New LEED® v4.0 in Canada and the Environmental Product Declarations

Lindita Bushi, Ph.D., LEED Green Associate

The Athena Sustainable Materials Institute

Construct Canada 2016 - November 30th  W151
Session Outline

- Athena Institute - Who we are, what we do
- Canada’s Green Building and LEED® v4
  - Canada’s Green Building Industry
  - LEED® v4 in Motion: Canada
- Materials & Resources Credit - How LEED® v4 is Changing and Driving EPD Demand
  - MR Credit 2- PCR/LCA/EPD Process
  - North American EPD Program Operators
  - Industry’s Response: Case Study of N.A. PCR & EPDs for Precast Concrete Products
  - MR Credit 1- Whole-Building (WB) LCA and Athena’s Impact Estimator for Building Software
- Q&A
Who we are, What we do

- A not-for-profit research organization established in 1997, with staff in Ottawa, Toronto, Vancouver and Pennsylvania.

- Work in partnership with forward-looking organizations focused on advancing a more sustainable built environment.

- Our core program is supported through membership funds and grants.

- Fee for service consulting:
  - LCAs, PCRs and EPD services
  - Verification services for EPD Program Operators
  - Life cycle policy analysis
What is Green Building?

Green building …

… is recognized globally as a *method and practice* for addressing climate change, minimizing energy and resource demands, and for building more resilient and healthy communities.

Source: 2016 CaGBC GREEN BUILDING IN CANADA Assessing the Market Impacts & Opportunities
In 2014, Canada’s green building industry:

**Generated**

- $23.45 billion in GDP

**Supported**

- 297,890 direct jobs

The portfolio of LEED® buildings in Canada certified between 2005 – 2015 will:

**Generate**

- $62.3 billion in total GDP

**Create**

- 701,700 jobs over their lifetime (direct, indirect, and induced)

**Provide**

- $128.0 billion in gross output (direct, indirect, and induced)
In 2014, the green building industry employed 297,890 direct full-time workers, this represents more Canadians employed than in the forestry, oil and gas, and mining industries combined.

297,890 JOBS

270,450 JOBS

38,585 JOBS

64,310 JOBS

65,540 JOBS

102,015 JOBS

Source: 2016 CaGBC GREEN BUILDING IN CANADA Assessing the Market Impacts & Opportunities
Green Building Industry Growth in Canada (1)

Source: 2016 CaGBC GREENBUILDING IN CANADA Assessing the Market Impacts & Opportunities

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Other Green Building Rating Systems and Third-Party Certification Programs in Canada (for both the residential and non-residential)

BOMA BEST 3.0
(Green Globes® rebranded)

http://bomacanada.ca/

http://www.nrcan.gc.ca/energy/products/energystar/about/12529

http://www.builtgreencanada.ca/

http://www.passivebuildings.ca/

Source: 2016 CaGBC GREEN BUILDING IN CANADA Assessing the Market Impacts & Opportunities

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ABOUT LEED®

- LEED is an acronym for **Leadership in Energy and Environmental Design** and was formed by **U.S. Green Building Council** in 1998 as a pilot program;

- LEED is a **global green building certification system** that provides third-party verification of the features, design, construction, maintenance, operation and effectiveness of green buildings;

- LEED is a tool that can be used to improve the environment, create better performing buildings and enhance public health;

- With specific achievement paths built in, LEED is designed for use in a **variety of climates and localities**, often synching with local laws and requirements;

- LEED is flexible enough to apply to **all building types** - commercial as well as residential;

- Every day, more than 170,000 square meters of space in **more than 150 countries** and territories certifies with LEED;

- More than 69,800 commercial projects are currently participating LEED comprising nearly 1.2 billion square meters of construction space worldwide

Source: USGBC May 2015, LEED® in Motion: Canada
2,200 LEED-certified projects (30 million gross square meters of space)

Source: USGBC May 2015, LEED® in Motion: Canada

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LEED® People-
Who in Canada is using LEED?

11,369 credential holders in Canada
4,069 of those individuals hold LEED AP with specialty or LEED Green Associate designations.

Source: USGBC May 2015, LEED® in Motion: Canada

(As of June 2015) Note: some LEED professionals hold more than one credential so the number of credentials issued is actually higher than the number of credential holders.

Source: USGBC May 2015, LEED® in Motion: Canada

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Introduction to LEED® v4

5 Rating Systems

Credit Categories

Each rating system is made up of a combination of credit categories. Within each of the credit categories, there are specific prerequisites projects must satisfy and a variety of credits projects can pursue to earn points. The number of points the project earns determines its level of LEED certification.

Source: WT Sustainability 2015

The Ratings

CERTIFIED
40-49 POINTS

SILVER
50-59 POINTS

GOLD
60-79 POINTS

PLATINUM
80+ POINTS

US GREEN BUILDING COUNCIL

LEED is administered by the US Green Building Council. For information on the scheme go to www.usgbc.com

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LEED v4 Certification

- Customer service
  - CaGBC
- Registration
  - CaGBC
- Administration of certification
  - GBCI
- Certification review
  - CaGBC
- Awarding of certification
  - GBCI

Source: Mark Hutchinson, CaGBC June 2016
How LEED® Works in Canada (2)?

**Canadian Federal Green Building Policy**

The federal green building policy in Canada, administered through the department of Public Works and Government Services Canada (PWGSC) officially states:

"PWGSC is committed to achieving
- **LEED Gold** for new construction and built-to-lease projects, and
- **LEED Silver** for major renovations."

**Provincial Green Building Policies**

- Alberta - **LEED Silver**
- British Columbia - **LEED Gold**
- Manitoba - **LEED Silver**
- New Brunswick - **LEED Silver**
- Newfoundland & Labrador - **LEED Silver**
- Nova Scotia - **LEED Silver**
- Ontario - **LEED Silver**
- Quebec - **LEED Certified**

Source: USGBC May 2015, LEED® in Motion: Canada
<table>
<thead>
<tr>
<th>LEED Certification</th>
<th>Cities in Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEED Gold</td>
<td>Calgary, AB</td>
</tr>
<tr>
<td></td>
<td>Kitchener, ON</td>
</tr>
<tr>
<td></td>
<td>Montreal, QC</td>
</tr>
<tr>
<td></td>
<td>New Westminster, BC</td>
</tr>
<tr>
<td></td>
<td>North Vancouver, BC</td>
</tr>
<tr>
<td></td>
<td>Regional Municipality of Wood Buffalo (Fort McMurray), AB</td>
</tr>
<tr>
<td></td>
<td>Richmond, BC</td>
</tr>
<tr>
<td></td>
<td>Vancouver, BC</td>
</tr>
<tr>
<td>LEED Silver</td>
<td>Banff, AB</td>
</tr>
<tr>
<td></td>
<td>Burlington, ON</td>
</tr>
<tr>
<td></td>
<td>East Gwillimbury, ON</td>
</tr>
<tr>
<td></td>
<td>Edmonton, AB</td>
</tr>
<tr>
<td></td>
<td>Halifax, NS</td>
</tr>
<tr>
<td></td>
<td>Mississauga, ON</td>
</tr>
<tr>
<td></td>
<td>Oakville, ON</td>
</tr>
<tr>
<td></td>
<td>Region of Waterloo, ON</td>
</tr>
<tr>
<td></td>
<td>Region of York, ON</td>
</tr>
<tr>
<td></td>
<td>Richmond Hill, ON</td>
</tr>
<tr>
<td></td>
<td>Saanich, BC</td>
</tr>
<tr>
<td></td>
<td>Victoria, BC</td>
</tr>
<tr>
<td></td>
<td>(Required: LEED Silver, Goal: LEED Gold)</td>
</tr>
<tr>
<td></td>
<td>Winnipeg, MB</td>
</tr>
<tr>
<td></td>
<td>Yellowknife, NWT</td>
</tr>
<tr>
<td>LEED Certified</td>
<td>Grand Prairie, AB</td>
</tr>
<tr>
<td></td>
<td>Moncton, NB</td>
</tr>
<tr>
<td></td>
<td>Ottawa, ON</td>
</tr>
<tr>
<td></td>
<td>(Required: LEED Certified, Goal: LEED Silver)</td>
</tr>
<tr>
<td></td>
<td>Spruce Grove, AB</td>
</tr>
<tr>
<td></td>
<td>St. Catherines, ON</td>
</tr>
</tbody>
</table>

Source: USGBC May 2015, LEED® in Motion: Canada

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LEED® v4 –
Materials & Resources (MR) Credit


LEED v4
LARGER SCOPE

RAW MATERIALS
Sourcing: wood, biobased, concrete, steel, mined and quarried
Rapidly renewable
Recycled content
Wood

BETTER INFORMATION

PRODUCTS
Building product disclosure and optimization:
environmental product declarations,
Material ingredient reporting, raw materials extraction
Local/regional
Recycled content

MORE COMPLETE

DESIGN AND CONSTRUCTION
Whole-building life cycle assessment
Recycling
Building reuse

LEED 2009

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LEED® v4 – MR Credit is more about Performance

MR Credit category focuses on **minimizing** the embodied energy and other impacts associated with the extraction, processing, transport, maintenance, and disposal of building materials. The requirements are designed to support a life-cycle approach that **improves performance** and promotes resource efficiency.

### MATERIALS & RESOURCES

<table>
<thead>
<tr>
<th>MRp1</th>
<th>Storage and collection of recyclables</th>
<th>POSSIBLE 13</th>
<th>REQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRp2</td>
<td>Construction and demolition waste management planning</td>
<td>POSSIBLE 13</td>
<td>REQ</td>
</tr>
<tr>
<td>MRc1</td>
<td>Building life-cycle impact reduction</td>
<td>POSSIBLE 13</td>
<td>5</td>
</tr>
<tr>
<td>MRc2</td>
<td>Building product disclosure and optimization – Environmental Product Declarations (EPD)</td>
<td>POSSIBLE 13</td>
<td>2</td>
</tr>
<tr>
<td>MRc3</td>
<td>Building product disclosure and optimization – Sourcing of Raw Materials</td>
<td>POSSIBLE 13</td>
<td>2</td>
</tr>
<tr>
<td>MRc4</td>
<td>Building product disclosure and optimization – Material Ingredients</td>
<td>POSSIBLE 13</td>
<td>2</td>
</tr>
<tr>
<td>MRc5</td>
<td>Construction and demolition waste management</td>
<td>POSSIBLE 13</td>
<td>2</td>
</tr>
</tbody>
</table>


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Option 1 - Environmental Product Declaration (1 point)

20 permanently installed products (at least 5 different manufacturers)

- Product specific declaration - publicly available, critically reviewed

  Life Cycle Assessment conforming to ISO 14044 - ¼ value

- Environmental Products Declaration (EPD) which conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930
  - Industry Average EPD – third party verified Type III EPD – ½ value;
  - Company specific product EPD – third party verified Type III EPD – full value

Option 2 – Multi-Attribute Optimization (1 point)

50% by cost – credit geared at **company level EPDs**

- Demonstrate Environmental Impact Reduction below an **Industry Average** profile in a minimum of **three** of the six impact categories:

Global Warming Potential
Measured in equivalent mass of CO₂ eq
- Affects everything
- Caused by greenhouse gas emissions such as Carbon dioxide (CO₂), Methane (CH₄), Nitrous oxide (N₂O), Chlorofluorocarbons (CFCs).

Source: Mark Lucuik, June 2015, adjusted
Ozone Depletion

Measured in equivalent mass of CFC-11 eq

- Caused by Chlorofluorcarbons (CFCs), Hydrochlorofluorocarbons (HCFCs), Halons, Bromochloromethane, Carbon Tetrachloride, Methyl Bromide, Methyl Chloroform, Hydrobromofluorocarbons etc.

- Reduces protection from dangerous solar radiation

Source: Mark Lucuik, June 2015, adjusted
Acidification of land and water sources
Measured in equivalent mass of sulphur dioxide (SO₂ eq) or in moles H⁺ eq

- This is the effect of acid rain
- Damaging to plants and animals

Source: Mark Lucuik, June 2015, adjusted
Eutrophication

Measured in equivalent mass of nitrogen (N eq) or phosphate (PO$_4^{3-}$ eq)

- Overly-enriched water systems leading to algae blooms that choke out other life

Source: Mark Lucuik, June 2015, adjusted
Formation of Tropospheric Ozone (Smog)

Measured in equivalent mass of nitrogen oxides ($\text{NO}_x \text{ eq}$), ozone ($\text{O}_3 \text{ eq}$), or ethene ($\text{C}_2\text{H}_4 \text{ eq}$)

- Wide range of harmful effects on humans, animals, plants and materials

Source: Mark Lucuiik, June 2015, adjusted
Depletion of Non-renewable Energy Resources

Measured in mega-joules (MJ)

- Fossil fuels are a finite global resource

Source: Mark Lucuik, June 2015
LCA is a compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.
ISO 14040/44 Framework

Life Cycle Assessment Framework

Goal & Scope Definition

Inventory Analysis

Impact Assessment

Interpretation

Direct Applications

- Product development and improvement
  - Strategic planning
  - Public policy making
  - Marketing
  - Other (e.g. Cornerstone of EPDs)

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EPD Development Process - PCR, LCA, and EPD

1. PCR set the rules for conducting the LCA and preparing EPD report (ISO 14025, EN 15804 or ISO 21930)

2. LCA conducted according to (ISO 14040/44) and PCR

3. EPD 3rd party verified by EPD Program Operator

4. Can support either industry average or company level reporting
North American EPD Program Operators for Building & Construction Products

Program Operator Consortium

Program Operator Consortium EPD / Transparency Report Catalog:
https://docs.google.com/spreadsheets/u/1/d/1XJtw9FN3AjTuMZiUENex6N7E7TawatNCCYxBEmrwdPM/pubhtml#

North American PCR Catalog:
https://docs.google.com/spreadsheets/d/1IS7ukMUG1cAWnMGHKiqlvgcgeHQQeICIHt95lnZy8/pubhtml

http://iere.org/programs/earthsure/

http://www.nrmca.org/sustainability/epdprogram/

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Building Life Cycle Stages (EN15804) and Types of EPDs

PRODUCTION Stage
- A1 Raw Material Supply
- A2 Transport
- A3 Manufacturing

CONSTRUCTION PROCESS Stage
- A4 Transport
- A5 Construction-installation Process

USE Stage
- B1 Use
- B2 Maintenance
- B3 Repair
- B4 Replacement
- B5 Refurbishment
- B6 Operational Energy Use
- B7 Operational Water Use

END OF LIFE Stage
- C1 De-construction Demolition
- C2 Transport
- C3 Waste Processing
- C4 Disposal

N.A. Building Product LCAs & EPDs typically C2Gate

B2B Focus

Declared Unit (e.g., m³ of concrete or wood)
Case Study – North American PCR for Precast Concrete Products (1)

**PCR Program Operator**: ASTM International

**PCR Scope**: Cradle-to-Gate (B2B Focus)

**Declared Unit** – One metric tonne

**Product groups** – Structural precast, architectural precast,
insulated architectural precast and underground precast
Case Study – North American PCR for Precast Concrete Products (2)
Case Study – North American EPDs for Precast Concrete Products (1)

Structural Precast Concrete Industry Wide EPD

Underground Precast Concrete Industry Wide EPD

Architectural & Insulated Wall Panel Industry Wide EPD
Case Study – North American EPDs for Precast Concrete Products (2)

EPD Production Stage Summary Results – **one metric ton** of Structural Precast

<table>
<thead>
<tr>
<th>Category Indicator</th>
<th>Unit</th>
<th>Raw Material Supply</th>
<th>Transport</th>
<th>Manufacturing</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A1</td>
<td>A2</td>
<td>A3</td>
<td></td>
</tr>
<tr>
<td>Global warming potential</td>
<td>kg CO₂ eq.</td>
<td>265.1</td>
<td>12.9</td>
<td>29.8</td>
<td>298.8</td>
</tr>
<tr>
<td>Acidification potential</td>
<td>kg SO₂ eq.</td>
<td>4.7</td>
<td>0.1</td>
<td>0.2</td>
<td>5.0</td>
</tr>
<tr>
<td>Eutrophication potential</td>
<td>kg N eq.</td>
<td>0.3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.3</td>
</tr>
<tr>
<td>Smog creation potential</td>
<td>kg O₃ eq.</td>
<td>54.0</td>
<td>3.0</td>
<td>1.6</td>
<td>58.6</td>
</tr>
<tr>
<td>Ozone depletion potential</td>
<td>kg CFC-11 eq.</td>
<td>1.9E-03</td>
<td>2.6E-13</td>
<td>5.8E-10</td>
<td>1.9E-03</td>
</tr>
</tbody>
</table>

**Primary Energy Consumption**

- Total Primary Energy: MJ, HHV
  - 1,900.4
  - 189.6
  - 530.2
  - 2,620.2

- Non-renewable (fossil, nuclear): MJ, HHV
  - 1,873.5
  - 189.3
  - 511.2
  - 2,574.1

- Renewable (solar, wind, biomass hydroelectric, & geothermal): MJ, HHV
  - 26.8
  - 0.3
  - 19.0
  - 46.1

**Material resources consumption**

- Total Material Resource Consumption: kg
  - 1,066.7
  - 0.0
  - 0.0
  - 1,066.7

- Non-renewable materials: kg
  - 1,065.8
  - 0.0
  - 0.0
  - 1,065.8

- Renewable materials: kg
  - 0.9
  - 0.0
  - 0.0
  - 0.9

- Fresh water: l
  - 1,340.3
  - 0.0
  - 257.0
  - 1,597.3

**Waste generated**

- Non-hazardous: kg
  - 1.0
  - 0.0
  - 64.2
  - 65.2

- Hazardous: kg
  - 0.01
  - 0.0
  - 10.0
  - 10.0
EPDs will soon be commonplace for most building materials and products.

EPDs are increasingly important for:
- Securing and enhancing market share
- Credible, transparent sustainability leadership
- Effective government relations
- Industry benchmarking and reporting
- Improving product performance
EPDs can drive supply chain innovation and improve decision making within a product type, but are less valuable when comparing competing materials (e.g., concrete vs. steel).

Long term benefit is building an inventory of supply chain EPD information to facilitate cradle-to-grave, whole-building LCAs.

Need assessment tools capable of drawing on these EPDs to optimize our investment in buildings.
LEED® v4 MR Credit 1 - Whole-Building LCA

- Athena IE4B complies with credits and system boundaries
- Developed “WB-LCA Guide” to assist users when targeting these credits

DOWNLOAD the software at: www.calculateLCA.com
LCA Points for Canadian LEED projects-MRc1, Option 4

- LEED v4
  
  MR Credit Building Life Cycle Impact Reduction (Option 4)
  
  - Base credit is worth 3 points
  - Exemplary performance is available for 1 Innovation point
  - In some areas, 1 Regional Priority point is available
    - Most of BC (Vancouver, Victoria, Kelowna, Prince George, etc)
    - Eastern Ontario (Toronto, London, Kingston, North Bay, Ottawa, etc)
    - Almost all of Quebec
    - Newfoundland and Labrador
    - Yukon, NWT and Nunavut

Source: Mark Lucuik, June 2015
Whole-Building LCA- In Several North American Codes, Standards and Rating Programs

**LEED® v4** MRc1 Credit Building Life-Cycle Impact Reduction Option 4 - Whole-building life-cycle assessment (3 points)

**Green Globes®** for New Construction (June 2013 release) rebranded as **BOMA BEST** – Section 3.5.1.1 Path A

The 2012 International Green Construction Code (**IgCC**) building Code – Section 303

The 2010 California Green Building Standard Code (**CALGreen**) Building code – Section A5.409.2

Source: 2014 Athena Guide to Whole-building LCA in Green building Programs

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<table>
<thead>
<tr>
<th>Compliance Requirements in North American Green Building Programs (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact Indicators to be Quantified</strong></td>
</tr>
<tr>
<td>LEED v4</td>
</tr>
<tr>
<td>Green Globes 2013</td>
</tr>
<tr>
<td>IgCC 2012</td>
</tr>
<tr>
<td>CALGreen 2010/2012</td>
</tr>
<tr>
<td>Non-renewable primary energy</td>
</tr>
<tr>
<td>Fossil fuel primary energy</td>
</tr>
<tr>
<td>Total primary energy</td>
</tr>
<tr>
<td>Fossil fuel primary energy</td>
</tr>
<tr>
<td>Global warming potential</td>
</tr>
<tr>
<td>Acidification potential</td>
</tr>
<tr>
<td>Eutrophication potential</td>
</tr>
<tr>
<td>Ozone depletion potential</td>
</tr>
<tr>
<td>Smog potential</td>
</tr>
<tr>
<td>Minimum 10% reduction for at least three impact indicators, one of which must be global warming potential.</td>
</tr>
<tr>
<td>Minimum 10% reduction for at least three impact indicators, one of which must be global warming potential; or, minimum 15% reduction for at two indicators, one of which must be GWP; or, minimum 20% reduction in GWP.</td>
</tr>
<tr>
<td>Minimum 20% reduction for at least three impact indicators, one of which must be global warming potential.</td>
</tr>
<tr>
<td>Minimum 10% reduction for at least three impact indicators, one of which must be global warming potential.</td>
</tr>
<tr>
<td>Maximum 5% increase for any impact indicator</td>
</tr>
<tr>
<td>No more than one impact indicator can increase.</td>
</tr>
<tr>
<td>None stated</td>
</tr>
<tr>
<td>None stated</td>
</tr>
<tr>
<td>Minimum 60 years and maximum of 120 years, unless otherwise approved by a Green Globes assessor.</td>
</tr>
<tr>
<td>None stated</td>
</tr>
<tr>
<td>Minimum 60 years unless approved by the enforcing agency</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Source: 2014 Athena Guide to Whole-building LCA in Green Building Programs</td>
</tr>
<tr>
<td>Construct Canada 2016, Bushi, L 20161130</td>
</tr>
</tbody>
</table>
Examples - Comparative Whole-Building LCA Results

Source: 2014 Athena Guide to Whole-building LCA in Green Building Programs

![Bar chart showing comparative LCA results for different impacts such as Global warming, Acidification, Eutrophication, Ozone depletion, Smog, and Primary energy. The chart illustrates improvements and exceedances in each category.]

<table>
<thead>
<tr>
<th>Impacts</th>
<th>Units</th>
<th>Reference Building</th>
<th>Proposed Building</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Warming</td>
<td>kg CO₂ eq.</td>
<td>384,786</td>
<td>338,612</td>
<td>-12%</td>
</tr>
<tr>
<td>Acidification</td>
<td>kg SO₂ eq.</td>
<td>3,231</td>
<td>3,199</td>
<td>-1%</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>kg N eq.</td>
<td>44.1</td>
<td>45.9</td>
<td>4%</td>
</tr>
<tr>
<td>Ozone depletion</td>
<td>kg CFC-11 eq.</td>
<td>0.00034</td>
<td>0.00034</td>
<td>0%</td>
</tr>
<tr>
<td>Smog</td>
<td>kg O₃ eq.</td>
<td>10,820</td>
<td>9,738</td>
<td>-10%</td>
</tr>
<tr>
<td>Primary Energy</td>
<td>MJ</td>
<td>6,560,563</td>
<td>5,576,479</td>
<td>-15%</td>
</tr>
</tbody>
</table>

Source: 2014 Athena Guide to Whole-building LCA in Green Building Programs

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Summary

- The **PCR, LCA and EPD** framework is now well established globally

- **Building material EPDs (LEED v4 MRc2)** are becoming more commonly available in North America

- **Supply Chain EPDs** can:
  - Drive transparency and innovation in lower burden materials
  - Help lay the groundwork for robust lifecycle inventory data and tools to make better project level decisions for sustainability

- **Whole-Building LCA** can be very complex, but software is available to greatly simplify the process

- **LEED V4 MRc1 (option 4)** is achievable and straightforward for many projects
The Athena Sustainable Materials Institute
Ottawa, ON, Canada

Athena Institute International
Kutztown, PA, USA

info@athenasmi.org

www.athenasmi.org

Get in touch with us for more information.

QUESTIONS ?