Embodied Carbon Network | 2018 Webinar Series

EMBODIED CARBON IN THE BUILT ENVIRONMENT: SESSION 3

May 18, 2018
Webinar Series Disclaimer

This session is provided as part of the Embodied Carbon Network 2018 Webinar Series. The Network is a collaboration of building sector practitioners, researchers, advocates, and government professionals. We invite guest speakers to share their knowledge and insight on carbon emission topics to get participants thinking and talking about new strategies to achieve climate change goals. Mention of trade names or commercial products does not constitute endorsement or recommendation for use. Please note the opinions, ideas, or data presented by speakers in this series do not represent Embodied Carbon Network members policy or constitute endorsement by the Network.
Embodied Carbon Network

- Launched in January 2017 by the Carbon Leadership Forum
- Platform for resource sharing, discussion, quick action
- Ten subject-specific Taskforces

Academic  Buildings  Construction
LCA Data/Tools  Materials  Outreach
Policy  Renewables  Reuse
Series Overview

Knowledge/strategies for reducing carbon emissions caused by building materials

Eight online sessions throughout 2018
Subject matter experts From ECN Taskforces
AIA Continuing Education Credits
Webinar Overview

Today We Will Explore:

Initiatives to help guide tracking & reducing total carbon emissions over a building’s life cycle

Academic-industry work to accelerate adoption of LCA in practice

Kate Simonen, Director
Carbon Leadership Forum
Associate Professor,
University of Washington

SEI committee’s guidance on creating ‘reference building’ in LEED

Megan Stringer
Senior Engineer
Holmes’ Structures
Webinar Overview

RICS Professional Statement: Whole life carbon assessment for the building environment

Ryan Zizzo
Technical Director
Zizzo Strategy

CaGBC Zero Carbon Buildings Standard and its approach to embodied carbon reporting

Kaitlyn Gillis,
Wellbeing & Sustainability Specialist, Stantec

Case Study: Brock Commons Tall Wood Building (Vancouver, BC)

Graham Twyford-Miles
Principal
Stantec
Embodied Carbon Network
Implementaing Whole Building LCA

Kate Simonen, AIA SE
Associate Professor of Architecture, University of Washington
Director of The Carbon Leadership Forum
ksimonen@uw.edu
http://www.carbonleadershipforum.org/resources/
WHOLE BUILDING LCA

Step-by-step guidance & LCA references

http://www.carbonleadershipforum.org/resources/
WHOLE BUILDING LCA

**Inventory**
- ESTIMATE OF QUANTITIES OF MATERIALS IN BUILDING
  - e.g. 100kg steel
  - e.g. 50kg glass
  - etc.

**Impacts**
- ESTIMATE OF ENVIRONMENTAL IMPACTS FOR EACH MATERIAL
  - 0.43 kg CO2e /kg steel
  - 1.064 kg CO2e /kg steel
  - etc.

**Total**
- ESTIMATE OF TOTAL ENVIRONMENTAL IMPACT OF BUILDING MATERIALS
  - 43 kg CO2e
  - 53.2 kg CO2e
  - etc.

Sum Total Impact
WB LCA TOOLS

Help estimate inventory and include impact estimates

http://www.carbonleadershipforum.org/resources/
LCA DATA

If you have a bill of materials you can use LCA data to generate a custom LCA.

http://www.carbonleadershipforum.org/resources/
COMMON PRACTICE IN NORTH AMERICA

North American WB LCA Tools

Open Source LCA Data

ENVIRONMENTAL PRODUCT DECLARATIONS

http://www.carbonleadershipforum.org/resources/
WB LCA TOOLS & DATA

WARNING: DATA IS NOT COMPARABLE BETWEEN TOOLS AND DATABASES AND EVEN BETWEEN MOST EPDS

http://www.carbonleadershipforum.org/resources/
LEED V4 Whole-building LCA Credit (3 points)

Goal:

Conduct a life-cycle assessment of the project’s structure and enclosure that demonstrate

- **minimum of 10% reduction**, in at least three of the six impact categories one of which must be global warming potential.
- No impact category may **increase more than 5%**
LEED Case Study Challenge

More than 25% reduction in all impacts except Ozone
Materials Database #1: Normalizing impacts
Materials Database #2: Normalizing impacts
Don’t recommend using Ozone Depletion Potential to select Building Materials.
Embodied Carbon Benchmarks

Much to learn!
Leverage WB LCA data to answer questions, inform practice.
Whole Building Life Cycle Assessment - Reference Building Structure and Strategies

Embodied Carbon Network - Webinar 3: Buildings

Presented by Megan Stringer
May 18, 2018
Whole Building Life Cycle Assessment - Reference Building Structure and Strategies

ASCE SEI Sustainability Committee

- WBLCA is recognized in LEED and green building standards such as IgCC, CALGreen, and ASHRAE 189.1
- Pre-standard focuses on embodied impacts from the building structure
Whole Building Life Cycle Assessment - Reference Building Structure and Strategies

ASCE SEI Sustainability Committee

• Defines “Reference Building” as required by green building standards and rating systems when performing WBLCA

• Strategies to reduce life cycle impacts of a building
  • Structural Material Quantity Reduction
  • Structure as Finish
  • Nonstructural Material Quantity Reduction
  • Performance-Based Design for Material Damage Reduction
  • Impact Reductions Achieved by Using Alternate Structural Systems
  • Impact Reduction of Functionally Equivalent Materials
  • Incorporating Salvaged Materials
  • Design for Deconstruction
  • Participating in Operational Energy Savings
Whole Building Life Cycle Assessment -
Reference Building Structure and Strategies

• Available August/September 2018
ASCE Publications www.asce.org/publications/
New guidance document from the UK

Whole life carbon assessment for the built environment

Embodied Carbon Network – Buildings Webinar
May 18, 2018

Ryan Zizzo
Technical Director, Zizzo Strategy
MASc, PEng, LEED AP ND
Royal Institute of Chartered Surveyors (RICS)

Very high quality document providing insight and instruction on performing whole life carbon assessment of construction projects.
Background

- RICS is a professional association. Cost consultants will be members of RICS. Other engineers may also be too.
- Started from looking at cost data, then grew into carbon.
- Partnership with “innovate UK” – government-funded research money. They have different focuses, one of which is buildings.
- It involved academia, contractors, LCA practitioners, etc.
  - Member of the Embodied Carbon Network, Building Group is one of the main authors.
- There was a big push in London previously under “allowable solution”, but got nixed.
- A number of key developers are asking for this type of analysis in the UK. Infrastructure is quite good at this now. HS2 is using.
Whole life carbon assessment for the build environment

- All RICS members are required to follow the rules and procedures outlined in the statement as of May 1 2018
- Includes both mandatory requirements (using ‘must’), and voluntary recommended practice (using ‘should’).
- Mandatory building sections to be included:
  - substructure (foundation) and superstructure (frame, upper floors, roof, stairs and ramps, external walls, windows and external doors)
  - align with LEED and the CaGBC’s ZCBS.
- Mandatory life cycle stages to be included is unique:
  - Product [A1-A3]
  - Construction [A4-A5]
  - Replacement [B4]
  - Operational energy use [B6]
    - Note that [B6] is specifically excluded from LEED and ZCBS, as it is reported elsewhere and not in the ‘embodied carbon’ sections.
Unique elements

• Guidance and **UK default values** provided

• Results must be reported in numerous ways, including for each individual building element group, and with **results normalized using different units** depending on the life cycle phase and on the building or infrastructure type.

• Requires assessment before the commencement of the technical design, RIBA Stage 4 or equivalent, ie: start of Construction Drawings, or 100% Design Development (DD).

• Recommends at least one additional assessment, at the ‘as built’ condition, to represent the final value to contribute to "static benchmarking" and future targets.

<table>
<thead>
<tr>
<th>Minimum Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building parts to be included</strong></td>
</tr>
<tr>
<td>1. Substructure</td>
</tr>
<tr>
<td>2. Superstructure</td>
</tr>
<tr>
<td><strong>Life stages to be included</strong></td>
</tr>
<tr>
<td>Product stage [A1–A3]</td>
</tr>
<tr>
<td>Construction process stage [A4–A5]</td>
</tr>
<tr>
<td>Replacement stage [B4] for facade</td>
</tr>
<tr>
<td>Operational energy use [B6]</td>
</tr>
<tr>
<td><strong>Assessment timing</strong></td>
</tr>
<tr>
<td>At design stage – prior to technical design</td>
</tr>
<tr>
<td>Material</td>
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<td>---------------</td>
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<tr>
<td>Concrete</td>
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<td>Steel</td>
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<td>Blockwork</td>
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<td>Timber</td>
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<td>Aluminium</td>
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<tr>
<td>Plasterboard</td>
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<tr>
<td>Insulation</td>
</tr>
</tbody>
</table>

Table 6: Default specifications for main building materials

The values in Table 6 are based on average industry standard practice.
Default transportation distances and examples + metal recovery rates

### Table 7: Default transport scenarios for UK projects

<table>
<thead>
<tr>
<th>Transport scenario</th>
<th>km by road*</th>
<th>km by sea**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locally manufactured e.g. concrete, aggregate, earth</td>
<td>50 [1]</td>
<td>-</td>
</tr>
<tr>
<td>Nationally manufactured e.g. plasterboard, blockwork, insulation</td>
<td>300 [1]</td>
<td>-</td>
</tr>
<tr>
<td>European manufactured e.g. CLT, façade modules, carpet</td>
<td>1,500 [2]</td>
<td>-</td>
</tr>
<tr>
<td>Globally manufactured e.g. specialist stone cladding</td>
<td>200 [3]</td>
<td>10,000 [3]</td>
</tr>
</tbody>
</table>

* Means of transport assumed as average rigid HGV with average laden – average laden as per BEIS carbon conversion factors.

** Means of transport assumed as average container ship.

### Table 10: Default metal recovery rates

<table>
<thead>
<tr>
<th>Metal</th>
<th>Recovery rate Repurposing: reuse or recycling</th>
<th>Disposal Landfill</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UK</td>
<td>Global</td>
</tr>
<tr>
<td>Steel</td>
<td>96% [1]</td>
<td>85% [2]</td>
</tr>
<tr>
<td>Aluminium</td>
<td>96% [3]</td>
<td>85% [4]</td>
</tr>
<tr>
<td>Copper</td>
<td>65% [5]</td>
<td>65% [5]</td>
</tr>
</tbody>
</table>

*Repurposing: reuse or recycling*
<table>
<thead>
<tr>
<th>Building part</th>
<th>Building elements/components</th>
<th>Expected lifespan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof</td>
<td>Roof coverings</td>
<td>30 years</td>
</tr>
<tr>
<td>Superstructure</td>
<td>Internal partitioning and dry lining</td>
<td>30 years</td>
</tr>
<tr>
<td>Finishes</td>
<td>Wall finishes:</td>
<td>30/10 years respectively</td>
</tr>
<tr>
<td></td>
<td>Render/Paint</td>
<td></td>
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<tr>
<td></td>
<td>Floor finishes</td>
<td>30/10 years respectively</td>
</tr>
<tr>
<td></td>
<td>Raised Access Floor (RAF)/Finish layers</td>
<td></td>
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<tr>
<td></td>
<td>Ceiling finishes</td>
<td>20/10 years respectively</td>
</tr>
<tr>
<td></td>
<td>Substrate/Paint</td>
<td></td>
</tr>
<tr>
<td>FF&amp;E</td>
<td>Loose furniture and fittings</td>
<td>10 years</td>
</tr>
<tr>
<td>Services/ MEP</td>
<td>Heat source, e.g. boilers, calorifiers</td>
<td>20 years</td>
</tr>
<tr>
<td></td>
<td>Space heating and air treatment</td>
<td>20 years</td>
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<tr>
<td></td>
<td>Ductwork</td>
<td>20 years</td>
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<tr>
<td></td>
<td>Electrical Installations</td>
<td>30 years</td>
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<td></td>
<td>Lighting fittings</td>
<td>15 years</td>
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<td></td>
<td>Communications Installations and controls</td>
<td>15 years</td>
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<td></td>
<td>Water and disposal Installations</td>
<td>25 years</td>
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<td></td>
<td>Sanitaryware</td>
<td>20 years</td>
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<td></td>
<td>Lift and conveyor Installations</td>
<td>20 years</td>
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<tr>
<td>Facade</td>
<td>Opaque modular cladding</td>
<td>30 years</td>
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<td></td>
<td>e.g. rain screens, timber panels</td>
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<tr>
<td></td>
<td>Glazed cladding/Curtain walling</td>
<td>35 years</td>
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<td></td>
<td>Windows and external doors</td>
<td>30 years</td>
</tr>
</tbody>
</table>

Table 9: Indicative component lifespans
<table>
<thead>
<tr>
<th>Building element category</th>
<th>Product stage</th>
<th>Construction process stage</th>
<th>Use stage</th>
<th>End of Life (EoL) stage</th>
<th>TOTAL*</th>
<th>[A] to [C] cradle to grave (kgCO₂e/m² or equivalent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demolition prior to construction</td>
<td>[A1]</td>
<td>[A2]</td>
<td>[A3]</td>
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<tr>
<td>1.1 Toxic/flammable/hazardous</td>
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<td>1.2 Material treatment</td>
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<td>1.3 Major demolition Works</td>
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<tr>
<td>Facilitating works</td>
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<tr>
<td>Temporary support to adjacent</td>
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<tr>
<td>1.3 Structure</td>
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<td>1.4 Accessible ground works</td>
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<td>1.5 Temporary excavation works</td>
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<tr>
<td>Extraordinary site investigation</td>
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<tr>
<td>1 Substructure</td>
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<tr>
<td>2.1 Floor</td>
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<td>2.2 Upper floors</td>
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<td>2.3 Wall</td>
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<td>2.4 Windows and external doors</td>
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<td>2.5 External walls and partitions</td>
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<td>2.6 Internal walls and partitions</td>
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<td>2.7 Stairs and Ramps</td>
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<tr>
<td>3 Finishes</td>
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<td>3.1 Fittings, furnishings</td>
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<tr>
<td>3.2 Equipment</td>
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<td>4 Services (MEP)</td>
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<td>Building-related systems</td>
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<tr>
<td>Non building-related systems</td>
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<tr>
<td>5 Prefabricated buildings</td>
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<td>6 Work to existing building</td>
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<tr>
<td>7 External works</td>
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<td>TOTAL</td>
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<td>TOTAL - normalised</td>
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</tbody>
</table>

- Decarbonisation applicable - Report decarbonised values alongside non-decarbonised ones.
Thank You

Ryan Zizzo | Technical Director
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1200 Bay Street | Suite 604 | Toronto
Case Study: UBC Brock Commons Tallwood House

Embodied Carbon Network Webinar
18 May 2018

Graham Twyford-Miles, Principal
Agenda

1. Introduction
2. Project Overview
3. UBC Policy Framework
4. Project Performance
5. Lessons Learned
At UBC's Vancouver campus, sustainability means simultaneous improvements in human and environmental wellbeing, not just reductions in damage or harm.

By 2035, such regenerative sustainability is embedded across the University throughout teaching, learning, research, partnerships, operations and infrastructure, and the UBC community.

UBC is a vibrant, healthy and resilient community, deeply engaged with its neighbours, surrounding region, partners around the world, and in a supportive and mutually respectful relationship with the Musqueam people.
Objectives

1. High quality, sustainable physical environments
2. Functionality, reliability and serviceability of facilities, systems and components
3. **Minimum LCC of ownership including design, construction, and O&M costs**
4. Flexibility for growth and change
5. Strong, positive and enduring quality of physical surroundings
6. **Environmental responsibility and sensitivity**
7. **Resource efficiency (energy, water, materials)**
8. Universal accessibility
9. Safety and security
10. Value in facilities and infrastructure investment
Scope

- Aligns with provincial funding requirements
- Companion document to Campus Plan & Technical Guidelines
- Coordinate implementation and certification
- Provide UBC specific guidance to project teams
- 27 mandatory credit requirements

Issued:
- February 2012 (LEED 2009)
- January 2013 (LEED 2009)
- August 2016 (LEED v4)
Guiding Principles:
Sustainability & Building Performance

Market leadership through cost effective & replicable design and construction methodology.

Reduced environmental footprint through the use of low impact, locally sourced mass timber construction.

Energy conservation through high performance envelope design, efficient building systems, and strong commissioning.

Effective management of water resources through efficient design strategies.

LEED Gold Certification (Version 4)
UBC Brock Commons Tallwood House

Project Overview
Project Team

• **Architect:** Acton Ostry
• **Structural:** Fast & Epp
• **Mechanical & Fire Protection:** Stantec
• **Electrical & Sustainability:** Stantec
• **Building Envelope:** RDH Building Science
• **Code:** GHL Consultants
• **Landscape Architecture:** Hapa Collaborative
• **Commissioning:** Zenith Commissioning
• **Contractor:** UrbanOne
• **Developer:** UBC Properties Trust
General Building Data

Site Area: 2,300 m²
Height: 18 storeys
Unit Count: 404
Building Size: 15,000 m²

Completed: 2017
Budget: $51M
**Foundation & Core:**
Cast in Place Concrete

**Superstructure:**
Prefab CLT floor assemblies on GLT & PSL columns with steel connections

**Building Envelope:**
Prefab steel-stud frame panels with wood laminate cladding
Post-occupancy

Performance Outcomes
• LEED V4 and Building LCA

• Complete overhaul of LEED material requirements
• Life Cycle Impact Reduction Credit
  Provides for quantitative comparison of materials across a range of environmental impact performance metrics vs. typical prescriptive measures
• Athena Institute’s EcoCalculator for Buildings
  • Material manufacturing and related transportation
  • On-site construction
  • Building type and assumed lifespan
  • Maintenance and replacement effects
  • Demolition and disposal
• Target of **10% Reduction in CO2e** and 2 other Categories
## Comparison of Proposed vs Baseline Construction Assemblies

<table>
<thead>
<tr>
<th>Assembly Group</th>
<th>Proposed Building</th>
<th>Baseline Building</th>
<th>Comparison of Environmental Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Foundations</strong></td>
<td>- RC Footings</td>
<td>- RC Footings (larger volume)</td>
<td>Baseline &gt; Proposed</td>
</tr>
<tr>
<td><strong>Walls</strong></td>
<td>- Exterior prefab panels (steel-framed)</td>
<td>- Prefab concrete sandwich panels</td>
<td>Baseline ≥ Proposed</td>
</tr>
</tbody>
</table>
| **Columns & Beams** | - Timber columns (Glulam/PSL)  
- Steel beams (WFS)  
- RC cores  
- Structural grid: 2.85 m x 4.00 m | - RC columns  
- Steel beams  
- RC cores  
- Structural grid: 5.50 m x 6.00 m | Baseline > Proposed                |
| **Floors**      | - CLT Floors  
- RC Slab on Grade | - RC Floors  
- RC Slab on Grade | Baseline > Proposed                |
| **Roof**        | - Metal deck roof with insulation entirely above deck | - Metal deck roof with insulation entirely above deck | Same as proposed                   |
| **Project Extra Materials** | - CLT canopy  
- RC stairs  
- Structural steel connections | - CLT canopy  
- RC stairs | Baseline < Proposed                |
## LCA Results by Environmental Indicator

<table>
<thead>
<tr>
<th>Assembly Group</th>
<th>Percent Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEEDv4 MRcr.1 – Option 4 Compliance Threshold</td>
<td>10%</td>
</tr>
<tr>
<td>1. Global warming potential CO\textsubscript{2}-eq</td>
<td>34%</td>
</tr>
<tr>
<td>1. Ozone depletion potential CFC\textsubscript{11}-eq</td>
<td>45%</td>
</tr>
<tr>
<td>1. Acidification potential (land and water) SO\textsubscript{2}-eq</td>
<td>25%</td>
</tr>
<tr>
<td>1. Eutrophication potential (fresh water) N\textsubscript{eq}</td>
<td>35%</td>
</tr>
<tr>
<td>1. Formation of tropospheric ozone (photochemical oxidant formation) O\textsubscript{3}-eq</td>
<td>24%</td>
</tr>
<tr>
<td>1. Depletion of nonrenewable energy resources MJ</td>
<td>26%</td>
</tr>
</tbody>
</table>

Achieved compliance? (Y/N)  
Eligible for exemplary performance? (Y/N)  
Number of eligible credits

Y  
Y  
3 cr. + 1 cr.
UBC Energy Performance Targets

UBC Energy Density Target
120 kWh/m²/yr
Lessons Learned & Future Directions
Conclusions: Old is New Again

- Local & Renewable Material
- Lower Embodied Carbon
- Reduced Life Cycle Impact (60 years)
- Reduced site waste
- Reduced transportation and noise impact on site
- Prefabrication & faster construction (2 floors/week)
- Low-impact demolition

Kyoto’s 180 foot Toji Temple was built of wood in 796
Contact

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The Canada Green Building Council’s Zero Carbon Building Standard

Kaitlyn Gillis, Wellbeing + Sustainability Specialist
Zero Carbon Building Standard

- First Canadian standard to focus on carbon emissions, both through operations and embodied carbon.

- Pilot was released on January 2017
  - Two year program

- Officially released in May 2017
Zero Carbon Building Standard

- Focus on carbon in order to meet COP21 targets

- Goes beyond energy performance to really considering the carbon intensity of the grid
Zero Carbon Building Standard

• Applicable for new and existing buildings
  • Commercial
  • Institutional
  • Multi-unit residential

• Design and Performance certification pathways
  • Design: Once design is completed
  • Performance: Existing buildings (at least 3 years) or 12 months post design certification
Overview

Seven sections:

1. Zero Carbon Balance
2. Zero Carbon Transition Plan
3. Onsite Renewable Energy Generation
4. Thermal Energy Demand Intensity
5. Energy Use Intensity
6. Peak Demand
7. Embodied Carbon
Embodied Carbon

• Cradle to grave analysis of carbon associated with building materials
  • Resource extraction
  • Product manufacturing
  • Transportation
  • Construction
  • Maintenance/replacement
  • Demolition/deconstruction/disposal

• Include structural and envelope components
Embodied Carbon

• Currently no performance targets, only reporting necessary

• Reporting is through Global Warming Potential (GWP) in CO$_2$e

• Applicable LCA programs include:
  • Athena Impact Estimator for Buildings
  • Tally
Pilot Projects

Sixteen projects were included in the two-year pilot phase.

• Included new and existing buildings
• Projects in six provinces
Pilot Projects

1. MacKimmie Complex Redevelopment, Calgary, Alberta
2. City of Vancouver Zero Emissions Fire Hall, Vancouver, British Columbia
3. EcoLock, Kelowna, British Columbia
4. Okanagan College – Health Sciences Centre, Kelowna, British Columbia
5. 1133 Melville, Vancouver, British Columbia
6. West 8th and Pine, Vancouver, British Columbia
7. Confidential Project, Winnipeg, Manitoba
9. evolv1 – Waterloo, Ontario
10. Mohawk College, Joyce Centre for Partnership & Innovation – Hamilton, Ontario
11. NiMA Trails Residential/Commercial Net Zero Building, Guelph, Ontario
12. Walkerton Clean Water Centre, Walkerton, Ontario
13. Toronto and Region Conservation Authority (TRCA) New Headquarters, Toronto, Ontario
14. 30 Bay Street, Toronto, Ontario
15. Major renovation of Arthur Meighen Building 25-55 St. Claire Avenue, East, Toronto, Ontario
16. Cure-Paquin Elementary Schools, Saint-Eustache, Quebec
Pilot Projects

1. MacKimmie Complex Redevelopment, Calgary, Alberta
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First project to receive Zero Carbon Building – Design Certification (April 2018)
Similar Systems Globally

World Green Building Council’s “Advancing Net Zero” project.

Five Green Building Council’s (of 15 participating) have released Net Zero Carbon Standards to date:

• Alliance HQE – Green Building Council France (October 2016) – E+C- (Energie Positive & Reduction Carbone)

• Canada Green Building Council (January 2017) – Zero Carbon Building Standard

• Green Building Council Australia (October 2017): Green Star – Performance (with Carbon Positive Innovation Challenges)


• Green Building Council South Africa (October 2017) – Net Zero/Net Positive certification program*

* Future versions to include embodied carbon
Resources

Canada Green Building Council’s Zero Carbon Building Standard

https://www.cagbc.org/zerocarbon

World Green Building Council “Advancing Net Zero” project

http://www.worldgbc.org/advancing-net-zero
Thank you!

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Wellbeing + Sustainability Specialist
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Stick around for Q & A

Next webinar: Materials | June 15 – Register today @ https://attendee.gotowebinar.com/register/4660380480208590081

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Reception: 5:30 - 7:00pm

Session: $85.00
Session + Book and
Raffle: $250

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