Environmental Product Declarations: Part 1

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Learning Objectives (Part 1+2)

- Identify the imperative for transparency
- Become aware of LEED v4 Material and Resources changes
- Understand Environmental Product Declarations (EPD)
- Realize the development of the Product Category Rule (PCR) for Concrete
- Introduce NRMCA EPD Program Operator status
So why should I care?

Why Should I Care?

Source: SBI Research, Green Building Materials and Construction, 3rd Edition
Opportunity for growth!

U.S. Nonresidential Green Building Market Size ($ Billions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Market Size ($ Billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>3</td>
</tr>
<tr>
<td>2008</td>
<td>29</td>
</tr>
<tr>
<td>2010</td>
<td>54</td>
</tr>
<tr>
<td>2015</td>
<td>145</td>
</tr>
</tbody>
</table>


Our competitors are doing it!

Steel

Asphalt

Wood
Proliferation of Green Standards

GREEN BUILDING
LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED V4)
Market Driver

- **Federal Government** – *Virtually every* federal agency has mandated LEED certification including:
  - GSA, the largest commercial property holder in the US
- **State Government** – *36 states* have enacted various LEED mandates
- **City Government** – *105* cities have mandated LEED requirements
- **Code** – A growing number of municipalities (San Francisco, Washington, Boston, LA) have implementing mandates
- **Private Sector Economics**
  - LEED Class A buildings on average $10/ft more lease rate
  - Vacancy rates were 4.2% lower for LEED

LEED v4 Credit Evolution
MR: Materials and Resources

- Recycled content for structural materials eliminated
- Regional Material eliminated
- Certified Wood eliminated
- Language for Fly Ash Mercury Restrictions removed (LEED HC)

MR: Building Life Cycle Impact Reduction

Option 4 Whole Building LCA (3 points)
- Impact reduction of 10% from Reference Building
- At least 60 year life span
- Not only focused on CO2 – via ISO 14044
  - Reduce GWP of CO₂ (Required)
  - Reduce ozone depletion (CFC)
  - Land /water Acidification
  - Eutrophication (phosphates)
  - Tropospheric Ozone (NOx)
  - Non renewable energy
MR: Building Product Disclosure And Optimization (3 Credits)

1. Environmental Product Declarations
2. Sourcing Of Raw Materials
3. Material Ingredients

- Transparency
- Third Party Verification

1. Environmental Product Declarations

Option 1 – EPDs (1 point)
20 Permanently Installed Products

- Product specific declaration – publicly available (1/4 Value)
- Industry average EPD – Third party certified Type III (1/2 Value)
- Product specific EPD – Third party certified Type III (Full Value)
- USGBC Approved Program
1. Environmental Product Declarations

Option 2 – Multi-Attribute Optimization (1 point)
50% by Cost

- Extended producer responsibility (1/2 Value)
- Environmental Impact Reduction below industry average – USGBC Approved Certification Program – (? Value, presumably full)
  - GWP
  - Ozone depletion
  - Eutrophication
  - Smog formation
  - Acidification
  - Depletion of nonrenewable energy

FINAL PRODUCT VALUE =
(base product value x valuation factor based on attribute criteria) * (valuation factor based on location)

100 Miles (200% Cost)
500 Miles (150% Cost)
2. Sourcing of Raw Materials

Option 1: Raw Material Source and Extraction Reporting (1 point)
- Manufacturer declared commitment (1/2 Value)
- Corporate Sustainability Report (Third Party Verified CSR) (Full Value)

Option 2: Leadership Extraction Practices (1 point)
- 25% By Cost
- Bio-based - Sustainable Agriculture
- New Wood – FSC
- Material Reuse – Salvage, Refurbished
- Recycled Content – pre/post consumer
- USGBC Approved Program
2. Sourcing of Raw Materials

FINAL PRODUCT VALUE =
(base product value x valuation factor based on attribute criteria)* (valuation factor based on location)

100 Miles (200% Cost)
500 Miles (150% Cost)

3. Material Ingredients

Option 1: Material Ingredients Reporting
(1 Point)
20 Permanently Installed Products

- **Manufacturer Inventory**
  - Chemical Abstract Service Registration Number
  - Green Screen List Translator Benchmark 1
- **Health Product Declaration (HPD)**
- **Cradle to Cradle Certification (silver)**
- **USGBC Approved Program**
- Inventoried to 1000 ppm
3. Material Ingredients

Option 2: Material Ingredients Optimization
(1 Point) 25% by Cost

- Manufacturer Inventory
  - No Ingredients have Green Screen List Translator Benchmark 1 Hazards
  - All Ingredients Pass Benchmark 2

- Cradle to Cradle Certification
  - Gold (100% of Cost)
  - Platinum (150% of Cost)

- USGBC Approved Program
- International Alternate – REACH

FINAL PRODUCT VALUE = 
(base product value x valuation factor based on attribute criteria) * (valuation factor based on location)

100 Miles (200% Cost)
500 Miles (150% Cost)
Buildings

U.S. Energy Consumption by Sector

Source: ©2011 2030, Inc. / Architecture 2030. All Rights Reserved
Data Source: U.S. Energy Information Administration (2011)
2030 Challenge for Buildings

- TODAY 60%
- 2015 70%
- 2020 80%
- 2025 90%
- 2030 CARBON NEUTRAL

The 2030 Challenge

Source: ©2013 2030, Inc. / Architecture 2030, All Rights Reserved.
*Using no fossil fuel GFC-emitting energy to operate.

2030 Challenge for Products

- 2015 35% or better
- 2020 40% or better
- 2025 45% or better
- 2030 50% or better

The 2030 Challenge for Products

Source: ©2011 2030, Inc. / Architecture 2030, All Rights Reserved.
GREEN BUILDING

INTERNATIONAL GREEN CONSTRUCTION CODE

CONCEPTS

- Will use the “model” code approach that provides communities the ability to modify.
- Minimum & advanced levels of performance (green & high-performance buildings).
- Written in mandatory language that provides a new regulatory framework.
- Work as an overlay to the ICC Family of Codes.
- Allow jurisdictional options beyond IGCC baseline.
Chapter 5
Materials & Resources

503.3 Building material life cycle assessment. The execution of a building material life cycle assessment shall be performed...
INFRASTRUCTURE

ISI ENVISION

BACKGROUND

- Links community quality of life
- Accounts for environmental and human capital
- 10 Primary criteria
- 74 sub criteria
- Graduated performance achievement
- Calculator
LD3.3 EXTEND USEFUL LIFE

INTENT:
Extend a project's useful life by designing the project in a way that results in a completed works that is more durable, flexible, and resilient.

METRIC:
The degree to which the project team incorporates full lifecycle thinking in improving the durability, flexibility and resilience.

LEVELS OF ACHIEVEMENT

(1) Marginal extensions.
Marginal incursions into project life cycle, nothing beyond construction.
Considerations of flexibility, durability, and resilience are minimally considered. (A)

(3) Nudging the boundaries.
A few directed extensions in the design, addressing flexibility, durability and resilience. More specific considerations to extending the useful life of the project. The project owner, working with the designer, expands considerations beyond the point of project delivery. They seek to expand the useful life of the delivered project by adding additional considerations of functionality that are useful to the owner: durability and resilience, ease of upgrading and expansion. (A, B, C)

(6) Pushing the boundaries.
Project owner and designer push boundaries to improve overall performance across the useful life of the project. Project owner, working with the designer, expands considerations to encompass flexibility, features are added to the design for future alternative uses. Expanded consideration of durability and resilience. Use materials that are easily adaptable for changing configurations, repairs, and ease retrofitting and repair. Focus is on areas of short-term payback. (A, B, C)

RA1.2 SUPPORT SUSTAINABLE PROCUREMENT PRACTICES

INTENT:
Obtain materials and equipment from manufacturers and suppliers who implement sustainable practices.

METRIC:
Percentage of materials sourced from manufacturers who meet sustainable practices requirements.

LEVELS OF ACHIEVEMENT

(2) Basic sustainable sourcing.
Written project team procurement policies are in place. Some high level criteria for use of suppliers that have sustainable procurement policies and practices. No targets set. A moderate amount of materials, supplies and equipment (15%) is purchased from manufacturers and suppliers that arguably follow sustainable practices. (A, B)

(3) Modest sustainable suppliers portfolio.
The project team has a defined program for sustainable procurement. The selection of manufacturers and suppliers uses basic triple bottom line criteria. 35% of the purchased materials and supplies meet these criteria. (A, B)

(6) Strong supplier evaluation practices.
The project team has a well-defined program for sustainable procurement. Increased breadth of environmental and social criteria. Increased reliance on third-party certified materials and supplies, e.g., ENERGY STAR, Forest Stewardship Council, Green Seal. 50% of the purchased materials and supplies meet sustainable procurement policies. (A, B, C)

(9) Exceptional sustainable sourcing.
The project team has a strong program for sustainable procurement with clear supplier performance specifications stating the characteristics of the products and materials to be supplied, packaging, use, disposal and product takeback. Increased emphasis on supplier social and ethical performance. 75% of the purchased materials and supplies meet sustainable procurement policies. (A, B, C, D)
Questions?

END OF PART 1
What are PCRs and EPDs?

Required by:
- Project Owners
- LEED v4
- Architecture 2030
- IgCC

Data:
Life Cycle Inventory Data, plant specific

Environmental Product Declarations
Life Cycle Assessment
Product Category Rule
Environmental Product Declaration (EPD)

- Provide quality assured and comparable information regarding environmental performance of a product and/or service

<table>
<thead>
<tr>
<th>Type</th>
<th>Standard</th>
<th>3rd party reviewed</th>
<th>Endorsement</th>
<th>Shorthand</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>ISO 14024</td>
<td>Yes</td>
<td>Yes</td>
<td>Eco-label</td>
</tr>
<tr>
<td>II</td>
<td>ISO 14021</td>
<td>No</td>
<td>Yes</td>
<td>Self-declaration</td>
</tr>
<tr>
<td>III</td>
<td>ISO 14025</td>
<td>Yes</td>
<td>No</td>
<td>Nutrition label</td>
</tr>
</tbody>
</table>

### Type III EPD

#### Nutrition Facts

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Amount</th>
<th>% Daily Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>199</td>
<td></td>
</tr>
<tr>
<td>Total Fat</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>Saturated Fat</td>
<td>2g</td>
<td></td>
</tr>
<tr>
<td>Cholesterol</td>
<td>0mg</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>1mg</td>
<td></td>
</tr>
<tr>
<td>Total Carbohydrate</td>
<td>2g</td>
<td></td>
</tr>
<tr>
<td>Dietary Fiber</td>
<td>1g</td>
<td></td>
</tr>
<tr>
<td>Sugars</td>
<td>1g</td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>4g</td>
<td></td>
</tr>
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</table>

#### PCR Impact Category

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
<th>Units/12</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRMC, Acidification Potential</td>
<td>2.0E+1</td>
<td>kg CO2-Equ.</td>
</tr>
<tr>
<td>TRMC, Eutrophication Potential (Water &amp; Air)</td>
<td>0.0E+0</td>
<td>kg B-Equ.</td>
</tr>
<tr>
<td>TRMC, Global Warming Potential</td>
<td>1.1E+1</td>
<td>kg CO2-Equ.</td>
</tr>
<tr>
<td>TRMC, Ozone Depletion Potential</td>
<td>3.3E+7</td>
<td>kg CFC-11-Equ.</td>
</tr>
<tr>
<td>TRMC, Smog Air</td>
<td>5.2E+7</td>
<td>kg NOx-Equ.</td>
</tr>
<tr>
<td>CML 2002, Acreage</td>
<td>0.0E+0</td>
<td>kg CO2-Equ.</td>
</tr>
<tr>
<td>CML2002, Eutrophication Potential</td>
<td>0.0E+0</td>
<td>kg P-Equ.</td>
</tr>
<tr>
<td>CML2002, Global Warming Potential (GWP 100 years)</td>
<td>1.1E+0</td>
<td>kg CO2-Equ.</td>
</tr>
<tr>
<td>CML2002, Ozone Layer Depletion Potential (ODP)</td>
<td>2.9E+7</td>
<td>kg C2F6-Equ.</td>
</tr>
<tr>
<td>CML2002, Photocatalytic Deactivation Potential (PODP)</td>
<td>0.0E+0</td>
<td>kg Ethene-Equ.</td>
</tr>
<tr>
<td>CML2002, Acidic Deposition</td>
<td>9.0E+7</td>
<td>kg SO2-Equ.</td>
</tr>
</tbody>
</table>
Life Cycle Assessment

- Technique to assess the environmental aspects and potential impacts associated with a product, process, or service.
- Part of the ISO 14000 environmental management standards

Product Category Rules

- Instructions on how and what to report via the EPD
  - Product studied
  - Functional unit
  - System boundaries
  - Life cycle stages included
  - Impacts reported
Allows For Comparisons

Helps Prevent
Why Bother?

- Building owners asking for EPDs
  - i.e., report your carbon footprint
- LEED v4
  - Industry average EPDs
  - Plant specific EPDs
- Required by Architecture 2030
  - Challenge for Building Products
- IgCC whole building LCA
  - Material EPDs can plug into LCA

PCR for Concrete
PCR Committee

**MEMBERS**

- Alicia Daniels Uhlig
- Jeff Davis
- Francesca DesMarais
- Chris Erickson
- Dean Frank
- Heather Gadonniex
- Won Lee
- Lionel Lemay
- Greg McKinnon
- Helena Meryman
- John Ochsendorf
- Carlo Strazza
- Mark Webster

**AFFILIATION**

- GGLO Architecture
- Central Concrete
- Architecture 2030 (observer)
- Climate Earth
- Precast/Pre-stressed Concrete Institute
- UL Environment
- Forell/Elsesser
- National Ready Mix Concrete Association
- Stoneway Concrete
- Consultant
- MIT
- University of Genoa
- Simpson Gumpertz & Heger

**www.carbonleadershipforum.org**

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**PCR Development Process**

<table>
<thead>
<tr>
<th>Task</th>
<th>Date</th>
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<tbody>
<tr>
<td>Committee Formed</td>
<td>May 2011</td>
</tr>
<tr>
<td>PCR Public Draft Issued</td>
<td>February 14, 2012</td>
</tr>
<tr>
<td>First Public Comments</td>
<td>March 31, 2012</td>
</tr>
<tr>
<td>Second Public Comments</td>
<td>September 5, 2012</td>
</tr>
<tr>
<td>Final Version</td>
<td>November 2012</td>
</tr>
</tbody>
</table>
Declared Unit / Product Description

- 1 m³ (yd³)

**Required**
- Specified compressive strength at age
- 30 MPa (4000 psi) at 28 days

**Optional**
- Exposure class (per ACI 318)
- Design slump or slump flow
- Other performance characteristics
Life Cycle Stages

System Boundaries
Excluded from System Boundary

- Production, manufacture and construction of buildings
- Production and manufacture of concrete production equipment, concrete delivery vehicles, earthmoving equipment, and laboratory equipment
- Personnel-related activities (travel, furniture, office supplies)

Impact Categories (2 Levels of Detail)

- **Carbon Footprint**
  - Global Warming Potential
- **ISO compliant Type III EPD**
  - Total primary energy consumption
  - Water Use
  - Climate Change (Carbon Footprint)
  - Ozone Depletion
  - Acidification Air
  - Eutrophication Air
  - Eutrophication Water
  - Photochemical Ozone Creation
Optional Additional Information

- Energy from waste recovery
- Total Water Use
- Total Waste Disposed
- Total Waste Recycled
- Total Waste Used
- Non-renewable Energy
- Renewable Energy
- Bio-mass Energy
- Chemicals of Concern
- Hazardous waste disposed
- Sequestered Carbon
- Particulate Matter
- Ecotoxicity Water
- Ecotoxicity Soil
- Human Toxicity Air
- Human Toxicity Water
- Human Toxicity Soil
- Depletion of Resources

Selection of Data

- Plant specific EPD results
- Company weighted average EPD results
- Regional weighted average EPD results
- ISO compliant LCI data from supplier
- ISO compliant industry average LCA / EPD
- CO$_2$e: Use defaults published by CLF
- LCI of concrete, Marceau, 2007
- LCI of chemical admixtures (European Fed of Chem Admix)
- USEPA (energy sources)
- US LCI Database (NREL)
- Specific data plant energy use, water use, fuel use etc.
Allocation Assumptions

- Emissions from waste incineration (e.g. tires) are considered to be allocated to the original intended use (e.g. cars)
- Emissions from coal power and steel or ferro-silica metal production need not be allocated to the waste products (SCMs)

Content of EPD

- The name and address of the manufacturer
- Description of product and declared unit
- A description of the main components
- Name of the EPD program used
- Date the declaration was issued (5 years)
- Which life cycle stages not considered
- Statement regarding data quality and variability
### Environmental Impacts

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Impacts (SI Units)</th>
<th>Impacts (US Units)</th>
<th>Reference</th>
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</thead>
<tbody>
<tr>
<td>Total Primary Energy</td>
<td>2957 MJ/m³</td>
<td>2.13 MBTU/yd³</td>
<td>N/A</td>
</tr>
<tr>
<td>Non-renewable</td>
<td>2665 MJ/m³</td>
<td>1.92 MBTU/yd³</td>
<td>N/A</td>
</tr>
<tr>
<td>Renewable</td>
<td>281 MJ/m³</td>
<td>0.21 MBTU/yd³</td>
<td>N/A</td>
</tr>
<tr>
<td>Batch Water</td>
<td>127 kg/m³</td>
<td>210 lbs/yd³</td>
<td>N/A</td>
</tr>
<tr>
<td>Wash Water</td>
<td>18 kg/m³</td>
<td>30 lbs/yd³</td>
<td>N/A</td>
</tr>
<tr>
<td>Total Waste Disposed</td>
<td>24 kg/m³</td>
<td>40 lbs/yd³</td>
<td>N/A</td>
</tr>
<tr>
<td>Global Warming Potential</td>
<td>334 kg CO₂eq/m³</td>
<td>254 kg CO₂ eq/yd³</td>
<td>TRACI</td>
</tr>
<tr>
<td>Ozone Depletion</td>
<td>0.00 kg CFC11 eq/m³</td>
<td>0.00 kg CFC11 eq/yd³</td>
<td>TRACI</td>
</tr>
<tr>
<td>Acidification Potential</td>
<td>0.78 kg SO₂ eq/m³</td>
<td>0.59 kg SO₂ eq/yd³</td>
<td>TRACI</td>
</tr>
<tr>
<td>Eutrophication Potential Air</td>
<td>0.00 kg N eq/yd³</td>
<td>0.00 kg N eq/yd³</td>
<td>TRACI</td>
</tr>
<tr>
<td>Eutrophication Potential Water</td>
<td>0.09 kg N eq/m³</td>
<td>0.07 kg N eq/ym³</td>
<td>TRACI</td>
</tr>
<tr>
<td>Photochemical Ozone Creation/Smog</td>
<td>0.06 kg C₂H₆ eq/m³</td>
<td>0.05 kg C₂H₆ eq/ym³</td>
<td>TRACI</td>
</tr>
<tr>
<td>Human Health Criteria (particulate matter)</td>
<td>0.49 kg PM10/m³</td>
<td>0.38 kg PM10/ym³</td>
<td>TRACI</td>
</tr>
<tr>
<td>Human Health CF Non-cancer</td>
<td>2.67E-5 CTUcancer/m³</td>
<td>2.03E-5 CTUcancer/ym³</td>
<td>TRACI</td>
</tr>
<tr>
<td>Human Health CF cancer</td>
<td>7.29E-6 CTUcancer/m³</td>
<td>5.54E-6 CTUcancer/ym³</td>
<td>TRACI</td>
</tr>
</tbody>
</table>
Can we do this for concrete?

- Thousands of mix designs at each plant
- New mix design developed for many projects
- Mix designs change with season
- Mix designs change with material availability
- Do we have upstream data?
- How much will this cost?
- How long will it take?
NRMCA EPD Program

- Will certify EPDs
- Review LCAs
- Develop PCRs

Consistent with other EPD Programs

---

Developing an EPD?

- Select PCR
- Conduct an LCA (critically reviewed)
- Produce draft EPD from LCA
- Submit your LCA report and draft EPD to NRMCA

NRMCA verifies they meet
- International standards
- Selected PCR
- EPD Program Operator Rules

If all requirements met, EPD is certified
- Use certified EPD for submittals and marketing
Certification Process

- Submit LCA Report
  - Already reviewed by independent reviewer
  - Or have NRMCA review it for you
- Submit Draft EPD
- Submittal Form and Fee
- NRMCA Conducts Initial Review
  - Make corrections if necessary
- NRMCA Sends to Independent Verifier
  - Make corrections if necessary

Different Levels of Verification

<table>
<thead>
<tr>
<th>Level</th>
<th>Service</th>
<th>Fee (member)</th>
<th>Fee (non-member)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Critical Review of LCA plus Independent Verification of EPD</td>
<td>$3500</td>
<td>$5000</td>
</tr>
<tr>
<td>2</td>
<td>Critical Review of LCA*</td>
<td>$2750</td>
<td>$3500</td>
</tr>
<tr>
<td>3</td>
<td>Independent Verification of EPD (first)</td>
<td>$1050</td>
<td>$1800</td>
</tr>
<tr>
<td>4</td>
<td>Independent Verification of EPD (second or more)</td>
<td>$750</td>
<td>$1500</td>
</tr>
</tbody>
</table>

* No certification with this option
Independent Reviews for NRMCA?

- Athena Institute
- Carbon Sense Solutions
- Climate Earth*
- NSF International*
- Resource Management Associates*

- Can also conduct LCA
  - Contract directly with them
  - Or use other LCA expert

* Verbal commitment

Certification

- Meets Requirements:
  - ISO 14025
  - Meets PCR
  - Meets NRMCA Program Rules
So why is NRMCA doing this?

Provide a service to the industry!
Help members meet new requirements

Grow the pie for concrete!
Questions?

www.nrmca.org/sustainability