Athena Sustainable Materials Institute

www.athenasmi.org

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

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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

Athena Impact Estimator for Buildings

Athena Pavement LCA

What is Green Building?

Green building …

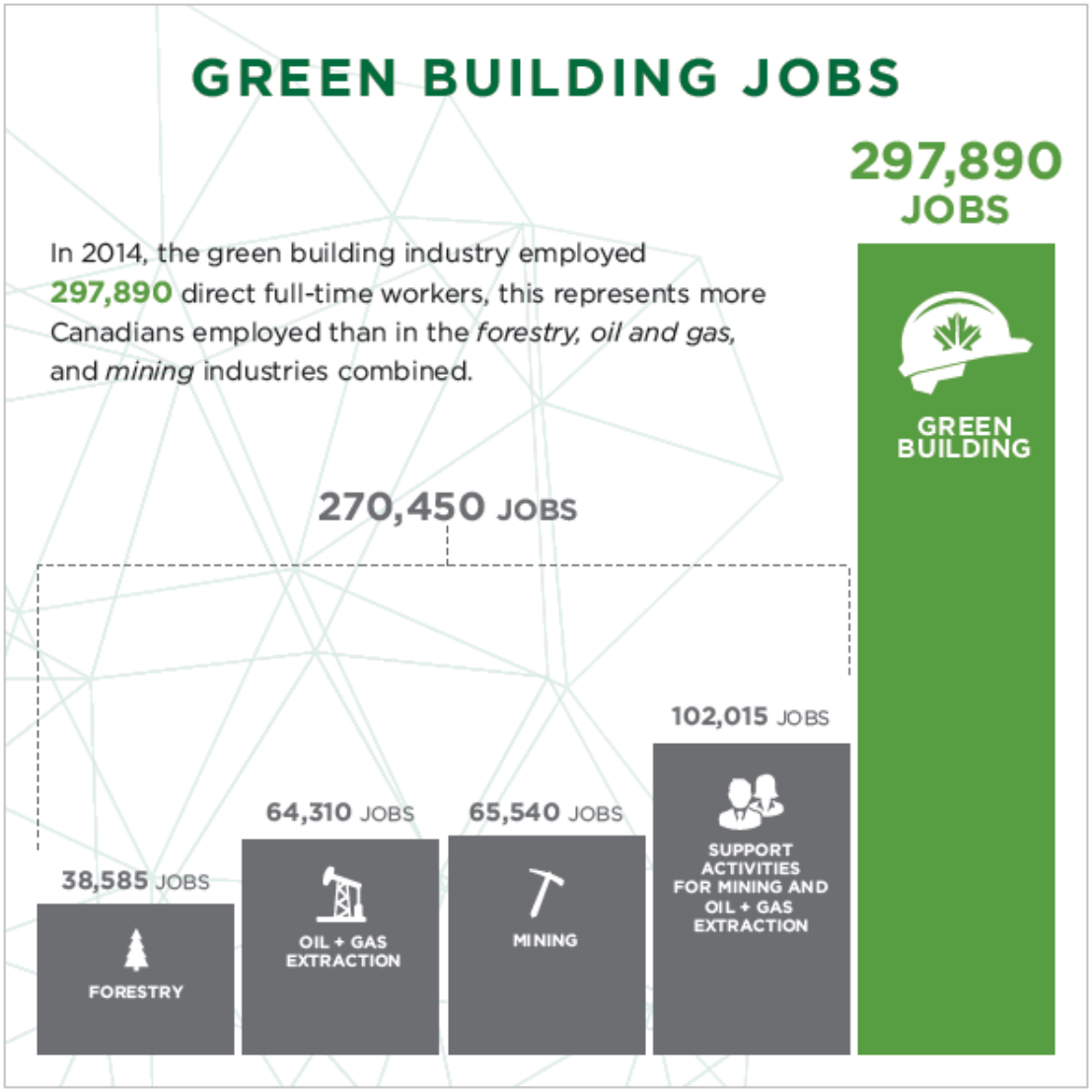
… is recognized globally as a **method and practice** for addressing climate change, minimizing energy and resource demands, and for building more resilient and healthy communities.

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

Economic Impact of Canada's Green Building Industry

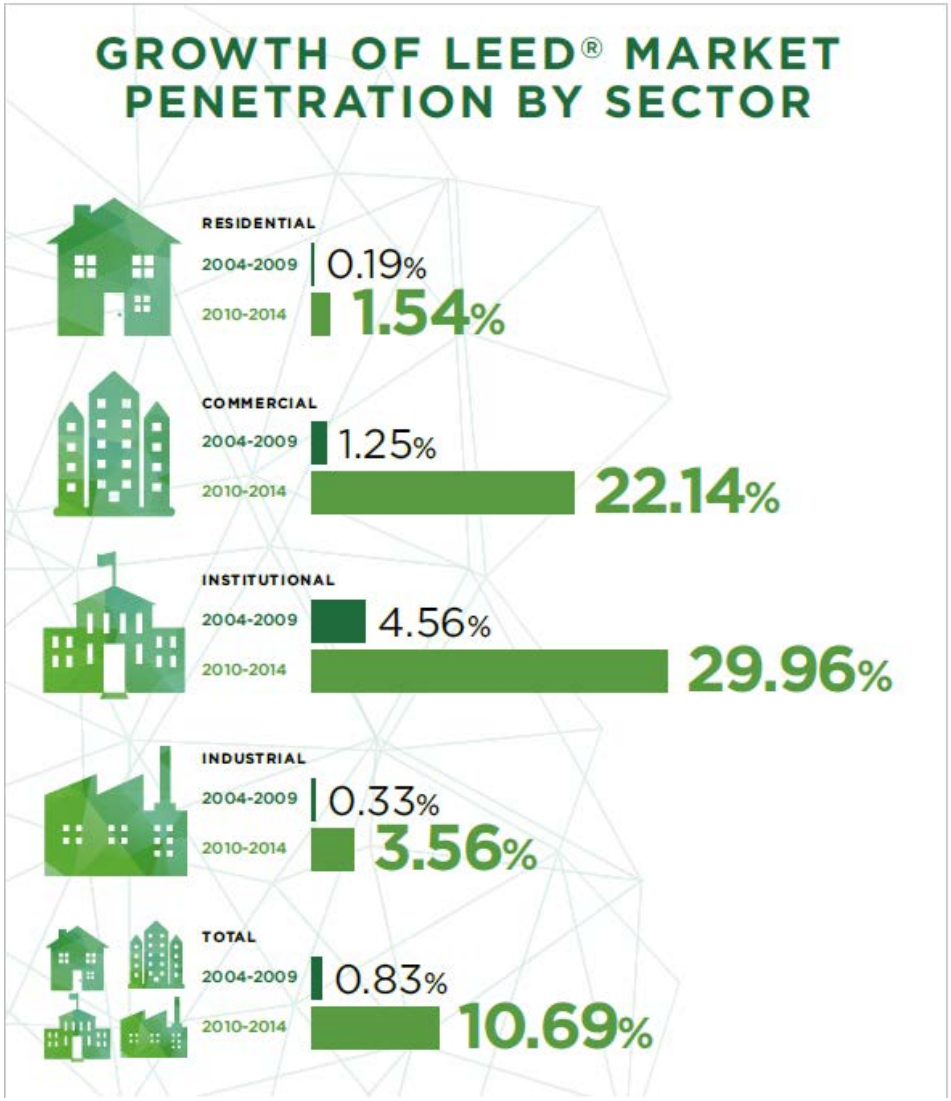
Source: 2016 CaGBC GREEN BUILDING IN CANADA Assessing the Market Impacts & Opportunities

Economic Impact of Canada's Green Building Industry (2)



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

Green Building Industry Growth in Canada (1)



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

Green Building Industry Growth in Canada (2)

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/

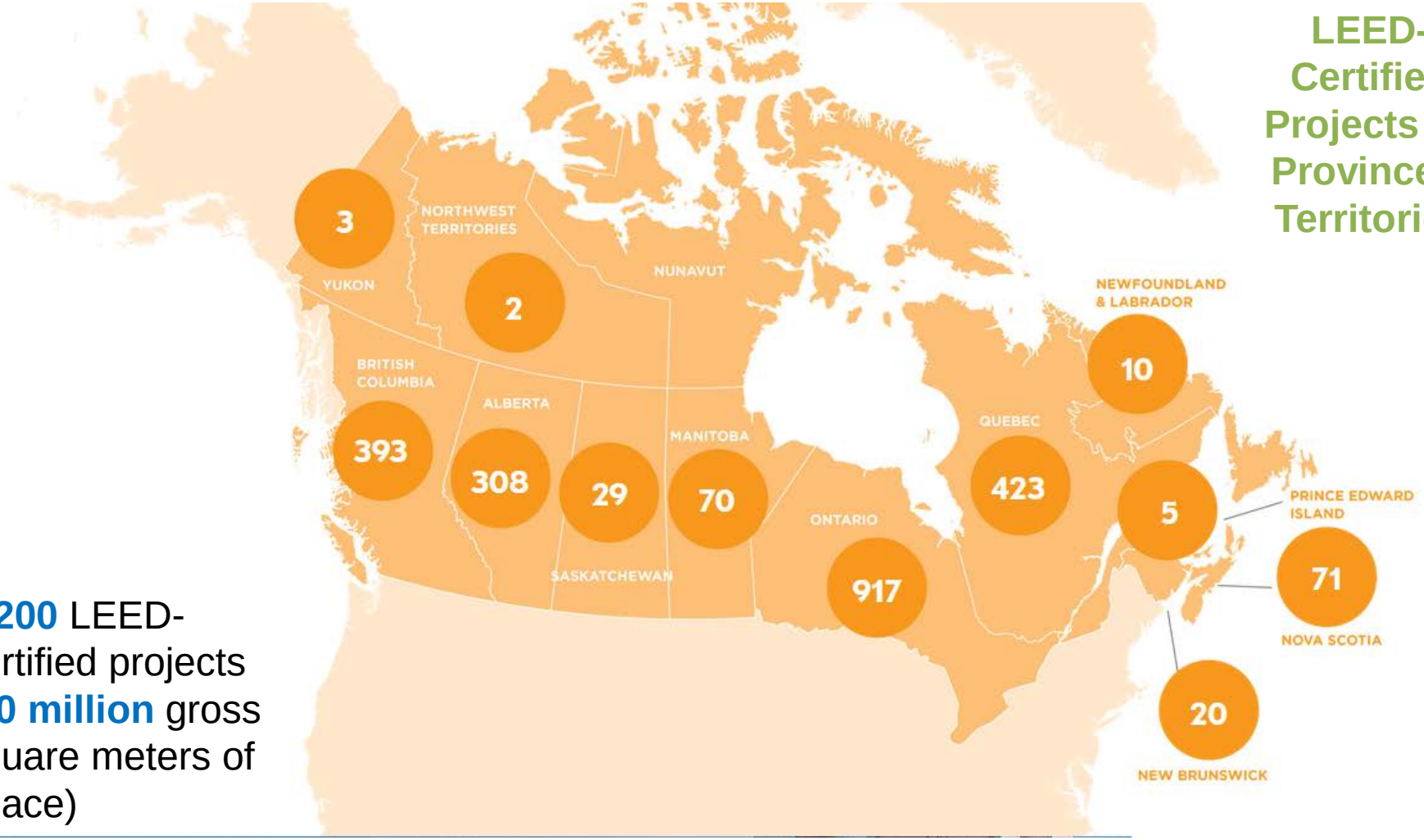
Source: 2016 CaGBC GREEN BUILDING IN CANADA Assessing the Market Impacts & Opportunities

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

LEED® Buildings- Where in Canada is LEED® being used?



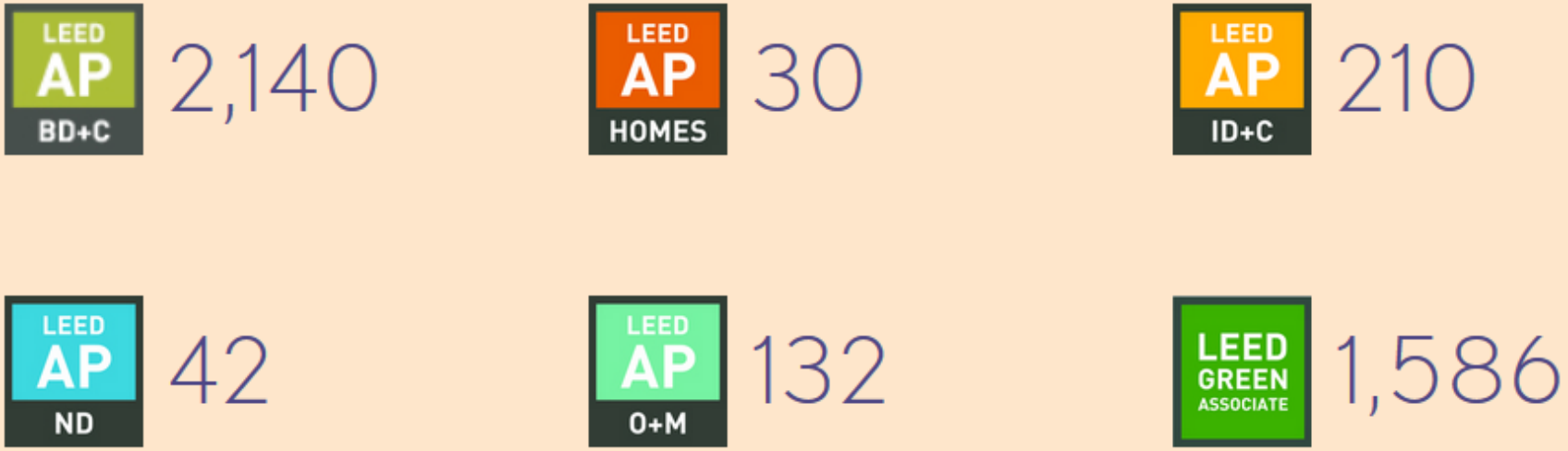
LEED-Certified Projects by Provinces/ Territories

2,200 LEED-certified projects (**30 million** gross square meters of space)

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

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.



(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

Introduction to LEED® v4

5 Rating systems

BD+C
BUILDING DESIGN + CONTRUCTION
New Construction
Core & Shell
Schools
Retail
Healthcare
Data Centres
Hospitality
Warehouses & Distribution

ID+C
INTERIOR DESIGN + CONSTRUCTION
Commerical Interiors
Retail
Hospitality

O+M
OPERATION + MAINTENANCE
Existing Buildings
Data Centres
Warehouses & Distribution
Hospitality
Schools
Retail

ND
NEIGHBOURHOOD DEVELOPMENT
New land developments
Land Redevelopment
Residential
Mixed Use
Commercial
Industrial

HOMES
HOUSES + UNITS
Single Homes
Low Rise Multi Unit
Mid Rise Multi Unit

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.

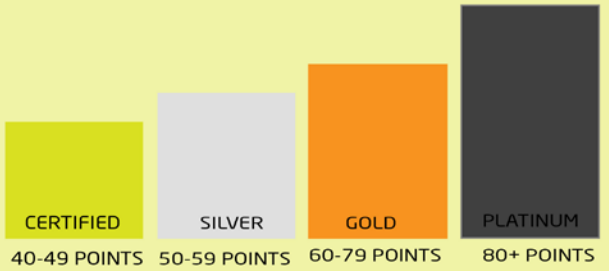
- **INTEGRATIVE PROCESS** — Encouraging cross discipline collaboration
- **LOCATION & TRANSPORTATION** — Access to variety of transport and/or credit for constrained sites
- **MATERIALS & RESOURCES** — Using sustainable materials & reducing waste
- **WATER EFFICIENCY** — Smart use and reuse of water
- **ENERGY & ATMOSPHERE** — Energy Performance
- **SUSTAINABLE SITES** — Minimising impact on ecosystems & water resources
- **INDOOR ENVIRONMENT** — Indoor air quality & access to natural light & views
- **INNOVATION**
- **REGIONAL PRIORITY** — Geographic environmental priorties

U.S. GREEN BUILDING COUNCIL — USGBC

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

Source: WT Sustainability 2015

The Ratings



How LEED® Works in Canada (1)?

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

How LEED® Works in Canada (3)?

LEED Requirements for City-Owned and/or Funded Projects in Canada

Calgary, AB
Kitchener, ON
Montreal, QC
New Westminster, BC
North Vancouver, BC
Regional Municipality of Wood Buffalo (Fort McMurray), AB
Richmond, BC
Vancouver, BC

Banff, AB
Burlington, ON
East Gwillimbury, ON
Edmonton, AB
Halifax, NS
Mississauga, ON
Oakville, ON
Region of Waterloo, ON
Region of York, ON
Richmond Hill, ON
Saanich, BC
Victoria, BC
(Required: LEED Silver, Goal: LEED Gold)
Winnipeg, MB
Yellowknife, NWT

Grand Prairie, AB
Moncton, NB
Ottawa, ON
(Required: LEED Certified, Goal: LEED Silver)
Spruce Grove, AB
St. Catherines, ON

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

LEED® v4 – Materials & Resources (MR) Credit

LEED v4

LEED 2009

	RAW MATERIALS	PRODUCTS	DESIGN AND CONSTRUCTION
LEED v4	**Sourcing:** wood, biobased, concrete, steel, mined and quarried	**Building product disclosure and optimization:** environmental product declarations, Material ingredient reporting, raw materials extraction	**Whole-building life cycle assessment**
LEED 2009	**Rapidly renewable** **Recycled content** **Wood**	**Local/regional** **Recycled content**	**Recycling** **Building reuse**

LARGER SCOPE

BETTER INFORMATION

MORE COMPLETE

Source: http://www.usgbc.org/articles/closer-look-materials-resources-leed-v4

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

Source: http://www.usgbc.org/credits/new-construction/v4/material-%26-resources

LEED® v4 - MR Credit 2, Option 1

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**

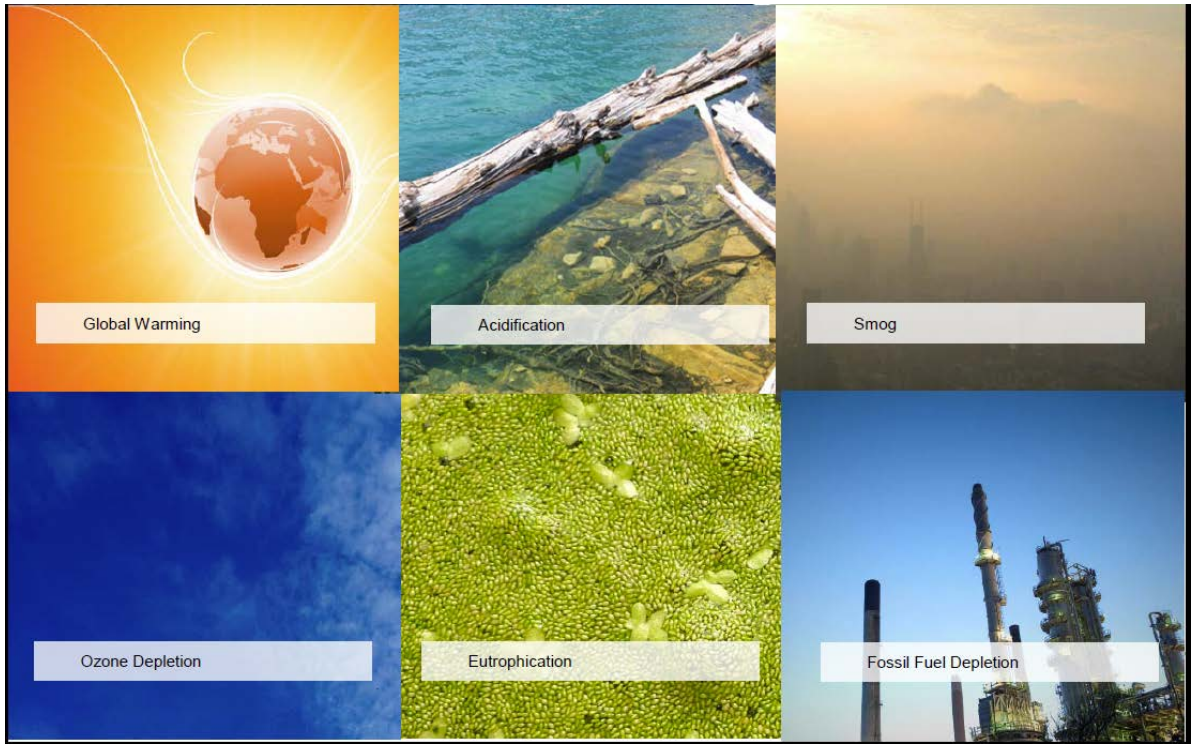
Source: http://www.usgbc.org/credits/new-construction-core-and-shell-schools-new-construction-retail-new-construction-healthca-22

LEED® v4 - MR Credit 2, Option 2

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:



Source: http://www.usgbc.org/credits/new-construction-core-and-shell-schools-new-construction-retail-new-construction-healthca-22

LEED® v4 – Impact Categories (1)

Global Warming Potential

Measured in equivalent mass of CO_2 eq

- Affects everything
- Caused by greenhouse gas emissions such as

  Carbon dioxide (CO_2), Methane (CH_4) Nitrous oxide (N_2O), Chlorofluorocarbons (CFCs).

Source: Mark Lucuik, June 2015, adjusted

LEED® v4 – Impact Categories (2)

Ozone Depletion

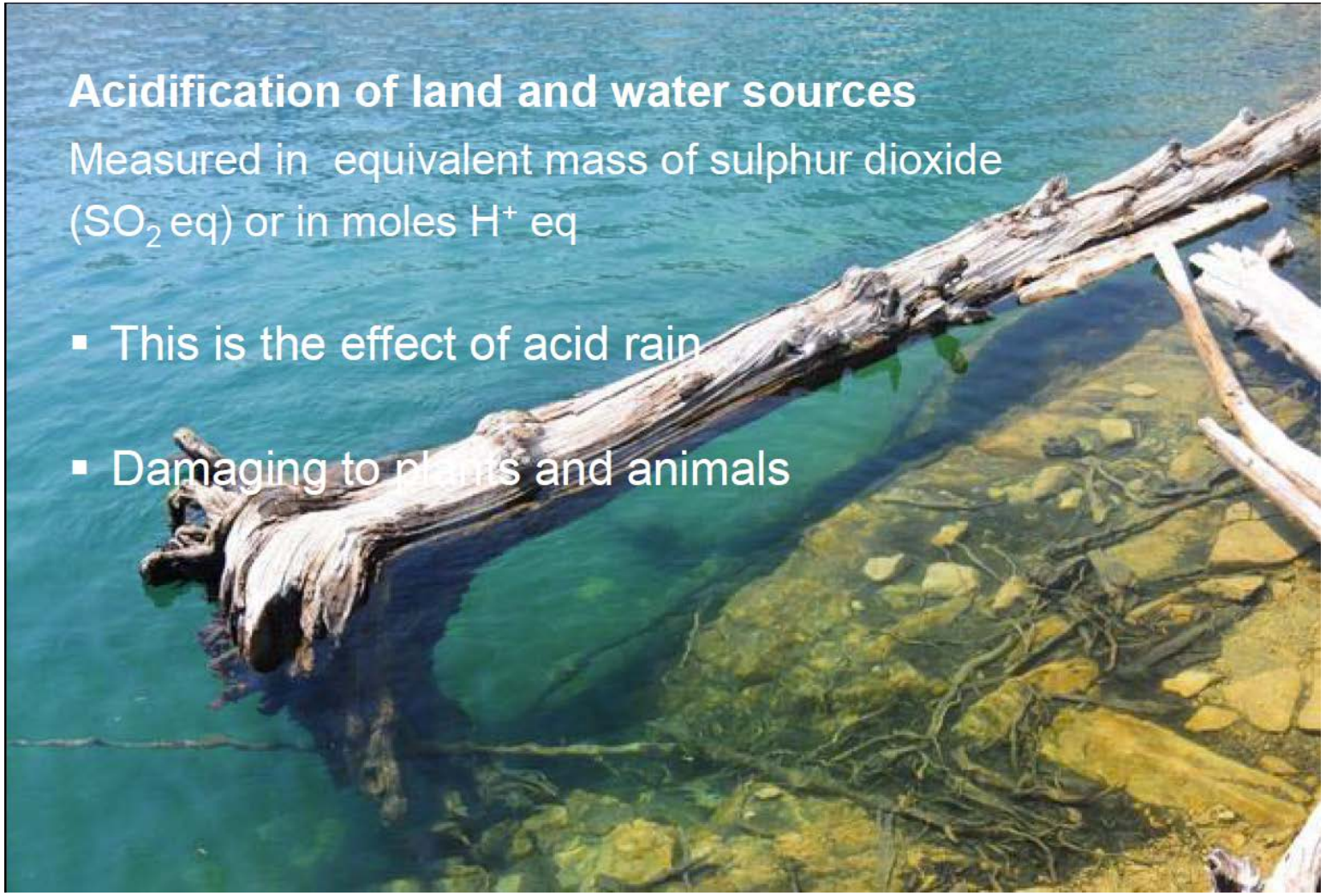
Measured in equivalent

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

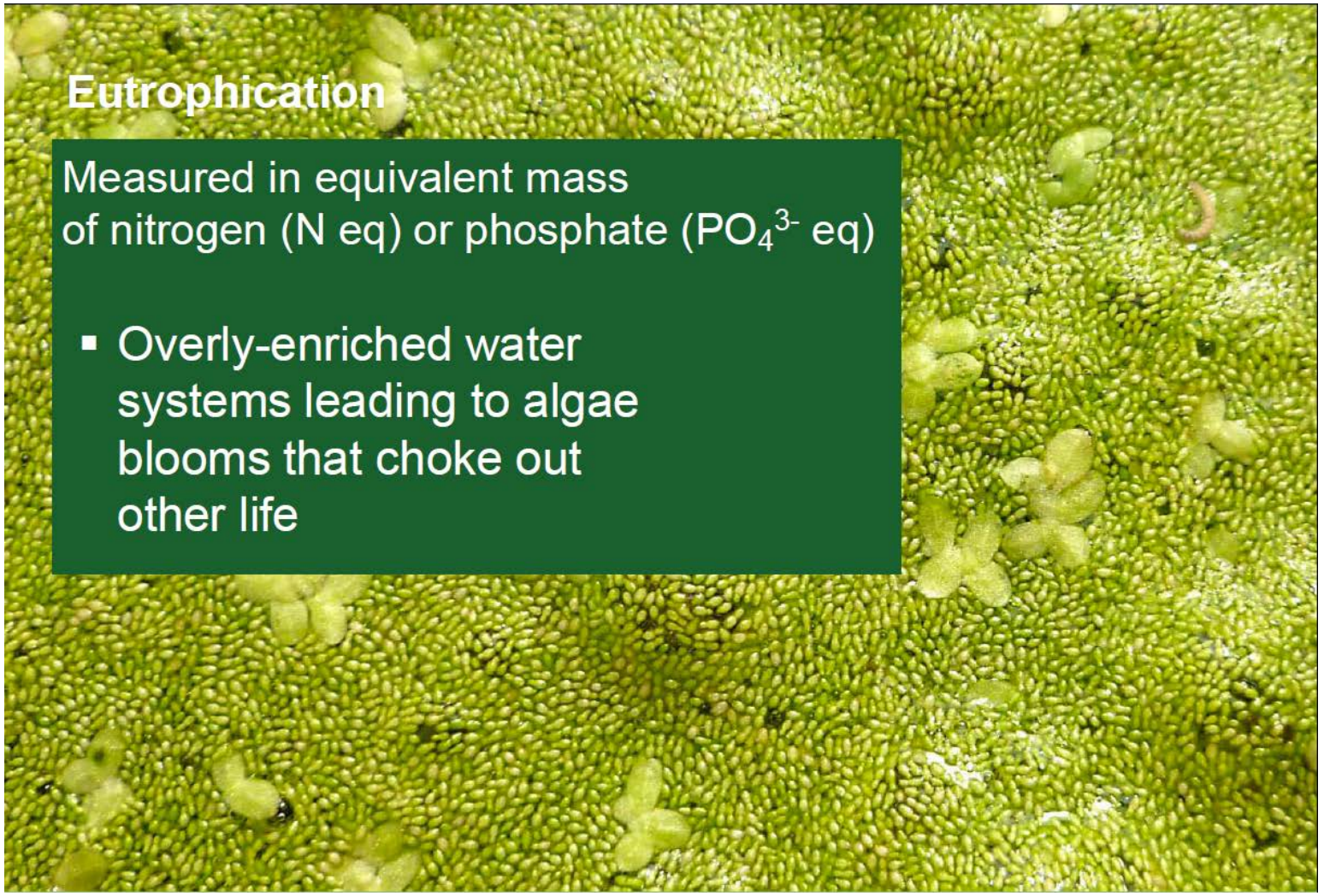
Source: Mark Lucuik, June 2015, adjusted

LEED® v4 – Impact Categories (3)



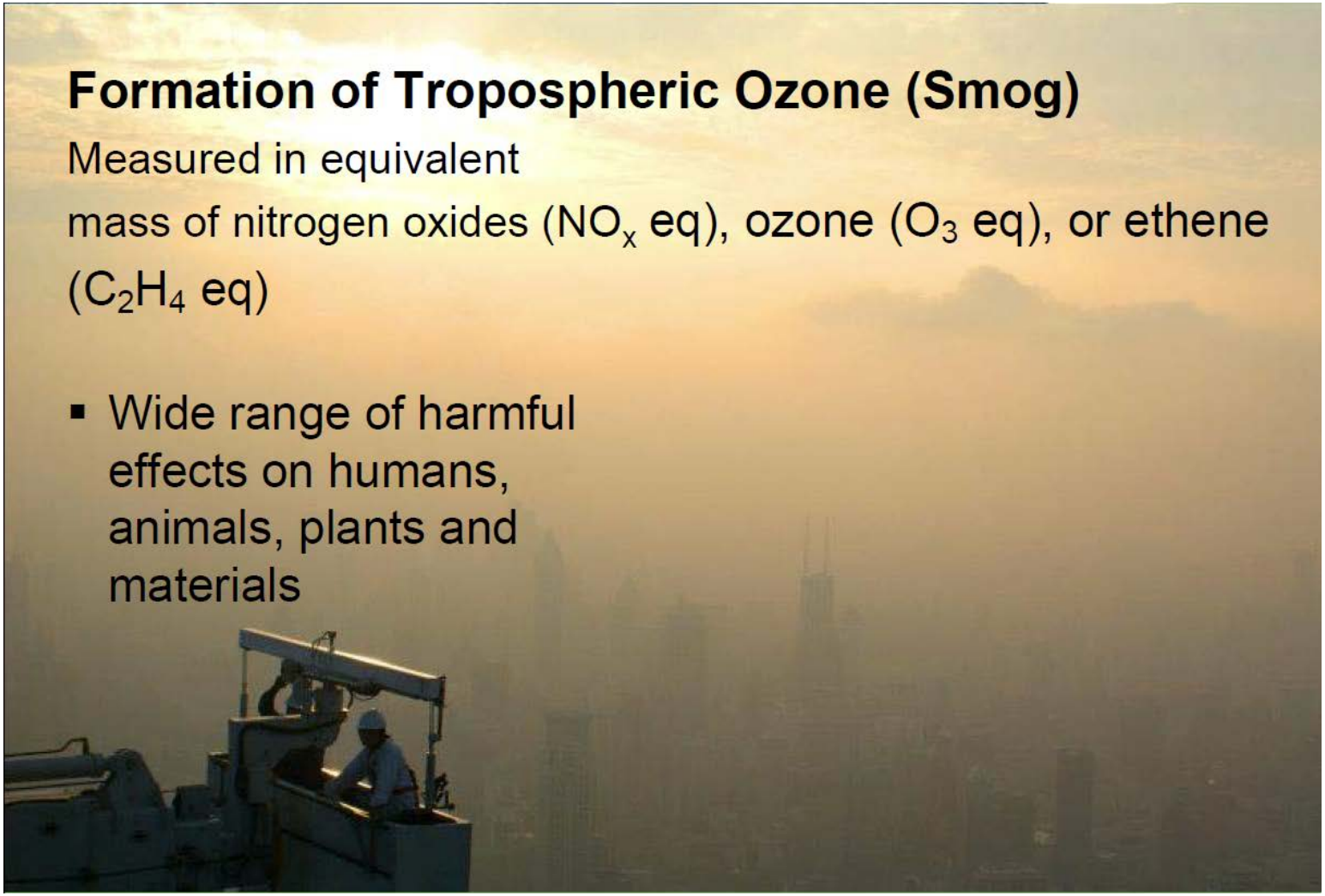
Source: Mark Lucuik, June 2015, adjusted

LEED® v4 – Impact Categories (4)



Source: Mark Lucuik, June 2015, adjusted

LEED® v4 – Impact Categories (5)



Source: Mark Lucuik, June 2015, adjusted

LEED® v4 – Impact Categories (6)

Depletion of Non-renewable Energy Resources

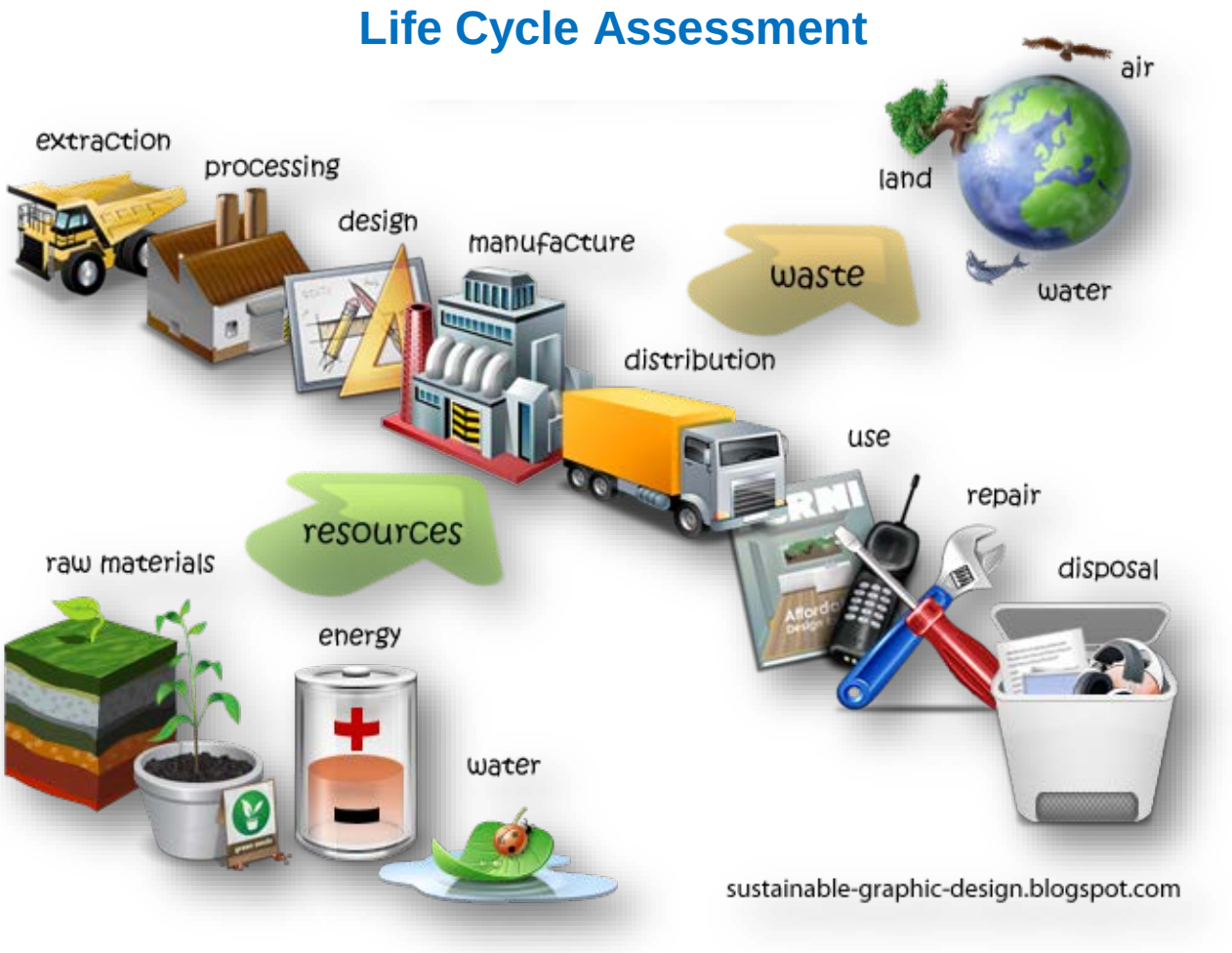
Measured in mega-joules (MJ)

- Fossil fuels are a finite global resource

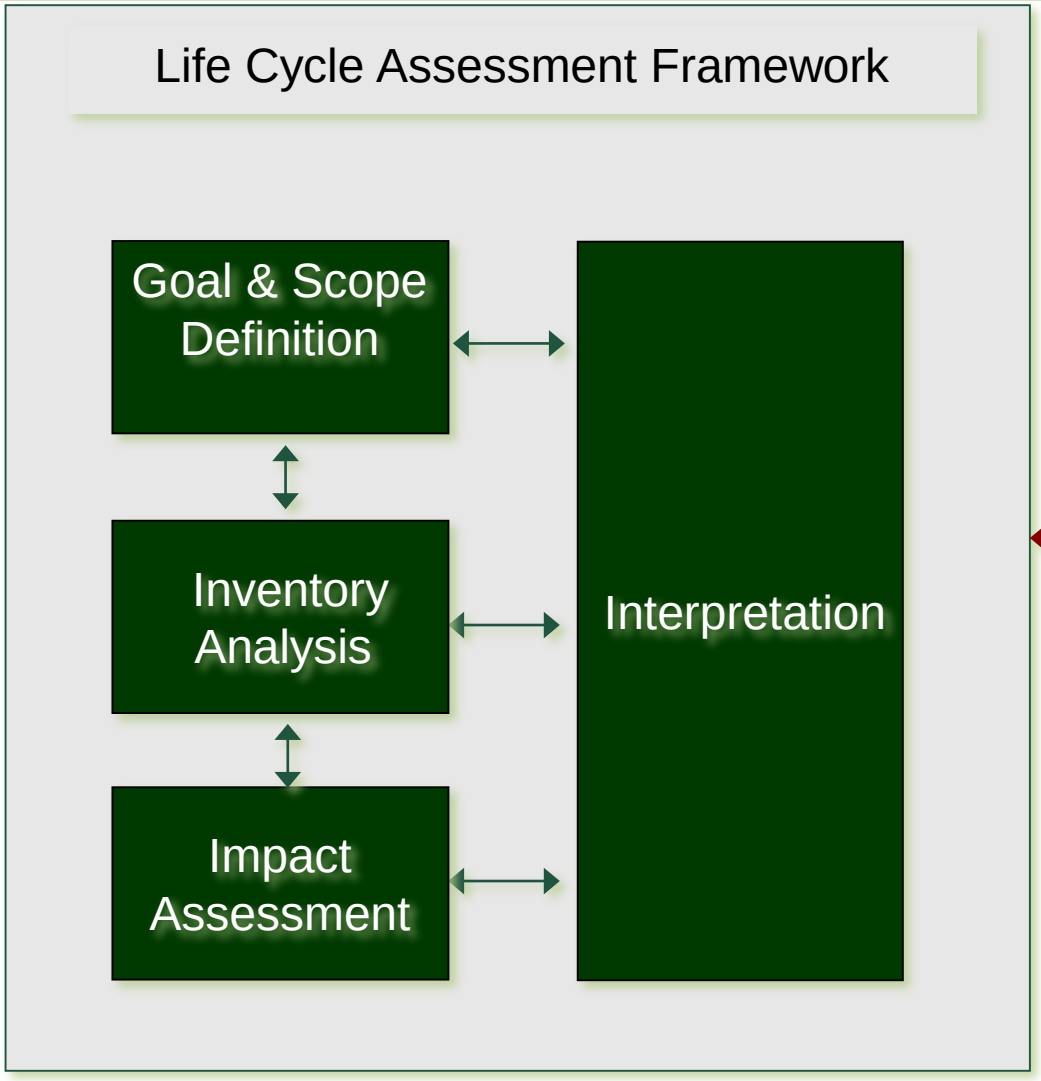
Source: Mark Lucuik, June 2015

Life Cycle Assessment- An Analytical Tool to Assess the Environmental Performance of Products

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



Direct Applications

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

EPD Development Process - PCR, LCA, and EPD

Utilize or Create Product Category Rules (PCR)

Conduct and Verify Life Cycle Assessment (LCA)

Create Environmental Product Declaration (EPD)

3rd Party Verification of EPD

Register EPD with Program Operator

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

ASTM INTERNATIONAL

SCSglobal SERVICES

ICC EVALUATION SERVICE

Sustainable Minds

NSF International

CSA Group

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/1lS7ukMUG1cAWnMGHKiqIvgcgeHQOeICIIH5t95InZy8/pubhtml

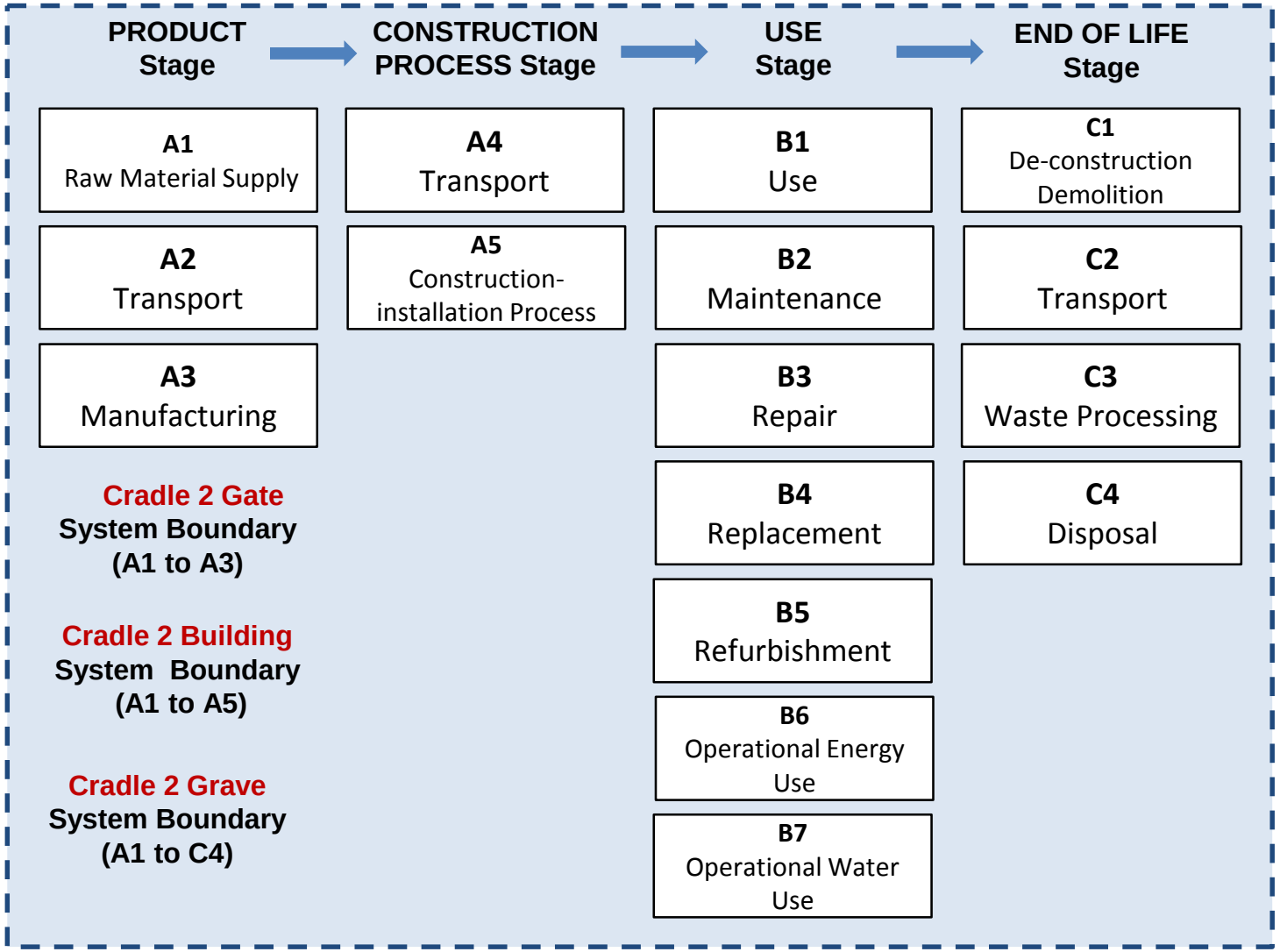
UL

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

NRMCA CERTIFIED EPD
http://www.nrmca.org/sustainability/epdprogram/

FPInnovations
www.fpinnovations.ca

Building Life Cycle Stages (EN15804) and Types of EPDs



N.A. Building Product LCAs & EPDs typically C2Gate

B2B Focus

Declared Unit (e.g., m^3 of concrete or wood)

Case Study – North American PCR for Precast Concrete Products (1)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE			
Raw material supply	Transport	Manufacturing	Transport	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste Processing	Disposal
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4

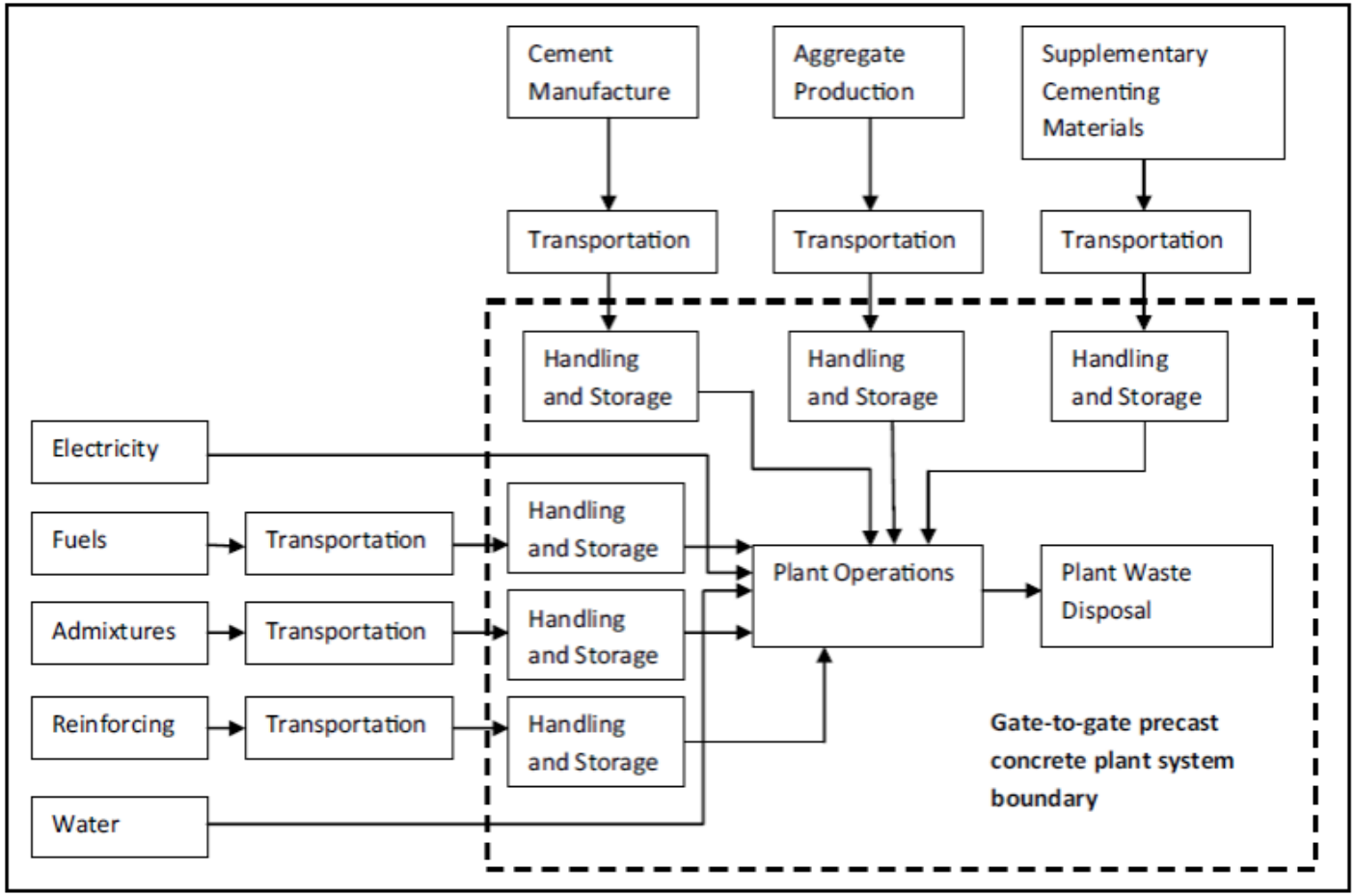
- **PCR Program Operator** : ASTM International
- **PCR Scope:** Cradle-to-Gate (B2B Focus)
- **Declared Unit** – One metric tonne
- **Product groups** – Structural precast, architectural precast,
- insulated architectural precast and underground precast

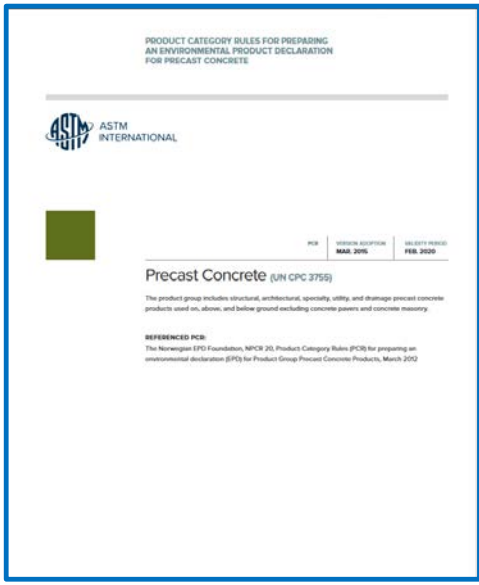
PRODUCT CATEGORY RULES FOR PREPARING AN ENVIRONMENTAL PRODUCT DECLARATION FOR PRECAST CONCRETE

ASTM INTERNATIONAL

Precast Concrete (UN CPC 3755)

Case Study – North American PCR for Precast Concrete Products (2)

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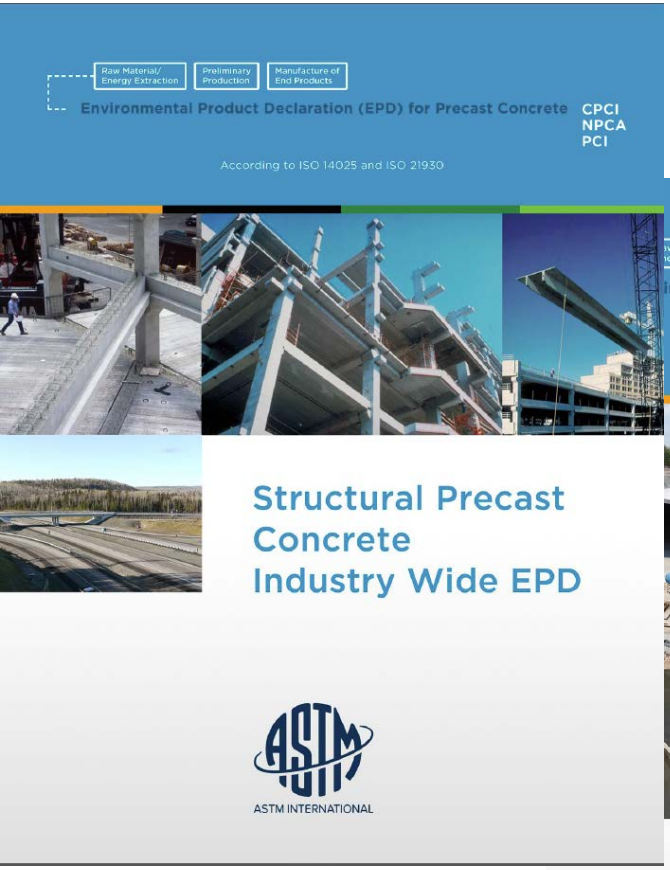
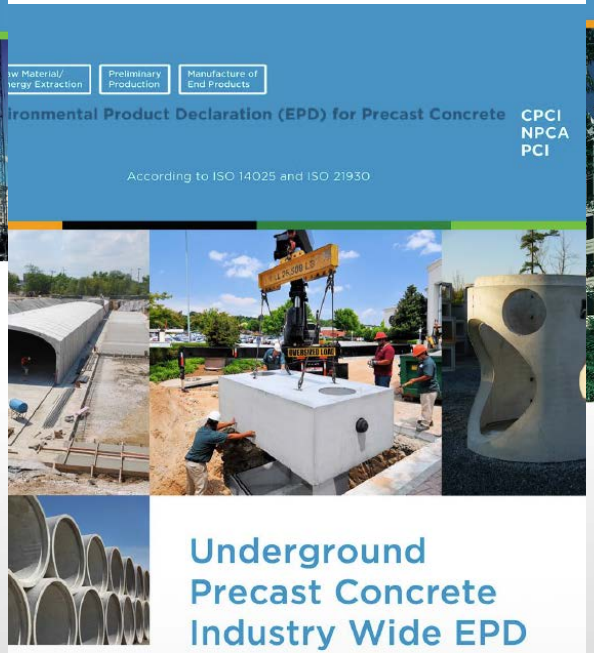
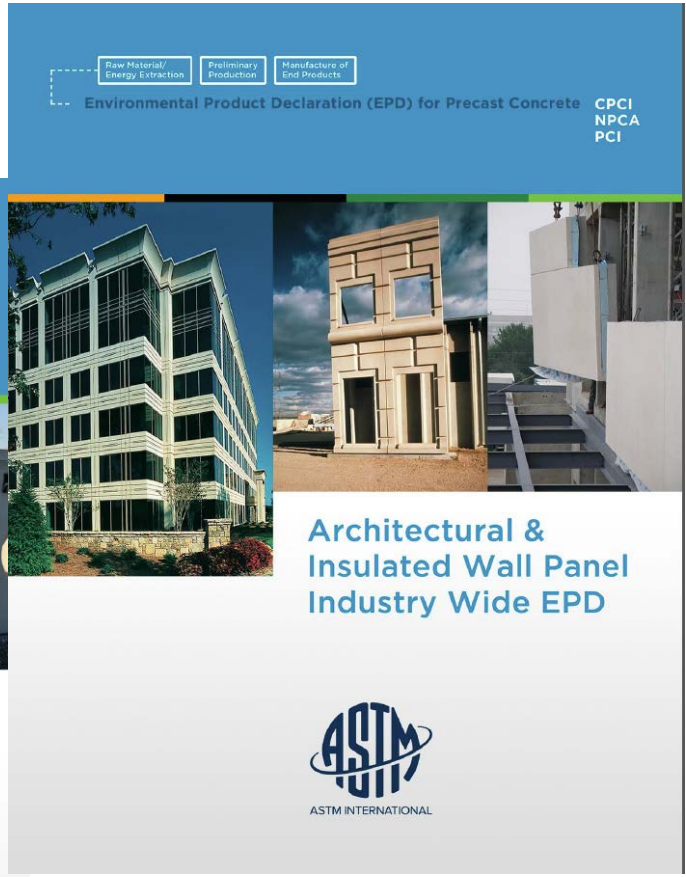
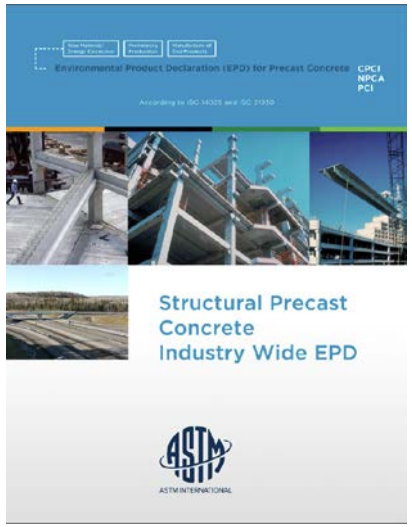






Case Study – North American EPDs for Precast Concrete Products (2)



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

Category Indicator	Unit	Raw Material Supply	Transport	Manufacturing	Total
		A1	A2	A3	
Global warming potential	kg CO_2 eq.	265.1	12.9	29.8	298.8
Acidification potential	kg SO_2 eq.	4.7	0.1	0.2	5.0
Eutrophication potential	kg N eq.	0.3	0.0	0.0	0.3
Smog creation potential	kg O_3 eq.	54.0	3.0	1.6	58.6
Ozone depletion potential	kg CFC-11 eq.	1.9E-03	2.6E-13	5.8E-10	1.9E-03
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

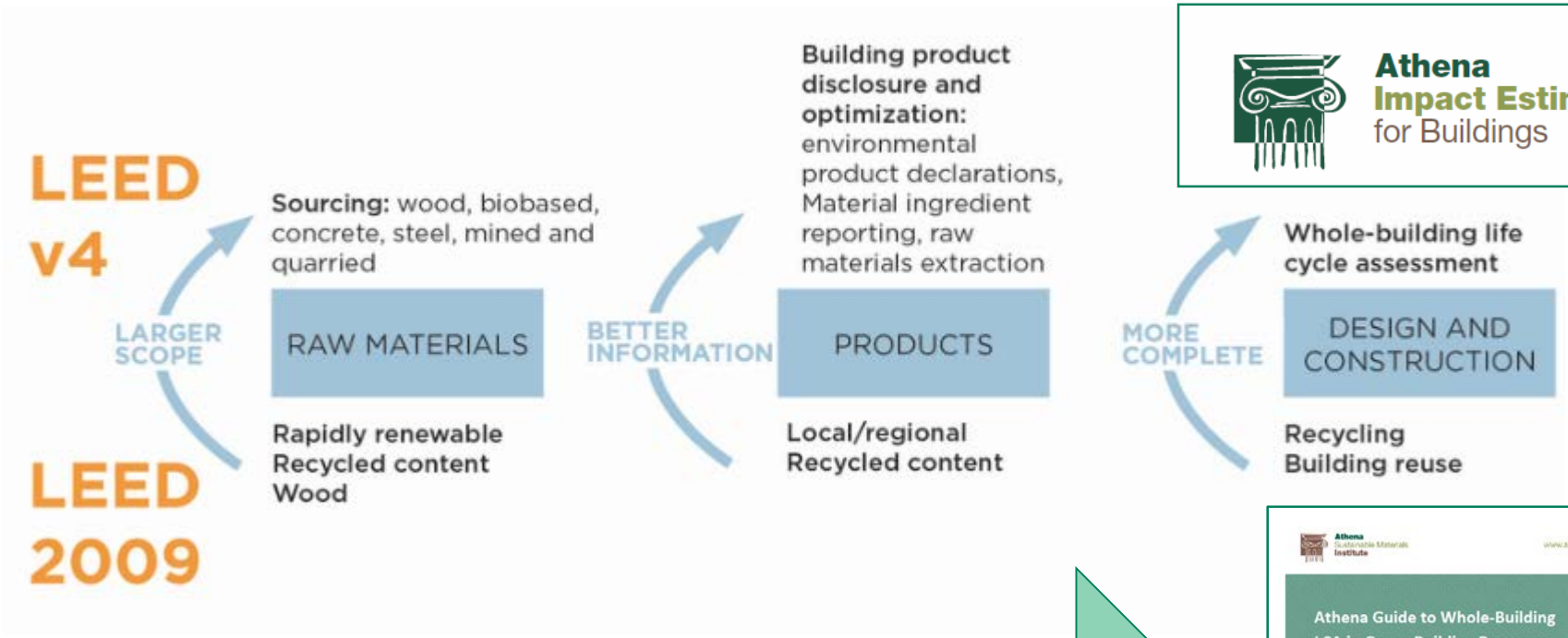
Building Products Industry Perspective

- 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

LCA & EPDs Can Drive Supply Chain Innovation

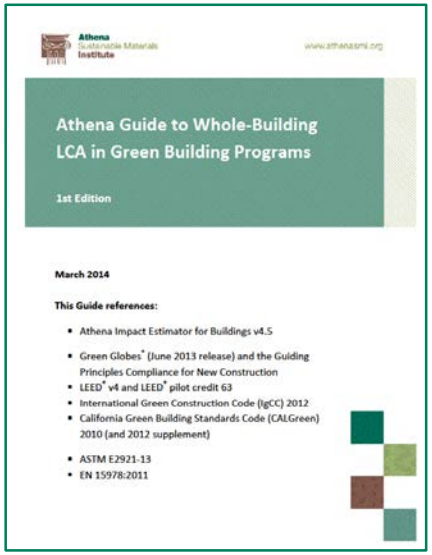
- EPDs can drive supply chain innovation and improve decision making within a product type, but are less valuable when comparing competing materials (e.g., concrete vs. steel)
- Long term benefit is building an inventory of supply chain EPD information to facilitate **cradle-to-grave, whole-building 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 Impact Estimator for Buildings

- 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

Athena Impact Estimator for Buildings

- 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

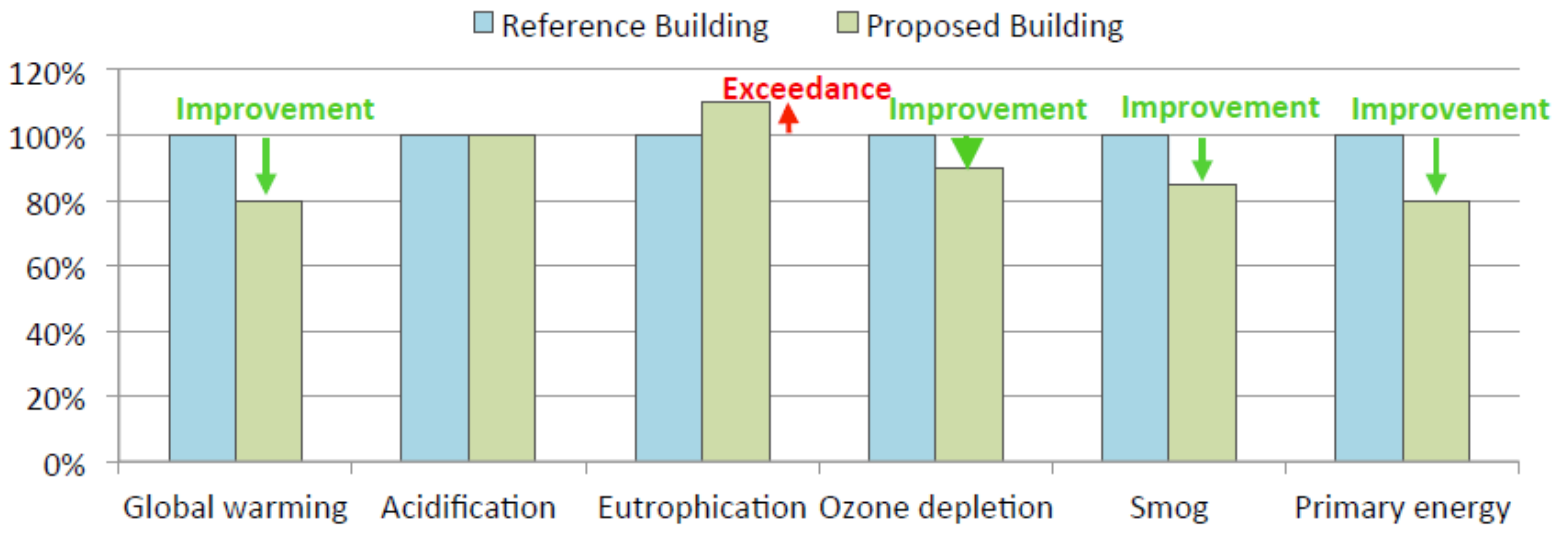
Source: 2014 Athena Guide to Whole-building LCA in Green building Programs
http://www.athenasmi.org/wp-content/uploads/2014/03/Athena_Guide_to_Whole-Building_LCA_in_Green_Building_Programs_March-2014.pdf

Compliance Requirements in North American Green Building Programs (1)

	LEED v4	Green Globes 2013[8]	IgCC 2012	CALGreen 2010/2012
Impact Indicators to be Quantified	Global warming potential Acidification potential Eutrophication potential Ozone depletion potential Smog potential			
	Non-renewable primary energy	Fossil fuel primary energy	Total primary energy	Fossil fuel primary energy
Improvement Target (Proposed Building relative to Reference Building)	Minimum 10% reduction for at least three of the impact indicators, one of which must be global warming potential.[9]	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.	Minimum 20% reduction for at least three impact indicators, one of which must be global warming potential.	Minimum 10% reduction for at least three impact indicators, one of which must be global warming potential.
Exceedance Limit (Proposed Building relative to Reference Building)	Maximum 5% increase for any impact indicator	No more than one impact indicator can increase.	None stated	None stated
Study Period	Minimum 60 years	Minimum of 60 years and maximum of 120 years, unless otherwise approved by a Green Globes assessor	None stated	Minimum 60 years unless approved by the enforcing agency

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

Examples - Comparative Whole-Building LCA Results



Impacts	Units	Reference Building	Proposed Building	% Change
Global Warming	kg CO_2 eq.	384,786	338,612	-12%
Acidification	kg SO_2 eq.	3,231	3,199	-1%
Eutrophication	kg N eq.	44.1	45.9	4%
Ozone depletion	kg CFC-11 eq.	0.00034	0.00034	0%
Smog	kg O_3 eq.	10,820	9,738	-10%
Primary Energy	MJ	6,560,563	5,576,479	-15%

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

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

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QUESTIONS ?