverings are used." "Flooring - One point where 95% of all coverings meet the TVOC emissions outlined in Table IEQ-8.3 (in the Technical Manual). Where no floor coverings have been installed in the project, the flooring point is 'Not Applicable' and is excluded from the total points available.	• VOC limits – wood finishes and wood-based products
IEQ-9 - Formaldehyde Minimisation	1	To encourage and recognise the use of products with low formaldehyde emission levels. One point is awarded where all engineered wood products (including exposed and concealed applications) have low formaldehyde emissions, see table IEQ-9.1 (in the Technical Manual), or have no formaldehyde. If no engineered wood products are used within the project, this credit is 'Not Applicable' and excluded from the total number of points available.	• Wood products - engineered wood products - Low or no formaldehyde

[34] Green Star - Multi Unit Residential v1

Mat-3 Recycled-Content & Re-used Products and Materials	1	To encourage and recognize designs that prolong the useful life of existing products and materials and encourage uptake of products with recycled content. One point is awarded where at least 1% of the project's total contract value is represented by: • Re-used products/materials (from the existing building or any other building); OR • Products/materials with a post-consumer recycled content of at least 20%. This credit excludes materials specifically addressed by other credits (i.e. steel, concrete, PVC and timber); neither does it address the re-use of the original building(s) on the site (addressed in Mat-2 'Building Re-use').	• Wood products - recycled content & reused materials (steel concrete, & timber are excluded)
Mat-4 - Concrete	3	To encourage and recognize the reduction of embodied energy and resource depletion occurring through use of concrete: • Up to two points are available where the project has reduced the absolute quantity of Portland cement, as an average across all concrete mixes, by substituting it with industrial waste product(s) or oversized aggregate as follows: o For one point, 30% for in situ concrete, 20% for pre-cast concrete and 15% for stressed concrete; o For two points, 60% for in situ concrete, 40% for pre-cast concrete and 30% for stressed concrete. • An additional point is awarded where, (1) at least one of the above points is achieved and; o (2) 20% of all aggregate used for structural purposes is recycled (Class 1 RCA in accordance with HB155-2002) or slag aggregate; and o (3) No natural aggregates are used in non-structural uses (e.g. building base course, sub-grade to any car parks and footpaths, backfilling to service trenches, kerb and gutter). If the material cost of new concrete represents less than 1% of the project's contract value, this credit is 'Not Applicable' and is excluded from the points available used to calculate the Materials Category Score.	• Competes with wood

Mat - 5 - Steel	2	To encourage and recognize the reduction in embodied energy and resource depletion associated with reduced use of virgin steel. Up to two points are awarded as follows: • One point is awarded where: - 60% of all steel, by mass, in the project either has a post-consumer recycled content greater than 50%, or is re-used. • Two points are awarded where: - 90% of all steel, by mass, in the project either has a post-consumer recycled content greater than 50%, or is reused. If the material cost of steel represents less than 1% of the project's total contract value, this credit is 'Not Applicable' and is excluded from the points available used to calculate the Materials Category Score.	• Competes with wood
Mat-7 - Sustainable Timber	2	To encourage and recognise the specification of re-used timber that has certified environmentally responsible forest management practices. Two points are awarded where: • 95% (by cost) of all timber products used in the building and construction works have been sourced from any combination of the following: - Re-used timber; - Post-consumer recycled timber; or - Forest Stewardship Council (FSC) certified timber. If the material cost of timber represents less than 0.1% of the project's total contract value then this credit is 'Not Applicable' and is excluded from the points used to calculate the Materials Category.	• Forest certification – timber – FSC OR • Reused
Mat-8 - Design for Disassembly	1	One point is awarded where: • 50% (by area) of the structural framing, roofing, and façade cladding systems are designed for disassembly; OR • 95% of the total façade is designed for disassembly. • If the material cost of the structural framing, roofing, and facade cladding systems represent less than 1% of the project's total contract value, this credit is 'Not Applicable' and is excluded from the points available used to calculate the Materials Category Score.	• Is wood framing easier for disassembly?

Mat-9 –De-materialisation	2	To encourage and recognise designs that require less material than conventional designs. One point is awarded where any two of the initiatives below are achieved; and two points are awarded where at least four of the initiatives below are achieved. • **Structure** - Within projects where at least 50% of the nominated area is framed in structural steel, and where it is demonstrated that the building's structural requirements and integrity have been achieved using 10% less steel (by mass) than in a structure with conventional steel framing, without changing the load path to other structural components; • **Ductwork** – (1) The building is fully naturally ventilated; OR (2) the requirement for ductwork has been reduced by 95%. • **Finishes** - As-installed final design must require no finish: (1) 90% of all base building floor material is exposed structure with no covering (e.g. exposed sealed concrete floor); OR (2) 90% of all base building ceiling is exposed structure (and services, where relevant) with no cladding (e.g. exposed concrete ceiling). • **Piping** – (1) No water supply piping is used for flushing of toilets (i.e. all toilets are water free); OR (2) Mass of underground piping is reduced by 25% for the same functional requirement and material. • **Cladding** – (1) 25% of the roof cladding area has a dual function (e.g. roof garden substrate or photovoltaic shingles serve as cladding); OR (2) 25% of the façade cladding area has a dual function (e.g. photovoltaic panels serve as cladding). • **Unit sizes** - 50% of dwellings meet the maximum size criteria as follows: > For studio apartments: 40m² > For one bedroom apartments: 50m² > For two bedroom apartments: 70m² > For three bedroom apartments: 95m² • Prefabricated Kitchens - 50% of kitchens are prefabricated modules • Prefabricated Bathrooms - 50% of bathrooms are prefabricated modules • Bathroom to Bedroom ratio - All dwellings have no more than one bathroom and toilet for every two bedrooms.	• Competes with wood – favours designs that are concrete & steel
Mat-11 - Flooring	1	To encourage and recognise the selection of flooring that has a reduced environmental impact relative to available alternatives. One point is awarded where it is demonstrated that • The flooring used in the project has a reduced environmental impact as determined by the assessment categories in the Green Star Flooring Calculator.	• Forest certification – See note below for descriptions of the calculators and their implications for wood

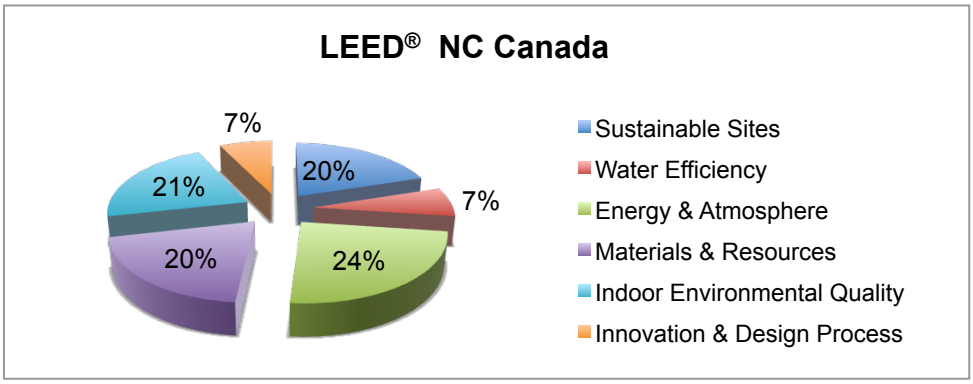
Mat-12 - Joinery	1	To encourage and recognise the selection of joinery that has a reduced impact on the environment relative to available alternatives. One point is awarded where it is demonstrated that: • The joinery used in the project has a reduced environmental impact as determined by the assessment categories in the Green Star Joinery Calculator.	and wood-products
Mat-14 - Internal Walls	2	To encourage and recognise the selection of internal walls that have a reduced environmental impact. Up to two points are awarded where it is demonstrated that: • The internal walls used in the project has a reduced environmental impact as determined by the assessment categories in the Green Star Internal Walls Calculator."	

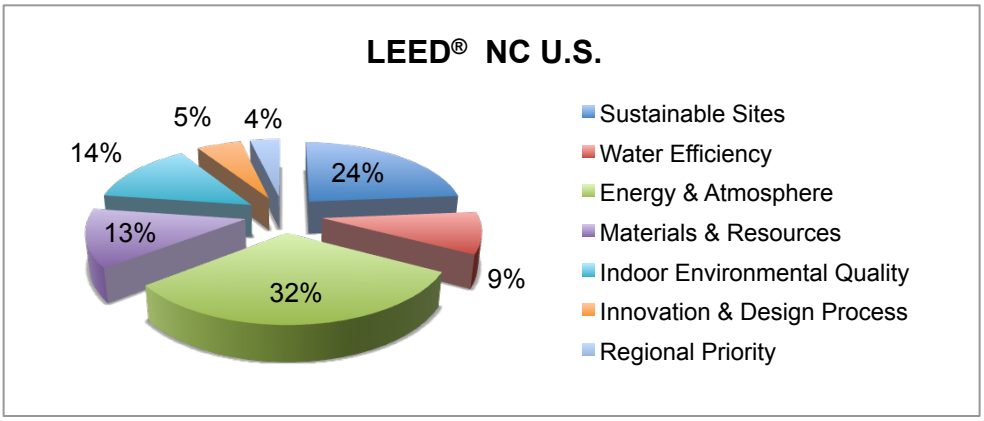
LEED®

Name(s):	LEED® NC (Canada & US), LEED® CI, LEED® for Homes
Location(s):	41 countries including US, Canada, Mexico, Brazil and India
Market Scope:	Lead rating and certification system in US & Canada
Building Types:	New (office) Construction (NC), Commercial interiors (CI), Single-detached homes (LEED® for Homes)
Organization:	United States Green Building Council (USGBC), Canadian Green Building Council (CaGBC)

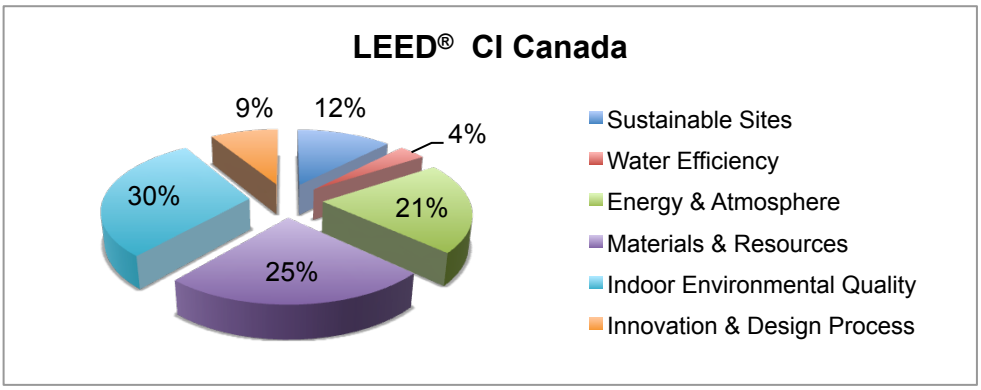
The Leadership in Energy and Environmental Design (LEED®) Green Building Rating System is a third-party certification program for the design, construction and operation of high performance green buildings. The Canadian rating systems are an adaptation of (and licensed by) the US Green Building Council (USGBC) and its LEED® Green Building Rating System, tailored specifically for Canadian climates, construction practices and regulations.

For LEED® NC and CI, credits and prerequisites are organized into these five categories. An additional category, Innovation & Design Process, addresses sustainable building expertise as well as design measures not covered under these five environmental categories:





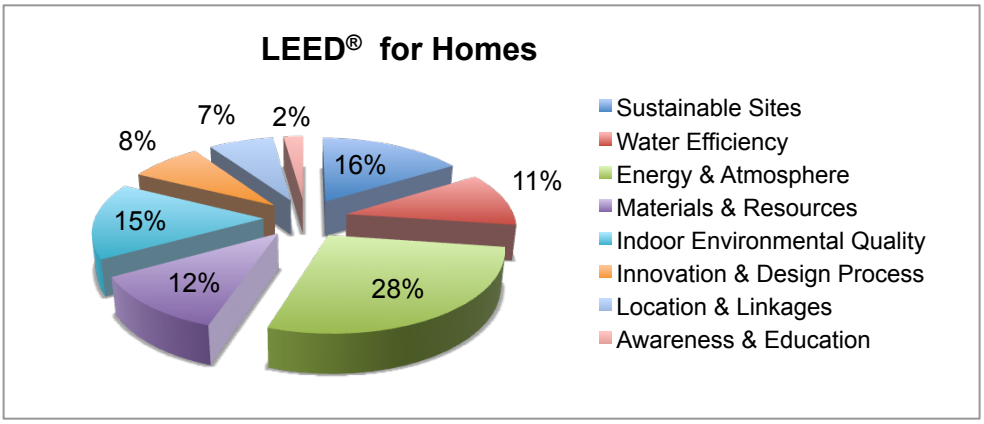
LEED® for Commercial Interiors also has a different weighting of categories, with the Materials category at 27%, instead of the 20% and 13% found in the LEED® NC systems.



Certification is based on the total point score achieved, according to the following table:

Certification Level	LEED® NC Canada	LEED® NC US	LEED® CI
Total Possible	70	110	57
Platinum	52	>80	42-57
Gold	39	60-79	32-41
Silver	33	50-59	27-31
Certified	26	40-49	21-26

LEED® for Homes is similar to the others, but is focused on single-detached homes. It has slightly different categories and credits:



LEED® for Homes certification ratings are based on achieving a certain amount of credits:

Certification Level	Points
Platinum	90-136
Gold	75-89
Silver	60-74
Certified	45-69

Prevalence of Wood

The LEED® NC systems each have 9 points that are related to wood, which represents 14% of total points in the Canadian system and 8% in the US system.

LEED® NC Canada

	Total	Relate to Wood	% Relate to Wood
Sustainable Sites	14	0	0.0%
Water Efficiency	5	0	0.0%
Energy & Atmosphere	17	0	0.0%
Materials & Resources	14	8	57.1%
Indoor Environmental Quality	15	2	13.3%
Innovation & Design Process	5	0	0.0%
Total	70	10	14.3%

LEED® NC US

	Total	Relate to Wood	% Relate to Wood
Sustainable Sites	26	0	0.0%
Water Efficiency	10	0	0.0%
Energy & Atmosphere	35	0	0.0%
Materials & Resources	14	7	50.0%
Indoor Environmental Quality	15	2	13.3%
Innovation & Design Process	6	0	0.0%
Regional Priority	4	0	0.0%
Total	110	9	8.2%

LEED® CI has ten points that are related to wood, which is 19% of the total.

LEED® CI Canada

	Total	Relate to Wood	% Relate to Wood
Sustainable Sites	7	0	0.0%
Water Efficiency	2	0	0.0%
Energy & Atmosphere	12	0	0.0%
Materials & Resources	14	9	64.3%
Indoor Environmental Quality	17	2	11.8%
Innovation & Design Process	5	0	0.0%
Total	57	11	19.3%

Finally, LEED® of Homes has a large majority of the Materials and Resources points that relate to wood and/or wood products (81%), however, the since the category is relatively small compared to the overall points, then these wood-related credits only account for 10% of the total points available.

LEED® for Homes

	Total	Relate to Wood	% Relate to Wood
Sustainable Sites	22	0	0.0%
Water Efficiency	15	0	0.0%
Energy & Atmosphere	38	0	0.0%
Materials & Resources	16	13	81.3%
Indoor Environmental Quality	21	0	0.0%
Innovation & Design Process	11	0	0.0%
Location & Linkages	10	0	0.0%
Awareness & Education	3	0	0.0%
	136	13	9.6%

Wood vs. Competing Products

In the two LEED® NC rating systems, using more or less wood only results in a difference of one point.

LEED® NC Canada

	Total	Total Related to Wood	More Wood	Less Wood
Materials & Resources	14	8	5	7
Indoor Environmental Quality	15	2	2	1
Total	29	10	7	8

LEED® NC US

	Total	Total Related to Wood	More Wood	Less Wood
Materials & Resources	14	8	5	7
Indoor Environmental Quality	15	2	2	1
Total	29	10	7	8

This difference accounts for 1.4% (Canada) and 0.9% (US) of the total points available.

Similarly, more and less wood in the LEED® CI systems results in a one-point difference, which accounts for 1.8% of the total points available.

LEED CI Canada

	Total	Total Related to Wood	More Wood	Less Wood
Materials & Resources	14	9	6	8
Indoor Environmental Quality	17	2	2	1
Total	31	11	8	9

In the above three LEED® systems (NC Canada, NC US, and CI), “Less Wood” was able to score more points in the Materials & Resources section because it was assumed that using “More Wood” made it unlikely for achieving the 10% and 20% recycled content credits. This is due to the fact that these percentages are based on the total dollar value of all the building materials and it is difficult to achieve this target in commercial buildings where the majority of the value is in concrete and steel.

In the LEED® for Homes rating system, points are set up so that both More Wood and Less Wood can earn equal points, depending on specific material choices. However it is likely that it is easier to earn these credits using wood materials, as they are more common in low-rise residential building practices.

LEED® for Homes

	Total	Total Related to Wood	More Wood	Less Wood
Materials & Resources	16	13	13	13
Total	16	13	13	13

Specific Credits - LEED® NC (Canada)[35]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
Materials and Resources[36]			•
MR 3.1 – Resource Reuse 5%	1	Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources. Use salvaged, refurbished or reused materials, products and furnishings for at least 5% of the total cost of building materials.	• Wood & wood products – reused and/or salvaged
MR 3.2 - Resource Reuse 10%	1	Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources. Use salvaged, refurbished or reused materials, products and furnishings for at least 10% of the total cost of building materials	• Wood & wood products – reused and/or salvaged
MR 4.1 – Recycled Content 7.5%	1	Increase demand for building products that incorporate recycled content materials therefore reducing the impacts resulting from the extraction and processing of new virgin materials and by-passing energy and greenhouse gas-intensive industrial and manufacturing processes. Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial content constitutes at least 15% of the total value of the materials in the project. The value of the recycled content portion of a material or furnishing shall be determined by dividing the weight of recycled content in the item by the total weight of all material in the item, then multiplying the resulting percentage by the total cost of the item. Mechanical and electrical components shall not be included in this calculation. Recycled content materials shall not be included in this calculation.	• Wood & wood products – recycled content

[35] LEED® Canada-NC Version 1.0, March2007

[36] While it is possible that wood may play a small role in the achievement of MR 2 Construction Waste, this credit has been left out for two reasons: (1) little wood is used in LEED NC types of buildings (relatively),and so using wood makes little impact the waste diversion rates by weight or volume, and since the main material choice is driven by structural considerations (where wood usually not an option) and (2) it is currently not the choice of materials that impacts the diversion rates, it is rahter the creation and execution of a waste diversion plan that drives diversion rates – as stated in the credit. At this stage of rating system uptake and industry sophistication, the relationship is too weak to consider this a wood-related credit.

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
MR 4.2 – Recycled Content 15%	1	Increase demand for building products that incorporate recycled content materials therefore reducing the impacts resulting from the extraction and processing of new virgin materials and by-passing energy and greenhouse gas-intensive industrial and manufacturing processes. Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial content constitutes at least 15% of the total value of the materials in the project. The value of the recycled content portion of a material or furnishing shall be determined by dividing the weight of recycled content in the item by the total weight of all material in the item, then multiplying the resulting percentage by the total cost of the item. Mechanical and electrical components shall not be included in this calculation. Recycled content materials shall not be included in this calculation.	• Wood & wood products – recycled content
MR 5.1 – Regional Materials – 10% Extracted & Manufactured Regionally	1	Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting form transportation. Use a minimum of 10% of building materials or products for which at least 80% of the mass is extracted, processed and manufactured within 800 km (500 miles) of the project site. OR Use a minimum of 10% of building materials or products for which at least 80% of the mass is extracted, processed and manufactured within 2,400 km (1,500 miles) of the project site, and shipped by rail or water. OR Use a minimum of 10% of building materials or products that reflect a combination of the above extraction, processing, manufacturing and shipping criteria (e.g. 5% within 800km (500 miles), and 5% shipped by rail within 2,400km (1,500 miles).	• Wood & wood products – local content
MR 5.2 – Regional Materials – 20% Extracted & Manufactured Regionally	1	Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting form transportation. Use a minimum of 20% of building materials or products for which at least 80% of the mass is extracted, processed and manufactured within 800 km (500 miles) of the project site. OR Use a minimum of 20% of building materials or products for which at least 80% of the mass is extracted, processed and manufactured within 2,400 km (1,500 miles) of the project site, and shipped by rail or water. OR Use a minimum of 20% of building materials or products that reflect a combination of the above extraction, processing, manufacturing and shipping criteria (e.g. 10% within 800km (500 miles), and 10% shipped by rail within 2,400km (1,500 miles).	• Wood & wood products – local content

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
MR 6 – Rapidly Renewable Materials	1	Reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials. Use rapidly renewable building materials and products (made form plants that are typically harvested within a ten-year cycle or shorter) for 5% of the total value of all building materials and products used in the projects.	• Competes with wood
MR 7 - Certified Wood	1	Encourage environmentally responsible forest management. Use a minimum of 50% of wood-based materials and products, certified in accordance with the Forest Stewardship Council's Principals and Criteria, for wood building components including, but not limited to, structural framing and general dimensional framing, flooring, finishes, and furnishings.	• Forest certification - FSC
EQ 4.1 – Low-Emitting Materials – Adhesives & Sealants	1	The VOC content of adhesives, sealants and sealant primers used must be less than the VOC content limits of the State of California's South Coast Air Quality Management District (SCAQMD) Rule #1168, June 2006.	• Wood products – finishes – low VOC
EQ 4.2 – Low-Emitting Materials – Paints & Coatings	1	Reduce the quantity of indoor air contaminants that are odorous, potentially irritating and/or harmful to the comfort and well-being of installers and occupants. Relevant for coatings applied on site and in interior spaces (not applied in factory). VOC emissions from paints must not exceed the VOC and chemical component limits of Green Seal's Standard GS-11 January 1997 requirements. AND The VOC content of anti-corrosive coatings must be less than the current VOC content limits of Green Seal Standard GS-03 May 1993 requirements AND For interior paints and coatings not already covered by GS-11 and GS-03, the VOC content of all primers, under coatings, sealers and clear wood finishes used must be less than the current VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule # 1113 November 1996 requirements.	• Wood products – finishes – low VOC
EQ 4.4 – Low-Emitting Materials – Composite Wood & Laminate Adhesives	1	Reduce the quantity of indoor air contaminants that are odorous, potentially irritating and/or harmful to the comfort and well-being of installers and occupants. Composite wood and agrifiber products, including core materials, must contain no added urea-formaldehyde resins. Adhesives used to fabricate laminated assemblies containing these products must contain no urea-formaldehyde.	• Wood products – composites & laminates – no formaldehyde

Specific Credits - LEED® NC (US)[37]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
MR 3 - Materials Reuse	1 - 2	To reuse building materials and products to reduce demand for virgin materials and reduce waste, thereby lessening impacts associated with the extraction and processing of virgin resources. 1 point for 5%, 2 points for 10% reused materials Requirements Use salvaged, refurbished or reused materials, the sum of which constitutes at least 5% or 10%, based on cost, of the total value of materials on the project. The minimum percentage materials reused for each point threshold is as follows: Mechanical, electrical and plumbing components and specialty items such as elevators and equipment cannot be included in this calculation. Include only materials permanently installed in the project. Furniture may be included if it is included consistently in MR Credit 3: Materials Reuse through MR Credit 7: Certified Wood. Potential Technologies & Strategies Identify opportunities to incorporate salvaged materials into the building design, and research potential material suppliers. Consider salvaged materials such as beams and posts, flooring, paneling, doors and frames, cabinetry and furniture, brick, and decorative items.	• Wood & wood products – reused and/or salvaged

[37] LEED 2009 for New Construction and Major Renovations Rating System, November 2008

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
MR 4 – Recycled Content	1 - 2	To increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials. 1 point for 10%, 2 points for 20% recycled content Requirements Use materials with recycled content such that the sum of postconsumer recycled content plus 1/2 of the pre-consumer content constitutes at least 10% or 20%, based on cost, of the total value of the materials in the project. The recycled content value of a material assembly is determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value. Mechanical, electrical and plumbing components and specialty items such as elevators cannot be included in this calculation. Include only materials permanently installed in the project. Furniture may be included if it is included consistently in MR Credit 3: Materials Reuse through MR Credit 7: Certified Wood.	• Wood & wood products – recycled content
MR 5 – Regional Materials	1 – 2	To increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation. Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% or 20%, based on cost, of the total materials value. If only a fraction of a product or material is extracted, harvested, or recovered and manufactured locally, then only that percentage (by weight) can contribute to the regional value. 1 point for 10%, and 2 points for 20% regional materials. Mechanical, electrical and plumbing components and specialty items such as elevators and equipment must not be included in this calculation. Include only materials permanently installed in the project. Furniture may be included if it is included consistently in MR Credit 3: Materials Reuse through MR Credit 7: Certified Wood. Potential Technologies & Strategies Establish a project goal for locally sourced materials, and identify materials and material suppliers that can achieve this goal. During construction, ensure that the specified local materials are installed, and quantify the total percentage of local materials installed. Consider a range of environmental, economic and performance attributes when selecting products and materials.	• Wood & wood products – local content

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
MR 7 – Certified Wood	1	To encourage environmentally responsible forest management. Requirements Use a minimum of 50% (based on cost) of wood-based materials and products that are certified in accordance with the Forest Stewardship Council's principles and criteria, for wood building components. These components include at a minimum, structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes. Include only materials permanently installed in the project. Wood products purchased for temporary use on the project (e.g., formwork, bracing, scaffolding, sidewalk protection, and guard rails) may be included in the calculation at the project team's discretion. If any such materials are included, all such materials must be included in the calculation. If such materials are purchased for use on multiple projects, the applicant may include these materials for only one project, at its discretion. Furniture may be included if it is included consistently in MR Credits 3, Materials Reuse, through MR Credit 7, Certified Wood. Potential Technologies & Strategies Establish a project goal for FSC-certified wood products and identify suppliers that can achieve this goal. During construction, ensure that the FSC-certified wood products are installed and quantify the total percentage of FSC certified wood products installed.	• Forest certification - FSC

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
IEQ – Low-Emitting Materials – Flooring Systems	1	To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants. Requirements: OPTION 1 All flooring must comply with the following as applicable to the project scope: • All carpet installed in the building interior must meet the testing and product requirements of the Carpet and Rug Institute Green Label Plus1 program. • All carpet cushion installed in the building interior must meet the requirements of the Carpet and Rug Institute Green Label program. • All carpet adhesive must meet the requirements of IEQ Credit 4.1: Adhesives and Sealants, which includes a volatile organic compound (VOC) limit of 50 g/L. • All hard surface flooring must be certified as compliant with the FloorScore2 standard (current as of the date of this rating system, or more stringent version) by an independent third-party. Flooring products covered by FloorScore include vinyl, linoleum, laminate flooring, wood flooring, ceramic flooring, rubber flooring and wall base. • An alternative compliance path using FloorScore is acceptable for credit achievement: 100% of the non-carpet finished flooring must be FloorScore-certified and must constitute at least 25% of the finished floor area. Examples of unfinished flooring include floors in mechanical rooms, electrical rooms and elevator service rooms. • Concrete, wood, bamboo and cork floor finishes such as sealer, stain and finish must meet the requirements of South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004. • Tile setting adhesives and grout must meet South Coast Air Quality Management District (SCAQMD) Rule 1168. VOC limits correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005. OR OPTION 2 All flooring elements installed in the building interior must meet the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda. Potential Technologies & Strategies Clearly specify requirements for product testing and/or certification in the construction documents. Select products that are either certified under the Green Label Plus program or for which testing has been done by qualified independent laboratories in accordance with the appropriate requirements.	• Wood products – flooring systems – low VOC

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
IEQ 4.4 - Low-Emitting Materials - Composite Wood and Agrifiber Products	1	To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants. Requirements Composite wood and agrifiber products used on the interior of the building (i.e., inside the weatherproofing system) must contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies must not contain added urea-formaldehyde resins. Composite wood and agrifiber products are defined as particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates and door cores. Materials considered fixtures, furniture and equipment (FF&E) are not considered base building elements and are not included. Potential Technologies & Strategies Specify wood and agrifiber products that contain no added urea-formaldehyde resins. Specify laminating adhesives for field and shop-applied assemblies that contain no added urea-formaldehyde resins. Review product cut sheets, material safety data (MSD) sheets, signed attestations or other official literature from the manufacturer.	• Wood products – composites & laminates – no formaldehyde
RP Credit 1: Regional Priority	1-4	To provide an incentive for the achievement of credits that address geographically-specific environmental priorities. Requirements Earn 1-4 of the 6 Regional Priority credits identified by the USGBC regional councils and chapters as having environmental importance for a project's region. A database of Regional Priority credits and their geographic applicability is available on the USGBC website, http://www.usgbc.org. One point is awarded for each Regional Priority credit achieved; no more than 4 credits identified as Regional Priority credits may be earned. Projects outside of the U.S. are not eligible for Regional Priority credits.	• Does wood factor into any of the USGBC's regional priorities?

Specific Credits - LEED® for Commercial Interiors (CI)[38]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
MR 3.1 – Resource Reuse – 5%	1	Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources. Use salvaged, refurbished or reused materials, products and furnishings for at least 5% of building (construction) materials, excluding furniture and furnishings.	• Wood & wood products – reused and/or salvaged
MR 3.2 - Resource Reuse 10%	1	Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources. Use salvaged, refurbished or reused materials, products and furnishings for at least 10% of building (construction) materials, excluding furniture and furnishings.	• Wood & wood products – reused and/or salvaged
MR 3.3 – Resource Reuse – 30% Furniture & Furnishings	1	Use salvage, refurbished or used furniture and furnishings for 30% of the total furniture and furnishings budget.	• Wood products – furniture & furnishings - reused and/or salvaged
MR 4.1 – Recycled Content 10%	1	Increase demand for building products that incorporate recycled content materials therefore reducing the impacts resulting from the extraction and processing of virgin materials. Use materials, including furniture and furnishings, with recycled content such that the sum of post-consumer recycled content plus ½ of the pre-consumer content constitutes at least 10% of the total value of the materials in the project. The value of the recycled portion of a material or furnishing shall be determined by dividing the weight of recycled content in the item by the total weight of all material in the item, then multiplying the resulting percentage by the total cost ($) of the item. Mechanical and electrical components shall not be included in this calculation. Plumbing products however may be included. Recycled content materials shall be defined in accordance with the Federal Trade Commission document, Guides for the Use of Environmental Marketing Claims, 16, CFR 260.7 (e) available at: www.ftc.gov/bcp/grnrule/guides980427.htm	• Wood & wood products – recycled content

[38] LEED® Canada for Commercial Interiors, Version 1.0, September 2006

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
MR 4.2 – Recycled Content 20%	1	Increase demand for building products that incorporate recycled content materials therefore reducing the impacts resulting from the extraction and processing of virgin materials. Use materials, including furniture and furnishings, with recycled content such that the sum of post-consumer recycled content plus ½ of the pre-consumer content constitutes at least 20% of the total value of the materials in the project. The value of the recycled portion of a material or furnishing shall be detrmined by dividing the weight of recycled content in the item by the total weight of all material in the item, then multiplying the resulting percentage by the total cost ($) of the item. Mechanical and electrical components shall not be included in this calculation. Plumbing products however may be included. Recycled content materials shall be defined in accordance with the Federal Trade Commission document, Guides for the Use of Environmental Marketing Claims, 16, CFR 260.7 (e) available at: www.ftc.gov/bcp/grnrule/guides980427.htm	• Wood & wood products – recycled content
MR 5.1 – Regional Materials – 20% Manufactured Regionally	1	Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the regional economy and reducing the environmental impacts resulting form transportation. Use a minimum of 20% of the combined value of construction and Division 12 (furniture) materials and products that are manufactured regionally within a radius of 800 km (500 miles). Manufacturing refers to the final assembly of components into the building product that is furnished and installed by the tradespeople. For example, if the hardware comes from Dallas, Texas, the lumber from Vancouver, BC and the joist is assembled in Kent, Washington, then the location of the final assembly is Kent, Washington.	• Wood & wood products – local content
MR 5.2 – Regional Materials – 10% Extracted & Manufactured Regionally	1	Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the regional economy and reducing the environmental impacts resulting form transportation. In addition to the requirements of MR 5.1, use a minimum of 10% of the combined value of construction and Division 12 (furniture) materials and products extracted, harvested or recovered, as well as manufactured, within 800 km (500 miles) of the project.	• Wood & wood products – local content
MR 6 – Rapidly Renewable Materials	1	Reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials. Use rapidly renewable construction and Division 12 (Furniture and Furnishings) materials and products made form plants that are typically harvested within a ten-year cycle or shorter for 5% of the total value of all building materials and products used in the project.	• Competes with wood
MR 7 - Certified Wood	1	Encourage environmentally responsible forest management. When using new wood-based products and materials, use a minimum of 50% that are certified in accordance with the Forest Stewardship Council's Principals and Criteria. Division 12 (Furniture) material value is included in the determination of the certified wood content.	• Forest certification - FSC

<table>
<tr><th>Credit ID & Title</th><th># Credits</th><th>Description(s) relating to wood, steel, or concrete</th><th>Implications for Wood</th></tr>
<tr><td>EQ 4.4 – Low-Emitting Materials – Composite Wood & Laminate Adhesives</td><td>1</td><td>Reduce the quantity of indoor air contaminants that are odorous, potentially irritating and/or harmful to the comfort and well-being of installers and occupants.
Composite wood and agrifiber products, including core materials, must contain no added urea-formaldehyde resins. Laminate adhesives used to fabricate on-site and shop applied assemblies containing laminate adhesives must contain no urea-formaldehyde. Products covered by EQ 4.5, Low-Emitting Materials, System Furniture and seating shall be excluded from these requirements.</td><td>• Wood products – composites & laminates – low VOC</td></tr>
<tr><td>EQ 4.4 – Low-Emitting Materials – Systems Furniture & Seating</td><td>1</td><td>Reduce the quantity of indoor air contaminants that are odorous, potentially irritating and/or harmful to the comfort and well-being of installers and occupants.
All systems furniture and seating introduced into the project space that has been manufactured, refurbished or refinished within on year prior to occupancy must meet one of the requirements below:
Option A – Greenguard Indoor Air Quality Certified
Option B – Calculated indoor air concentrations that are less than or equal to those established in below for furniture systems and seating determined by a procedure based on the US Environmental Protection Agency’s Environmental Technology Verification ETV) Large Chamber Test Protocol for Measuring Emission of VOCs and Aldehydes (Sept 1999) testing protocol conducted in an independent air quality testing laboratory.
<table>
<tr><th>Chemical Content</th><th>Emission Limits Systems Furniture</th><th>Emission Limits Seating</th></tr>
<tr><td>TVOC</td><td>0.5 mg/m^3</td><td>0.25 mg/m^3</td></tr>
<tr><td>Formaldehyde</td><td>50 parts per billion</td><td>25 parts per billion</td></tr>
<tr><td>Total Aldehydes</td><td>100 parts per billion</td><td>50 parts per billion</td></tr>
<tr><td>4 – Phenylcyclohexene (4-PCH)</td><td>0.0065 mg/m^3</td><td>0.00325 mg/m^3</td></tr>
</table>
• Systems furniture is defined as either a panel-based workstation comprised of modular interconnecting panels, hang-on components and drawer/filing components or a freestanding grouping of furniture items and their components that have been designed to work in concert.
• Seating is defined as task and guest chairs used with systems furniture
• Furniture other than systems furniture and task and guest chairs is defined as occasional furniture and is excluded from the credit requirements.
• Salvaged and used furniture that is more than 1 year old at time of occupancy is also excluded from the credit requirements.</td><td>• Wood products – furniture & seating – no formaldehyde</td></tr>
</table>

Specific Credits - LEED® for Homes Canada[39]

<table>
<tr><th>Credit ID & Title</th><th># Credits</th><th>Description(s) relating to wood, steel, or concrete</th><th>Implication for Wood</th></tr>
<tr><td>MR 1 - Material-Efficient Framing</td><td>5</td><td>
Prerequisites - 1.1 Framing Order Waste Factor Limit. Limit the overall estimated waste factor to 10% or less. If the waste factor on any portion of the framing order exceeds 10%, calculate the overall waste factor. Waste factor is defined as the percentage of framing material ordered in excess of the estimated material needed for construction.

Credits 1.2 - Detailed Framing Documents (1 point). Prior to construction, create detailed framing plans or scopes of work and accompanying architectural details for use on the job site. Indicate the specific locations, spacing, and sizes of all framing members in the floors, walls, roof, and ceiling (if different from the roof).

Table 23. Efficient Framing Measures
<table>
<tr><th>Measure</th><th>Points</th></tr>
<tr><td>Precut framing packages</td><td>1.0</td></tr>
<tr><td>Open-web floor trusses</td><td>1.0</td></tr>
<tr><td>Structural insulated panel (SIP) walls</td><td>1.0</td></tr>
<tr><td>SIP roof</td><td>1.0</td></tr>
<tr><td>SIP floors</td><td>1.0</td></tr>
<tr><td>Stud spacing greater than 400 mm (16 inches) o.c</td><td>1.0</td></tr>
<tr><td>Ceiling joist spacing greater than 400 mm (16 inches) o.c.
Finger-jointed framing materials</td><td>0.5
0.5</td></tr>
<tr><td>Floor joist spacing greater than 400 mm (16 inches) o.c.</td><td>0.5</td></tr>
<tr><td>Roof rafter spacing greater than 400 mm (16 inches) o.c.</td><td>0.5</td></tr>
<tr><td>Implement any 2 of the following:
Size headers for actual loads
Use ladder blocking or drywall clips
Use 2-stud corners</td><td>0.5</td></tr>
</table>
[40]Detailed Cut List and Lumber Order (1 point). The requirements in MR 1.2 must be met to earn this credit. Prior to construction, create a detailed cut list and lumber order that corresponds directly to the framing plans and/or scopes of work.
AND/OR
</td><td>

Building technique & skills
Wood products - SIPs

</td></tr>
</table>

[39] LEED® Canada For Homes, March 2009
[40] LEED® Canada For Homes, March 2009, p 101.

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implication for Wood
		1.4 Framing Efficiencies (maximum 3 points). Implement measures from Table 23. OR 1.5 Off-Site Fabrication (4 points). Use either of the following alternatives to on-site framing: ▪ Panellized construction. Wall, roof, and floor components are delivered to the job site preframed. ▪ Modular, prefabricated construction. All principal building sections are delivered to the job site as prefabricated modules.	▪
MR 2 - Environmentally Preferable Products	8	Increase demand for environmentally preferable products and products or building components that are extracted, processed, and manufactured within the region. **Prerequisites 2.1 - FSC-Certified Tropical Wood**. Meet the following two requirements, as applicable: a) Provide all wood-product suppliers with a notice containing all the following elements: i) a statement that the builder's preference is to purchase products containing tropical wood only if it is FSC-certified; ii) a request for the country of manufacture of each product supplied; and iii) a request for a list of FSC-certified tropical wood products the vendor can supply. b) If tropical wood is intentionally used (i.e., specified in purchasing documents), use only FSC-certified tropical wood products. Reused or reclaimed materials are exempt. Note: A species of wood is considered tropical for the purposes of this prerequisite if it is grown in a country that lies between the Tropics of Cancer and Capricorn. **Credits 2.2 - Environmentally Preferable Products** (0.5 point each, maximum 8 points). Use building component materials that meet one or more of the criteria below. Except as noted in Table 24, a material must make up 90% of the component, by weight or volume. A single component that meets each criterion (i.e., environmentally preferable, low emissions, and local sourcing) can earn points for each. a) Environmentally preferable products (0.5 point per component) that reduce environmental impact external to the house site (EPP Specification), or internal to the house (Emission Specification). Product specifications, including EPP and Emission Specifications, are listed in Table 24. Note: Recycled content products must contain a minimum of 25% postconsumer recycled content, except as noted in Table 24. Post-industrial (preconsumer) recycled content must be counted at half the rate of postconsumer content. AND/OR	• Forest certification – tropical wood – FSC • Wood products – environmentally preferred – emissions, recycled content, local content

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implication for Wood
		b) Low emissions (0.5 point per component). Use products that meet the emissions specifications in Table 24. AND/OR c) Local production (0.5 point per component). Use products that were extracted, processed, and manufactured within 800 km (500 miles) of the home if moved by truck or within 2400 km (1500 miles) if moved by rail. For each category shown in Table 24, earn 0.5 point (maximum for all products under each category) for each of the three criteria type met (EPP Specifications, Emission Specifications, and/or "local"). Except as noted otherwise below, 90% of the component, as defined in each category, must meet the specification shown.	•

Assembly	Component	EPP Specifications (0.5 points per component)	Emissions specifications (0.5 points per component)	Local production (0.5 points per component)
Exterior wall	Framing/wall structure	Concrete wall structure: use 30% supplemental cementious material Wood frame: FSC-certified or reclaimed or finger joint studs	N/A	Eligible
Exterior wall	Siding or masonry	Recycled content, reclaimed, or FSC-certified	N/A	Eligible
Floor	Flooring (45% of total floor area)	Linoleum, cork, bamboo, FSC-certified or reclaimed wood, sealed concrete, recycled-content flooring, or combination	Carpet & pad: all carpet and pad complies with Carpet & Rug Institute Green Label Plus program Hard flooring: automatic 0.5 point for 100% hard surface flooring Hard flooring: additional 0.5 point for using a product that is SCS FloorScore-certified	Eligible
Floor	Flooring (90% of total floor area)	Meet specifications above to receive additional 0.5 point		Eligible (additional 0.5 points)
Floor	Framing	FSC-certified or reclaimed	N/A	Eligible
Foundation	Cement	Use 30% supplemental cementious material	N/A	Eligible
Foundation	Cement	Use 50% supplemental cementious material (receive an additional 0.5 point)	N/A	Eligible
Interior wall	Framing	FSC-certified or reclaimed	N/A	Eligible
Interior wall *and* ceilings	Gypsum board	N/A	N/A	Eligible
Interior wall *and* ceilings	Paints and coatings	Recycled paint that meets Green Seal standard GS-43	Use products that comply with all applicable standards in Table 25	N/A
Landscape	Decking or patio material	Recycled content, FSC-certified or reclaimed	N/A	Eligible
Other	Cabinets	Recycled content, FSC-certified or reclaimed *and* composite materials must contain no added urea-formaldehyde resins	N/A	N/A
Other	Counters (kitchens and bathrooms)	Recycled content, FSC-certified or reclaimed *and* composite materials must contain no added urea-formaldehyde resins	N/A	Eligible
Other	Doors (not including garage or insulated doors) and trim	Recycled content, FSC-certified or reclaimed *and* composite materials must contain no added urea-formaldehyde resins	N/A	Eligible
Other	Adhesives and sealants	N/A	Use products that comply with all applicable standards in Table 25	N/A
Roof	Framing	FSC-certified	N/A	Eligible
Roof	Roofing	Recycled content	N/A	Eligible
Roof *and* floor *and* wall	Insulation	Recycled content of 20% or more	Comply with California "Practice for Testing of VOCs from Building Materials Using Small Champers" (www.dhs.ca.gov/ehlb/IAQ/VOCS/Practice.htm)	Eligible
Roof, floor, wall (2 of 3)	Sheathing	Recycled content, FSC-certified or reclaimed	N/A	Eligible

41

[41] LEED® Canada For Homes, March 2009, p 105.

Living Building Challenge

Name(s): The Living Building Challenge
Location(s): Mainly US & Canada
Market Scope: Small number of projects in US & Canada
Building Types: All building types
Organization: Cascadia Green Building Council

The Living Building Challenge aims to be an international program with projects emerging around the globe, but it is mainly active in Canada and the United States. It is meant to be the next step after LEED Platinum and a step before regenerative buildings.

The Living Building Challenge is difficult to achieve. Its stated purpose is "to define the highest measure of sustainability attainable in the built environment based on the best current thinking – recognizing that 'true sustainability' is not yet possible." No project has yet to incorporate all facets of the program.

There are no credits in this program – only 16 prerequisites in six categories:

1. Site
2. Energy
3. Materials
4. Water
5. Indoor Quality
6. Beauty & Inspiration

With only prerequisites and no credits, evaluating the prevalence of wood and comparing hypothetical "More" and" Less" wood scenarios does not apply in this case.

It is important to note however that all wood must be either FSC certified or be salvaged or harvested on-site. According in industry sources, it remains to be clarified if timber from a beetle-killed forest can be considered as "salvaged".

It is also important to note that there is a local content prerequisite and no embodied energy requirements, yet it is unclear whether the intent is local economic development or low environmental lifecycle impacts.

Specific Credits - Living Building Challenge[42]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
Materials		The intent of these prerequisites are to remove, from a health and pollution standpoint, the worst known offending materials, and to reduce and offset the environmental impacts associated with the construction process. There are significant limitations to achieving the level of the Living Building in the materials realm. The biggest limitation is due to the market itself. While there are a huge number of "green" products on the market, there is a shortage of good data that sufficiently backs up manufacturer claims and provides consumers with the ability to make conscious, informed choices. Cascadia recognizes the Pharos Project protocol developed by the Healthy Building Network, University of Tennessee Center for Clean Products and Cascadia as the best framework for evaluating materials and the most progressive tool for consumer benefit. Project teams are encouraged to eliminate all known persistent bio-accumulative toxins (PBTs), carcinogens and reproductive toxicants from their specifications.	
Prerequisite 5 – Materials Red List	n/a	The project cannot contain any of the following Red List materials or chemicals: • Cadmium • Chlorinated Polyethylene and Chlorosulfonated Polyethlene • Chlorofluorocarbons (CFCs) • Chloroprene (Neoprene) • Formaldehyde (added) • Halogenated Flame Retardants • Hydrochlorofluorocarbons (HCFCs) • Lead • Mercury • Petrochemical Fertilizers and Pesticides • Phthalates • Polyvinyl Chloride (PVC) • Wood treatments containing Creosote, Arsenic or Pentachlorophenol	• Wood products – zero added formaldehyde
Prerequisite 7 – Responsible Industry	n/a	All wood must be certified by the Forest Stewardship Council (FSC), from salvaged sources, or the intentional harvest of timber onsite for the purpose of clearing the area for construction.	• Forest certification – all wood – FSC or salvaged.

[42] The Living Building Challenge, Version 1.3, August 2008

<table>
<tr><th>Credit ID & Title</th><th># Credits</th><th>Description(s) relating to wood, steel, or concrete</th><th>Implications for Wood</th></tr>
<tr><td>Prerequisite 8 – Appropriate Materials/ Services Radius</td><td>n/a</td><td>Source locations for Materials and Services must adhere to the following restrictions:

<table><tr><th>ZONE</th><th>MATERIAL OR SERVICE</th><th>MAXIMUM DISTANCE</th></tr><tr><td>7</td><td>Ideas</td><td>12,429.91 miles</td></tr><tr><td>6</td><td>Renewable Energy Technologies</td><td>35,9000 miles</td></tr><tr><td>5</td><td>Assemblies that actively contribute to building performance once installed</td><td>3,000 miles</td></tr><tr><td>4</td><td>Consultant Travel</td><td>1,500 miles</td></tr><tr><td>3</td><td>Light, low density materials</td><td>1,000 miles</td></tr><tr><td>2</td><td>Medium weight and density materials</td><td>500 miles</td></tr><tr><td>1</td><td>Heavy, high density materials</td><td>250 miles</td></tr></table>
It is also acceptable to jump one Zone to comply with either Prerequisite 5 or 7 if compliant materials or products are not procurable within apportioned Zones. Once a compliant product is available within the Zone as originally designated in this standard, the exception will be removed. Refer to the User’s Guide for more information.</td><td>• Local content</td></tr>
<tr><td>Indoor Quality</td><td colspan="3">Most buildings provide far less than ideal conditions for maximum health and productivity. As comfort decreases, environmental impact often increases, as people find inefficient and wasteful solutions to improve their physical environment. The intent of these prerequisites is not to address all of the potential ways that an interior environment could be compromised, but to focus on best practices to create a healthy interior environment.

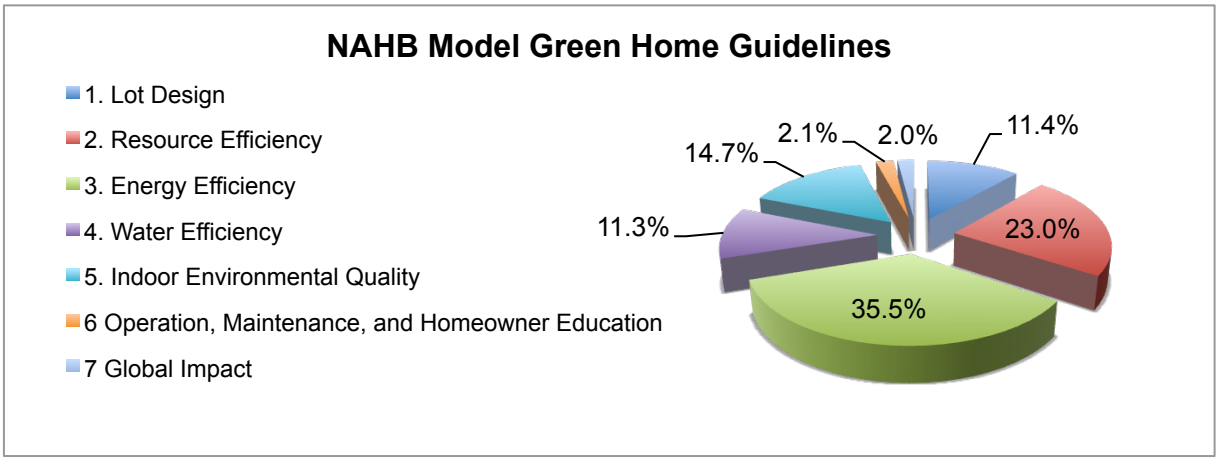
The Living Building Challenge envisions an indoor environment that enhances physical and emotional well being. However, it is difficult to ensure that these places will remain vibrant for people – especially over time - as sensory aspects such as air quality, thermal control and visual comfort can easily be compromised in numerous ways. Further, it is difficult to insure optimal conditions due to the unpredictable nature of how people operate and maintain a building.</td></tr>
<tr><td>Prerequisite T13 – Healthy Air: Source Control</td><td>n/a</td><td>All interior finishes, paints and adhesives must comply with SCAQMD 2007/2008 standards. All other interior materials such as flooring and case works must comply with California Standard 01350 for IAQ emissions.</td><td>• Wood products – finishes, flooring, casings – low VOC standards</td></tr>
</table>

NAHB Model Green Home Buildings Guidelines

Name(s): Model Green Home Buildings Guidelines
Location: United States
Market Scope: National program – all of US
Building Types: Single-detached, low-rise residential
Organization: National Association of Home Builders

NAHB's Model Green Home Building Guidelines, now part of NAHB's National Green Building Program, was published in 2005. These Guidelines are the basis for the Green Scoring Tool - another resource under the National Green Building Program - but were also written for local organizations to use as a foundation for their own Green Building programs, for easy customization to reflect local geographic and climate conditions

The voluntary guidelines cover seven areas:



The following points much be achieved in each category in order to reach the different certification levels.

	Bronze	Silver	Gold
Lot Design, Preparation, and Development	8	10	12
Resource Efficiency	44	60	77
Energy Efficiency	37	62	100
Water Efficiency	6	13	19
Indoor Environmental Quality	32	54	72
Operation, Maintenance, and Homeowner Education	7	7	9
Global Impact	3	5	6
Additional Points From Sections of Your Choice	100	100	100

Prevalence of Wood

There are 110 points of out of 892 that are related to wood and/or wood products. This represents 12% of the total.

NAHB Green Guidelines	Total Possible	Related to Wood	% Related to Wood
1. Lot Design	102	0	0.0%
2. Resource Efficiency	206	82	39.8%
3. Energy Efficiency	318	18	5.7%
4. Water Efficiency	101	0	0.0%
5. Indoor Environmental Quality	132	10	7.6%
6 Operation, Maintenance, and Homeowner Education	19	0	0.0%
7 Global Impact	18	0	0.0%
Total	896	110	12.3%

Wood vs. Competing Products

Using more wood results 10 additional points than using less wood. This is 9.1% of all the wood-related credits, but only of 1.1% of the total points available in the rating system.

	Total	Total Related to Wood	More Wood	Less Wood
2. Resource Efficiency	206	82	81	69
3. Energy Efficiency	318	18	16	18
5. Indoor Environmental Quality	132	10	10	10
Total	656	110	107	97

Specific Credits - NAHB Model Green Home Buildings Guidelines[43]

Credit ID & Title	# Credits	Description(s) relating to wood, steel, or concrete	Implications for Wood
Resource Efficiency			
2.1.2	8	Use advanced framing techniques that reduce the amount of building material while maintaining the structural integrity of the home (see User Guide for examples).	• Building technique & skills
2.1.4	7	Create a detailed framing plan and detailed material takeoffs. Provide an onsite cut list for all framing and sheathing material.	• Building technique & skills
2.1.5	4	Use building materials that require no additional finish resources to complete application onsite.	• Wood products – factory finishes
2.1.6a	3 per	Use pre-cut or pre-assembled building systems or methods. Provide a pre-cut (joist) or pre-manufactured (truss) 3 per floor and roof framing package—points provided for a flooring or a roof framing package—additional points provided if both packages are used.	• Wood products – joists, trusses, floor & roof frames - pre-cut or pre-assembled
2.1.6b	6	Provide a panelized wall framing system.	• Wood products – SIPs – framing
2.1.6c	6	Provide a panelized roof system	• Wood products – SIPs - roofing
2.1.6d	7	Provide modular construction for the entire house	• Wood products – modular construction
2.2.8	7	Use termite-resistant materials for walls, floor joists, trusses, exterior decks, etc., in areas known to be termite infested	• Wood products – termite-resistant
2.3.2	5	Reuse salvaged materials where possible.	• Salvaged wood
2.4.1	3	Use recycled-content building materials.	• Wood products – recycled content – building materials
2.6.1	3	Use materials manufactured from renewable resources or agricultural by-products such as soy-based insulation, bamboo, or wood-based products	• Wood-products – all

[43] NAHB Model Green Home Building Guidelines, 2006

2.6.2	4	Use certified wood for wood and wood-based materials and products from all credible third-party-certified sources, including: A. The Sustainable Forestry Initiative® Program B. The American Tree Farm System® C. The Canadian Standards Association's Sustainable Forest Management System Standards (CAN/CSA Z809) D. Forest Stewardship Council (FSC) E. Program for the Endorsement of Forest Certification Systems (PEFC), and F. Other such credible programs as they are developed and implemented.	• Forest Certification – wood and wood products – SFI, CSA, FSC
2.7.1	3	Use products that contain fewer resources than used traditional products.	• How does wood fair with this credit?
2.8.1	5	Use locally available, indigenous materials.	• Local content
2.8.2	8	Use a life-cycle assessment (LCA) tool to compare the environmental burden of building materials and, based on the analysis, use the most environmentally preferable product for that building component.	• Do Bees and Athena favour wood and wood products?
Energy Efficiency			
3.3	18	Building Envelope - (PP) A. Increase effective R-value of building envelope using advanced framing techniques, continuous insulation, and/or integrated structural insulating system. Measures may include: SIPs, ICFs, Advanced framing, etc…	• Building technique & skills • Competes with wood
Indoor Environmental Quality			
5.1.5	6	Ensure particleboard, medium-density fiberboard (MDF) and hardwood plywood substrates are certified to low formaldehyde emission standards ANSI A208.1, ANSI A208.2, and ANSI/HPVA HP1, respectively. Composite wood/agrifiber panel products must either contain no added urea-formaldehyde resins or must be third-party certified for low formaldehyde emissions.	• Wood products – MDF, plywood, composites – low or no formaldehyde
5.3.8	4	Check moisture content of wood before it is enclosed on both sides. Ensure moisture content of subfloor/substrate meets the appropriate industry standard for the finish flooring material to be installed.	• Wood – moisture content
Global Impact			
7.11	3	Product manufacturer's operations and business practices include environmental management system concepts (the product line, plant, or company must be ISO 14001 certified).	• Wood industry - ISO 14001 certification

SB Tool

Name(s): SB Tool

Location: Worldwide

Market Scope: Worldwide usage, but primarily for the annual international Green Building Challenge

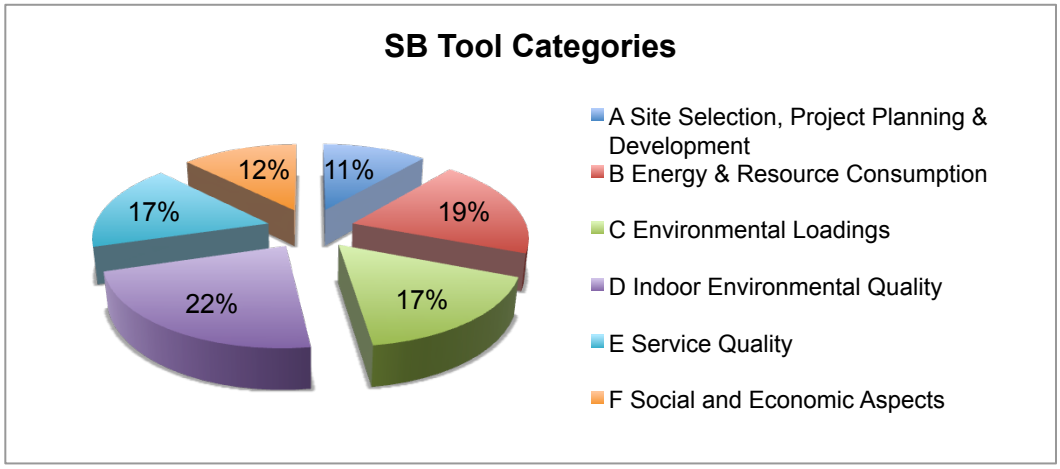
Building Types: All types of buildings

Organization: International Initiative for a Sustainable Built Environment

SBTool, formerly known as GBTool, is the software implementation of the Green Building Challenge (GBC) assessment method that has been under development since 1996 by a group of more than a dozen teams. The GBC process was launched by Natural Resources Canada, but responsibility was handed over to the International Initiative for a Sustainable Built Environment (iiSBE) in 2002.

The Tool can be modified to be as narrow or as broad as desired, ranging from 125 criteria to half a dozen. SBTool takes into account region-specific and site-specific context factors, and these are used to switch off or reduce certain weights, as well as providing background information for all parties.

The system handles large projects or single buildings, residential or commercial, new and existing construction, or a mix of the two, and is comprised of the following sections:



An important feature of the system is that the characteristics of a specific design are compared to Benchmark values, and that the design is then scored and weighted. Results are meaningless unless the design team has first established the benchmark values and adjusted the scoring guides and the weights, depending on their region.

Prevalence of Wood

This analysis was based on the default settings for the values and weights for Vancouver, BC.

SB Tool	Total Possible	Related to Wood	% Related to Wood
A Site Selection, Project Planning & Development	90	0	0.0%
B Energy & Resource Consumption	155	45	29.0%
C Environmental Loadings	135	5	3.7%
D Indoor Environmental Quality	180	5	2.8%
E Service Quality	135	0	0.0%
F Social and Economic Aspects	100	10	10.0%
G Cultural and Perceptual Aspects	15	0	0.0%
Total	810	65	8.0%

There are 65 points that are related to wood and/or wood products. This accounts for 8% of the total points.

Wood vs. Competing Products

Comparing the two scenarios of More and Less wood requires a detailed analysis of the SB Tool and its assumptions, which is beyond the scope of the research.

Since the SB Tool is designed as a framework from which region-specific rating systems can be developed, then it is important to note that the Tool focuses on both lifecycle embodied energy and lifecycle greenhouse gas emissions. If the wood industry prefers these approaches, then SB Tool might be used as a good reference in lobbying other rating systems to adopt the approaches.

Specific Credits - SB Tool[44]

<table>
<tr><th>Credit ID & Title</th><th># Credits</th><th>Description(s) relating to wood, steel, or concrete</th><th>Implications for Wood</th></tr>
<tr><td colspan="4">B - Energy & Resource Consumption</td></tr>
<tr><td>B1.1 - Annualized non-renewable primary energy embodied in construction materials.</td><td>-1 - 5</td><td>To minimize the embodied primary energy used in the building, annualized over the estimated lifespan of the building.
Estimate of embodied primary energy used for structure, envelope (excl. glazing), and major interior components, as determined by a program designed to estimate embodied energy and emissions through Life Cycle Analysis; also, estimate of lifespan.
Note that minimization of embodied energy may not always be optimal. For example, the greater embodied energy associated with high thermal mass will, in most cases, reduce operating energy, and the total net lifecycle energy could then be reduced.
The predicted embodied energy for materials used in the structure and building envelope, as determined by an acceptable LCA-based estimating method.
<table>
<tr><th>Occupancy 1</th><th>Apartment</th><th>GJ/m2</th><th>MJ/m2 per yr.</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The predicted embodied energy for materials used in the structure and building envelope, as determined an acceptable LCA-based estimating method:</td><td>8.6</td><td>115</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>8.0</td><td>107</td><td>0</td></tr>
<tr><td>Good Practice</td><td>6.2</td><td>83</td><td>3</td></tr>
<tr><td>Best Practice</td><td>5.0</td><td>67</td><td>5</td></tr>
</table>
</td><td>Use an embodied energy estimating system, based on LCA (Life Cycle Assessment). Alternatively, use the crude estimating method provided in this system.</td></tr>
</table>

[44] SBTool 2007

<table>
<tr>
<td>B4.2 – Minimal use of finishing materials</td>
<td>-1 - 5</td>
<td>To encourage the minimum use of virgin, re-used or recycled finishing materials, where functionally appropriate, in order to minimize the direct or indirect consumption of resources.
The percent of above-grade interior floor, wall or ceiling surface areas in which structural elements are left exposed.

<table>
<tr><th>Occupancy 1</th><th>Apartment</th><th>Percent area</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The percent of above-grade interior floor, wall or ceiling surface areas in which structural elements are left exposed is approximately:</td><td>2%</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>5%</td><td>0</td></tr>
<tr><td>Good Practice</td><td>14%</td><td>3</td></tr>
<tr><td>Best Practice</td><td>20%</td><td>5</td></tr>
</table>
</td>
<td>Review of design team analysis.</td>
</tr>
<tr>
<td>B4.3 - Minimal use of virgin materials.</td>
<td>-1 - 5</td>
<td>To reduce the use of virgin finishing materials, where functionally appropriate, in order to minimize the direct consumption of natural resources.

The percent of interior floor, wall or ceiling surfaces that consist of non-virgin materials.

<table>
<tr><th>Occupancy 1</th><th>Apartment</th><th>Percent area</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The percent of above-grade interior floor, wall or ceiling surface areas which consist of non-virgin materials is approximately:</td><td>8%</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>20%</td><td>0</td></tr>
<tr><td>Good Practice</td><td>56%</td><td>3</td></tr>
<tr><td>Best Practice</td><td>80%</td><td>5</td></tr>
</table>
</td>
<td>Review of design team analysis by an outside materials specialist.</td>
</tr>
</table>

<table>
<tr>
<td>B4.4 - Use of durable materials.</td>
<td>-1 - 5</td>
<td>To encourage the use, where functionally appropriate, of materials that are durable.
The percentage of materials by cost, excluding structural materials, that meet or exceed Service Life expectations.

Applicable Standards:
• ISO 15686-1 Building and Construction Assets Service Life Planning: General Principles
• Canadian Standards Association CSA 478-95 "Guideline on Durability in Buildings"

<table>
<tr><th>Total project</th><th>Total Project</th><th>% by cost</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The percentage of materials by cost, excluding structural materials, predicted to meet or exceed Service Life expectations.</td><td>3%</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>3%</td><td>0</td></tr>
<tr><td>Good Practice</td><td>4%</td><td>3</td></tr>
<tr><td>Best Practice</td><td>5%</td><td>5</td></tr>
</table>
</td>
<td>Review of contract documentation by an outside materials specialist.</td>
</tr>
</table>

<table>
<tr>
<td>B4.5 - Re-use of salvaged materials.</td>
<td>-1 - 5</td>
<td>To encourage the re-use in the project of suitable existing materials from the site or from off-site sources.
The percentage, by cost, of the materials, products, and furnishings in the project that are salvaged and refurbished or reused from on- or off-site sources.
LEED ranges from 5% to 10%. Note that structural components that are re-used are likely to require re-certification by a structural engineer. In large projects, an on-site engineer is worthwhile.
<table>
<tr><th>Total project</th><th>Total Project</th><th>% by cost</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The percentage (by cost) of the materials, products, and furnishings in the project that are salvaged and refurbished or reused :</td><td>1%</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>3%</td><td>0</td></tr>
<tr><td>Good Practice</td><td>10%</td><td>3</td></tr>
<tr><td>Best Practice</td><td>15%</td><td>5</td></tr>
</table>
</td>
<td>Review of contract documentation by an outside materials specialist.</td>
</tr>
</table>

<table>
<tr>
<td>B4.6 - Use of recycled materials from off-site sources.</td>
<td>-1 - 5</td>
<td>To encourage the use of recycled materials from off-site sources as part of the new facility, where they are suitable.
The percentage, by cost, of the materials, products, and furnishings in the project are recycled from off-site sources. LEED ranges from 25% to 50%.
<table>
<tr><th>Total project</th><th>Total Project</th><th>% by cost</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The percentage (by cost) of the materials, products, and furnishings in the project that are made from materials that recycled from off-site post-consumer sources :</td><td>7%</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>10%</td><td>0</td></tr>
<tr><td>Good Practice</td><td>19%</td><td>3</td></tr>
<tr><td>Best Practice</td><td>25%</td><td>5</td></tr>
</table>
</td>
<td>Review of contract documentation by an outside materials specialist.</td>
</tr>
<tr>
<td>B4.7 - Use of bio-based products obtained from sustainable sources.</td>
<td>-1 - 5</td>
<td>To encourage the use of bio-based products that are certified by a recognized certification agency as coming from renewable sources, or the equivalent.
The percentage, by cost, of bio-based products used in the building, including wood and agricultural products, that are certified by a recognized certification agency.
<table>
<tr><th>Total project</th><th>Total Project</th><th>Percent by cost</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The percentage (by cost) of the wood-based products in the building certified by a recognized certification agency as coming from renewable sources:</td><td>9%</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>10%</td><td>0</td></tr>
<tr><td>Good Practice</td><td>13%</td><td>3</td></tr>
<tr><td>Best Practice</td><td>15%</td><td>5</td></tr>
</table>
</td>
<td>Review of contract documentation by an outside materials specialist.</td>
</tr>
</table>

<table>
<tr>
<td>B4.8 - Use of cement supplementing materials in concrete.</td>
<td>-1 - 5</td>
<td>To encourage the use of cement supplementing materials in concrete, such as flyash, steel slag or rice ash, in order to reduce GHG emissions from the use of cement.
The percentage, by volume, of cement substitute used in concrete.
Note that up to 50% of CSM has been used, but curing time increases with volume used. Typical industry utilisation ranges from 15% to 25%.
<table>
<tr><th>Total project</th><th>Total Project</th><th>% by vol.</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The percentage, by volume, of an acceptable cement supplementing material used in concrete:</td><td>8%</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>15%</td><td>0</td></tr>
<tr><td>Good Practice</td><td>36%</td><td>3</td></tr>
<tr><td>Best Practice</td><td>50%</td><td>5</td></tr>
</table>
</td>
<td>Review of contract documentation by an outside concrete specialist</td>
</tr>
<tr>
<td>B4.9 - Use of materials that are locally produced</td>
<td>-1 - 5</td>
<td>To encourage the procurement of high-weight materials such as aggregate, sand, concrete, masonry, steel and glass, from sources within the greater urban region.
The percentage, by weight, of the aggregate, sand, concrete, masonry, steel and glass used in the project produced within the greater urban region, if local sources of acceptable quality are available.
LEED specifies specific distances, but we consider that this is not applicable to all areas.
<table>
<tr><th>Total project</th><th>Total Project</th><th>% by weight</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The percentage, by weight, of the aggregate, sand, concrete, masonry, steel and glass used in the project produced within the greater urban region:</td><td>42%</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>50%</td><td>0</td></tr>
<tr><td>Good Practice</td><td>74%</td><td>3</td></tr>
<tr><td>Best Practice</td><td>90%</td><td>5</td></tr>
</table>
</td>
<td>Review of contract documentation by an outside materials specialist.</td>
</tr>
</table>

<table>
<tr>
<td>B4.10 - Design for disassembly, re-use or recycling.</td>
<td>-1 - 5</td>
<td>To encourage a building design that will facilitate the easy disassembly of components so that they can be re-used or recycled at the end of the service life of the components.
Measures taken to facilitate future disassembly and re-use or recycling.
<table>
<tr><th>Total project</th><th>Total Project</th><th>Score</th></tr>
<tr><td>Negative</td><td>No measures have been taken to facilitate future disassembly, re-use or recycling.</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>Limited measures have been taken to facilitate future disassembly, re-use or recycling, such as the use of modular interior partitions and other interior components.</td><td>0</td></tr>
<tr><td>Good Practice</td><td>Measures have been taken to facilitate future disassembly, re-use or recycling, such as the use of modular interior components and the use of bolted structural or building envelope components.</td><td>3</td></tr>
<tr><td>Best Practice</td><td>Extensive measures have been taken to facilitate future disassembly, re-use or recycling, such as the use of modular interior components, the use of bolted structural or building envelope components, and the non-use of composite or bonded materials.</td><td>5</td></tr>
</table>
</td>
<td>Review of contract documentation by an outside deconstruction specialist.</td>
</tr>
<tr><td colspan="4">C. Environmental Loadings</td></tr>
</table>

<table>
<tr>
<td>C1.1 - Annualized GHG emissions embodied in construction materials.</td>
<td>-1 - 5</td>
<td>To minimize the amount of CO2-equivalent emissions from primary non-renewable energy used in the extraction, fabrication and transportation of materials and components in the building.
CO2-equivalent emissions per Kg. per m2 of gross area, as determined by calculations based on design documents and fuel emission values plus process-related emissions related to the region of production, and annualized according to the predicted lifespan of the building.
Benchmarks for GJ/m2 are the same as those selected for Benchmark B1.1. Values in BREEAM range from about 1000 to 300 kgCO2/m2 for Residential, and 100 to 500 kgCO2/m2f or offices (not annualized).
<table>
<tr><th>Occupancy 1</th><th>Apartment</th><th>GJ/m2</th><th>kg/m2 * year</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The annualized amount of CO2-equivalent emissions from primary non-renewable energy used in materials and components for structure and building envelope, based on design documents:</td><td>8.6</td><td>6.3</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>8.0</td><td>5.9</td><td>0</td></tr>
<tr><td>Good Practice</td><td>6.2</td><td>4.5</td><td>3</td></tr>
<tr><td>Best Practice</td><td>5.0</td><td>3.7</td><td>5</td></tr>
</table>
</td>
<td>We recommend that this analysis be carried out only with new projects, since there are likely to be insurmountable difficulties in obtaining emission data for materials that are located in an existing building.</td>
</tr>
<tr><td colspan="4">D. Indoor Environmental Quality</td></tr>
</table>

<table>
<tr>
<td>D1.3 - Off-gassing of pollutants from interior finish materials.</td>
<td>-1 - 5</td>
<td>Ensure high indoor air quality by screening all indoor materials, including paints, sealants, adhesives, carpets and composite wood products, for low rates of VOC emissions, and by not using composite wood products that contain urea-formaldehyde resins.
The selection of interior finish materials with minimal or zero rates of TVOC emissions.
<table>
<tr><th>Total project</th><th>Total Project</th><th>Score</th></tr>
<tr><td>Negative</td><td>Indoor materials, including paints, sealants, adhesives, carpets and composite wood products, have not been selected for low rates of VOC emissions, and composite wood products that contain urea-formaldehyde resins may have been used.</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>More than 75% of indoor materials, including paints, sealants, adhesives, carpets and composite wood products, have been selected for low rates of VOC emissions, and composite wood products that contain urea-formaldehyde resins have not been used.</td><td>0</td></tr>
<tr><td>Good Practice</td><td>All indoor materials, including paints, sealants, adhesives, carpets and composite wood products, have been selected for LOW rates of VOC emissions, and composite wood products that contain urea-formaldehyde resins have not been used.</td><td>3</td></tr>
<tr><td>Best Practice</td><td>All indoor materials, including paints, sealants, adhesives, carpets and composite wood products, have been selected for ZERO rates of VOC emissions, and composite wood products that contain urea-formaldehyde resins have not been used.</td><td>5</td></tr>
</table>
</td>
<td>Review of design team analysis of materials.</td>
</tr>
<tr><td colspan="4">F2 – Social and Economic Aspects</td></tr>
</table>

<table>
<tr>
<td>F2.1 - Minimization of life-cycle cost.</td>
<td>-1 - 5</td>
<td>To assess the level of total Life Cycle Cost of the project
Predicted Life Cycle Cost over a 25-year period, with calculations carried out in accordance with recognized procedures.
<table>
<tr><th>Occupancy 1</th><th>Apartment</th><th>CD per m2</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">The predicted Life Cycle Cost, with calculations carried out in accordance with recognized procedures.</td><td>9,880</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>9,500</td><td>0</td></tr>
<tr><td>Good Practice</td><td>8,360</td><td>3</td></tr>
<tr><td>Best Practice</td><td>7,600</td><td>5</td></tr>
</table>
</td>
<td>Review of LCC analysis by a qualified cost consultant.</td>
</tr>
<tr>
<td>F2.2 - Minimization of construction cost.</td>
<td>-1 - 5</td>
<td>To assess the difference between the capital cost of the Design with that of a reference building designed according to standards of Acceptable Practice.
Predicted construction cost per unit area, according to design documentation.
<table>
<tr><th>Occupancy 1</th><th>Apartment</th><th>CD/m2</th><th>Score</th></tr>
<tr><td>Negative</td><td rowspan="4">Predicted construction cost per unit area for this occupancy, according to design documentation.</td><td>2,480</td><td>-1</td></tr>
<tr><td>Acceptable practice</td><td>2,400</td><td>0</td></tr>
<tr><td>Good Practice</td><td>2,160</td><td>3</td></tr>
<tr><td>Best Practice</td><td>2,000</td><td>5</td></tr>
</table>
</td>
<td>Review of cost analysis by a qualified cost consultant.</td>
</tr>
</table>