2.0 Developing Industry Leaders

- Offers a limited number of company-nominated middle managers the unique opportunity to network with peers and senior leaders from across the country while also learning about issues, and solutions, facing the ready mixed concrete industry.

- This Year's DIL Group:
  - Comparing Tools for Carbon Reduction – Whole Building Concrete GWP
    - Daniel Corneau, Aggregate Industries
    - Justin Walker, Titan America
    - Leighton Reynolds, Bayou Concrete
    - Frank Russo-Alesi, Preferred Materials
    - James Bogdan, NRMCA Liaison

Comparing Tools for Carbon Reduction - Whole Building Concrete GWP

Presented by:
Justin Walker - Roanoke Cement - Princeton WV

Leighton Reynolds - Bayou Concrete - Gulfport MS

Frank Russo-Alesi - Preferred Materials - St. Petersburg FL

Dan Corneau - Aggregate Industries - Denver CO

Architect John A. Bodziak St. Petersburg Fl.

Justin Walker, Roanoke Cement/Titan America Princeton, WV.

Frank Russo-Alesi - Preferred Materials - St. Petersburg FL

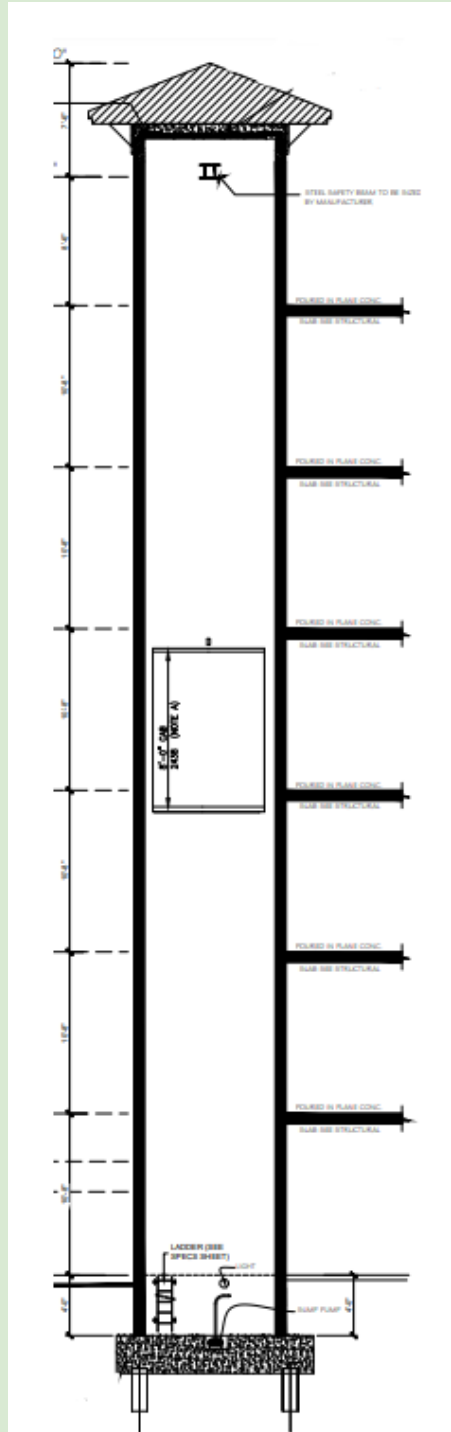
Leighton Reynolds - Bayou Concrete - Gulfport MS

Dan Corneau - Aggregate Industries - Denver CO

NRMCA Promotions Committee - Sustainability Team 2021 DIL Project

Introduction to the Comparison

Calculating the embodied carbon represented in the concrete for a new construction project could be paramount to the success of the industry in very soon. Many producers are already making a Net 0 pledge for a future date. The ability to quantify CO2 reduction levels by comparing benchmark mix designs for various concrete elements to the same elements using CO2 reduced mix designs is how reduction capacity is measured. There are currently a number of tools available to make those calculations, so the GWP comparisons can be made. This presentation will demonstrate concrete CO2 reduction compared to benchmark CO2 for a mid-rise residential project but also compare two different tools for estimation of GWP. The EC3 tool and the Athena Impact Estimator.



John A Bodziak Architect AIA

The Process:

- Identify a low to mid-rise building project that utilizes various concrete elements and where the project is located regionally
- Identify the building concrete elements, required compressive strength of concrete for each element, and total volume required for each element
- Use the NRMCA Industry Wide average report to identify GWP for benchmark mixes for the project concrete elements in the project region
- Identify the reduced carbon mixes for each of the project concrete elements
- Use the EC3 carbon calculator tool to produce a second set of GWP numbers for the same set of the project concrete elements for the reduced CO2 concrete mixes.
- Use the Athena Impact Estimator tool to report on GWP numbers for each of the project concrete elements for benchmark and reduced CO2 concrete mixes
- Compare baseline mix results with reduced carbon mixes for total GWP reduction, and compare the two calculators used for similarities or differences
- Based on the total GWP reduction, make a suggestion for a way to go about specification for GWP reduction on the project level for engineers or architects.

The (fictitious) Project:

- 6 story residential
- Great Lakes Region
- Foundations 950cy - 3000psi
- Columns/Shear Walls 650cy - 6000psi
- SOG 300cy - 4000psi
- Slabs on Deck 1450cy - 5000psi

Architect John A. Bodziak St. Petersberg Fl.

NRMCA IW Average Benchmark Mix Data:

Table B3-Great Lakes Midwest Benchmark Mix Designs (per cubic yard)										
Compressive Strength	psi	2500	3000	4000	5000	6000	8000	3000 LW	4000 LW	5000 LW
Portland Cement	lbs	341	382	468	576	611	733	383	468	556
Fly Ash	lbs	39	44	54	67	71	85	44	54	64
Slag Cement	lbs	24	27	33	41	44	52	27	33	40
Mixing Water	lbs	267	267	267	276	300	300	271	271	271
Crushed Coarse Aggregate	lbs	1,517	1,489	1,445	1,387	1,431	1,373	0	0	0
Natural Coarse Aggregate	lbs	245	240	233	224	231	221	0	0	0
Crushed Fine Aggregate	lbs	14	14	14	13	14	13	14	12	11
Natural Fine Aggregate	lbs	1,460	1,432	1,390	1,335	1,376	1,321	1,371	1,248	1,138
Man.Lightweight Aggregate	lbs	0	0	0	0	0	0	1,050	1,070	1,080
Air %	%	6%	6%	6%	6%	6%	0	6%	6%	2%
Air Entraining Admixture	oz	1	1	1	1	1	1	1	1	0
Plasticizer & Superplasticizer	oz	3	3	3	7	3	3	3	7	7
Set Accelerator	oz	25	20	15	10	25	20	15	10	10
Total Weight	lbs	3,908	3,895	3,905	3,919	4,076	4,098	2,110	2,087	2,080

Great Lakes Region Benchmark Mix Data

Information from: Appendix D: NRMCA Member National and Regional LCA Benchmark (Industry Average) Report – V 3.0 from November 2019

Table E3-Great Lakes Midwest LCA Results (per cubic yard)										
Strength	psi @28 days	2,500	3,000	4,000	5,000	6,000	8,000	3000LW	4000LW	5000LW
Core Mandatory Impact Indicator										
GWP	kg CO2e	192.43	211.66	252.63	304.40	321.68	380.19	401.57	445.91	489.97
ODP	kg CFC11e	5.17E-06	5.66E-06	6.71E-06	8.03E-06	8.49E-06	9.98E-06	1.50E-05	1.63E-05	1.74E-05
AP	kg SO2e	0.68	0.73	0.84	0.97	1.02	1.16	2.02	2.15	2.27
EP	kg Ne	0.23	0.25	0.30	0.36	0.38	0.45	0.71	0.76	0.82
SFP	kg O3e	14.22	15.17	17.22	19.80	20.83	23.76	25.81	28.01	30.18
ADPf	MJ, NCV	978.01	1,071.94	1,276.27	1,538.32	1,625.82	1,922.96	2,732.57	2,972.04	3,205.97
ADPe	kg Sbe	2.01E-04	2.13E-04	2.39E-04	2.71E-04	2.85E-04	3.22E-04	2.58E-04	2.87E-04	3.16E-04
FFD	MJ Surplus	103.35	107.87	118.62	132.88	138.87	155.27	205.50	218.55	231.68
Use of Primary Resources										
RPRE	MJ, NCV	50.60	55.92	67.34	81.96	86.74	103.20	285.25	301.16	315.44
RPRM	MJ, NCV	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00
NRPRE	MJ, NCV	1,349.29	1,450.64	1,673.13	1,958.14	2,060.62	2,384.52	3,295.44	3,555.14	3,808.81
NRPRM	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Secondary Material, Secondary Fuel and Recovered Energy										
SM	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF	MJ, NCV	72.50	81.21	99.54	122.56	129.89	155.89	81.43	99.57	118.27
RE	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mandatory Inventory Parameters										
FW	m3	2.73	2.90	3.28	3.80	4.06	4.59	3.16	3.54	3.93
CCE	kg CO2e	74.91	83.91	102.85	126.64	134.21	161.08	84.14	102.89	122.21
Indicators Describing Waste										
HWD	kg	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NHWD	kg	7.37	7.37	7.37	7.37	7.37	7.37	7.37	7.37	7.37
HLRW	m3	1.03E-06	1.01E-06	9.90E-07	9.61E-07	9.83E-07	9.54E-07	4.79E-07	4.65E-07	4.53E-07
LLRW	m3	1.14E-06	1.12E-06	1.10E-06	1.06E-06	1.09E-06	1.06E-06	2.17E-06	2.19E-06	2.19E-06
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EE	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

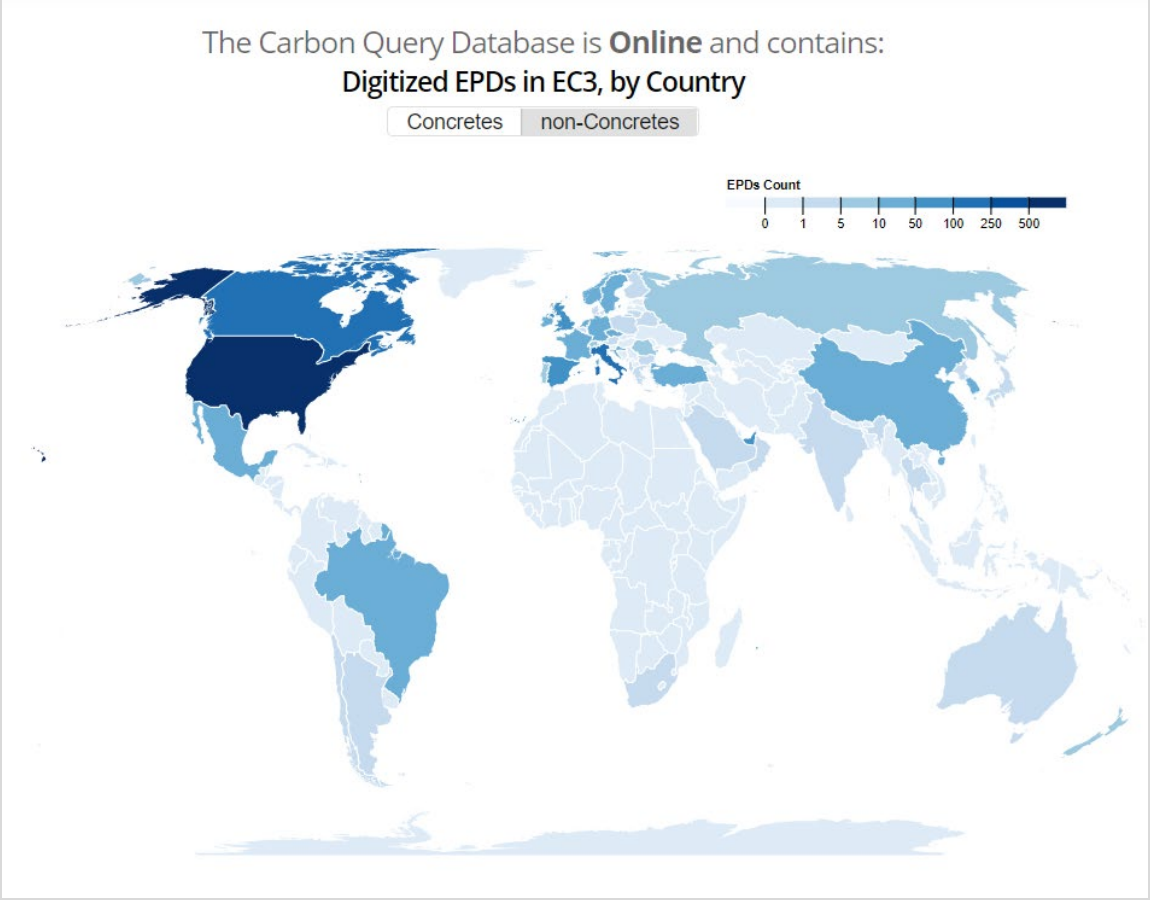
Benchmark Mix Designs - NRMCA

Concrete Element	Volume	Mix PSI	Portland Type I/II	Slag (lbs)	Fly Ash (lbs)	Total Cementitious	Benchmark GWP kgCO2e	Total CO2 / element
Foundations	950	3000	382	27	44	453	211.66	201077
Columns / Shear Walls	650	6000	611	44	71	726	321.68	209092
SOG	300	4000	468	33	54	555	252.63	75789
SOD	1450	5000	576	41	67	684	304.4	441380

Benchmark Embodied Carbon Project Total = 927,338 kg

Embodied Carbon in Construction Calculator (EC3)

- EDP Database
- Domestic & International
- Calculate embodied carbon for complete buildings
- Compare manufacturers and suppliers
- EPD’s for various building materials



Building Design & Data

DIL BUILDING

PRIVATE | Anonymize & Publish | Save | Cancel

Upload a jpeg/png/gif file of size 10Mb or less

Project Name *: DIL Building

Building Use: Residential.Multi-Unit

Approximate Construction Start Date: 2021-01-01

Project address: Michigan Center, MI, United States

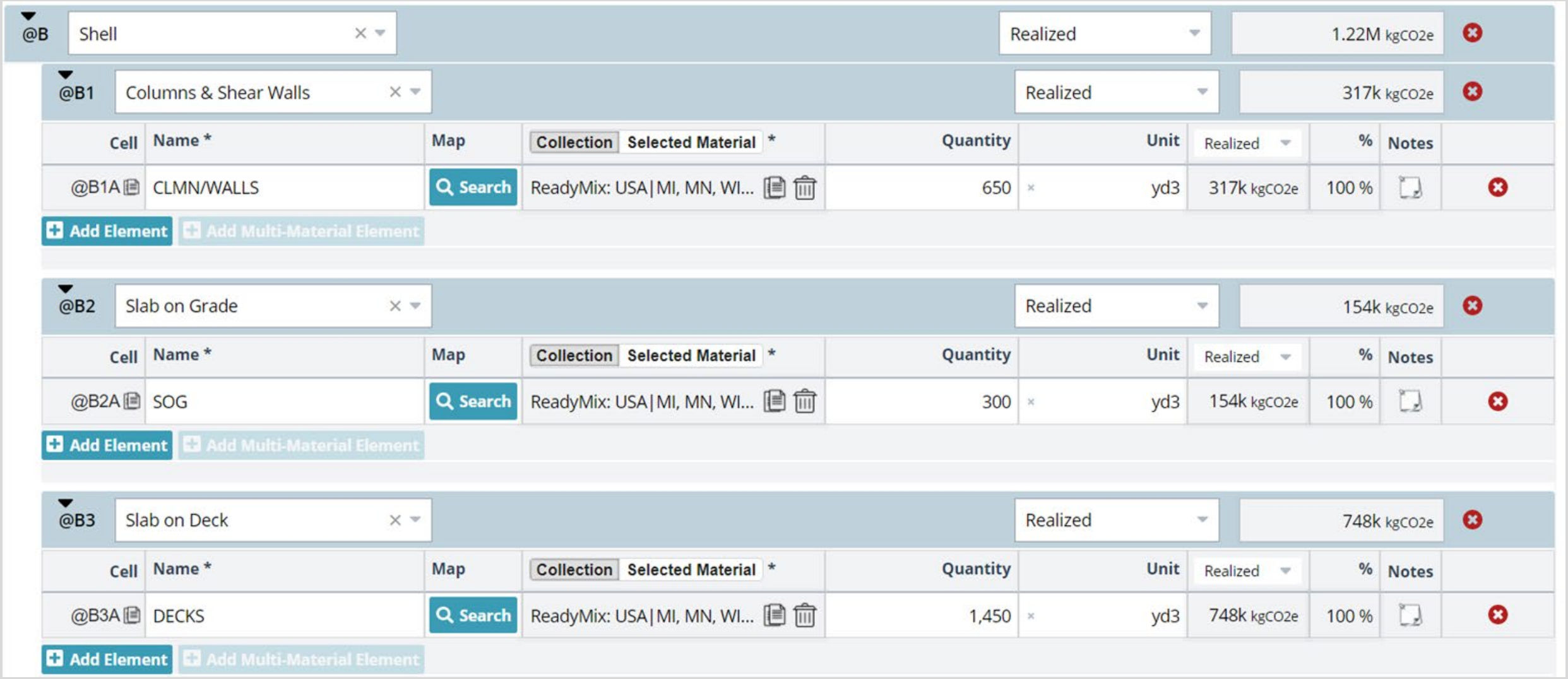
BUILDING CLASSIFICATION

REFERENCE & COMPARISON

SAMPLE SUPPLIER DOCUMENTS

Gross Floor Area: 63,000 ft2	Floors: 6 Stories	EC Total (Conservative): 1.66M kgCO2e	EC Intensity (Conservative): 26.3 kgCO2e / ft2
Floor Area Above Grade: 63,000 ft2	Height	EC Total (Achievable): 756k kgCO2e	EC Intensity (Achievable): 12.0 kgCO2e / ft2
Floor Area Below Grade: 0 ft2	Weight: 11.6M lbs	EC Total (Realized): 1.66M kgCO2e	EC Intensity (Realized): 26.3 kgCO2e / ft2

Building Elements



Element Data Entry

SEARCH BY PROPERTIES: 03 30 00 CAST-IN-PLACE CONCRETE

Compare Products

✓ CHANGE THIS ELEMENT

PERFORMANCE SPECIFICATIONS

Compressive Strength: ≅ 3000 psi

@ Curing Time: 28d

≅ Compressive Strength Other

@ Curing Time

Cementitious Materials

≥ Gray Portlan... | ≥ White Portlan... | ≥ GGBS | ≥ Fly Ash | ≥ Silica Fume | ≥ Ground Glass

≥ Natural pozz... | ≥ Metakaolin | ≥ Other SCMs

Slump (min) | Options | ≤ W/C Ratio | ≤ EC3 / 1 yd3

◯ Standardweight ◯ Lightweight

GEOGRAPHIC

Filter by Region

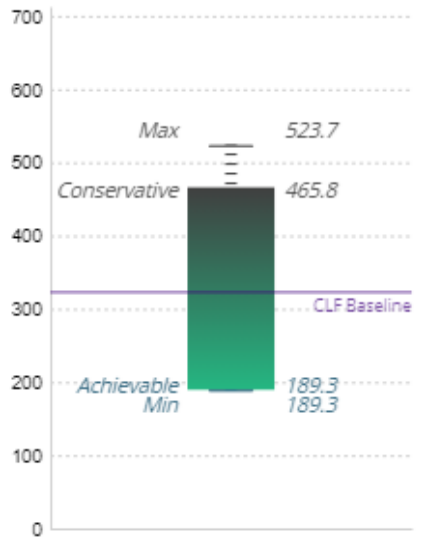
Filter by Country/State/Province: Michigan × Ohio × Indiana × Illinois × Wisconsin ×

Max Distance from Project Site

GWP Transport Cost

kgCO2e embodied per 1 yd3

Tour : BOXPLOT DIAGRAM



EPD Data and Files

- EDP's from various suppliers in the specified geographical area.
- Data is used for EC3 calculations.
- User has the ability to view each EDP

PRODUCT EPDS

Subcategory	Manufacturer	Plant or Plan...	Product	Description	Compressiv...	EC3 / 1 yd3	Straight-line Di...	Details
	Compare	Compare			Compare			
ReadyMix	Scioto Ready Mix	Alexandria	6 Sand / 1 Ce...	6 Sand / 1 Cement	3000 psi	402 kgCO2e	172 miles	Details Open
ReadyMix	Scioto Ready Mix	Alexandria	Mix c8d830f...	3000 2 In Pump	3000 psi	347 kgCO2e	172 miles	Details Open
ReadyMix	Scioto Ready Mix	Alexandria	300FN1L5M	3000 Footing	3000 psi	278 kgCO2e	172 miles	Details Open
ReadyMix	Scioto Ready Mix	Alexandria	553BN1L8D	Enacsement w/ D...	3000 psi	321 kgCO2e	172 miles	Details Open
ReadyMix	Scioto Ready Mix	Alexandria	Mix 89be5b0...	3000 Light Weight	3000 psi	510 kgCO2e	172 miles	Details Open
ReadyMix	Platte River Conc...	Council Bluffs, IA	Mix e14af205...	RAVEN L3000 NA...	3000 psi	343 kgCO2e	600 miles	Details Open
ReadyMix	Platte River Conc...	Council Bluffs, IA	Mix a89618a...	RAVEN CLSM	3000 psi	268 kgCO2e	600 miles	Details Open
ReadyMix	Platte River Conc...	Council Bluffs, IA	Mix 6f44df2a...	LF3000 AE	3000 psi	288 kgCO2e	600 miles	Details Open

Compare By Manufacturer

3000 psi for Foundations

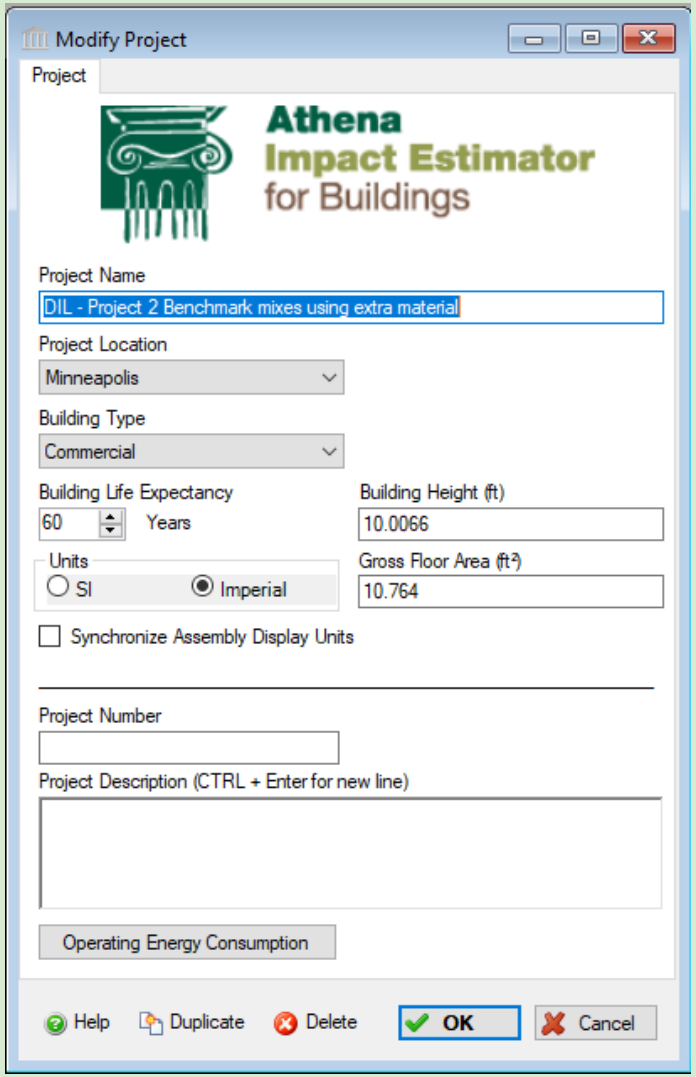
Reduced Carbon Mix Designs - EC3 Tool estimates

Used EC3 tool professional user free access to access Great Lakes regional EPD's to get estimated carbon reduction.

Concrete Element	Volume	Mix PSI	Portland cement	Slag (lbs)	Fly Ash (lbs)	Total Cementitious	**Achievable** Total kgCO2 / element	**Realized** Total kgCO2 / element
Foundations	950	3000	N/A	N/A	N/A	N/A	180,000	438,000
Columns / Shear Walls	650	6000	N/A	N/A	N/A	N/A	152,000	317,000
SOG	300	4000	N/A	N/A	N/A	N/A	70,400	154,000
SOD	1450	5000	N/A	N/A	N/A	N/A	353,000	748,000

Achievable 756k kg - vs. Realized 1.66M kg

Athena Impact Estimator for Buildings

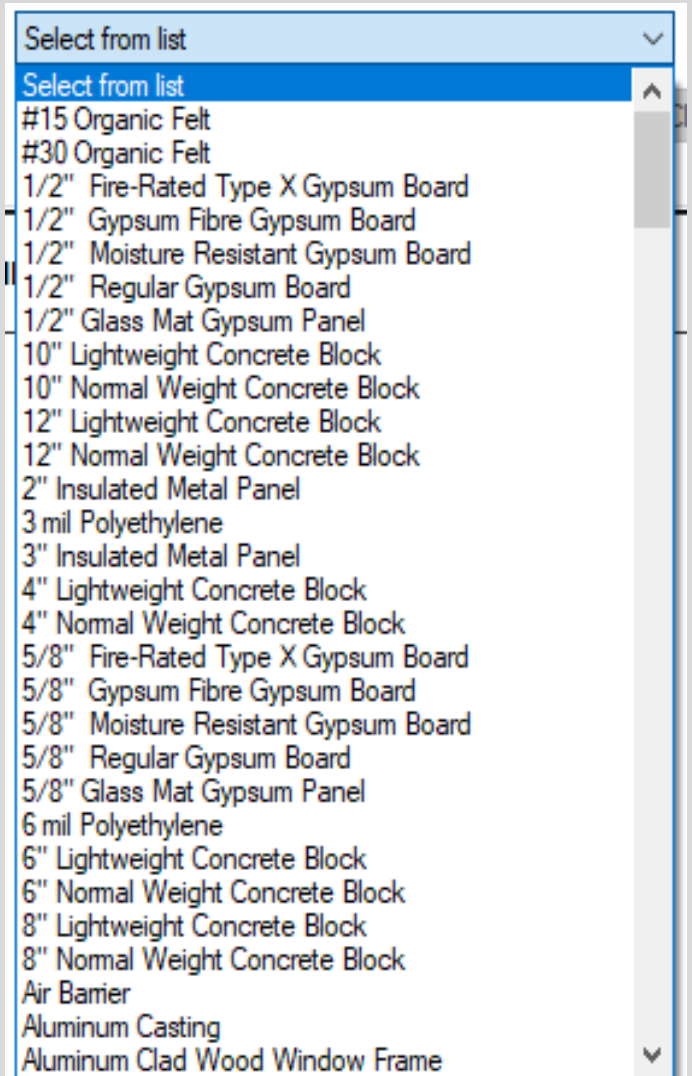


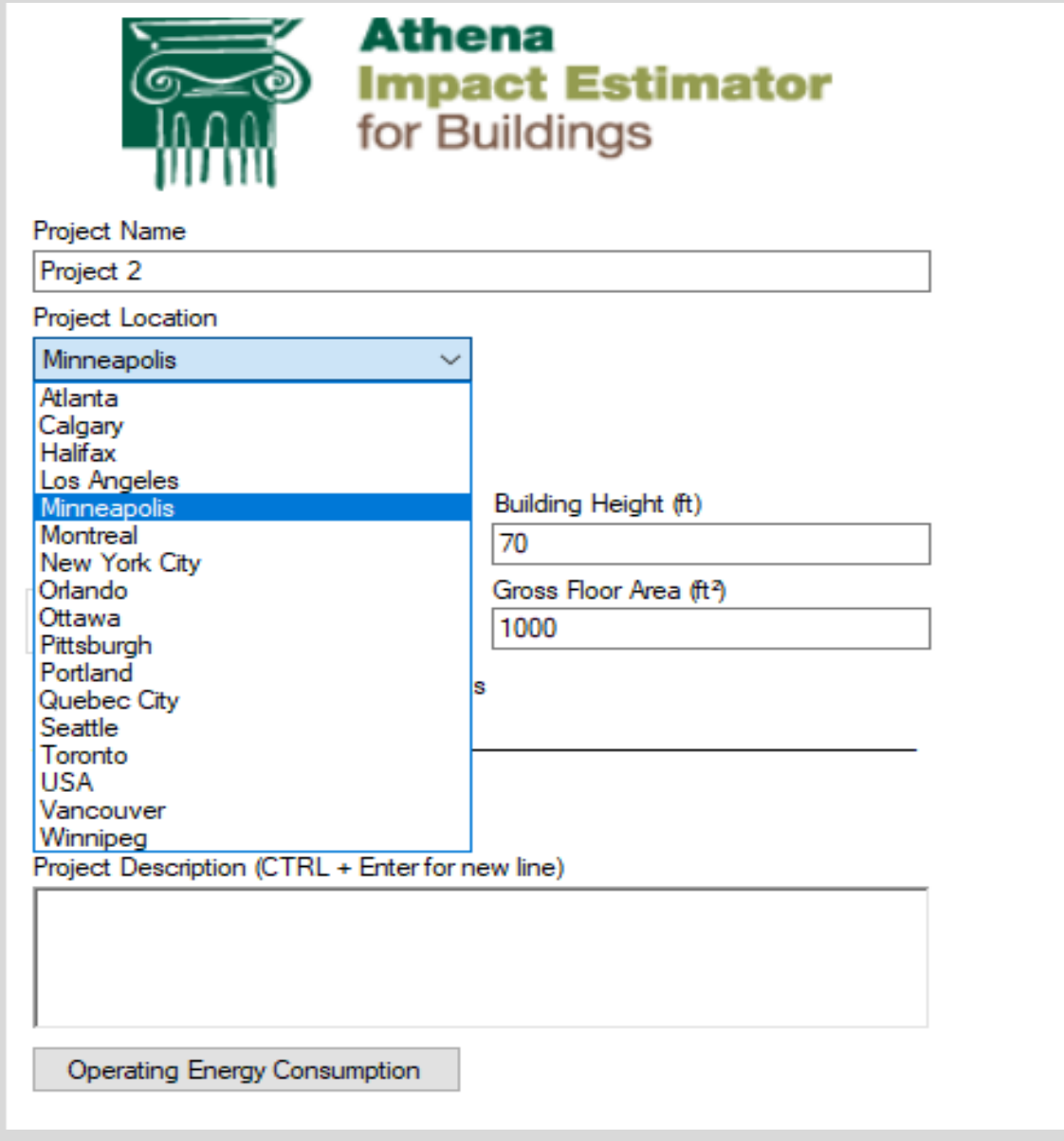
Assumptions taken:

- Mix library in the estimator tool are claimed to be USA average based on NRMCA data
- The achievable GWP discovered by the EC3 tool based on existing EPD's was an average number and lower GWP could be possible
- Small changes in SCM percentage can make big changes in GWP results
- 50% portland cement replacement was used For this exercise, Fly ash was 40% and Slag was 60% of the portland replacement.

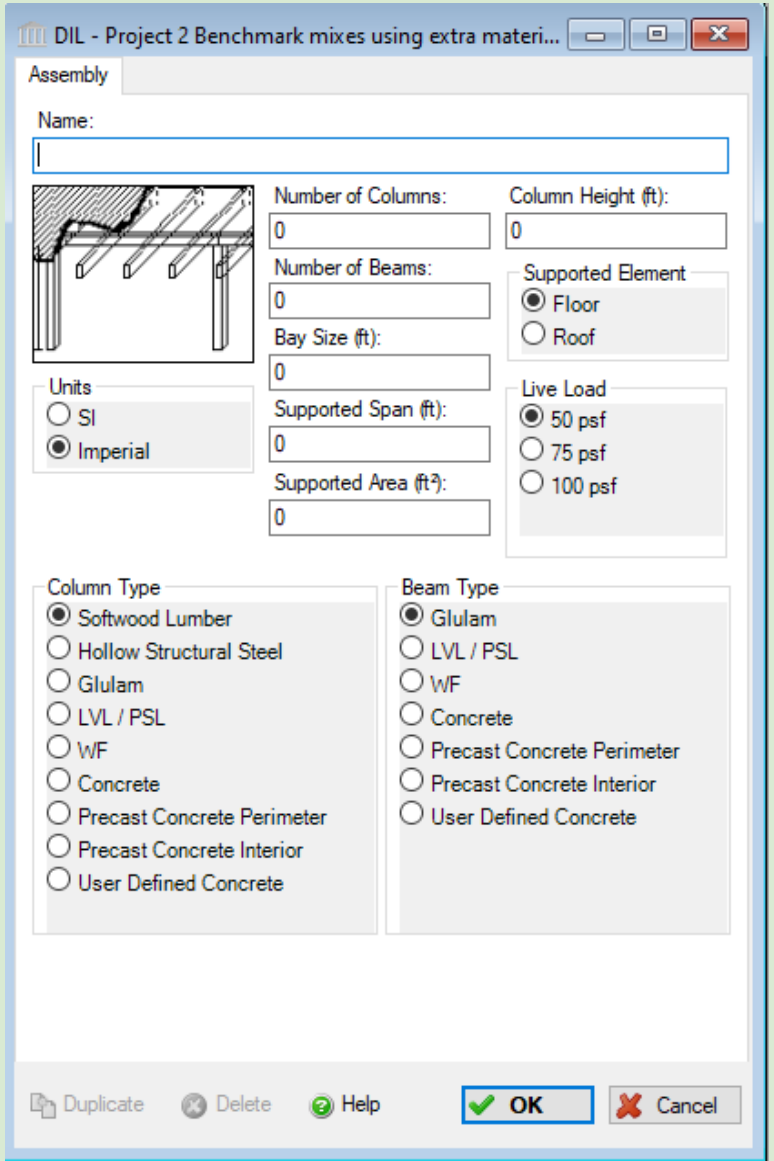
Embodied Carbon in Athena Calculator

- Project Location in Select cities in USA and Canada
- EPDs for several building materials

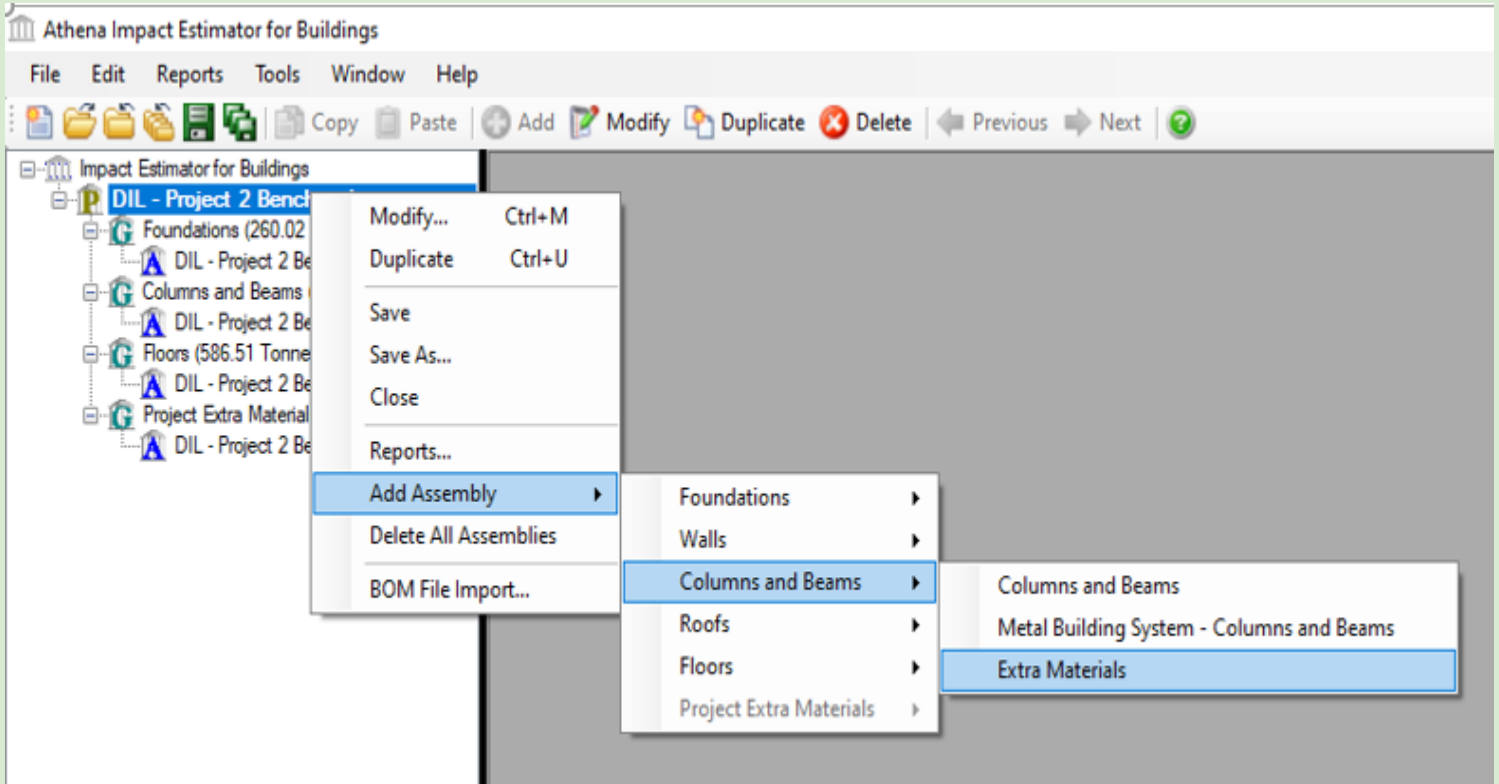




Athena Impact Estimator Project input options



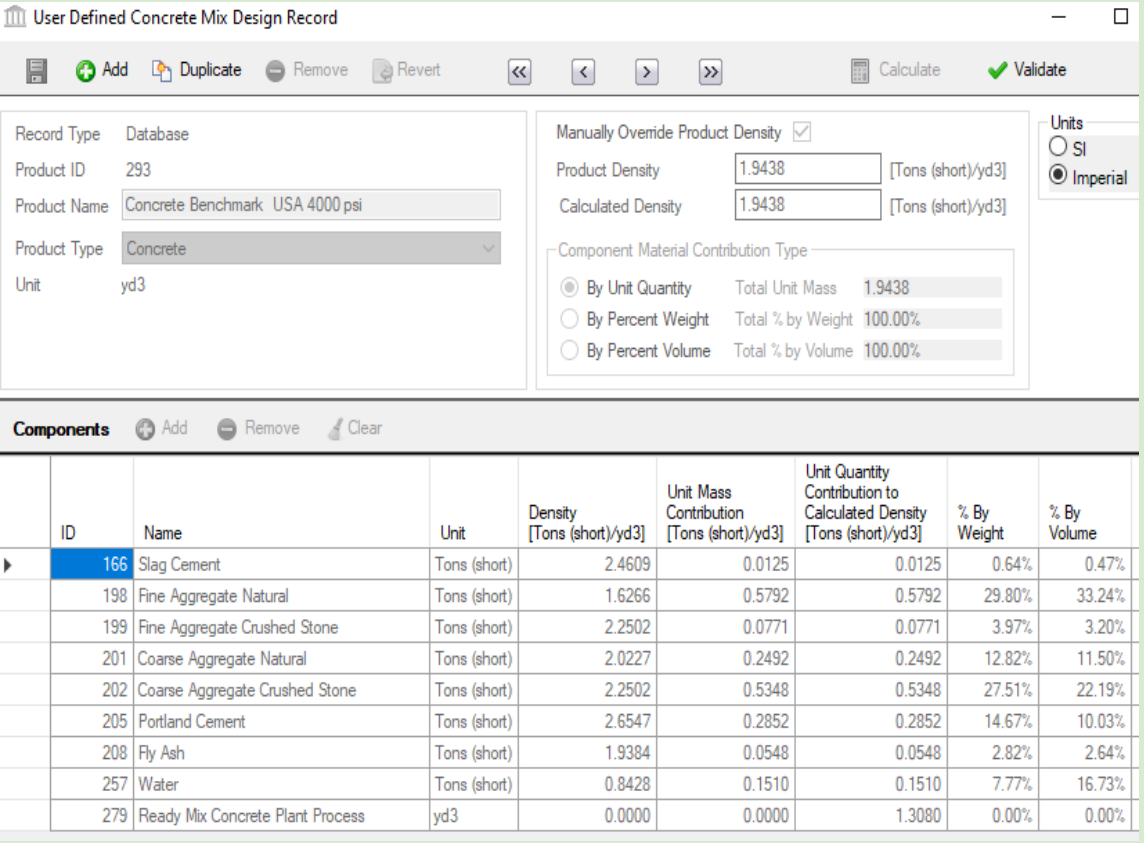
- Assembly can be defined by dimensions of the element making specific project information define concrete volumes and therefore element specific GWP
- Using the extra materials option allows one to simply define concrete volume, concrete mix and customize constituents for the element on a project level.
- 5% is automatically added to any volumes entered for project waste.



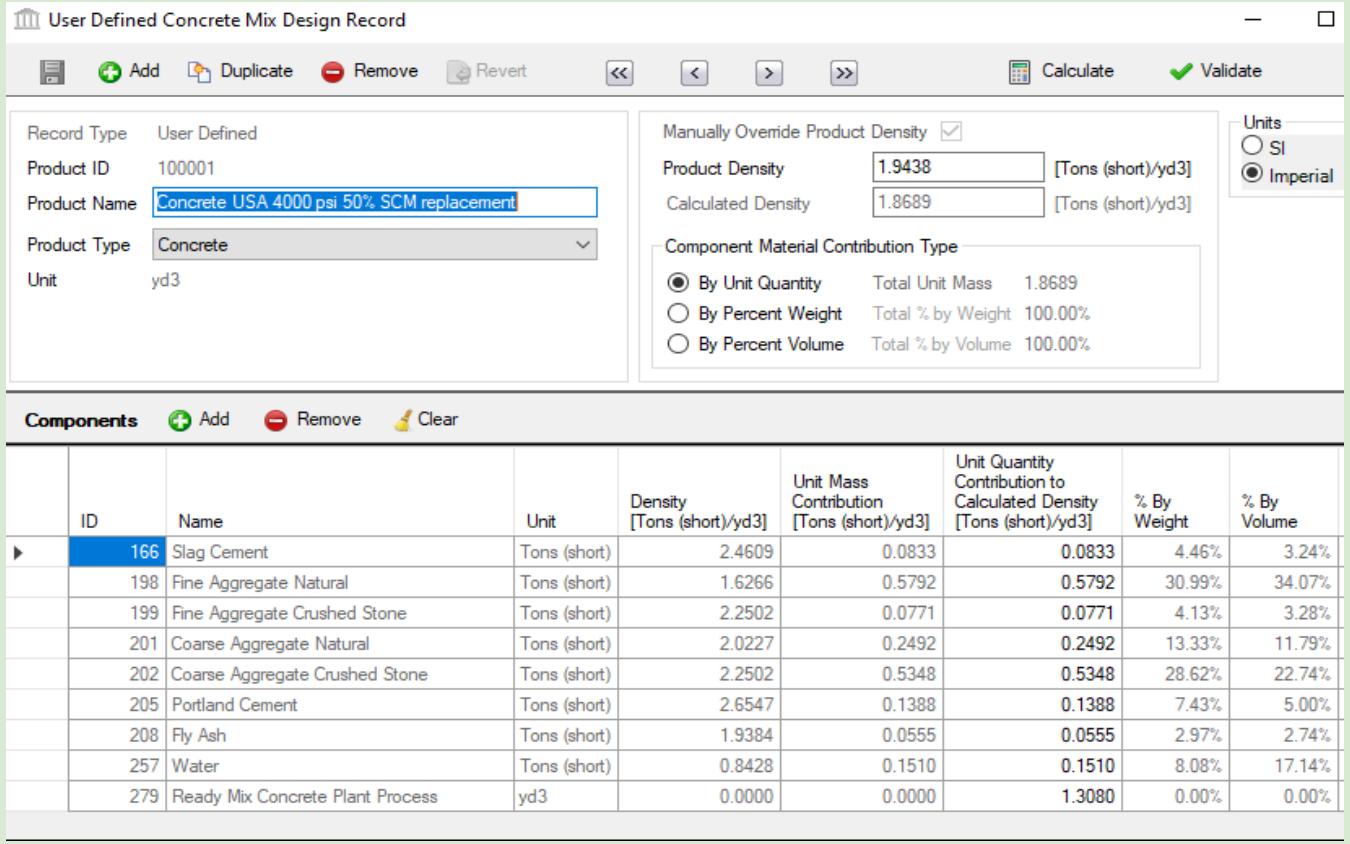
Benchmark and Custom mixes to compare for calculating GWP reduction

- Benchmark mixes are based on NRMCA USA averages
- Mix constituents are listed in unit mass contribution, % by weight and % by volume

- Mix constituents are customizable to meet project and producer needs
- Each constituent can be custom entered by unit quantity, % by weight, or % by volume to make the custom mix



ID	Name	Unit	Density [Tons (short)/yd3]	Unit Mass Contribution [Tons (short)/yd3]	Unit Quantity Contribution to Calculated Density [Tons (short)/yd3]	% By Weight	% By Volume
166	Slag Cement	Tons (short)	2.4609	0.0125	0.0125	0.64%	0.47%
198	Fine Aggregate Natural	Tons (short)	1.6266	0.5792	0.5792	29.80%	33.24%
199	Fine Aggregate Crushed Stone	Tons (short)	2.2502	0.0771	0.0771	3.97%	3.20%
201	Coarse Aggregate Natural	Tons (short)	2.0227	0.2492	0.2492	12.82%	11.50%
202	Coarse Aggregate Crushed Stone	Tons (short)	2.2502	0.5348	0.5348	27.51%	22.19%
205	Portland Cement	Tons (short)	2.6547	0.2852	0.2852	14.67%	10.03%
208	Fly Ash	Tons (short)	1.9384	0.0548	0.0548	2.82%	2.64%
257	Water	Tons (short)	0.8428	0.1510	0.1510	7.77%	16.73%
279	Ready Mix Concrete Plant Process	yd3	0.0000	0.0000	1.3080	0.00%	0.00%



ID	Name	Unit	Density [Tons (short)/yd3]	Unit Mass Contribution [Tons (short)/yd3]	Unit Quantity Contribution to Calculated Density [Tons (short)/yd3]	% By Weight	% By Volume
166	Slag Cement	Tons (short)	2.4609	0.0833	0.0833	4.46%	3.24%
198	Fine Aggregate Natural	Tons (short)	1.6266	0.5792	0.5792	30.99%	34.07%
199	Fine Aggregate Crushed Stone	Tons (short)	2.2502	0.0771	0.0771	4.13%	3.28%
201	Coarse Aggregate Natural	Tons (short)	2.0227	0.2492	0.2492	13.33%	11.79%
202	Coarse Aggregate Crushed Stone	Tons (short)	2.2502	0.5348	0.5348	28.62%	22.74%
205	Portland Cement	Tons (short)	2.6547	0.1388	0.1388	7.43%	5.00%
208	Fly Ash	Tons (short)	1.9384	0.0555	0.0555	2.97%	2.74%
257	Water	Tons (short)	0.8428	0.1510	0.1510	8.08%	17.14%
279	Ready Mix Concrete Plant Process	yd3	0.0000	0.0000	1.3080	0.00%	0.00%

Athena tool benchmark - Full project results

- Athena Impact Estimator tool complete LCA report by element.
- Reports are exportable to various software
- Internal calculators multiply per cubic yard GWP metrics by volumes input for each element

LCA Measure Table By Assembly Groups (A to C)

Project: DIL - Project 2 Benchmark mixes using extra material

LCA Measures	Unit	Foundations	Walls	Columns and Beams	Roofs	Slabs on Deck	Slabs on Grade	Total
Global Warming Potential	kg CO2 eq	2.60E+05	0.00E+00	2.77E+05	0.00E+00	5.87E+05	1.02E+05	**1.23E+06**
Acidification Potential	kg SO2 eq	1.02E+03	0.00E+00	9.61E+02	0.00E+00	2.04E+03	4.11E+02	**4.43E+03**
HH Particulate	kg PM2.5 eq	1.68E+02	0.00E+00	1.83E+02	0.00E+00	3.87E+02	6.61E+01	**8.05E+02**
Eutrophication Potential	kg N eq	2.81E+02	0.00E+00	3.08E+02	0.00E+00	6.52E+02	1.12E+02	**1.35E+03**
Ozone Depletion Potential	kg CFC-11 eq	5.57E-03	0.00E+00	6.36E-03	0.00E+00	1.34E-02	2.21E-03	**2.76E-02**
Smog Potential	kg O3 eq	2.46E+04	0.00E+00	2.18E+04	0.00E+00	4.64E+04	1.01E+04	**1.03E+05**
Total Primary Energy	MJ	1.88E+06	0.00E+00	1.86E+06	0.00E+00	3.95E+06	7.39E+05	**8.42E+06**
Non-Renewable Energy	MJ	1.82E+06	0.00E+00	1.79E+06	0.00E+00	3.80E+06	7.15E+05	**8.12E+06**
Fossil Fuel Consumption	MJ	1.72E+06	0.00E+00	1.68E+06	0.00E+00	3.57E+06	6.78E+05	**7.66E+06**

Athena Impact Estimator - Benchmark GWP

Concrete Element	Volume	Mix PSI	Portland Type I/II	Slag (lbs)	Fly Ash (lbs)	Total Cementitious	Benchmark GWP kgCO2e/cy	Total CO2 / element
Foundations	950+5%	3000	455	20	88	563	273.68	260,000kg
Columns / Beams	650+5%	6000	759	33	146	938	426.15	277,000kg
SOG	300+5%	4000	570	25	110	705	340	102,000kg
SOD	1450+5%	5000	719	32	138	889	404.8	587,000kg

Benchmark Embodied Carbon Project Total = 1,226,000 kg

Reduced Carbon Mixes with 50% SCM Replacement - Athena

LCA Measure Table By Assembly Groups (A to C)

Project: DIL Sustainability Project with 50% SCM Replacement

LCA Measures	Unit	Foundations	Walls	Columns and Beams	Roofs	Floors	Slab on Grade	Total
Global Warming Potential	kg CO2 eq	1.59E+05	0.00E+00	1.59E+05	0.00E+00	3.36E+05	6.16E+04	**7.15E+05**
Acidification Potential	kg SO2 eq	7.79E+02	0.00E+00	7.12E+02	0.00E+00	1.51E+03	3.26E+02	**3.32E+03**
HH Particulate	kg PM2.5 eq	1.13E+02	0.00E+00	1.17E+02	0.00E+00	2.46E+02	4.32E+01	**5.20E+02**
Eutrophication Potential	kg N eq	1.73E+02	0.00E+00	1.79E+02	0.00E+00	3.78E+02	6.73E+01	**7.97E+02**
Ozone Depletion Potential	kg CFC-11 eq	3.98E-03	0.00E+00	4.33E-03	0.00E+00	9.09E-03	1.51E-03	**1.89E-02**
Smog Potential	kg O3 eq	1.82E+04	0.00E+00	1.55E+04	0.00E+00	3.30E+04	7.96E+03	**7.46E+04**
Total Primary Energy	MJ	1.33E+06	0.00E+00	1.24E+06	0.00E+00	2.63E+06	5.26E+05	**5.73E+06**
Non-Renewable Energy	MJ	1.29E+06	0.00E+00	1.20E+06	0.00E+00	2.55E+06	5.12E+05	**5.55E+06**
Fossil Fuel Consumption	MJ	1.22E+06	0.00E+00	1.12E+06	0.00E+00	2.37E+06	4.82E+05	**5.19E+06**

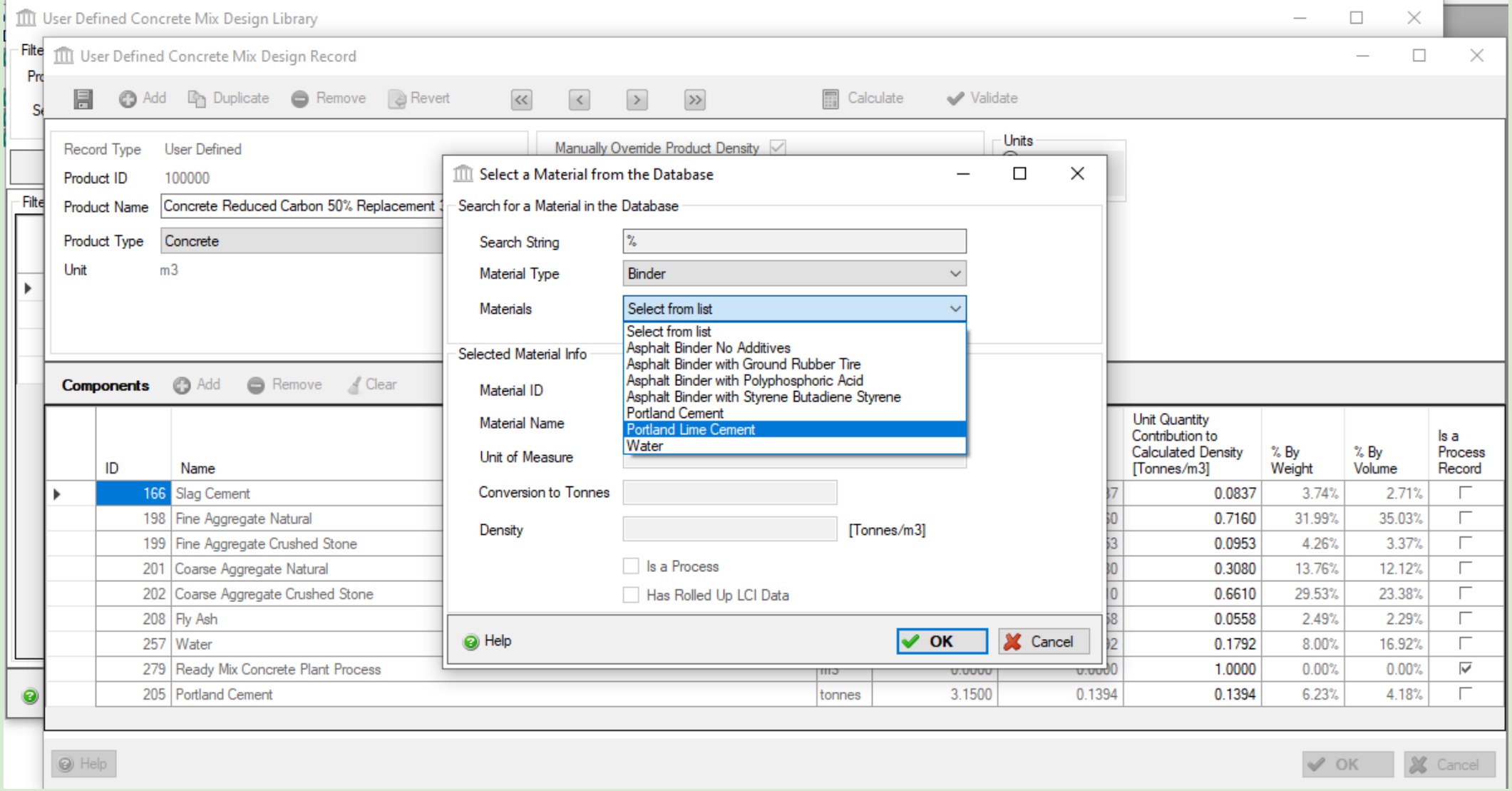
	Foundations	Columns & Beams	Floors	Slab on Grade	Total
GWP (in kg CO2)	159,000	159,000	336,000	61,600	**715,600**

Reduced Carbon Mix Designs - Athena Calculator estimates

Used Athena calculator to enter mix designs with reduced carbon based from NRMCA benchmark mixes.

Concrete Element	Volume	Mix PSI	Portland Type I/II	Slag (lbs)	Fly Ash (lbs)	Total Cementitious	Reduced Co2 GWP kgCO2e/cy	Total CO2 / element
Foundations	950	3000	235	141	94	470	167.37	159,000
Columns / Beams	650	6000	363	218	145	726	244.62	159,000
SOG	300	4000	278	167	111	556	205.33	61,600
SOD	1450	5000	342	205	137	684	231.72	336,000

Proposed Reduced CO2 Project Total = 715,600 kg



- Change to Portland Lime Cement by changing binder in material database

- Must add PLC, manually input quantity and remove Portland Cement

Reduced Carbon Mixes with 50% SCM Replacement & PLC Cement - Athena

LCA Measure Table By Assembly Groups (A to C)

Project: Copy of DIL Sustainability Project with 50% SCM Replacement

LCA Measures	Unit	Foundations	Walls	Columns and Beams	Roofs	Floors	Slab on Grade	Total
Global Warming Potential	kg CO2 eq	1.49E+05	0.00E+00	1.48E+05	0.00E+00	3.12E+05	5.78E+04	**6.67E+05**
Acidification Potential	kg SO2 eq	7.55E+02	0.00E+00	6.85E+02	0.00E+00	1.45E+03	3.17E+02	**3.21E+03**
HH Particulate	kg PM2.5 eq	1.08E+02	0.00E+00	1.11E+02	0.00E+00	2.33E+02	4.10E+01	**4.93E+02**
Eutrophication Potential	kg N eq	1.70E+02	0.00E+00	1.76E+02	0.00E+00	3.71E+02	6.62E+01	**7.83E+02**
Ozone Depletion Potential	kg CFC-11 eq	3.77E-03	0.00E+00	4.10E-03	0.00E+00	8.62E-03	1.43E-03	**1.79E-02**
Smog Potential	kg O3 eq	1.78E+04	0.00E+00	1.51E+04	0.00E+00	3.22E+04	7.83E+03	**7.30E+04**
Total Primary Energy	MJ	1.28E+06	0.00E+00	1.19E+06	0.00E+00	2.51E+06	5.06E+05	**5.48E+06**
Non-Renewable Energy	MJ	1.24E+06	0.00E+00	1.15E+06	0.00E+00	2.43E+06	4.93E+05	**5.31E+06**
Fossil Fuel Consumption	MJ	1.17E+06	0.00E+00	1.07E+06	0.00E+00	2.26E+06	4.64E+05	**4.96E+06**

	Foundations	Columns & Beams	Floors	Slab on Grade	Total
GWP (in kg CO2)	149,000	148,000	312,000	57,800	**666,800**

Low Carbon Mixes with Portland vs PLC

With Portland Cement					
	Foundations	Columns & Beams	Floors	Slab on Grade	Total
GWP (in kg CO2)	159,000	159,000	336,000	61,600	**715,600**

With PLC Cement					
	Foundations	Columns & Beams	Floors	Slab on Grade	Total
GWP (in kg CO2)	149,000	148,000	312,000	57,800	**666,800**

- Additional 7% Reduction in CO2 by using PLC

Side By Side Comparison EC3 to Athena Impact Estimator for Buildings

Project Application	Volume	NRMCA Benchmark GWP	EC3 Tool Achievable GWP	% GWP Reduction	Athena IE Tool Benchmark GWP	Athena IE Tool Benchmark GWP	% GWP Reduction
Foundations	950	201000	180000	10%	260000	159000	39%
Columns/Shear Walls	650	209000	152000	27%	277000	159000	43%
Slab on Deck	1450	76000	71000	7%	102000	62000	39%
SOG	300	441000	353000	20%	587000	336000	43%
Total Project GWP in kgCO2e	3350	927000	756000	18%	1226000	716000	42%

- This free download can demonstrate to engineers / architects on a project basis how much GWP percentage reduction can be targeted or even specified.
- Producers can use the tools to demonstrate capabilities to owners, architects, and engineers.
    - Provide architects/engineers a day-to-day approach on how to reduce the total carbon footprint from concrete.
- Producers can work with engineers to custom design mixes per building element as required based on project requirements.

Considerations for Specifiers and Suppliers:

- Tools that utilize a database are limited to data submitted in the region
- GWP reduction levels may or may not be achievable based on specific available raw materials
- GWP reduction levels should be considered a guide on the possibilities
- Write the spec for the desired kgCO2e without prescribing the mix properties
- Consider accepting 56 day performance ILO 28 day that is typically considered.

Thank you for your time!

Questions?