

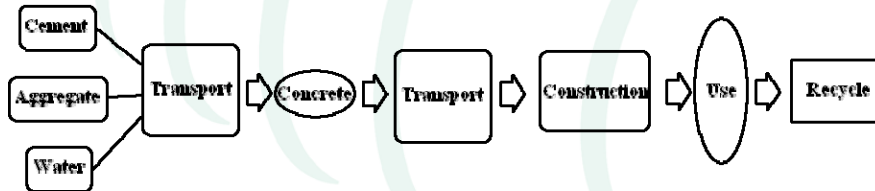
Specifying Sustainable Concrete

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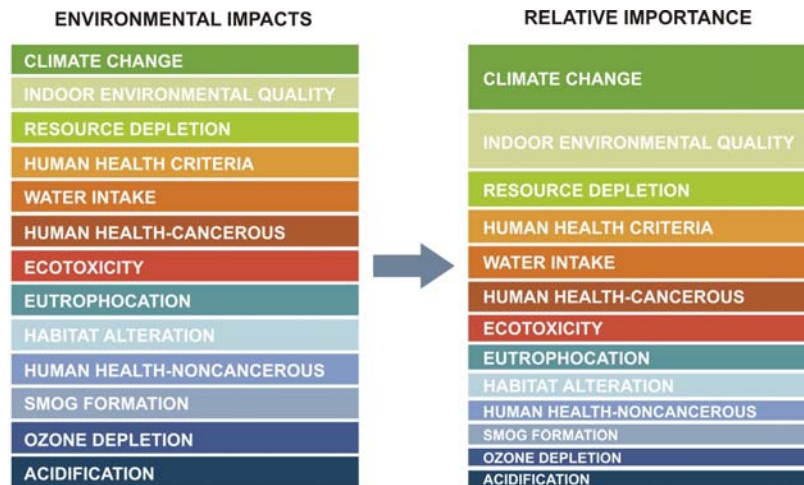


How Do You Measure Sustainability?

- 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



NATIONAL READY MIXED CONCRETE ASSOCIATION
SUSTAINABILITY INITIATIVES



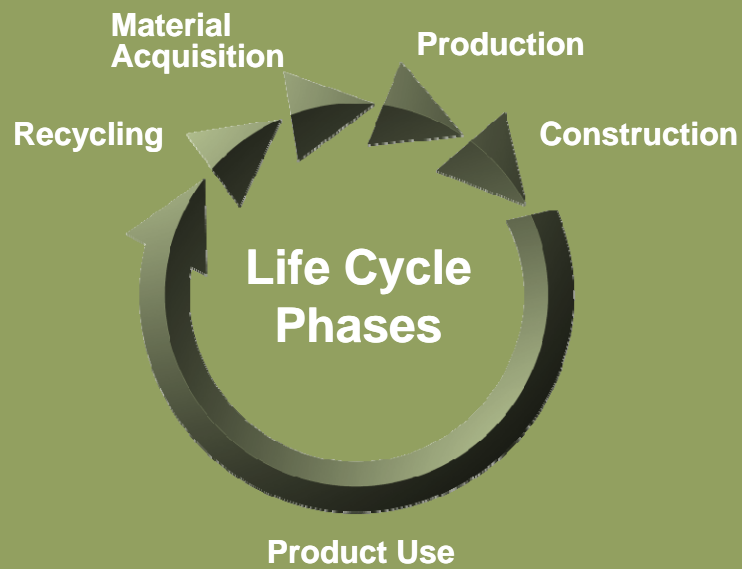
Vision



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.

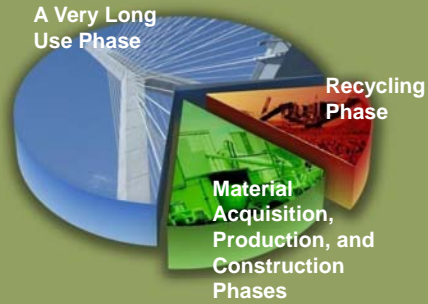


Life Cycle Perspective



Objectives

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



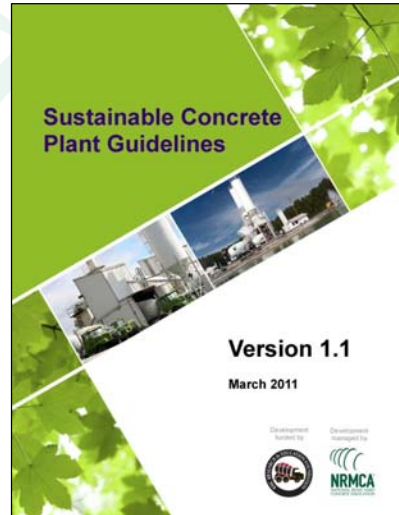
Life Cycle Perspective

Targets Per Unit of Concrete Produced*

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



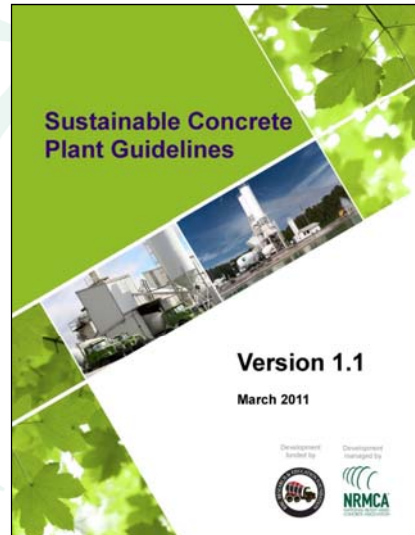
Green-Star Certification

- Utilizes an EMS
- Plan-Do-Check-Act model
- Easy to use templates to develop an EMS

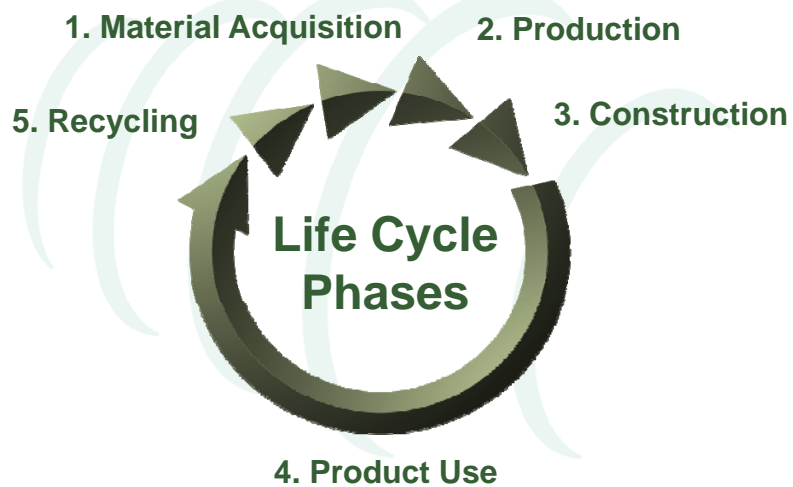


Sustainable Concrete Plant Certification

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



Credit Categories



Sustainability Credits

Category	Credits
Prerequisites	0
Material Acquisition	16
Production	52
Delivery and Construction	13
Product Use	6
Material Reuse and Recycling	8
Additional Sustainable Strategies	5
Total Points	100

Impact Categories and Credits

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

Sustainability Levels

- Platinum
 - 90-100 point
- 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

Plant CO ₂ e 5% or more below U.S. national baseline	1 point
Plant CO ₂ e 10% or more below U.S. national baseline	+1 point
Plant CO ₂ e 15% or more below U.S. national baseline	+1 point
Plant CO ₂ e 20% or more below U.S. national baseline	+1 point

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

≥ 50% weighted process emission controls	1 point
≥ 75% weighted process emission controls	+1 point
≥ 90% weighted process emission controls	+1 point

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).

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

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

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

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.

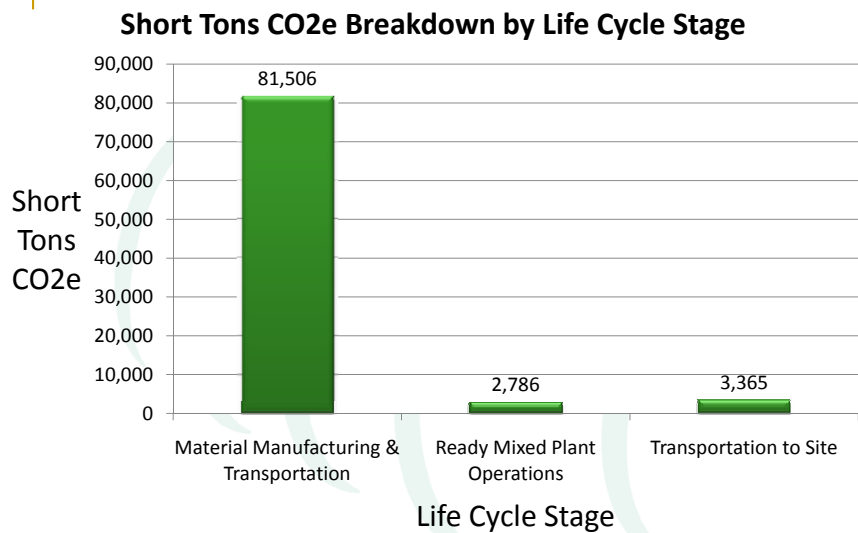
Carbon Calculator

■ 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)



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?



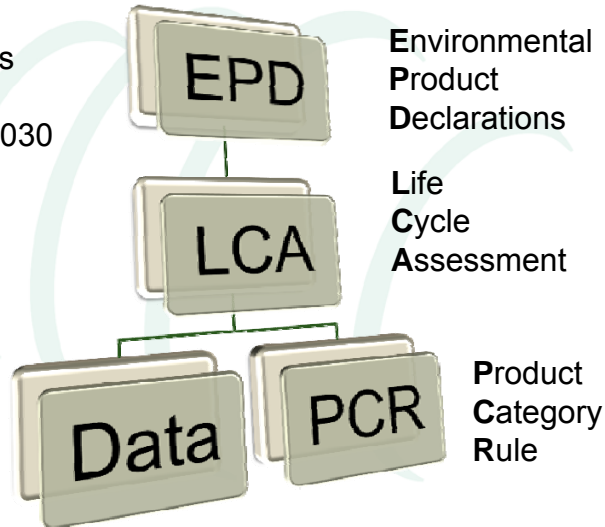
Environmental Product Declarations

Required by:

- Project Owners
- LEED 2012
- Architecture 2030
- IgCC

Data:

Life Cycle
Inventory Data,
plant specific



PCR Committee (being led by University of Washington)

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

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



www.nrmca.org/sustainability

