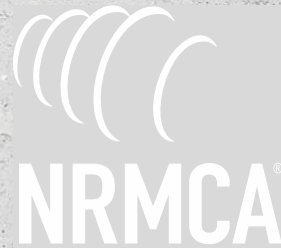


EPD Development Within the Concrete Industry

Brian Killingsworth, P.E.

National Ready Mixed Concrete Association



PAVE  AHEAD

DURABLE. SUSTAINABLE. **CONCRETE.**



A COALITION OF THE NATIONAL READY MIXED CONCRETE ASSOCIATION

NRMCA Sustainability Initiatives

SUSTAINABILITY



CONCRETE
ENVIRONMENTAL
LIFE CYCLE

MATERIAL
ACQUISITION

PRODUCTION

CONSTRUCTION

USE

RECYCLING

Sustainable Plant and Personnel Certifications:

Sustainability Research:

GREEN-STAR
NRMCA 

Environmental Professional Certification
For the Ready Mixed Concrete Industry



CSHub

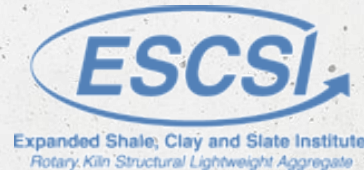


CONCRETE
SUSTAINABILITY
HUB

www.nrmca.org/sustainability/

BUILD WITH STRENGTH

Sustainability in the Concrete Industry



Transparency

- Concrete EPD development was in response to building market factors.
- Need for concrete producers to be able to respond to specifiers wanting to make more informed and responsible decisions.



Market Landscape

LEED as a Driver for EPDs

BUILD WITH STRENGTH

LEED v4



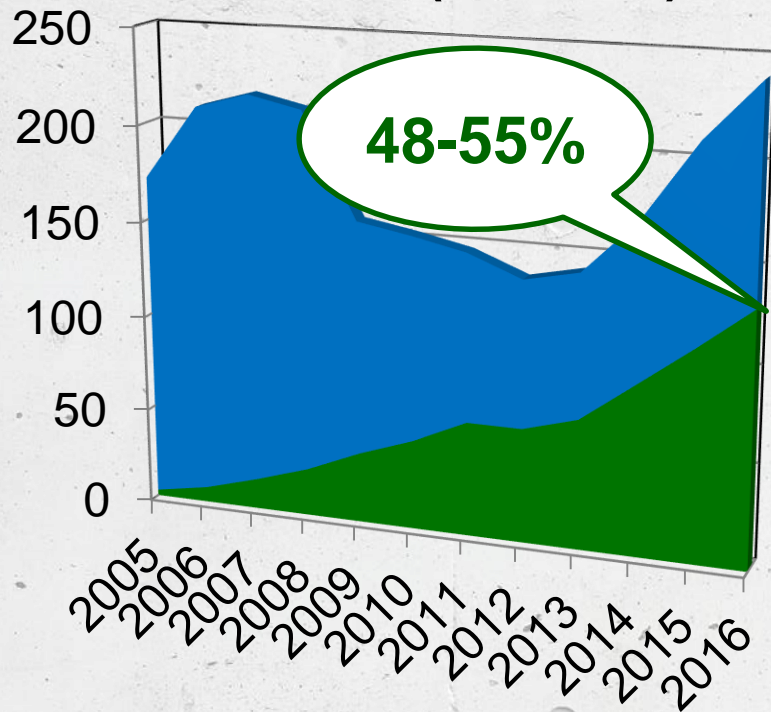
MATERIALS & RESOURCES

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	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

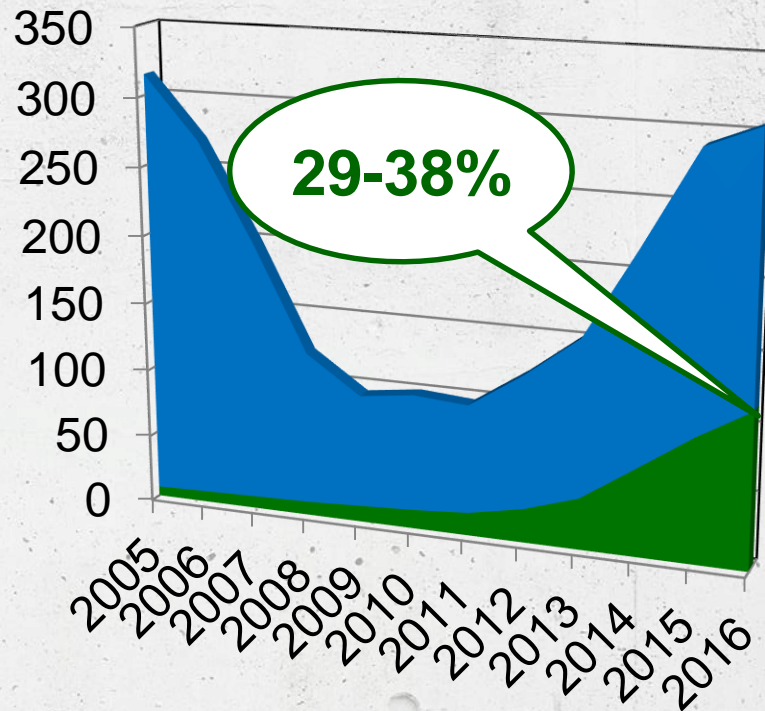
Green Building Growth

**U.S. NON-residential
Green Building Market
2005-2016 (\$Billions)**



■ Green ■ Conventional

**U.S. Residential
Green Building Market
2005-2016 (\$Billions)**



■ Green ■ Conventional

Source: McGraw Hill

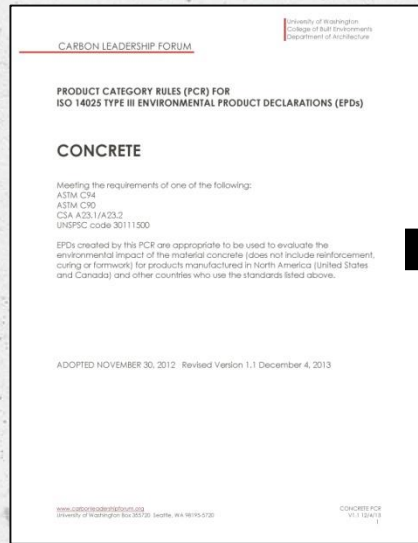


EPD DEVELOPEMNT IN CONCRETE INDUSTRY



Concrete Industry EPD Development

- CLF PCR
- v1 Nov 2012
- v1.1 Dec 2013

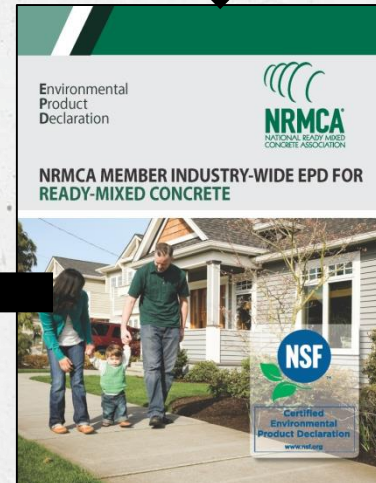


- 2013
- EPD Program Operator
- 13 companies
- 2100+ products
- More coming



2010-2013

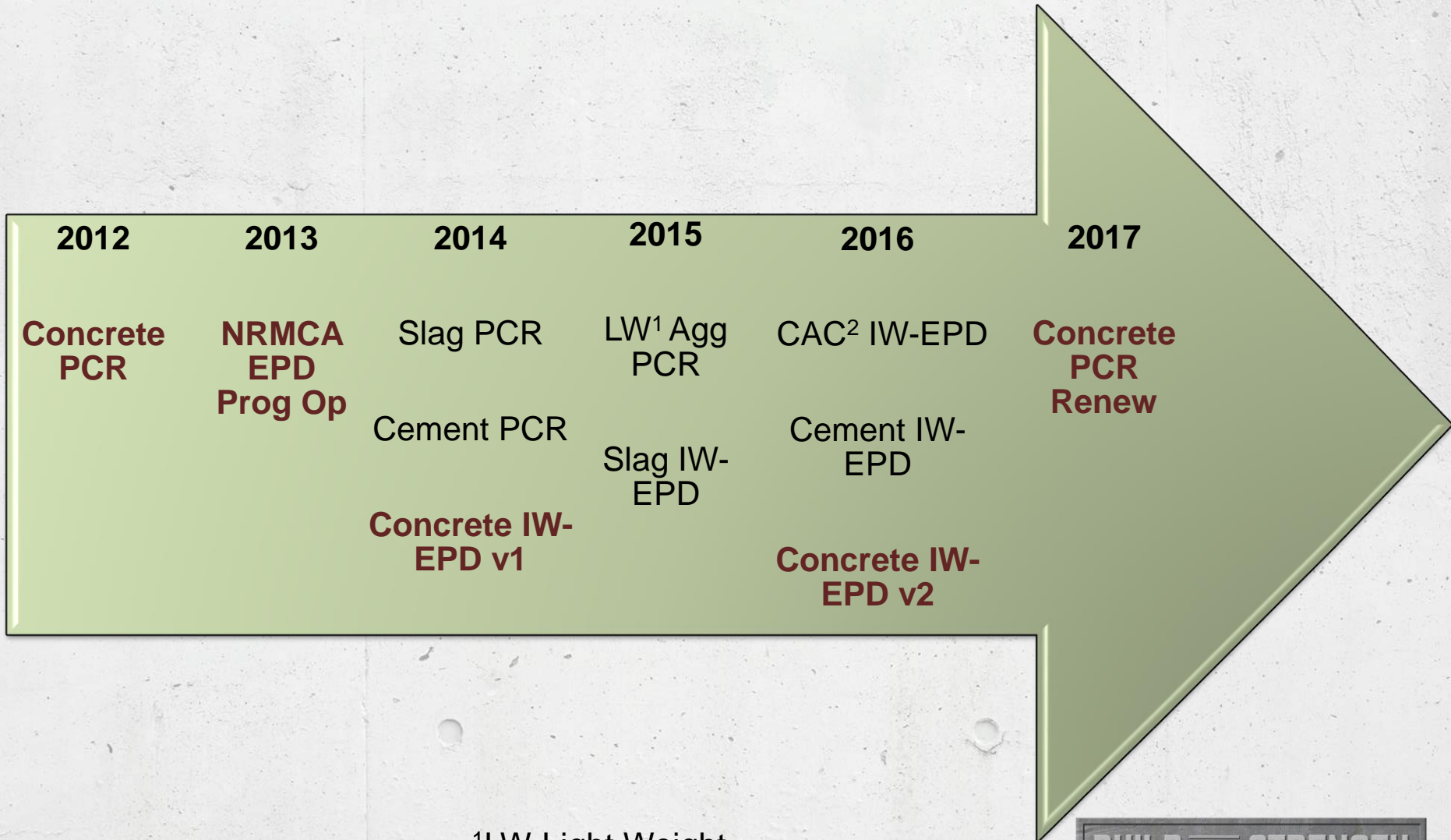
Feb 2011



- Oct 2014
- 90 companies
- 2700 plants
- 95% production
- Baselines

BUILD WITH STRENGTH

Industry EPD Development

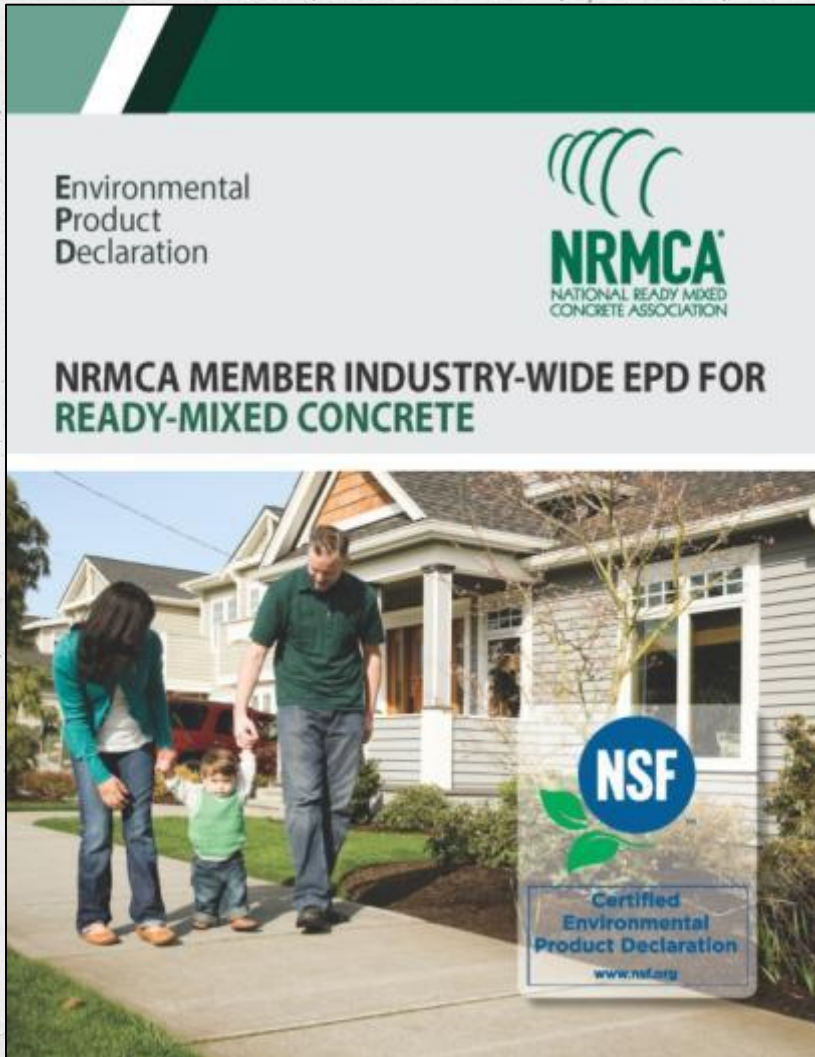


¹LW-Light Weight

²CAC-Cement Association of Canada



Industry Wide EPD



- Provides average industry wide environmental impacts
 - identified various compression strengths and mix designs of various SCMs % and LW aggregate
 - 72 mix designs that represents >95% of production
- 90 producers / 2,700 plants
- Contribution by smaller companies with limited resources
- Version 1 Published in 2014 and Version 2 upcoming in 2017

BUILD WITH STRENGTH

IW-EPD: 72 Mixture Designs

Normal Weight Agg.

- 2500 psi
- 3000 psi
- 4000 psi
- 5000 psi
- 6000 psi
- 8000 psi

Light-Weight Agg.

- 3000 psi
- 4000 psi
- 5000 psi

SCMs

- <20% Fly Ash and/or Slag
- 20-29% Fly Ash
- 30-39% Fly Ash
- 40-49% Fly Ash
- 30-39% Slag
- 40-49% Slag
- 50% Slag
- $\geq 20\%$ Fly Ash and $\geq 30\%$ Slag

Admixtures

- <5000 psi w/ A-E admix
- >5000 psi w/o A-E, w/HRWR admix
- All mixes with WR & Accel admix
- LW w/ A-E admix



Industry-Wide EPD

Table 8a. Summary Results (A1-A3): 3001-4000 psi (20.69-27.58 MPa) RMC product, per cubic yard

Indicator/LCI Metric	GWP	ODP	AP	EP	POCP	PEC	NRE	RE	NRM	RM	CBW	CWW	TW	CHW	CNHW
Unit (equivalent)	kg CO2	kg CFC-11	kg SO2	kg N	kg O3	MJ	MJ	MJ	kg	kg	m3	m3	m3	kg	kg
Minimum	192.6	5.50E-6	0.75	0.24	15.77	1466	1437	27	1538	1.54	0.10	0.09	0.22	0.32	3.30
Maximum	318.7	8.00E-6	1.00	0.38	20.54	2020	1981	39	1779	2.33	0.10	0.09	0.22	0.36	4.55
4000-00-FA/SL	318.7	8.00E-6	1.00	0.38	20.54	2020	1981	39	1779	2.33	0.10	0.09	0.22	0.33	4.55
4000-20-FA	272.4	6.80E-6	0.88	0.33	18.28	1762	1728	34	1668	1.99	0.10	0.09	0.22	0.33	4.16
4000-30-FA	247.4	6.20E-6	0.82	0.30	17.06	1622	1591	31	1608	1.81	0.10	0.09	0.22	0.33	3.94
4000-40-FA	221.1	5.50E-6	0.75	0.27	15.77	1476	1448	27	1545	1.61	0.10	0.09	0.22	0.32	3.72
4000-30-SL	243.0	7.20E-6	0.95	0.30	18.35	1738	1703	35	1655	1.90	0.10	0.09	0.22	0.35	3.80
4000-40-SL	217.8	7.00E-6	0.93	0.28	17.63	1645	1611	34	1614	1.76	0.10	0.09	0.22	0.36	3.55
4000-50-SL	192.6	6.70E-6	0.92	0.25	16.90	1551	1519	32	1572	1.62	0.10	0.09	0.22	0.36	3.30
4000-50-FA/SL	192.8	6.00E-6	0.83	0.24	15.98	1466	1437	29	1538	1.54	0.10	0.09	0.22	0.35	3.36

NRMCA EPD Program Operator

- Became an EPD program operator in 2013
 - execute verification of EPDs
 - encourage members to engage disclosure
- Built a network of LCA/EPD partners to expedite the development of LCA reports and verification of EPDs
- Costs* range from \$1,250 to \$5,000 depending on verification services provided and NRMCA membership status

*Fee covers an EPD for up to 3 plants with up to 30 mix designs per plant.



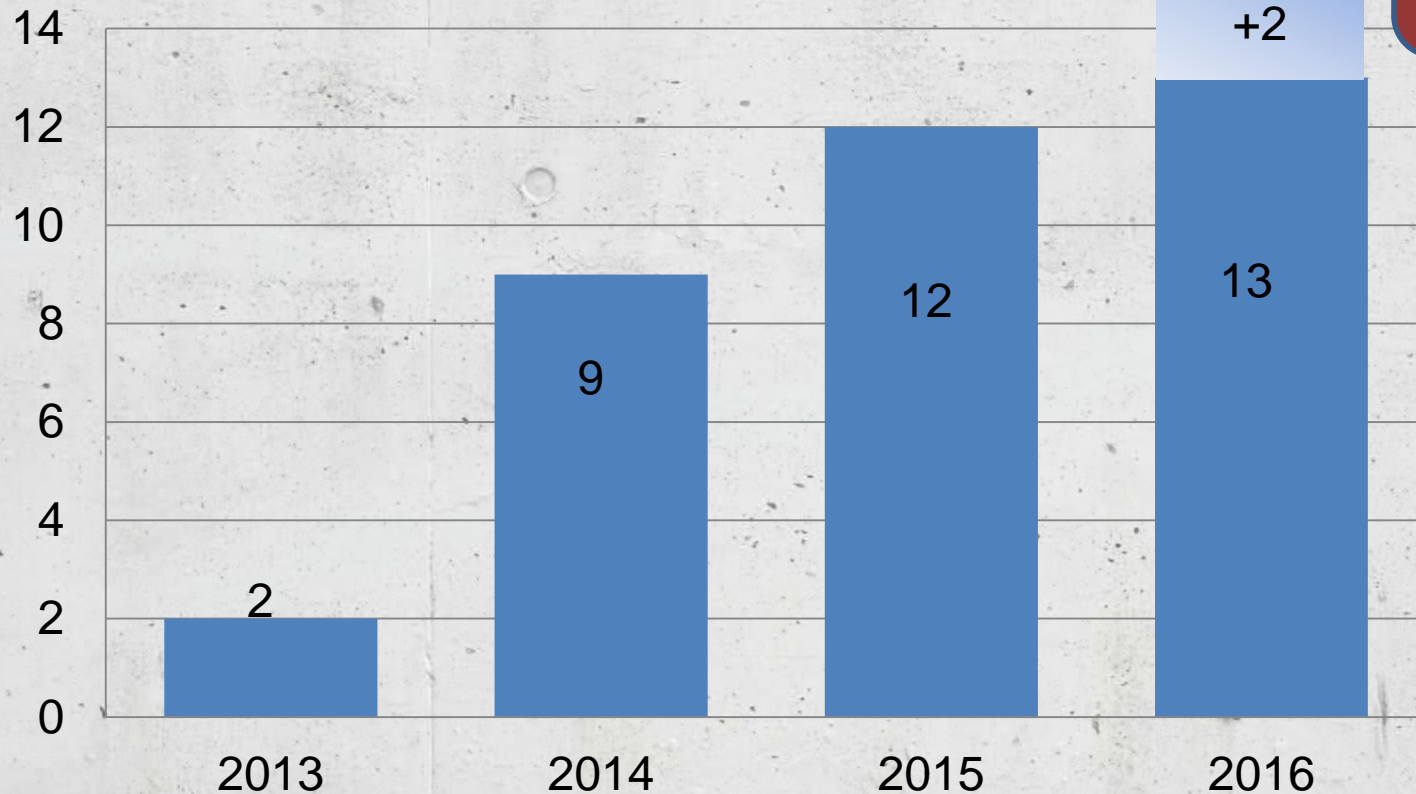
Product Specific (i.e. Producer) EPDs



- Initiated by the Producer
- 13 ready-mix concrete EPDs
 - NRMCA program
 - Other program

Tracking EPDs (cumulative)

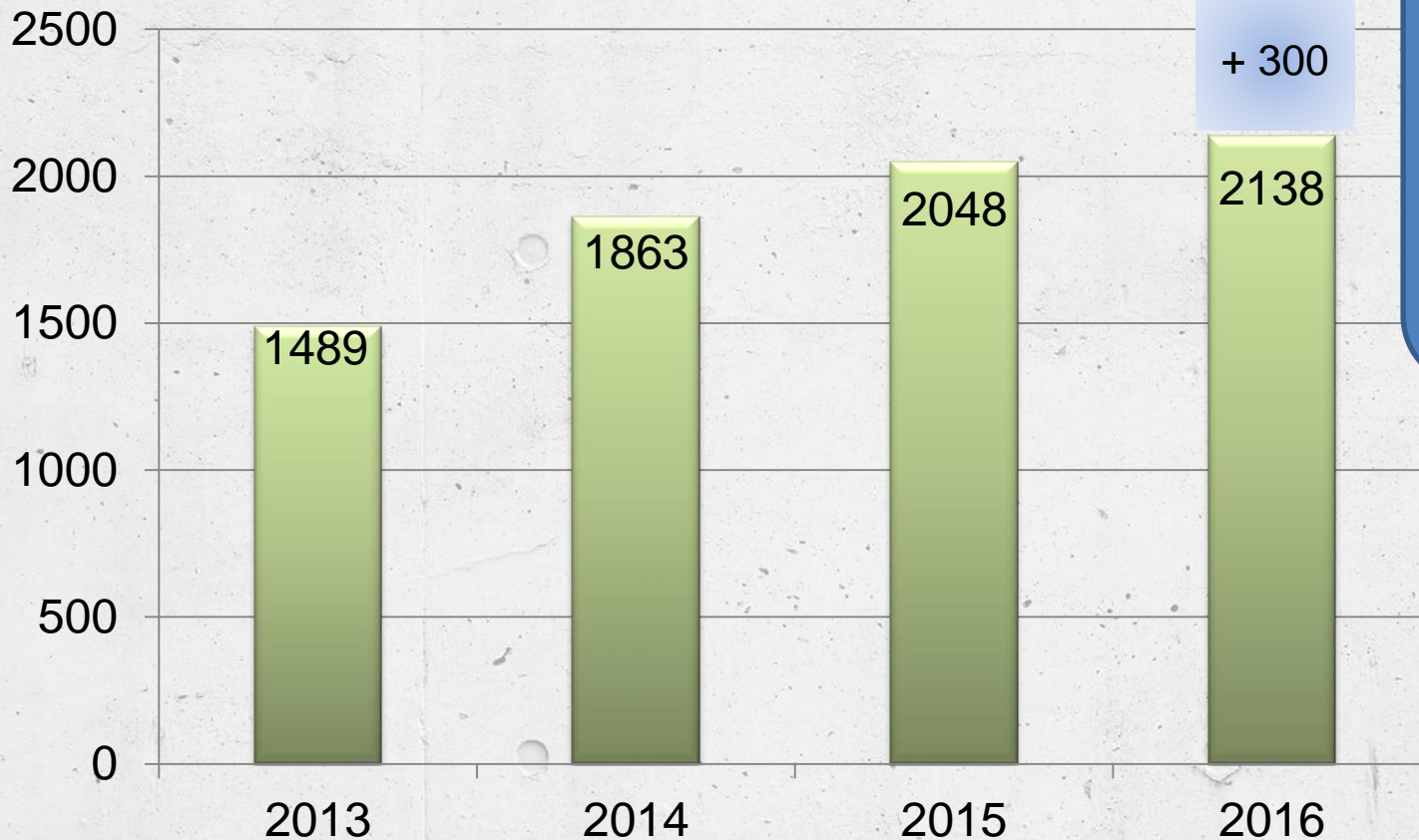
EPDs



70% verified
through NRMCA
EPD program

Tracking EPD Mix/Product (cumulative)

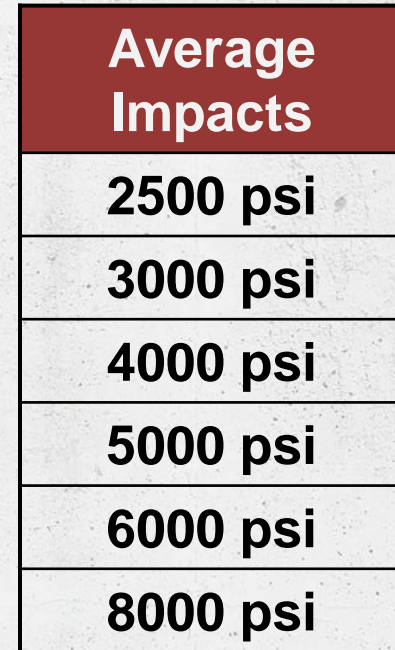
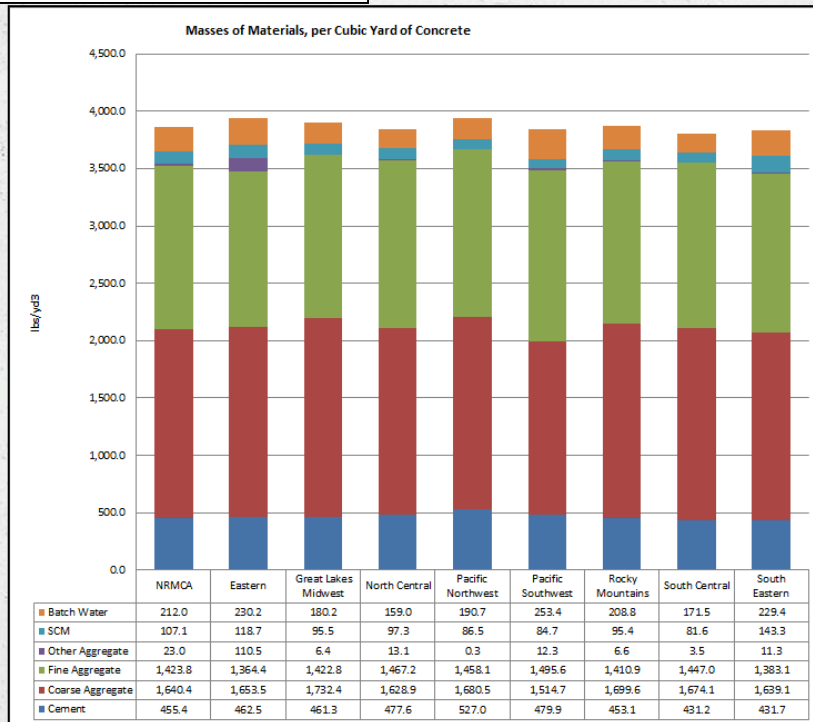
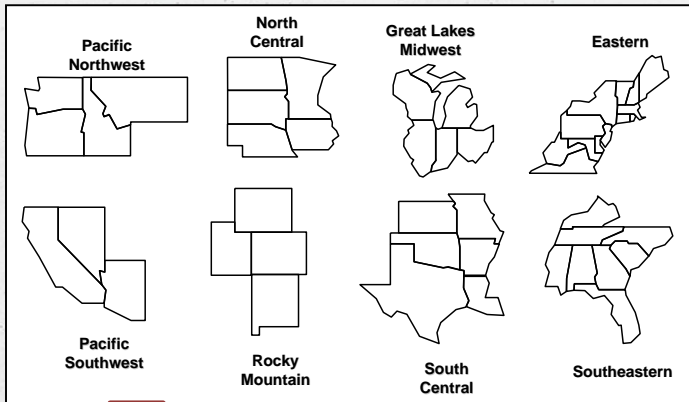
Mixes



•98% verified through NRMCA EPD program

•Expect >3,500 Verified EPDs by 2020

Industry Baselines/Averages



Compare to Benchmark Report

CENTRAL
CONCRETE COMPANY

Environmental Product Declaration

The Environmental Product Declaration (EPD) covers 1,475 concrete units produced for 7 different concrete plants of 8 concrete plants owned and operated by Central Concrete, a U.S. Concrete Company in the San Francisco Bay Area.

Company
Central Concrete, a U.S. Concrete Company, has been serving the San Francisco Bay Area for over 50 years. The company works to improve high-performance concrete while lowering its carbon footprint. Central Concrete has committed to reducing its energy, water, and waste, increasing efficiency, and continuing to provide exceptional products and quality customer service.

Headquarters
Central Concrete
700 Broadway Avenue
San Jose, CA 95128
(408) 434-1000

Service Areas covered by this EPD

Meridian Plant
1911 Broadway Boulevard
Meridian, CA 95432

San Jose Plant
1000 Broadway Avenue
San Jose, CA 95128

Houston Plant
401 W. Wilson Avenue
Houston, TX 77002

Dallas Plant
1601 South Loop West
Dallas, TX 75243

Fort Worth Plant
407 Quorum Lane
Fort Worth, TX 76102

South San Francisco Plant
1620 San Bruno Avenue
South San Francisco, CA 94080

NMCA
CONCRETE
EPD

NRCA
National Ready Mixed Concrete Association
www.nrca.org

NRCA Member National and Regional Life Cycle Assessment Benchmark (Industry Average) Report

Prepared by: National Ready Mixed Concrete Association (NRCA)

Prepared by: Dr. Linda Stroh and Grant Peterson
The Athena Sustainable Materials Institute

October 2014

Product	Plant	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e
135POB01	Pleasanton	3,500	2,062E+03	6,871E-02	7,344E-03	2,894E+02	2,990E+06	1,871E+00	7,838E-04	2,327E+01								
340POB01	Pleasanton	4,500	2,258E+03	6,871E-02	7,344E-03	3,241E+02	4,592E+06	2,354E+00	8,716E-02	3,096E+01								
340POB01	Pleasanton	4,500	2,185E+03	6,871E-02	7,344E-03	2,849E+02	4,752E+06	2,134E+00	8,474E-02	2,874E+01								
340POB02	Pleasanton	4,000	2,188E+03	6,871E-02	7,344E-03	3,950E+02	4,190E+06	1,190E+00	6,195E-02	2,877E+01								
340POB01	Pleasanton	4,500	2,153E+03	6,871E-02	7,344E-03	2,897E+02	4,734E+06	2,096E+00	8,307E-02	2,768E+01								
340POB02	Pleasanton	4,000	2,153E+03	6,871E-02	7,344E-03	2,897E+02	4,239E+06	2,596E+00	8,237E-02	2,768E+01								
340POB01	Pleasanton	4,000	2,153E+03	6,871E-02	7,344E-03	2,827E+02	5,522E+06	1,849E+00	1,109E-01	3,168E+01								
345POB01	Pleasanton	4,500	2,488E+03	6,871E-02	7,344E-03	3,422E+02	4,782E+06	2,495E+00	9,009E-02	3,268E+01								
345POB01	Pleasanton	4,500	2,262E+03	7,287E-02	7,344E-03	3,124E+02	4,436E+06	2,284E+00	8,711E-02	2,982E+01								
345POB02	Pleasanton	4,500	2,262E+03	6,871E-02	7,344E-03	3,125E+02	4,462E+06	2,264E+00	8,648E-02	2,982E+01								

Table 10-Pacific Northwest LCA Results		CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e	CO ₂ e
1000 gal	per yd ³	347.07	3,652.06	1.05	0.30	13.74	1,838.9	1,904.3	34.7	1,703.1	0.41	0.15	0.10	0.30	0.00	24.24		
1000 gal	per yd ³	323.55	4,771.06	1.38	0.12	17.87	2,236.0	2,495.7	45.4	2,227.6	0.54	0.20	0.21	0.40	0.00	31.70		
1000 gal	per yd ³	279.05	4,052.06	1.31	0.11	14.81	2,125.1	2,094.8	38.5	1,717.3	0.44	0.15	0.16	0.30	0.00	24.24		
1000 gal	per yd ³	308.51	4,441.06	1.43	0.17	22.58	2,355.4	1,794.2	55.2	2,274.7	0.66	0.26	0.21	0.40	0.00	31.70		
1000 gal	per yd ³	419.02	4,052.06	1.21	0.10	25.45	3,133.7	1,682.2	37.5	1,765.7	0.59	0.16	0.17	0.30	0.00	24.24		
1000 gal	per yd ³	348.06	3,912.06	1.26	0.25	34.60	4,080.4	4,005.3	75.2	2,883.3	0.77	0.21	0.22	0.40	0.00	31.70		
1000 gal	per yd ³	441.81	4,371.06	1.35	0.20	27.44	3,283.8	3,333.3	60.5	1,813.1	0.41	0.17	0.18	0.30	0.00	24.24		
1000 gal	per yd ³	377.87	4,342.06	1.08	0.20	35.89	4,295.0	4,215.9	79.1	2,879.1	0.80	0.22	0.22	0.40	0.00	31.70		
1000 gal	per yd ³	339.17	3,731.06	1.21	0.23	31.20	3,517.4	3,884.0	79.3	1,949.7	0.71	0.17	0.18	0.30	0.00	24.24		
1000 gal	per yd ³	305.21	1,052.06	0.30	0.30	40.80	3,176.1	1,086.1	95.9	2,419.3	0.93	0.21	0.21	0.40	0.00	31.70		



Tools for Developing LCA Reports & Draft EPDs for Verification

- Athena
 - A web-based tool for instant, custom environmental footprint data
- Climate Earth
 - Links production software with environmental impact data
- WBCSD CSI* tool
 - online calculation tool
 - PCA / Quantis



Athena
Sustainable Materials
Institute

The logo for Climate Earth, featuring the text "climate earth" in a sans-serif font, with "climate" in grey and "earth" in green. A green arc with a dot at its end curves over the text.The logo for Quantis, featuring a stylized blue and green arrow pointing right, followed by the word "Quantis" in a blue sans-serif font.

*World Business Council for Sustainable Development's
Cement Sustainability Initiative

BUILD WITH STRENGTH



“...will target Platinum ... is pursuing the EPD credit”

“...provide EPDs for concrete mix designs, including pre-cast and cast-in-place concrete, and all steel.”



Proposed Spec: 90% by volume of the cast-in-place concrete submit EPDs...demonstrate lower GWP (CO₂e) as compared to NRMCA Benchmarks for Northwest Region.

EPDs for Transportation Projects

The Next Challenge...

Pavement EPD/LCA: Implementation Strategies

- 1) Incorporate into matls/const specifications.
- 2) Incorporate into design optimization.
- 3) Utilize in pavement type selection process.
- 4) Use as part of asset management decisions.
- 5) Make integral to green rating system(s).
- 6) Assess effectiveness of recycling program.
- 7) Report adherence to legislative mandate.

Green Rating Systems: Roads and Highways



THE ENVISION™ RATING SYSTEM





Thank You

?? Questions ??

PAVE  AHEAD

DURABLE. SUSTAINABLE. **CONCRETE.**

BUILD  WITH STRENGTH

A COALITION OF THE NATIONAL READY MIXED CONCRETE ASSOCIATION