

## Environmental Product Declarations: Part 2

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Sr. VP, Sustainability



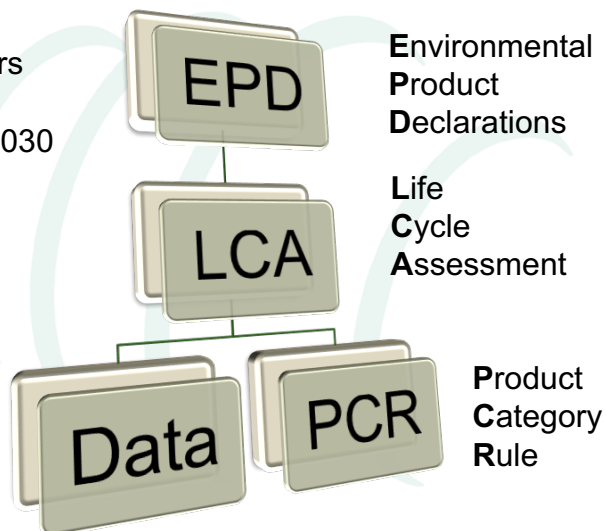
## What are PCRs and EPDs?

### Required by:

- Project Owners
- LEED v4
- Architecture 2030
- IgCC

### Data:

Life Cycle  
Inventory Data,  
plant specific



## Environmental Product Declaration (EPD)

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

Type	Standard	3 <sup>rd</sup> party reviewed	Endorsement	Shorthand
I	ISO 14024	Yes	Yes	Eco-label
II	ISO 14021	No	Yes	Self-declaration
III	ISO 14025	Yes	No	Nutrition label

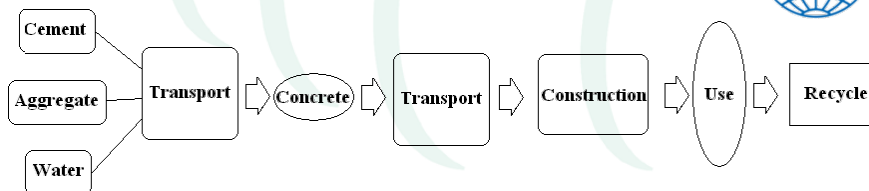
## Type III EPD

Nutrition Facts																													
Serving Size 1/2 cup dry (40 g)																													
Servings Per container: 13																													
Amount Per Serving																													
<b>Calories 150</b>	Calories from Fat 25																												
<b>% Daily Value*</b>																													
<b>Total Fat</b> 3 g	4%																												
Saturated Fat 0.5 g	2%																												
Trans Fat 0 g	0%																												
Cholesterol 0 mg	0%																												
Sodium 0 mg	0%																												
<b>Total Carbohydrate</b> 27 g	9%																												
Dietary Fiber 4 g	15%																												
Sugars 1 g																													
<b>Protein</b> 5 g																													
Vitamin A	0%																												
Vitamin C	0%																												
Calcium	0%																												
Iron	10%																												
*Percent Daily Values are based on a 2,000 calorie diet.																													
Your daily values may be higher or lower depending on your calorie needs.																													
	<table><tr><td></td><td>Calories:</td><td>2,000</td><td>2,500</td></tr><tr><td>Total Fat</td><td>Less than</td><td>65 g</td><td>80 g</td></tr><tr><td>Sat Fat</td><td>Less than</td><td>20 g</td><td>25 g</td></tr><tr><td>Cholesterol</td><td>Less than</td><td>300 mg</td><td>300 mg</td></tr><tr><td>Sodium</td><td>Less than</td><td>2,400 mg</td><td>2,400 mg</td></tr><tr><td>Total Carbohydrate</td><td>Less than</td><td>300 g</td><td>375 g</td></tr><tr><td>Dietary Fiber</td><td></td><td>25 g</td><td>30 g</td></tr></table>		Calories:	2,000	2,500	Total Fat	Less than	65 g	80 g	Sat Fat	Less than	20 g	25 g	Cholesterol	Less than	300 mg	300 mg	Sodium	Less than	2,400 mg	2,400 mg	Total Carbohydrate	Less than	300 g	375 g	Dietary Fiber		25 g	30 g
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Total Carbohydrate	Less than	300 g	375 g																										
Dietary Fiber		25 g	30 g																										

PCR Impact Category	Impact	Units/m2
US TRACI		
TRACI, Acidification Potential	2.08	mol H+ Equiv.
TRACI, Eutrophication Potential (Water & Air)	0.012	kg N-Equiv.
TRACI, Global Warming Potential	11.33	kg CO2-Equiv.
TRACI, Ozone Depletion Potential	3.3 x 10 <sup>-7</sup>	kg CFC 11-Equiv.
TRACI, Smog Air	6.2 x 10 <sup>-7</sup>	kg NOx-Equiv.
CML 2002		
CML2002, Acidification Potential	0.041	kg SO2-Equiv.
CML2002, Eutrophication Potential	0.01	kg Phosphate-Equiv.
CML2002, Global Warming Potential (GWP 100 years)	11.55	kg CO2-Equiv.
CML2002, Ozone Layer Depletion Potential (ODR steady state)	2.9 x 10 <sup>-7</sup>	kg R11-Equiv.
CML2002, Photochem. Ozone Creation Potential (POCP)	.004	kg Ethene-Equiv.
CML2002, Abiotic Depletion	9 x 10 <sup>-7</sup>	kg Sb-Equiv.

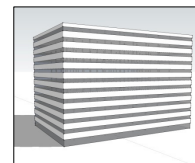
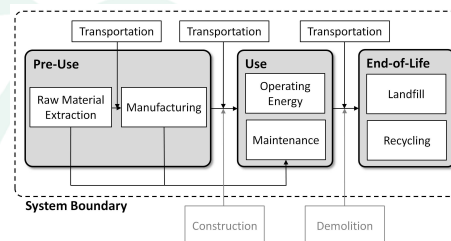
## Life Cycle Assessment

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

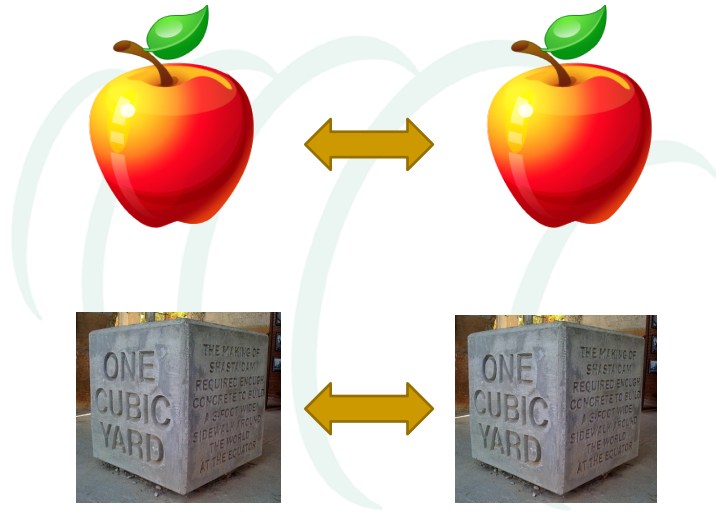


## Product Category Rules

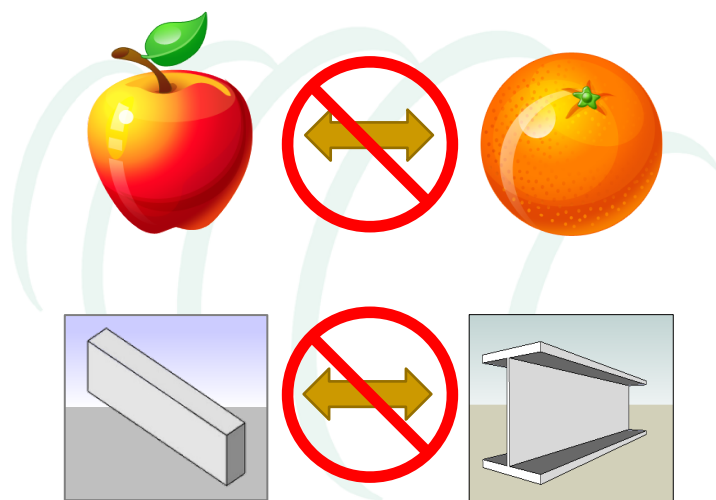
- Instructions on how and what to report via the EPD
  - ❑ Product studied
  - ❑ Functional unit
  - ❑ System boundaries
  - ❑ Life cycle stages included
  - ❑ Impacts reported



## 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

### The Carbon Leadership Forum Industry-Academic Collaborative Research



[www.carbonleadershipforum.org](http://www.carbonleadershipforum.org)

## 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](http://www.carbonleadershipforum.org)

## PCR Development Process

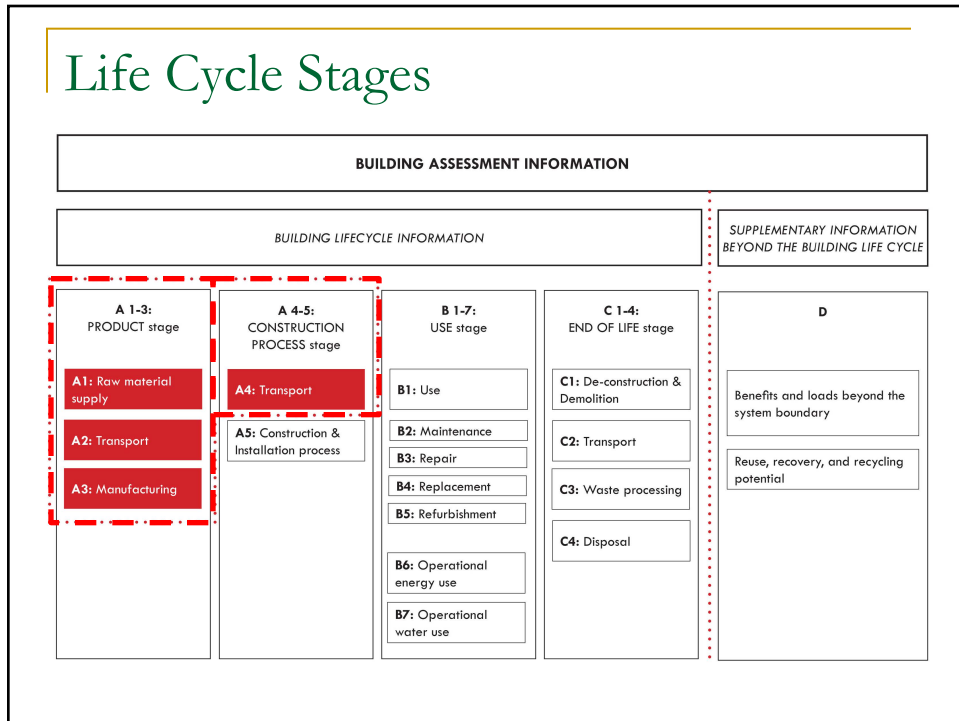
Task	Date
Committee Formed	May 2011
PCR Public Draft Issued	February 14, 2012
First Public Comments	March 31, 2012
Second Public Comments	September 5, 2012
Final Version	November 2012

		<div> <div>University of Washington College of Built Environments Department of Architecture</div> <div>CARBON LEADERSHIP FORUM</div> <div> 1 2 3 <b>PRODUCT CATEGORY RULES (PCR) FOR</b> 4 <b>ISO 14025 TYPE III ENVIRONMENTAL PRODUCT DECLARATIONS (EPDs) of</b> 5 6 <b>CONCRETE</b> 7 8 ASTM C 94 9 10 UNSPSC code 30111500 11 12 CONSTRUCTION SPECIFICATIONS INSTITUTE/CSI SPECIFICATION SECTIONS: 13 03 03X XX Cast in Place Concrete 14 03 4X XX Precast Concrete 15 03 70 00 Mass Concrete 16 17 Draft for Stakeholder review and comment 18 V4: February 14, 2012 19 20 Carbon Leadership Forum 21 pcrconc@uw.edu 22 23 <b>ACKNOWLEDGEMENTS:</b> The development of this PCR was supported by: 24 25 The University of Washington, College of Built Environment Dean's research funds 26 27 And 28 29 The Carbon Leadership Forum's founding sponsors: Climate Earth, Design Avenues, 30 Ecological Building Network, EHDD Architecture, Loisos + Ubbelohde, Magnusson 31 Klemencic Associates, Serious Materials, Tipping Mar, Webcor Builders, As well as 32 additional support from Arup and Degenkolb. 33 </div> </div>	
	1	CONCRETE PCR: DRAFT 02/14/12	

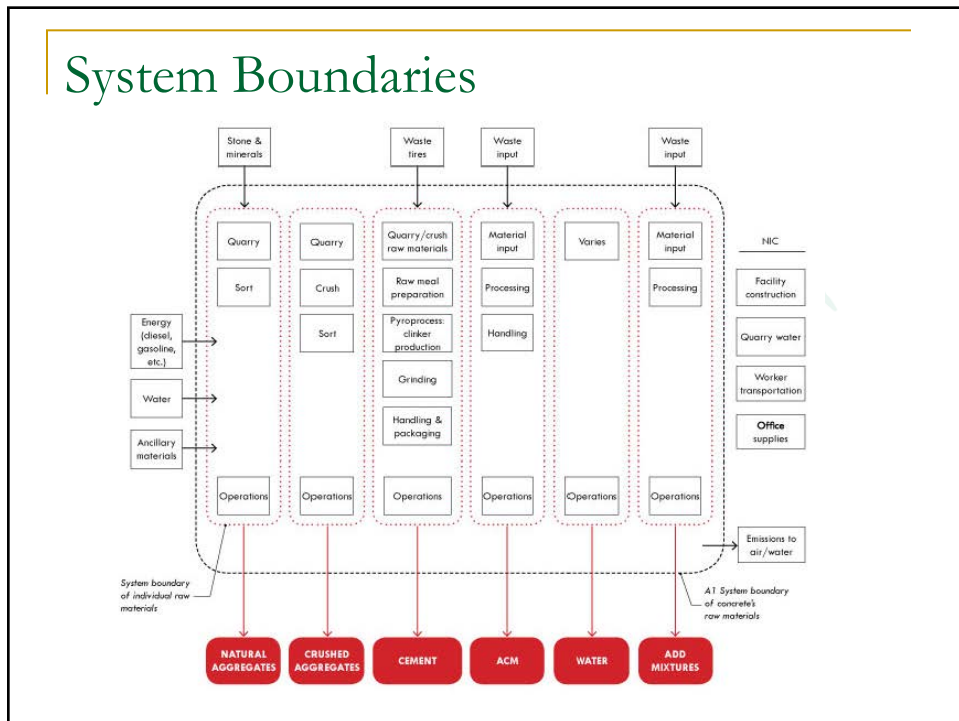
## Declared Unit / Product Description

- 1 m<sup>3</sup> (yd<sup>3</sup>)
- 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)

- |                                  |  |
|----------------------------------|--|
| ■ <b><u>Carbon Footprint</u></b> | ■ <b><u>ISO compliant Type III EPD</u></b> |
| ■ Global Warming Potential       | ■ 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<sub>2</sub>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

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

## EPD Document







## 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

Level	Service	Fee (member)	Fee (non-member)
1	Critical Review of LCA plus Independent Verification of EPD	\$3500	\$5000
2	Critical Review of LCA*	\$2750	\$3500
3	Independent Verification of EPD (first)	\$1050	\$1800
4	Independent Verification of EPD (second or more)	\$750	\$1500

\* No certification with this option

## Independent Reviews for NRMCA?

- Athena Institute
- Carbon Sense Solutions
- Climate Earth
- NSF International
  
- Can also conduct LCA
  - Contract directly with them
  - Or use other LCA expert

## Certification

- Meets Requirements:
  - ISO 14025
  - Meets PCR
  - Meets NRMCA Program Rules



Service Area: Brentwood (M0 miss)												
Mix Code	Plant	Perf	Impacts									
			CS	TPE	CWB	CWW	GWP	ODP	AP	EP	POCP	
			minimum	2,500	2.155E+03	6.871E-02	4.504E-03	2.058E+02	3.634E-06	1.513E+00	8.143E-02	2.568E+01
			maximum	6,000	3.629E+03	7.287E-02	4.504E-03	4.819E+02	6.637E-06	3.466E+00	1.395E-01	4.745E+01
325PC901	Brentwood	2,500	2.556E+03	6.871E-02	4.504E-03	3.058E+02	4.237E-06	2.174E+00	9.251E-02	3.072E+01	3.072E+01	
325PC902	Brentwood	2,500	2.552E+03	7.287E-02	4.504E-03	3.056E+02	4.249E-06	2.173E+00	9.197E-02	3.067E+01	3.067E+01	
325PC9D1	Brentwood	2,500	2.231E+03	6.871E-02	4.504E-03	2.529E+02	3.634E-06	1.786E+00	8.243E-02	2.572E+01	2.572E+01	
325PC9D2	Brentwood	2,500	2.225E+03	7.287E-02	4.504E-03	2.525E+02	3.638E-06	1.784E+00	8.143E-02	2.568E+01	2.568E+01	
325PC9Q1	Brentwood	2,500	2.161E+03	6.871E-02	4.504E-03	2.062E+02	4.591E-06	1.515E+00	1.004E-01	2.760E+01	2.760E+01	
325PC9Q2	Brentwood	2,500	2.155E+03	7.287E-02	4.504E-03	2.058E+02	4.571E-06	1.513E+00	9.997E-02	2.754E+01	2.754E+01	
			minimum	2,000	2.155E+03	6.871E-02	4.504E-03	2.058E+02	3.634E-06	1.513E+00	8.143E-02	2.568E+01
			maximum	6,000	3.629E+03	7.287E-02	4.504E-03	4.819E+02	6.637E-06	3.466E+00	1.395E-01	4.745E+01
325PC901	Brentwood	2,500	2.556E+03	6.871E-02	4.504E-03	3.058E+02	4.237E-06	2.174E+00	9.251E-02	3.072E+01	3.072E+01	
325PC902	Brentwood	2,500	2.552E+03	7.287E-02	4.504E-03	3.056E+02	4.249E-06	2.173E+00	9.197E-02	3.067E+01	3.067E+01	
325PC9D1	Brentwood	2,500	2.231E+03	6.871E-02	4.504E-03	2.529E+02	3.634E-06	1.786E+00	8.243E-02	2.572E+01	2.572E+01	
325PC9D2	Brentwood	2,500	2.225E+03	7.287E-02	4.504E-03	2.525E+02	3.638E-06	1.784E+00	8.143E-02	2.568E+01	2.568E+01	
325PC9Q1	Brentwood	2,500	2.161E+03	6.871E-02	4.504E-03	2.062E+02	4.591E-06	1.515E+00	1.004E-01	2.760E+01	2.760E+01	
325PC9Q2	Brentwood	2,500	2.155E+03	7.287E-02	4.504E-03	2.058E+02	4.571E-06	1.513E+00	9.997E-02	2.754E+01	2.754E+01	
325PG9C1	Brentwood	2,500	2.536E+03	6.871E-02	4.504E-03	3.047E+02	4.147E-06	2.170E+00	8.987E-02	3.063E+01	3.063E+01	
325PG9D1	Brentwood	2,500	2.311E+03	6.871E-02	4.504E-03	2.674E+02	3.760E-06	1.894E+00	8.401E-02	2.707E+01	2.707E+01	
325PG9Q1	Brentwood	2,500	2.344E+03	6.871E-02	4.504E-03	2.310E+02	5.036E-06	1.704E+00	1.109E-01	3.082E+01	3.082E+01	
315PC9D1	Brentwood	3,500	2.552E+03	6.871E-02	4.504E-03	3.058E+02	4.237E-06	2.174E+00	9.251E-02	3.072E+01	3.072E+01	
315PC9D2	Brentwood	3,500	2.545E+03	7.287E-02	4.504E-03	3.056E+02	4.249E-06	2.169E+00	9.022E-02	3.069E+01	3.069E+01	
315PC9Q1	Brentwood	3,500	2.392E+03	6.871E-02	4.504E-03	2.364E+02	5.160E-06	1.741E+00	1.139E-01	3.148E+01	3.148E+01	
315PC9Q2	Brentwood	3,500	2.389E+03	7.287E-02	4.504E-03	2.361E+02	5.138E-06	1.740E+00	1.131E-01	3.141E+01	3.141E+01	
315PG9C1	Brentwood	3,500	2.881E+03	6.871E-02	4.504E-03	3.638E+02	4.871E-06	2.402E+00	1.010E-01	3.619E+01	3.619E+01	
315PG9C2	Brentwood	3,500	2.887E+03	7.287E-02	4.504E-03	3.636E+02	4.835E-06	2.404E+00	1.008E-01	3.620E+01	3.620E+01	
315PG9D1	Brentwood	3,500	2.871E+03	6.871E-02	4.504E-03	3.600E+02	4.734E-06	2.376E+00	9.936E-02	3.590E+01	3.590E+01	
315PG9D2	Brentwood	3,500	2.883E+03	7.099E-02	4.504E-03	3.617E+02	4.768E-06	2.399E+00	9.895E-02	3.606E+01	3.606E+01	
315PG9Q1	Brentwood	3,500	2.642E+03	6.871E-02	4.504E-03	3.217E+02	4.304E-06	2.202E+00	9.328E-02	3.224E+01	3.224E+01	
315PG9Q2	Brentwood	3,500	2.567E+03	6.871E-02	4.504E-03	2.612E+02	5.602E-06	1.937E+00	1.211E-01	3.479E+01	3.479E+01	
315PG9C2	Brentwood	3,500	2.592E+03	7.287E-02	4.504E-03	2.648E+02	5.697E-06	1.964E+00	1.219E-01	3.525E+01	3.525E+01	
340PC9D1	Brentwood	4,000	2.804E+03	6.871E-02	4.504E-03	3.454E+02	4.667E-06	2.473E+00	9.961E-02	3.499E+01	3.499E+01	
340PC9D2	Brentwood	4,000	2.805E+03	7.287E-02	4.504E-03	3.475E+02	4.694E-06	2.490E+00	9.934E-02	3.486E+01	3.486E+01	
340PC9C1	Brentwood	4,000	2.655E+03	6.871E-02	4.504E-03	3.221E+02	4.386E-06	2.202E+00	9.506E-02	3.239E+01	3.239E+01	
340PC9C2	Brentwood	4,000	2.654E+03	7.287E-02	4.504E-03	3.221E+02	4.405E-06	2.202E+00	9.471E-02	3.227E+01	3.227E+01	

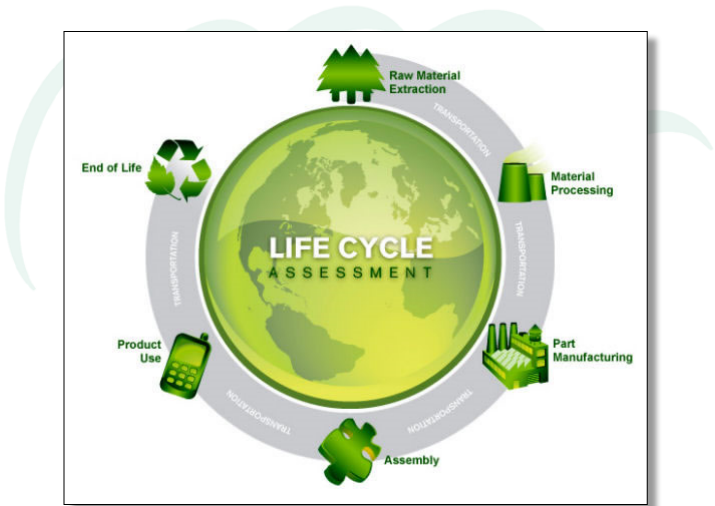
Central Concrete EPD

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Central Concrete EPD

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# THE BIG PICTURE: LIFE CYCLE ASSESSMENT



## Components of an LCA

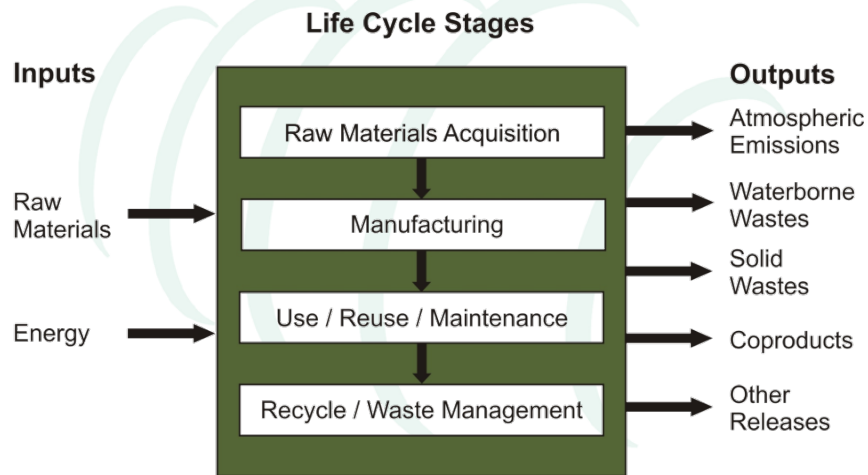
- Goal definition and scoping
- Inventory Analysis
- Impact Assessment
- Interpretation

## Impact Assessment – Key Component

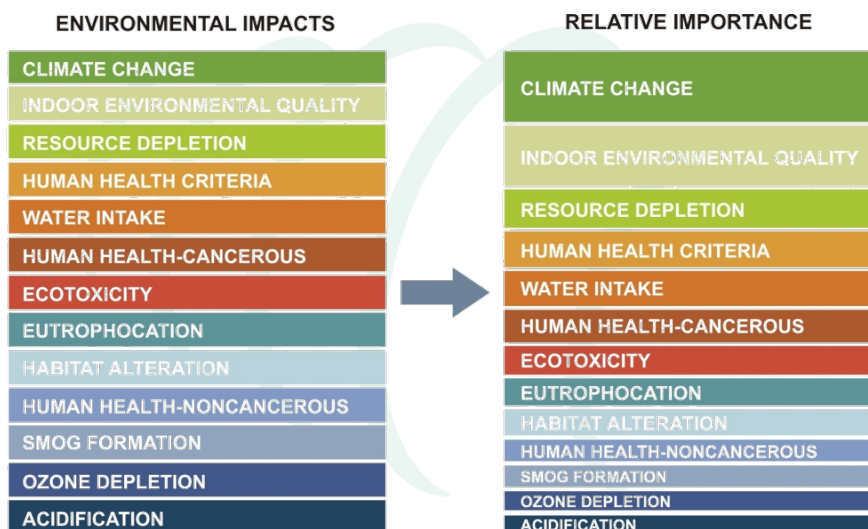
- A **Stressor** – a set of conditions that may lead to an environmental impact.



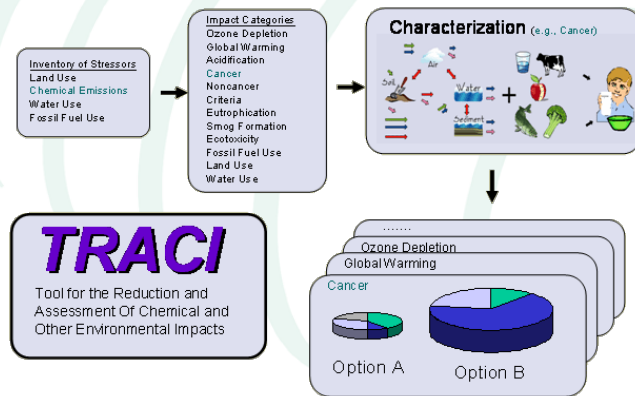
## Identifying Stressors



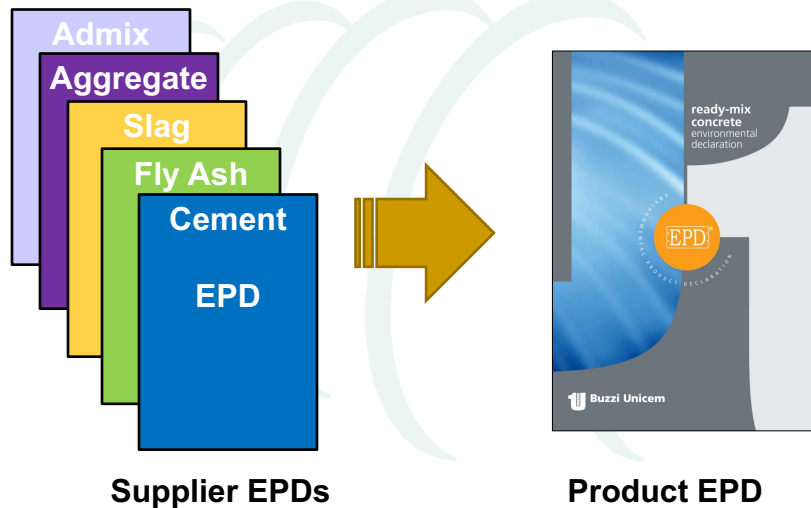
## Quantifying/Prioritizing Impacts



## TRACI – Tool for the Reduction and Assessment of Chemical and other environmental Impacts



## SUPPLIER EPDs FEED INTO PRODUCT EPDs

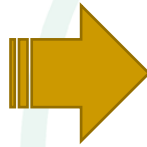




## PRODUCT EPDs FEED INTO LARGER SYSTEM LCA



**Product EPDs**



**Whole Building LCA**

### Pre-use Phase



**5.5% to 8%**

### Cradle to Cradle Perspective



**Global  
Warming  
Potential**

### Use Phase



**92% to 94.5%**

Source: Architecture 2030

So why is NRMCA doing this?



Provide a service to the industry!



Help members meet new requirements



envision<sup>tm</sup>



Grow the pie for concrete!



Questions?

[www.nrmca.org/sustainability](http://www.nrmca.org/sustainability)

