Specifying Sustainable Concrete

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How Do You Measure Sustainability?

- Best Approach: Life Cycle Assessment
- LCA is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service.
**Prioritize Impacts**

**Pros and Cons of LCA**

- **Pros**
  - Pinpoints where process improvements can yield environmental benefits
  - Identifies trade-offs
  - Good communication tool

- **Cons**
  - Extremely complex and expensive
  - Lack/unreliable Life Cycle Inventory data
  - Prioritization of impacts is subjective
Should we Conduct LCA for Every Product/Project?

- Probably Not Realistic

Rating Systems
- Surrogates for LCA
- Identify impacts
- Prioritize impacts
- Identify trade offs
- Communication tool

Rating Systems

Incorporate partial LCA in some cases
Rating System for Concrete?

- Continuously improve product
- Continuously improve process
The vision of the ready mixed concrete industry is to transform the built environment by improving the way concrete is manufactured and used in order to achieve an optimum balance among environmental, social and economic conditions.

Life Cycle Perspective

- Material Acquisition
- Production
- Recycling
- Construction

Life Cycle Phases

Product Use
Objectives

- Minimize Energy Use
- Reduce Emissions
- Conserve Water
- Minimize Waste
- Increase Recycled Content
- Social and Human Health Issues

A Very Long Use Phase

Conserve Water

Reduce Emissions

Recycling Phase

Reduce Waste

Increase Recycled Content

Material Acquisition, Production, and Construction Phases

Social and Human Health Issues

Life Cycle Perspective

Targets Per Unit of Concrete Produced*

- Embodied energy:
  - 20% reduction by 2020
  - 30% reduction by 2030
- Carbon footprint:
  - 20% reduction by 2020
  - 30% reduction by 2030
- Potable water:
  - 10% reduction by 2020
  - 20% reduction by 2030
- Waste:
  - 30% reduction by 2020
  - 50% reduction by 2030
- Recycled content:
  - 200% increase by 2020
  - 400% increase by 2030

*from 2007 Levels
Industry Programs

Performance Based Specifications

- P2P Initiative (Prescriptive to Performance Specifications for Concrete)
- Removes limits on materials
- Allows producers to meet performance requirements
- Minimize environmental impact

www.nrmca.org/P2P
Concrete Plant Certification

- Ensures quality concrete production
- Quality control leads to lower environmental footprint
  - Optimize mix designs
  - Reduce waste

Green-Star Certification

- Utilizes an EMS
- Plan-Do-Check-Act model
- Easy to use templates to develop an EMS
Sustainable Concrete Plant Certification

- Guidance for continuous improvement
- Assessment tool for producers
- Rating system for concrete plants
- 3rd Party Audited

Credit Categories

1. Material Acquisition
2. Production
3. Construction
4. Product Use
5. Recycling

Life Cycle Phases
Sustainability Credits

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Prerequisites</td>
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<tr>
<td>Material Acquisition</td>
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<tr>
<td>Production</td>
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<td>Delivery and Construction</td>
<td>13</td>
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<td>Product Use</td>
<td>6</td>
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<td>Material Reuse and Recycling</td>
<td>8</td>
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<tr>
<td>Additional Sustainable Strategies</td>
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<tr>
<td><strong>Total Points</strong></td>
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</table>

Impact Categories and Credits

- Embodied Energy
- Carbon Footprint
- Water Use
- Waste
- Recycled Content
- Social Concerns and Human Health
**Sustainability Levels**

- **Platinum**
  - 90-100 points

- **Gold**
  - 70-89 points

- **Silver**
  - 50-69 points

- **Bronze**
  - 30-49 points

**Metrics**

- Simple Equations
- Worksheets
- Carbon Calculators (LCA tool)
Evaluation Period

- All measurements for 12 month period
- Evaluation is repeated every 2 years

Prerequisites

- Comply with national and local regulations
- Environmental Management System (EMS)
  - NRMCA Green-Star
  - ISO 14001
- Energy Audit
- Site Plan (with environmental strategies)
**Credit 1.3: Material Transportation Analysis**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>Plant CO2e 5% or more below U.S. national baseline</td>
<td>1 point</td>
</tr>
<tr>
<td>Plant CO2e 10% or more below U.S. national baseline</td>
<td>+1 point</td>
</tr>
<tr>
<td>Plant CO2e 15% or more below U.S. national baseline</td>
<td>+1 point</td>
</tr>
<tr>
<td>Plant CO2e 20% or more below U.S. national baseline</td>
<td>+1 point</td>
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</table>

**Documentation**
Copy of the *Materials Transportation Calculator* with calculated results

**Credit 2.1: Process Dust Emissions Control**

Complete *Emissions Calculator* to determine weighted process emission controls

<table>
<thead>
<tr>
<th>Percentage of Weighted Emission Controls</th>
<th>Points</th>
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<tbody>
<tr>
<td>≥ 50%</td>
<td>1 point</td>
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<tr>
<td>≥ 75%</td>
<td>+1 point</td>
</tr>
<tr>
<td>≥ 90%</td>
<td>+1 point</td>
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**Documentation**
Completed “Dry Batch Process Emissions” or “Central Mix Process Emissions” worksheet from the *Emissions Calculator*. 


Credit 2.4: Reduction of Fresh Water Use in Batching

Batching fresh water use percentage below national baseline of 25 gal/cy (124 l/m³).

\[
\text{batching fresh water use (\% below baseline)} = \left( \frac{25 - \text{plant use (gal/cy)}}{25} \right) \times 100
\]

- Water in batching 10% or more below U.S. national baseline: 1 point
- Water in batching 20% or more below U.S. national baseline: +1 point
- Water in batching 30% or more below U.S. national baseline: +1 point

**Documentation**
Letter from the company’s accountant or corporate officer stating total amount of municipal fresh water purchases and onsite well water used for batching purposes.

Credit 2.10: Reduced Carbon Footprint

Use CO2 Calculator to calculate the plant CO2 footprint

\[
\text{CO2e (\% below baseline)} = \left( \frac{634 - \text{plant CO2e (lb CO2e/cy)}}{634} \right) \times 100
\]

- CO2e 5% or more below U.S. baseline: 1 point
- CO2e 10% or more below U.S. baseline: +1 point
- CO2e 15% or more below U.S. baseline: +1 point
- CO2e 20% or more below U.S. baseline: +1 point
- CO2e 25% or more below U.S. baseline: +1 point
- CO2e 30% or more below U.S. baseline: +1 point

**Documentation**
Submit a copy of the CO2 Calculator’s output page.
Carbon Calculator

- **Input Data**
  - Material Purchase Data
  - Material Transportation Data
  - Plant Energy Data
  - Fleet Energy Data

- **Results**
  - Plant Annual Carbon Footprint (total and per cy)
  - Plant Annual Energy Use (total and per cy)

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**Short Tons CO2e Breakdown by Life Cycle Stage**

- **Material Manufacturing & Transportation**: 81,506 Short Tons CO2e
- **Ready Mixed Plant Operations**: 2,786 Short Tons CO2e
- **Transportation to Site**: 3,365 Short Tons CO2e
Auditor: Independent Third Party

- Not an employee of NRMCA
- Nor an employee of the company they are auditing
- Nor an employee of a concrete producer, equipment supplier or product supplier
- Auditors may consult for companies who are in the process of submitting a plant for Certification
  - But cannot Audit a plant for which they provided consulting services related to the Certification Application being audited

What’s Coming?
Environmental Product Declarations

Required by:
• Project Owners
• LEED 2012
• Architecture 2030
• IgCC

Data:
Life Cycle Inventory Data, plant specific

Environmental Product Declarations
Life Cycle Assessment
Product Category Rule

PCR Committee (being led by University of Washington)

<table>
<thead>
<tr>
<th>MEMBERS</th>
<th>AFFILIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alicia Daniels Uhlig</td>
<td>GGLQ Architecture</td>
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<tr>
<td>Jeff Davis</td>
<td>Central Concrete</td>
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<tr>
<td>Francesca DesMarais</td>
<td>Architecture 2030 (observer)</td>
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<tr>
<td>Chris Erickson</td>
<td>Climate Earth</td>
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<tr>
<td>Dean Frank</td>
<td>Precast/Pre-stressed Concrete Institute</td>
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<tr>
<td>Heather Gadonniex</td>
<td>UL Environment</td>
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<tr>
<td>Won Lee</td>
<td>Forell/Elsesser</td>
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<tr>
<td>Linnet Lemay</td>
<td>National Ready Mix Concrete Association</td>
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<tr>
<td>Greg McKinnon</td>
<td>Stonaway Concrete</td>
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<tr>
<td>Helona Moriyman</td>
<td>Consultant</td>
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<tr>
<td>John Ochsendorf</td>
<td>MIT</td>
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<tr>
<td>Caro Strazza</td>
<td>University of Genoa</td>
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<tr>
<td>Mark Webster</td>
<td>Simpson Gumpertz &amp; Heger</td>
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[www.carbonleadershipforum.org]
Specifying Sustainable Concrete

- Specify strength at age (more than 28 days)
- Specify ACI 318 Exposure Class

- No prescriptive requirements, such as:
  - Minimum cement content
  - Maximum w/cm
  - Maximum SCM content

- NRMCA Concrete Plant Certification (Quality)
- NRMCA Green-Star Plant Certification (EMS)

Other Potential Options

- NRMCA Sustainable Concrete Plant Certification (Bronze or higher)
  - OR -

- Plant meets intent of credit 2.10 in the NRMCA Sustainable Concrete Plant Guidelines (1 point or higher)
For Future (1 year +)

- Concrete supplier shall submit an Environmental Product Declaration
  - Plant specific EPD is preferred
  - Industry wide EPD (where company is listed) is acceptable

For the Future (5 years +)

- Concrete supplier shall demonstrate through the use of EPD that concrete mixture proposed for the project has lower carbon footprint* than baselines established by NRMCA.

* And/or other environmental impact