

Buy Clean Maryland

Nudging Concrete's Decarbonization

Tien Peng, GreenPlum Street LLC

Content

1. The Buy Clean Maryland Act 2023
2. Climate Goals & Disclosure Tools
3. ACI-323 Low Carbon Concrete Code
4. Maryland Acceptable GWP Limits
5. Compliance Questions

1. Buy Clean Maryland Act



MARYLAND GENERAL ASSEMBLY

Search

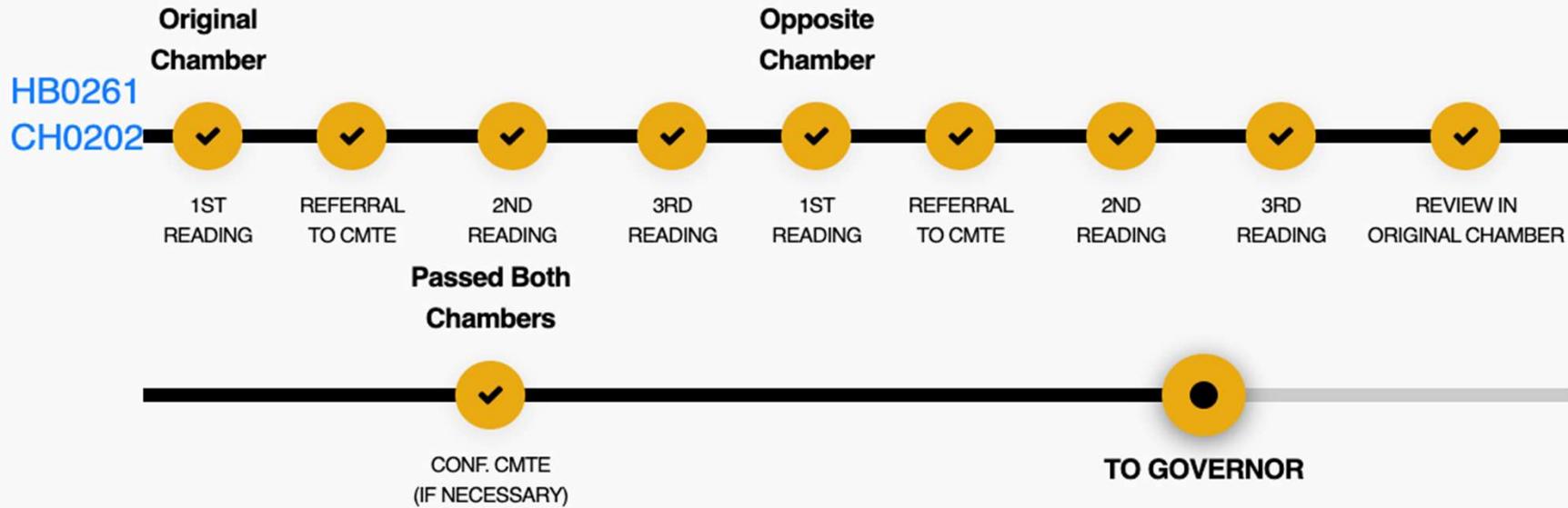


- MEMBERS
- COMMITTEES
- MEETINGS
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- FLOOR ACTIONS
- REDISTRICTING
- SEARCH

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- Full Text
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- Media

Legislation

Session: 2023 Regular Sess



Procurement of Construction Materials (Buy Clean Maryland Act) Signed by Governor



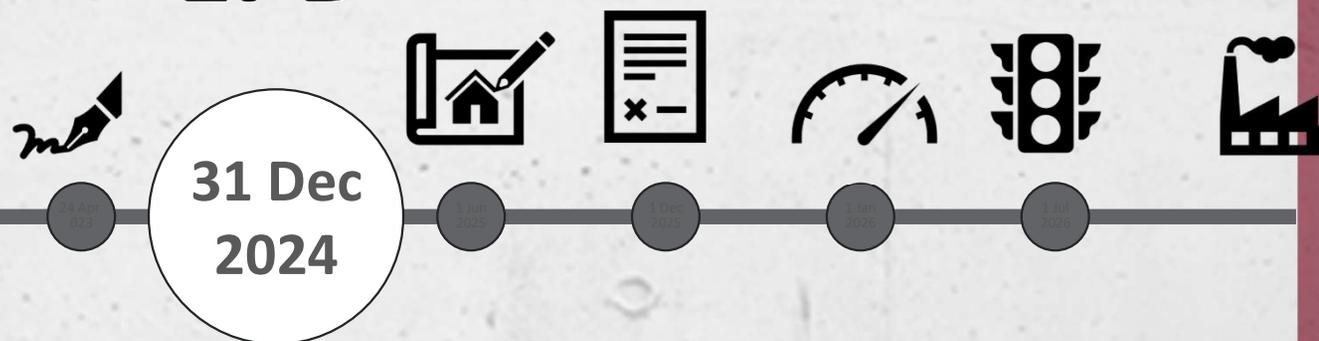
24 Apr
2023

EPD

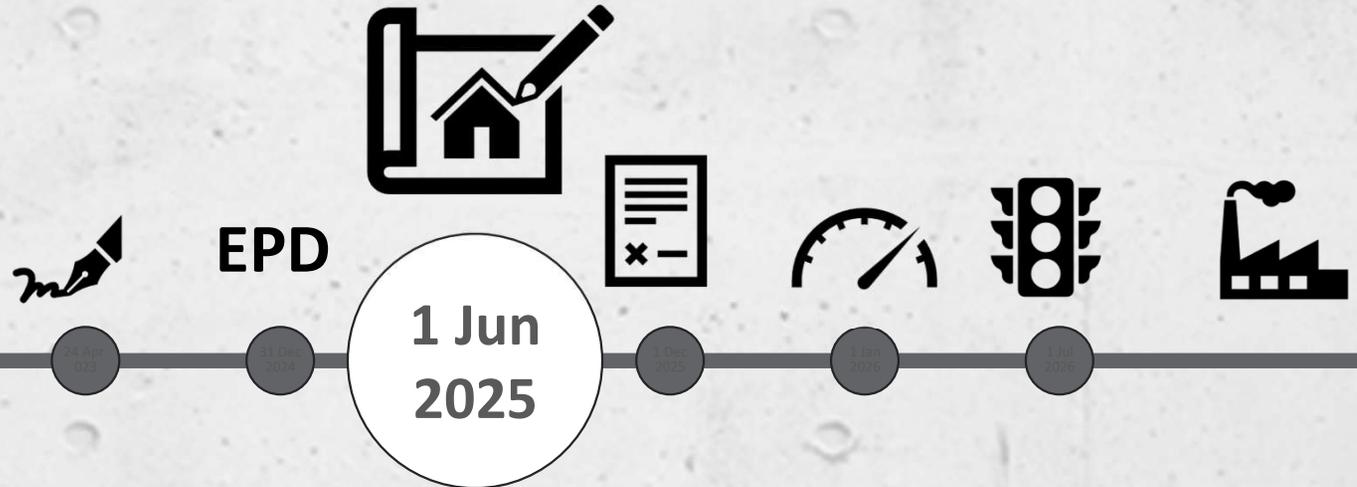


**Producers of Eligible Materials
submit Environmental Product
Declarations to Department of
General Services**

EPD



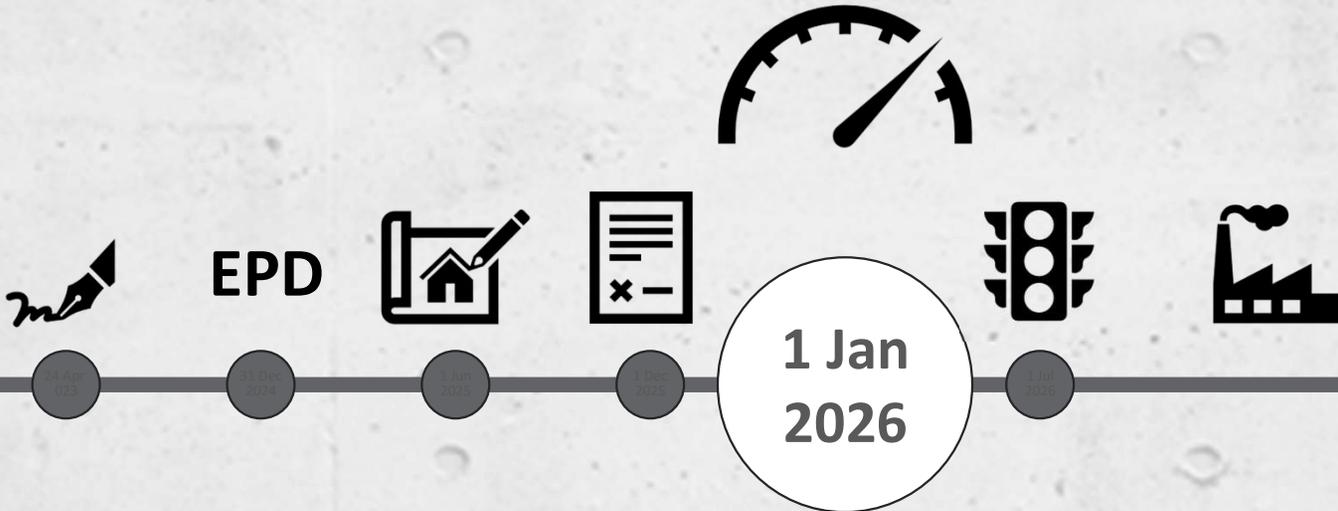
GreenPlum Street LLC Research Findings Proposed Implementation Methodology



**DGS submits Report to
Maryland General Assembly
Research Findings
Proposed Implementation
Methodology**



DGS Establish Maximum Global Warming Potential (GWP) Limits to Cement and Concrete



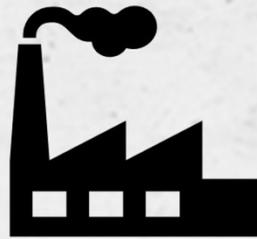
**DGS Shall Require A Successful Bidder of an Eligible Project to Submit, EPDs (or LCA) to be Used in the Eligible Project
Contractor May Not Install Eligible Material unless Submits EPD**



Two (2) Additional Products as Eligible Materials

January 1, 2029, and every
3 Years thereafter, DGS
shall review the Maximum
GWP for each Category of
Eligible Materials

EPD



2. Climate Goals and Disclosure Tools

Maryland Industrial Emissions

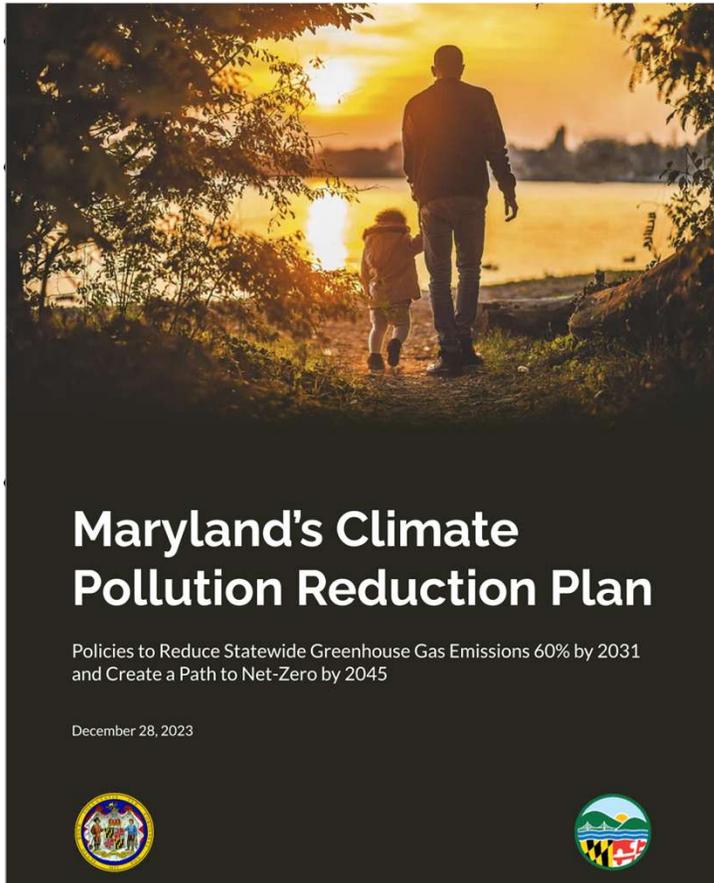
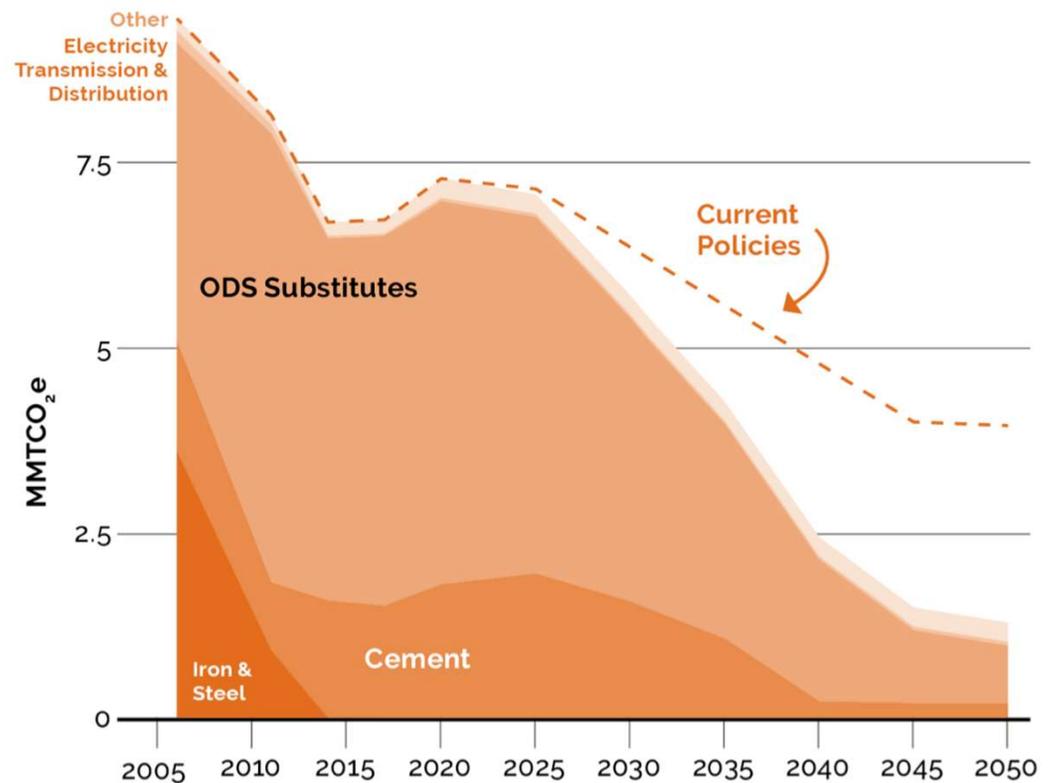


Figure 6: Maryland's industrial processes and product use GHG emissions trends, historical and projected, from 2006 to 2050 based on current and new policies



Carbon Disclosure in Green Building RATINGS for High Performance Green Building Program



LIVING
BUILDING
CHALLENGESM



Passive House Institute US

BREEAM[®]



Environmental Product Declarations (EPD)

This Environmental Product Declaration (EPD) reports the impacts for 1 m³ of ready mixed concrete mix, for use in business-to-business (B2B) communication meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSA A23.1/A23.2: Concrete Materials and Methods of Concrete Construction
- CSI Division 03-30-00: Cast-in-Place Concrete

COMPANY

8700 Bryn Mawr Ave Suite #300
Chicago, IL 60631-3512

PLANT

Rockville East Plant
14824 Southlawn La.
Rockville, MD 20850

EPD PROGRAM OPERATOR

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428



DATE OF ISSUE

03/18/2024 (valid for 5 years until 03/18/2029)
(Portable plant validity is limited to location specified)

ENVIRONMENTAL IMPACTS

Declared Product:

Mix ECOS40714 • Rockville East Plant
Description: 4000,ECOPACT STANDARD,ST AE HRWR
Compressive strength: 4000 PSI at 28 days

Declared Unit: 1 m³ of concrete (1 cyd)

Global Warming Potential (kg CO ₂ -eq)	244 (186)
Ozone Depletion Potential (kg CFC-11-eq)	7.29E-6 (5.58E-6)
Acidification Potential (kg SO ₂ -eq)	1.13 (0.86)
Eutrophication Potential (kg N-eq)	0.44 (0.34)
Photochemical Ozone Creation Potential (kg O ₃ -eq)	20.2 (15.4)
Abiotic Depletion, non-fossil (kg Sb-eq)	3.66E-5 (2.80E-5)
Abiotic Depletion, fossil (MJ)	1,478 (1,130)
Total Waste Disposed (kg)	1.96 (1.50)
Consumption of Freshwater (m ³)	3.47 (2.66)

Product Components: crushed aggregate (ASTM C33), natural aggregate (ASTM C33), Portland cement (ASTM C150), slag cement (ASTM C989), admixture (ASTM C494), batch water (ASTM C1602), admixture (ASTM C260)

Additional detail and impacts are reported on page three of this EPD

GWP
Kg CO₂e / m³
(Kg CO₂e/yd³)

US BENCHMARKS: CONCRETE, CEMENT

Table 3.1.1 NRMCA National and Regional Benchmarks for Ready Mixed Concrete (2022) in kgCO₂e/m³

	2500 psi	3000 psi	4000 psi	5000 psi	6000 psi	8000 psi	LW 3000 psi	LW 4000 psi	LW 5000 psi
Pacific Southwest	257	279	323	378	401	456	500	546	594
Pacific Northwest	235	261	316	386	408	487	518	575	632
Rocky Mountains	232	255	301	358	379	440	484	532	580
South Central	226	245	286	336	356	409	468	510	555
North Central	241	264	312	372	394	460	487	537	591
Southeastern	247	268	309	360	382	435	478	521	562
Great Lakes	232	255	303	363	383	452	499	551	603
Eastern	240	264	314	378	399	472	517	573	628
National	240	262	308	365	385	446	492	540	588

Global Warming Potential, GWP 100, IPCC 2013	Per 1 metric ton	Unit
ASTM C-150 portland cement	919	KgCO ₂ eq
ASTM C595 portland-limestone cement	844	KgCO ₂ eq
ASTM C595 blended cement	739	KgCO ₂ eq
ASTM C91 masonry cement	587	KgCO ₂ eq

Benchmarks, IW & Products Specific EPDs

Environmental Product Declaration



NRMCA
NATIONAL READY MIXED CONCRETE ASSOCIATION

NRMCA MEMBER INDUSTRY-WIDE ENVIRONMENTAL READY-MIXED CONCRETE



Athena Sustainable Materials Institute

www.athenasmi.org

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

Summary: Appendix D is intended for use by NRMCA members, who participated in the IW-EPD, that have developed product specific third-party verified LCAs and/or EPDs to compare the environmental impacts of their products with industry average impacts.

November 2019

Environmental Product Declaration

A U.S. CONCRETE COMPANY

This Environmental Product Declaration (EPD) covers 1,479 concrete mixes produced for 7 different service areas at 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 60 years. The company works to engineer high performing concrete while lowering carbon footprint. Central Concrete has committed to collaborating with owners, architects, structural engineers, and contractors to evaluate project requirements and identify solutions that match each client's unique needs.

Headquarters
Central Concrete
755 Stockton Avenue
San Jose, CA 95128
966-434-1000

Service Areas covered in this EPD

Berkeley Berkeley Plant 11811 Brentwood Boulevard Berkeley, CA 94612	Redwood City Redwood City Plant 635 Scepter Boulevard Redwood City, CA 94063
Hayward Hayward Plant 1848 W. Wilton Avenue Hayward, CA 94545	San Jose Stockton Plant 700 Stockton Avenue San Jose, CA 95128
Albion Walnut Creek/Martinez Plant 893 Woodburn Way San Jose, CA 95128	Quincy Lakes Plant 457 Quince Lakes San Jose, CA 95112
Pleasanton Pleasanton Plant 5215 Chabot Road Pleasanton, CA 94588	South San Francisco South San Francisco Plant 3300 San Mateo Avenue South San Francisco, CA 94080




RATECH
Environmentally Responsible

Environmental Product Declaration

Environmentally Responsible Concrete

Environmentally Responsible Concrete (EPD) covers 11 concrete mix produced by RATECH. The additive plant is located in Roseburg, OR. Each lot, developer addresses that, when mixed with cement, aggregate, and water, produce a ready-mix concrete product. RATECH does not own any concrete plant in the U.S. to ready-mix plants that produce the concrete.

Manufacturer's address at 401 Texas St., Roseburg, OR 97530

Environmental Product Declaration

This Environmental Product Declaration (EPD) covers twelve concrete mixes produced by CEMEX at the Pier 92 plant in San Francisco, California.

Company
CEMEX is a global building materials company that provides high quality products and reliable service to customers and communities throughout the Americas, Europe, Africa, the Middle East, and Asia. We produce, distribute, and sell cement, ready-mix concrete, aggregates, and related building materials in more than 90 countries, and we maintain trade relationships in close to 100 nations.

Headquarters
CEMEX USA Headquarters
920 Memorial City Way, Suite 100
Houston, TX 77024
(+1) 713-455-6300

Plant
CEMEX Plant 4433: Pier 92
920 Annapolis Street
San Francisco, CA 94054
(+1) 966-476-2764



Plants covered in this EPD

Albion 2067 Hwy 112 Jacks, TX 75247	Alvin 1605 New York Ave Alvin, TX 75819	Conroe 800 W. Hwy 121 Conroe, TX 77385	Daingerman 245 Daingerman Blvd Dallas, TX 75212	Fl. Worth 1600 Houston Fl. Worth, TX 75150	Fl. Worth 19200 Hwy 121 Fl. Worth, TX 75025	Hurst 1889 Keller Plaza Rd Hurst, TX 76118	Irving 2102 Precinct Line Rd Irving, TX 75038	Lubbock 1225 S. Railroad Lubbock, TX 79401	Marshall 1719 Avenue 34 Marshall, TX 75849	Proctor 270 S. Dallas Pkwy Proctor, TX 75079	Richardson 1200 Digital Dr Richardson, TX 75081	Seagraves 1027 Janna Rd Seagraves, TX 75779	Southlake 1660 Burnham Southlake, TX 75082	Southwest 1100 Oldhamstead Rd. S Fort Worth, TX 76114	Tarrant 103 Belvedere Hwy Tarrant, TX 75150	Waxahatchie 4100 South Hwy 77 Waxahatchie, TX 75166
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About Argos Ready Mix South Central
Argos Ready Mix South Central, headquartered in Irving, Texas, is a focused concrete supplier serving the major metropolitan market of Dallas-Ft. Worth. From Argos' network of 30 concrete plants concentrated in this area, production is ready to meet the needs of concrete industry.

Argos Ready Mix South Central is part of Argos USA Corp., a wholly owned subsidiary of Cementos Argos S.A., which, in turn, is a publicly traded corporation with headquarters in Colombia, South America. Argos is a member of the Dow Jones Sustainability Index.




Environmental Product Declaration (EPD) for Concrete

Ready-Mixed Concrete



About Cementos Argos Panama
Argos Panama S.A., is a Panamanian cement and concrete supplier that is the market leader in the country. Through its network of ten Argos concrete plants located in the country, its annual concrete production reaches 480,000 m³. As for cement, its installed capacity is of 1,340,200 tons per year.

Argos Panama S.A. is part of Cementos Argos S.A., a company whose headquarters are located in Colombia. For the second consecutive year, Argos has been included in the Dow Jones Sustainability Index.

Cementos Argos Panama
Tomas Argos, Sr. CEO
Juan Diaz, Comptroller Santa Maria Business District
Llano Bombó, Ciudad de Panama

Planta Miraflores
Transcendia, Via Saen Bolivar, Ciudad de Panama.

EPD Program Operator: National Ready Mixed Concrete Association
EPD Issued: November 12, 2019
EPD Validity: 5 years
EPD Revision: 12, 2019
EPD Version: NRMCA-EPD-10000

Date of Issue: November 12, 2019
Period of Validity: 5 years
Date of Revision: 12, 2019
Revision Number: NRMCA-EPD-10000



3. ACI 323 – Low Carbon Concrete Code

IN-LB Inch-Pound Units

Low-Carbon Concrete— Code Requirements and Commentary

Reported by ACI Committee 323

ACI CODE-323-24



- Provides a standardized method and definition;
- Narrow scope focused on up-front embodied carbon emissions for cast-in-place concrete;
- Material technology agnostic
- Adopted as a stand-alone code or with a structural design code;
- Adopted by an authority having jurisdiction;
- Format based on the structure type.

EXCEPTIONS



CHAPTER 1—GENERAL

CHAPTER 2—NOTATION AND TERMINOLOGY

CHAPTER 3—REFERENCED STANDARDS

CHAPTER 4—CONCRETE MIXTURE GLOBAL
WARMING POTENTIAL (GWP)

CHAPTER 5—BUILDINGS

CHAPTER 6—PAVEMENT AND HARDSCAPE

CHAPTER 7—BRIDGES

CHAPTER 8—OTHER STRUCTURES

COMMENTARY REFERENCES

APPENDIX A—REGIONAL GWP BENCHMARKS

APPENDIX B—EXAMPLE CALCULATION AND
DOCUMENTATION

ACI 323

- cradle-to-gate global warming potential (GWP) of concrete mixtures
- an independent third-party verified
- product-specific EPD
- GWP calculated on weighted average
- GWP benchmark [limits] to be determined by authority having jurisdiction (AHJ)
- f_c' at any age can be compared to the GWP limit even if the GWP limit is determined from a benchmark f_c' at a different age

CHAPTER 1—GENERAL

CHAPTER 2—NOTATION AND TERMINOLOGY

CHAPTER 3—REFERENCED STANDARDS

CHAPTER 4—CONCRETE MIXTURE GLOBAL WARMING POTENTIAL (GWP)

CHAPTER 5—BUILDINGS

CHAPTER 6—PAVEMENT AND HARDSCAPE

CHAPTER 7—BRIDGES

CHAPTER 8—OTHER STRUCTURES

COMMENTARY REFERENCES

APPENDIX A—REGIONAL GWP BENCHMARKS

APPENDIX B—EXAMPLE CALCULATION AND DOCUMENTATION

ACI 323

How does the code work?



- Building, Pavement, Bridge, Other

- Based on the size of the project
- Three paths

- Limit GWP
- Require documentation
- No action needed

Total allowable GWP is based on a weighted average.
Actual GWP is also a weighted average.

COMPLIANCE PATH: SIZE Tiers

$\geq 50,000$ SF	GWP Limit
Smaller projects	Document, no limits

CHAPTER 1—GENERAL

CHAPTER 2—NOTATION AND TERMINOLOGY

CHAPTER 3—REFERENCED STANDARDS

CHAPTER 4—CONCRETE MIXTURE GLOBAL WARMING POTENTIAL (GWP)

CHAPTER 5—BUILDINGS

CHAPTER 6—PAVEMENT AND HARDSCAPE

CHAPTER 7—BRIDGES

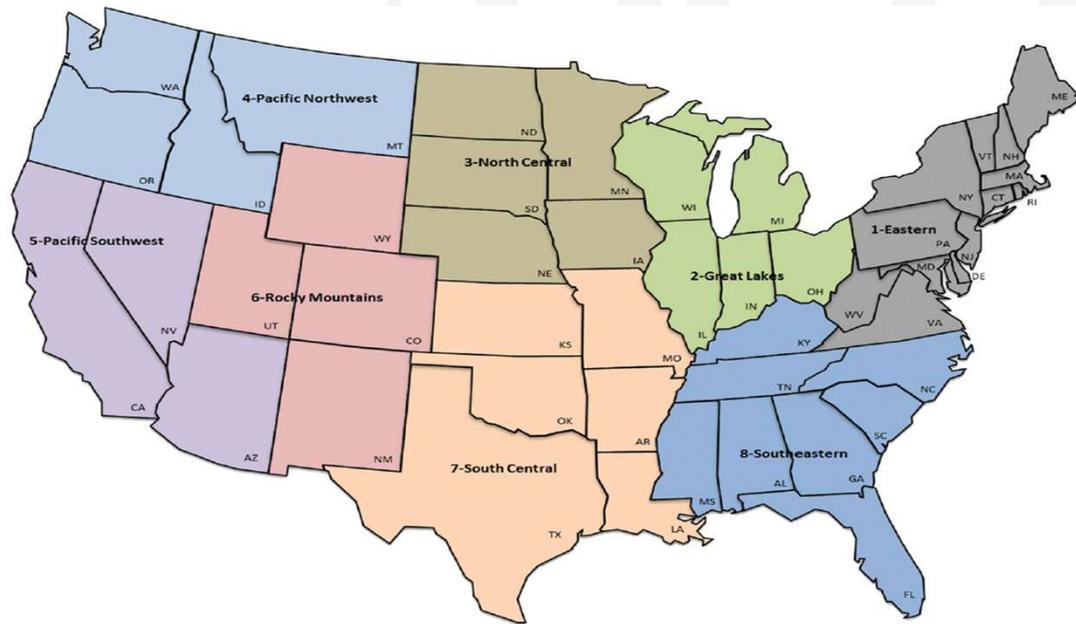
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ACI 323



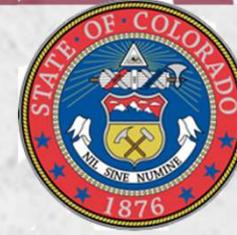
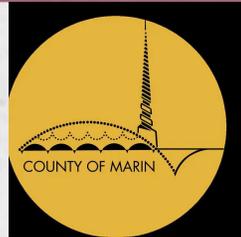
NRMCA Member National and Regional LCA Benchmark (Industry Average) Report – V 3.2

4. Maryland GWP Limits

Maryland EPDs

Codes and Standards

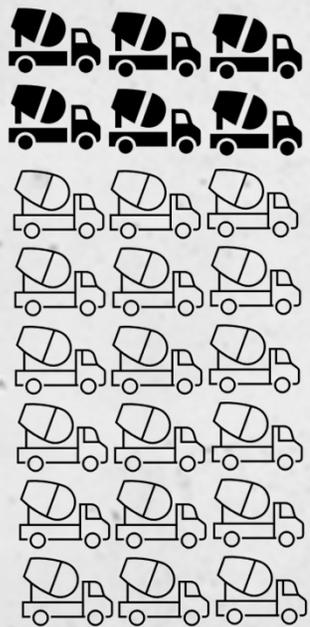
Peer Buy Clean



	NRMCA National Benchmark	Marin Co (Kg CO ₂ e/m ³)	Portland (Kg CO ₂ e/m ³)	New York (Kg CO ₂ e/m ³)	Colorado (Kg CO ₂ e/m ³)	GSA (Kg CO ₂ e/m ³)
Compressive Strength		Public / Private	Public /Private	Public	Public	Public
2500 psi	240	260	235	360	232	277
3000 psi	262	289	261	395	255	318
4000 psi	308	313	316	471	301	352
5000 psi	365	338	386	568	358	382
6000 psi	385	356	408	600	379	407
8000 psi	446	394	487	708	440	402

EC3 – Maryland Sampling Size

Maryland
Concrete
Producers



EPDs

1454

2500 psi 55

3000 psi 265

4000 psi 386

5000 psi 371

6000 psi 64

8000 psi 26

3 LW 3000 psi

6 LW 4000 psi

2 LW 5000 psi

Limitations of EPDs

Weighted
Averages

Not
consumption
quantities

Functional
Equivalence

4000 psi
Application 1

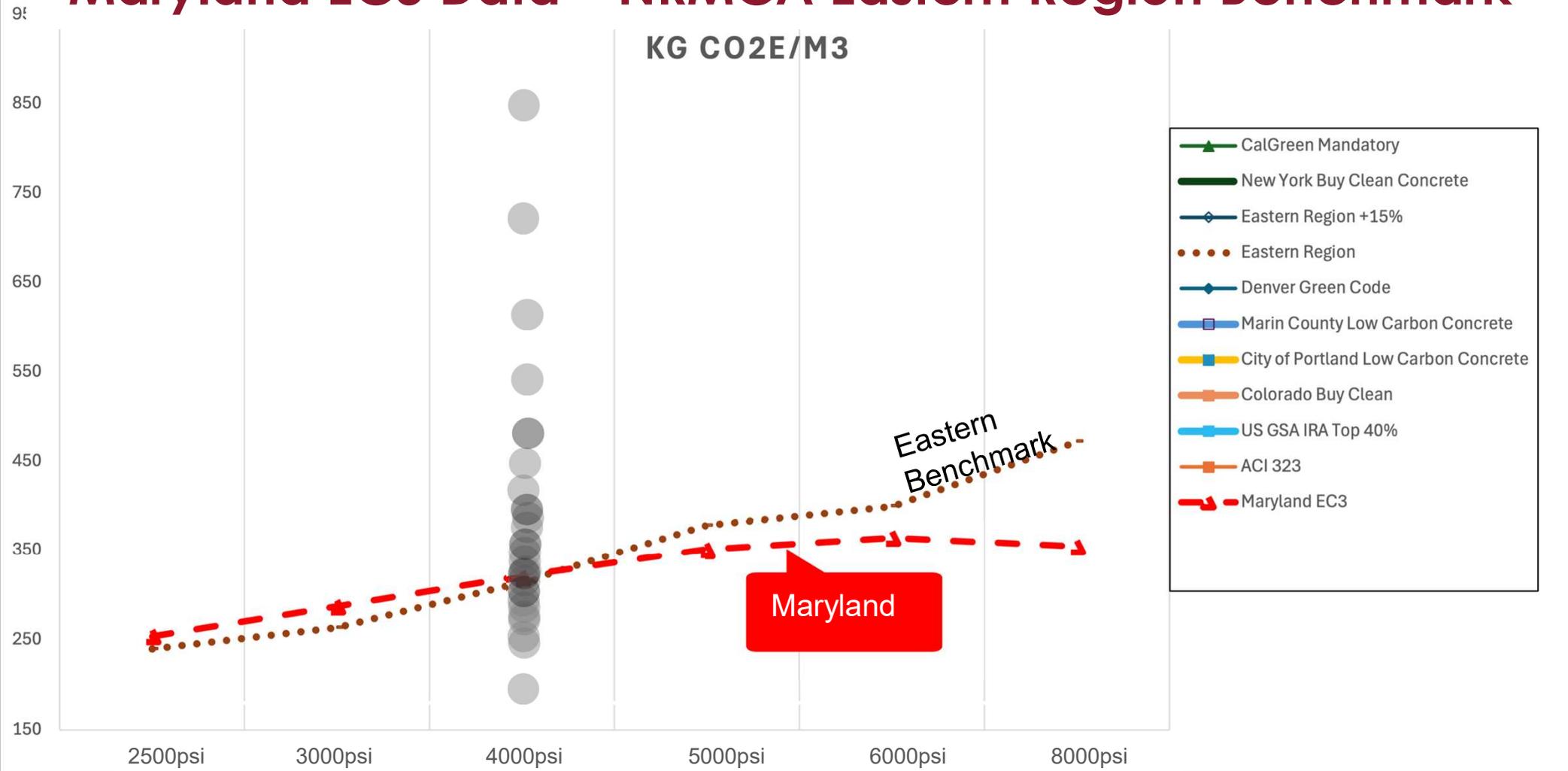
4000 psi
Application 2

Uncertainties

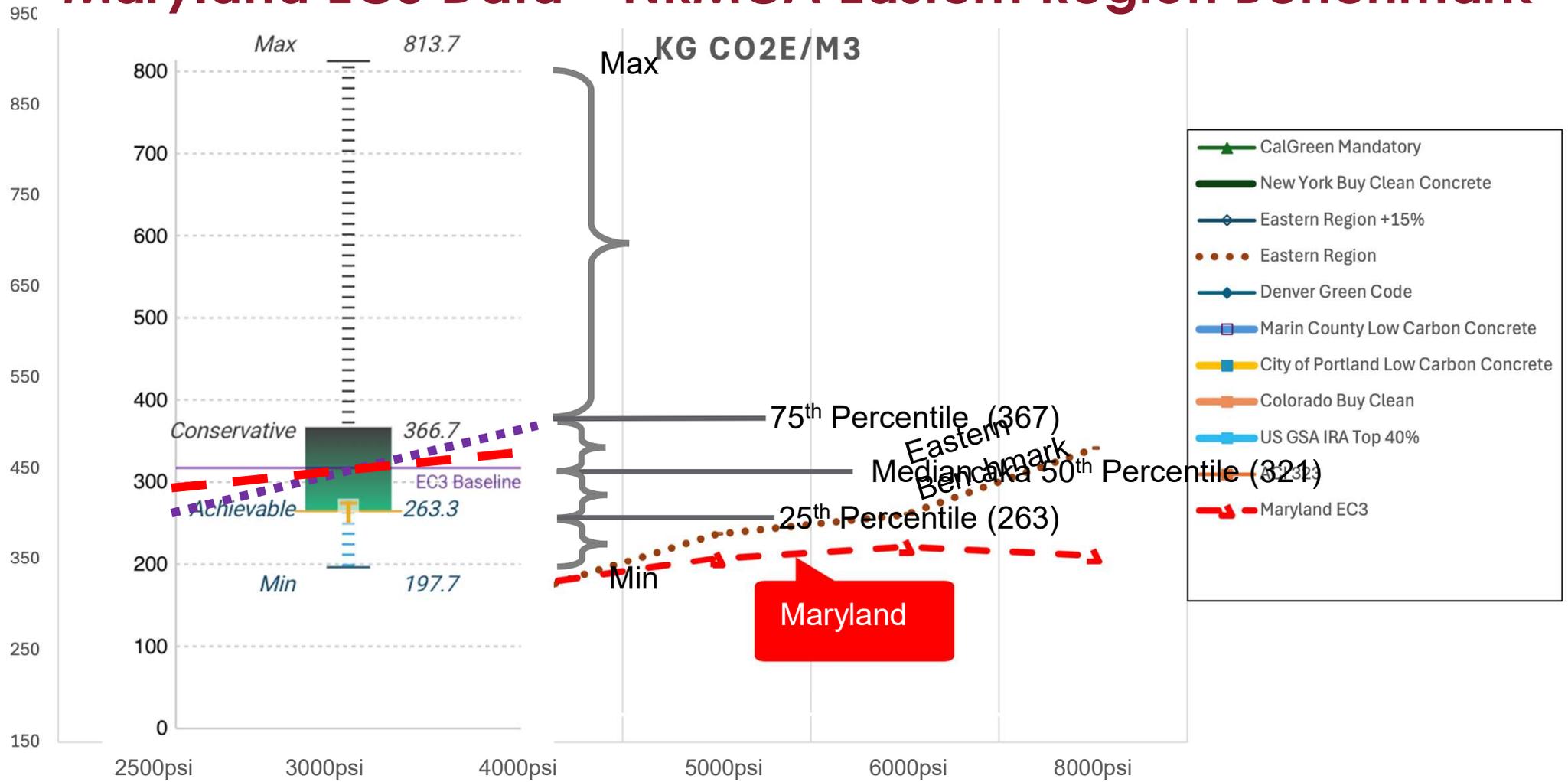
Product
Plant

Batch
Supply Chain

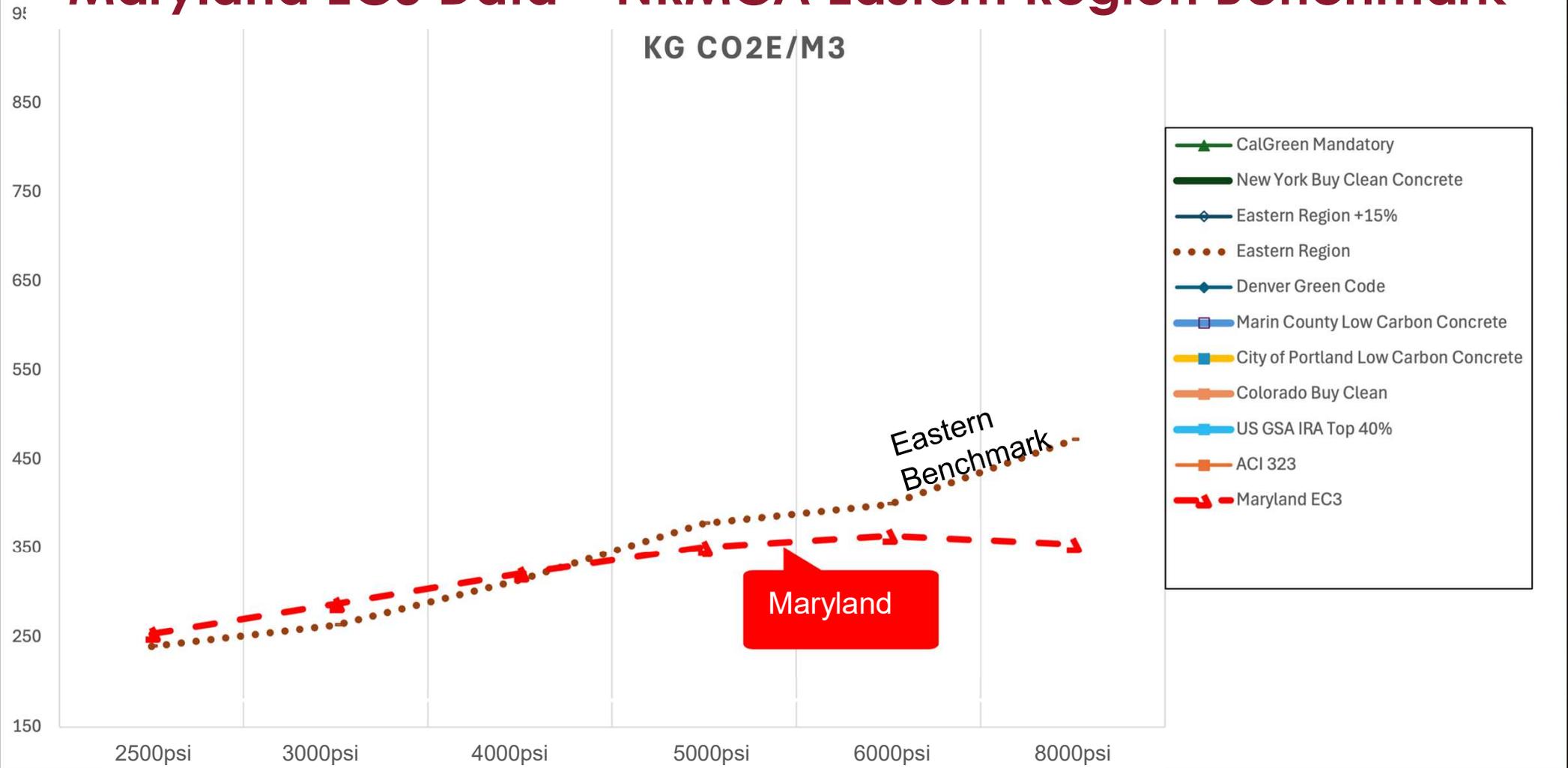
Maryland EC3 Data – NRMCA Eastern Region Benchmark



Maryland EC3 Data – NRMCA Eastern Region Benchmark

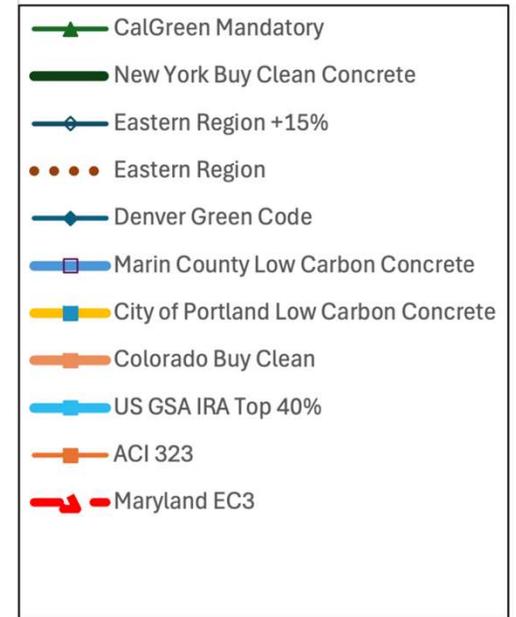


Maryland EC3 Data – NRMCA Eastern Region Benchmark



Maryland – Eastern Benchmark – Codes

KG CO2E/M3



CalGreen

Denver

ACI 323

Maryland

2500psi

3000psi

4000psi

5000psi

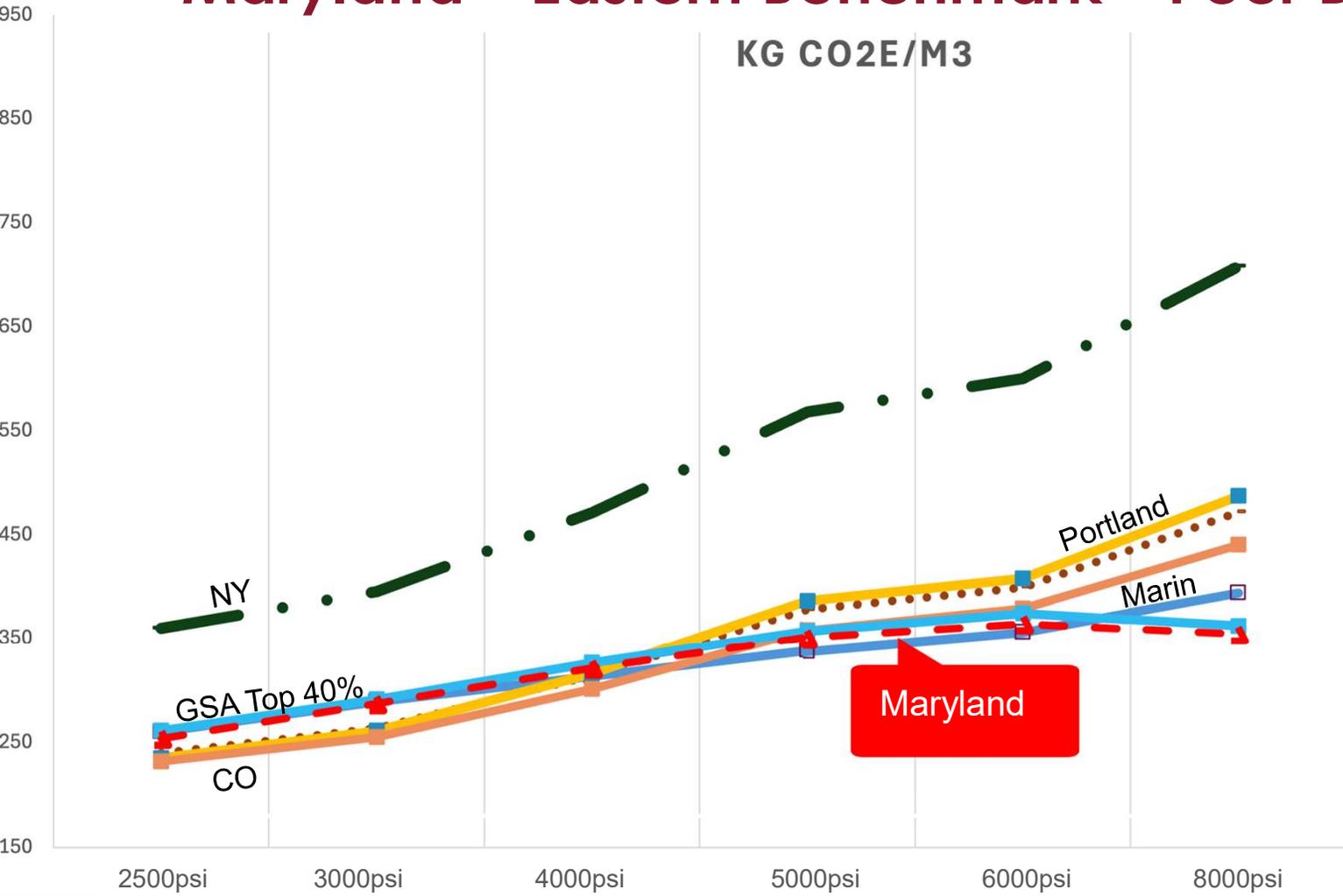
6000psi

8000psi

Maryland – Eastern Benchmark – Peer Buy Clean

KG CO₂E/M³

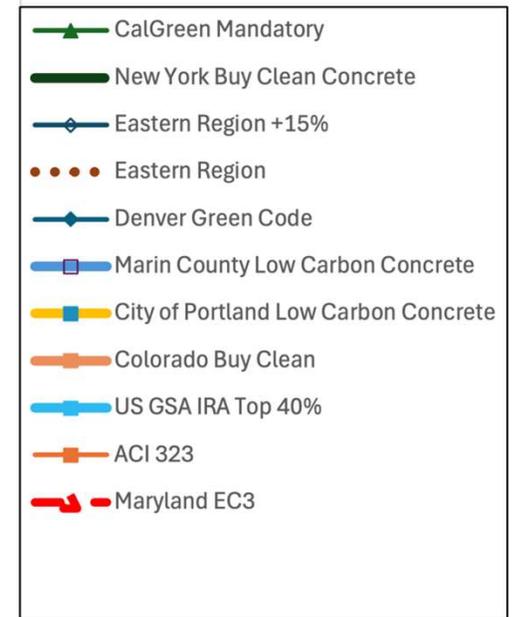
- ▲ CalGreen Mandatory
- New York Buy Clean Concrete
- ◇ Eastern Region +15%
- Eastern Region
- ◆ Denver Green Code
- Marin County Low Carbon Concrete
- City of Portland Low Carbon Concrete
- Colorado Buy Clean
- US GSA IRA Top 40%
- ACI 323
- ▼ Maryland EC3



Maryland

Maryland – Everyone

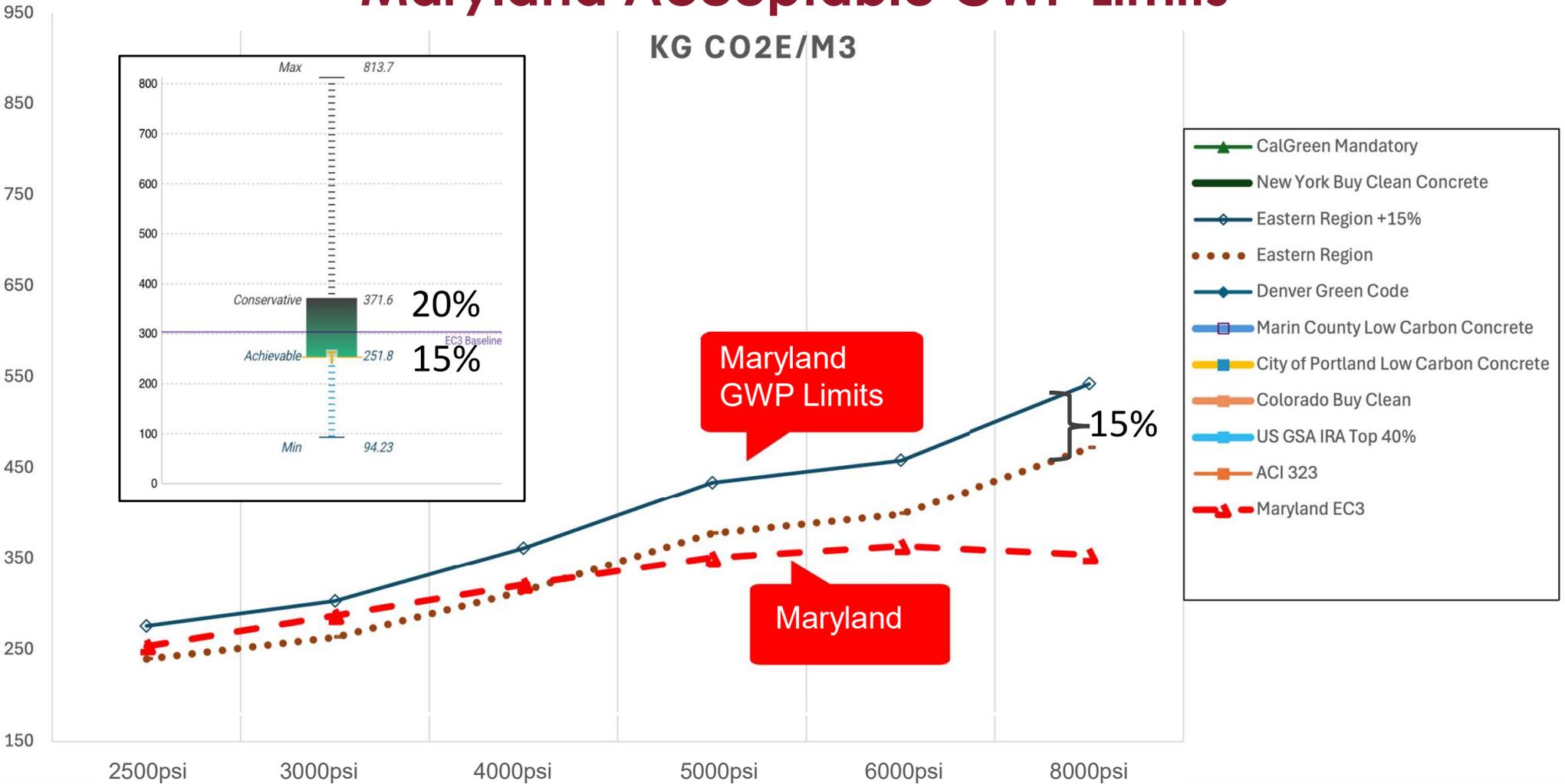
KG CO2E/M3



Maryland

Maryland Acceptable GWP Limits

KG CO2E/M3



MARYLAND Acceptable GWP Limits in Kg CO₂e/m³ (KgCO₂e/yd³)

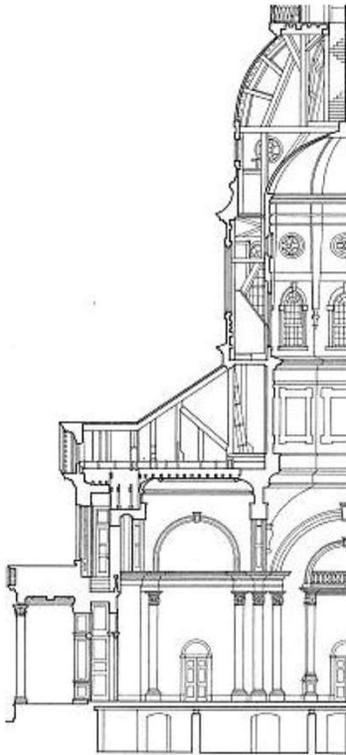
	Normal weight						Lightweight		
Compressive Strength	2500 psi	3000 psi	4000 psi	5000 psi	6000 psi	8000 psi	3000 psi	4000 psi	5000 psi
NRMCA Eastern Region Benchmark	240 (183)	264 (201)	314 (240)	378 (289)	399 (305)	472 (361)	517 (395)	573 (438)	628 (480)
Maryland Concrete GWP Limit	276 (211)	303 (232)	361 (276)	435 (333)	459 (351)	542 (414)	595 (453)	659 (504)	722 (552)
Maryland Cement GWP Limit	800 kgCO ₂ e/t								

5. Compliance

Per Strength

Weighted Average

Maryland DGS Procedure Manual





Maryland

Procedure Manual and Standards

for
Facility Planning,
Design and Construction

STATE OF MARYLAND
Wes Moore, Governor
Aruna Miller, Lieutenant Governor

DEPARTMENT OF GENERAL
SERVICES
Atif Chaudhry, Secretary

DRAFT For Internal Review

October 2024

STATE OF MARYLAND – DEPARTMENT OF GENERAL SERVICES
PROCEDURE MANUAL AND STANDARDS

01 10 00 SUMMARY

18 R Resources (Reserved for Future)

19 X Other (Reserved for Future)

20 Z Shop Drawings (Reserved for Future)

21 O Operations (Reserved for Future)

22 X Sustainable Design (Reserved for Future)

23 Cost

01 35 73 DELEGATED DESIGN

01 41 00 REGULATORY REQUIREMENTS

01 41 19 SPACE STANDARDS

01 50 00 FIELD OFFICES AND EQUIPMENT

01 81 00 SUSTAINABLE REQUIREMENTS - BIRD

02 21 13 SITE SURVEYS

02 41 19 SELECTIVE DEMOLITION

10 28 14 DIAPER CHANGING ACCESSORIES

11 11 37 ELECTRIC VEHICLE SUPPLY EQUIPMENT

27 51 26 ASSISTIVE LISTENING SYSTEMS_041122

28 39 00 EMERGENCY MASS NOTIFICATION SYSTEM

3. FORMS

UPDATE AND ADD FROM EXISTING MANUAL

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STATE OF MARYLAND – DEPARTMENT OF GENERAL SERVICES
PROCEDURE MANUAL AND STANDARDS

01 33 16.10-00-GENERAL SUBMISSION REQUIREMENTS

SUBMISSION REQUIREMENTS BY PROJECT PHASE - SUMMARY					
Program	Schematic Design	Design Development	Construction Documents	BID & Conformed Documents	Post Construction
Area and volume efficiency analysis	Area and volume efficiency analysis	Area and volume efficiency analysis	Area and volume efficiency analysis		
1.3 Cost Analysis³					
Facility condition index for alterations, additions and replacement of existing facilities and equipment.	Facility condition index for alterations, additions and replacement of existing facilities and equipment.				
Construction cost estimate	Construction cost estimate	Construction cost estimate	Construction cost estimate	Construction cost estimate	
		Value Engineering	Value Engineering		
1.4 Sustainability					
Preferred sustainability path and goal	Preferred sustainability path and goal	Sustainability path and goal	Sustainability path and goal	Sustainability path and goal	Sustainability certification
		Narrative of features	Narrative of features	LEED Score sheet	
1.5 Specifications⁴					
		Outline Specifications	Draft through final	Final AE signed and sealed	As-Built Record
		Schedule of delegated design	Schedule of delegated design	Schedule of delegated design	
			Schedule of bid alternates	Schedule of bid alternates	
					Operational Maintenance

Div 03 30 00 – Cast in place concrete

SECTION 033000 – CAST-IN-PLACE CONCRETE

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- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 DEFINITIONS
- 1.4 PREINSTALLATION MEETINGS
- 1.5 ACTION SUBMITTALS
- 1.6 INFORMATIONAL SUBMITTALS
- 1.7 QUALITY ASSURANCE
- 1.8 PRECONSTRUCTION TESTING
- 1.9 DELIVERY, STORAGE, AND HANDLING
- 1.10 FIELD CONDITIONS
- 1.11 WARRANTY

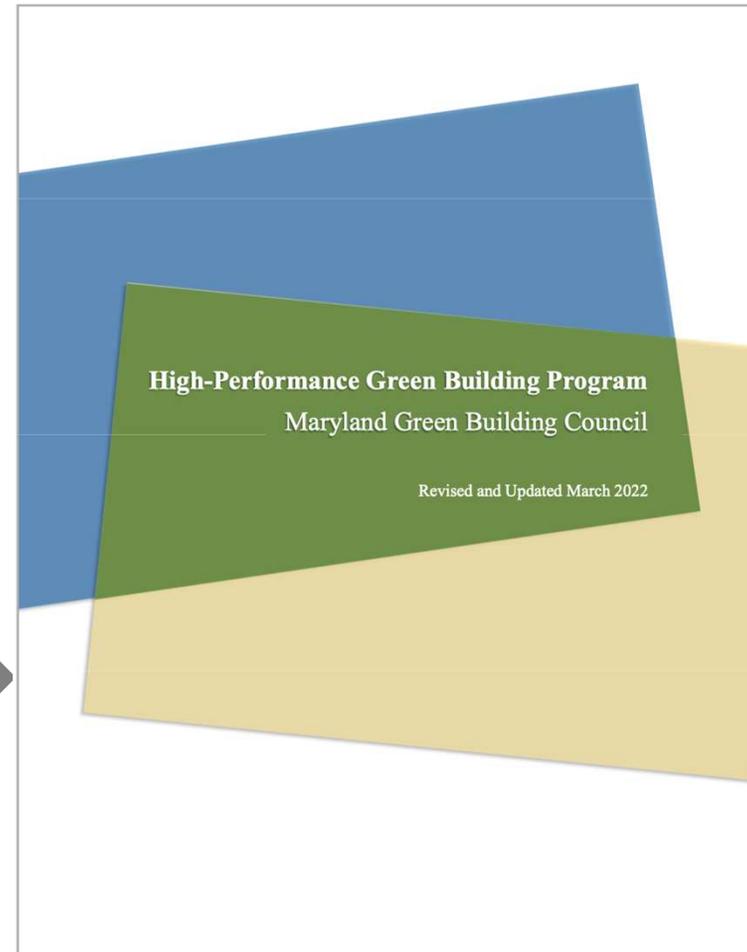
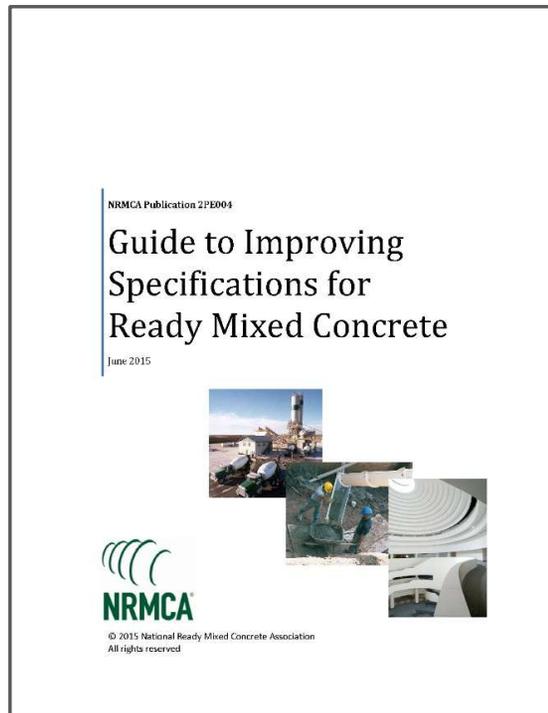
PART 2 – PRODUCTS

- 2.1 CONCRETE, GENERAL
- 2.2 CONCRETE MATERIALS
- 2.3 FIBER REINFORCEMENT
- 2.4 VAPOR RETARDERS
- 2.5 FLOOR AND SLAB TREATMENTS
- 2.6 LIQUID FLOOR TREATMENTS
- 2.7 CURING MATERIALS
- 2.8 RELATED MATERIALS
- 2.9 REPAIR MATERIALS
- 2.10 CONCRETE MIXTURES, GENERAL
- 2.11 CONCRETE MIXTURES
- 2.12 CONCRETE MIXING

PART 3 – EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
- 3.3 INSTALLATION OF EMBEDDED ITEMS
- 3.4 INSTALLATION OF VAPOR RETARDER
- 3.5 JOINTS
- 3.6 CONCRETE PLACEMENT
- 3.7 FINISHING FORMED SURFACES
- 3.8 FINISHING FLOORS AND SLABS
- 3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS
- 3.10 CONCRETE CURING
- 3.11 TOLERANCES
- 3.12 APPLICATION OF LIQUID FLOOR TREATMENTS
- 3.13 JOINT FILLING
- 3.14 CONCRETE SURFACE REPAIRS
- 3.15 FIELD QUALITY CONTROL
- 3.16 PROTECTION

HPGBP Addendum



Project Specifications

- Sustainability criteria should have minimum impact on performance or service life of concrete
- Specifications should not restrict concrete from being sustainable



Most Common Prescriptive Requirements

Prescriptive Requirement	Frequency Seen
Restriction on SCM quantity	85%
Max w/cm (when not applicable)	73%
Minimum cementitious content	46%
Restriction on SCM type, characteristics	27%
Restriction on aggregate grading	25%

GWP_{MIX} < GWP_{LIMIT}

Customer				Ship To			
[
Instructions				P.O. Number		Driver (Id : Name)	
Load	Leave Plant	Arrive Job Site	Start Discharge	Finish Discharge	Leave Job Site	Arrive Plant	
12:16 PM	12:24 PM	12:46 PM	1:30 PM	3:17 PM	3:23 PM	3:45 PM	
Plant	Ticket No.	Truck	Load Size	Mix	Slump	Order No.	Date
08	116774	132	10	CY	4.00	51644	3/4/2025
Usage		Lot		Block			
WALL Tailgate							
LOAD QUANTITY	CUMULATIVE QUANTITY	ORDERED QUANTITY	PRODUCT CODE	DESC.	UNIT OF MEASURE	UNIT PRICE	AMOUNT
10	10.00	10.00	B45105-08	4500 PSI 57/AE/HRWR (WALL)	CY		
10	10.00	10.00	ENVIRO-08	ENVIRONMENTAL FEE	YD		
10	10.00	10.00	WINHEAT-08	Winter Heat Charge	YD		
10	10.00	10.00	HAULRMC1-08	READY MIX DELIVERY BY YARD	YD		
Customer Notes							
Note:							
Gallons of Water Added		30					
Disclaimer							



EPD
ENVIRONMENTAL PRODUCT DECLARATION

READY- MIXED CONCRETE PRODUCED BY: BAY READY MIX

FACILITY:

STRENGTH:

MIX NAME:

IMPACT INDICATOR		PER YD3	PER M3
Global Warming Potential	kg CO2e	314.25	411.02
Ozone Depletion	kg CFC11e	3.18E-06	4.17E-06
Acidification	kg SO2e	0.94	1.23
Eutrophication	kg Ne	0.54	0.71
SFP (Smog)	kg O3e	22.51	29.44
Non-renew. energy	MJ, NCV	2302.54	3011.60

GENERAL INFORMATION

Declared Product: Ready - Mixed Concrete produced by Bay Ready Mix

Date of Issue: July 16, 2024

Period of Validity: 5 years; 3/6/2028

EPD Holder: Bay Ready Mix
4700 Annapolis Rd,
Bladensburg, MD 20710

Program Operator: ASTM International
100 Bar Harbor Drive
West Conshohocken, PA 19428-2959

LCA and EPD Developer: WAP Sustainability Consulting
1701 Market Street Chattanooga,
TN 37408
www.wapsustainability.com

Core PCR: ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products

Sub-category PCR: NSF International Product Category Rule (PCR) for Concrete Version 2.2 (December 2022), Reviewed by Thomas P. Gloria, Bill Stough, and Michael Overcash.

Independent LCA Reviewer and EPD Verifier: Internal External Thomas P. Gloria, PhD Industrial Ecology Consultants

For Additional Explanatory Material: Manufacture Representative: Aaron Fisher (afisher@emcblock.com)
Software Tool: theta by WAP Sustainability Consulting V.1.0.

The declared product meets the following product specifications:

- ACI 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- ACI 318: Building Code Requirements for Structural Concrete.
- ASTM C94 Standard Specification for Ready-Mixed Concrete.
- CSA A23.1/A23.2: Concrete Materials and Methods of Concrete Construction
- CSI Masterformat Division 03-30-00: Cast-in-Place Concrete.
- UNSPSC Code 30111500: Ready Mix

Disclaimer:
EPDs are comparable only if they comply with this document, use the same sub-category PCR where applicable, include all relevant information modules, use the same functional unit and are based on equivalent scenarios with respect to the context of construction works. This EPD is intended for business-to-business communications.
This EPD was calculated using manufacturer specific cement data that represents 100% of the total cement used in this mix.



READY- MIXED CONCRETE PRODUCED BY: BAY READY MIX

FACILITY:

STRENGTH:

MIX NAME:

IMPACT INDICATOR	PER YD3	PER M3
Global Warming Potential	kg CO2e 288.28	377.05
Ozone Depletion	kg CFC11e 2.98E-06	3.90E-06
Acidification	kg SO2e 0.90	1.17
Eutrophication	kg Ne 0.51	0.66
SFP (Smog)	kg O3e 21.35	27.92
Non-renew. energy	MJ, NCV 2152.54	2815.42

GENERAL INFORMATION

Declared Product	Ready - Mixed Concrete produced by Bay Ready Mix
Date of Issue	July 16, 2024
Period of Validity	5 years; 3/6/2028
EPD Holder	Bay Ready Mix 4700 Annapolis Rd, Bladensburg, MD 20710



ASTM 19428-2959,
consulting
ittanooga,
com
ability in Building Construction - Environmental Declaration
Product Category Rule (PCR) for Concrete Version 2.2 (December
omas P. Gloria, Bill Stough, and Michael Overcash.

TY	CUMULATIVE QUANTITY	ORDERED QUANTITY	PRODUCT CODE	4500 PSI
	10.00	10.00	B45105-08	
	10.00	10.00	ENVIRO-08	ENVIRO
	10.00			
	10.00			

Compressive Strength	Normal weight						Lightweight		
	2500 psi	3000 psi	4000 psi	5000 psi	6000 psi	8000 psi	3000 psi	4000 psi	5000 psi
Maryland Concrete GWP Limit	276 (211)	303 (232)	361 (276)	435 (333)	459 (351)	542 (414)	595 (453)	659 (504)	722 (552)

Example: for a submitted 4500 psi concrete mix:
 $(333-276)/(5000-4000) = (x-276)/(4500-4000); x=305$ is the maximum GWP/yd³ for the 4500psi mix.

305

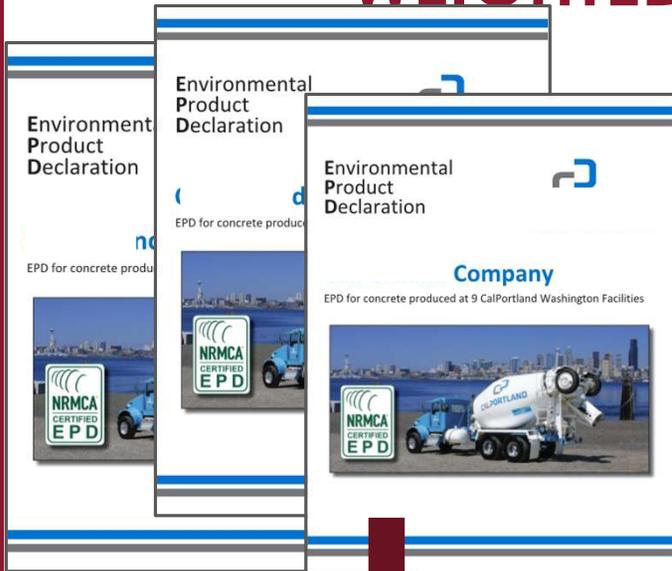
SCHEDULE, NOT TECHNOLOGY

PT Decks
3 day strength
Strip forms
Less SCMs

Mat Slabs, Footings
56 or 90 day strength
control heat of hydration
More SCMs



WEIGHTED AVERAGE GWP_{PROJ} < GWP_{LIMITS}



Equation:

$$\text{SUM } (GWP_1)(V_1) + (GWP_2)(V_2) \dots (GWP_n)(V_n)$$

<

$$\text{SUM}((GWP_{L1})(V_1)) + (GWP_{L2})(V_2) \dots (GWP_{Ln})(V_n)$$

Table 5a: LCA Results for Ready Mix Concrete
Calculated Results A1-A3 per yd³

Mix ID		64335	0866	0932	3100	3110	3200	3324	3421	3434	3716
PSI @ 28											
Strength	days	4000	4000	4000	3000	3000	4000	4500	5000	5000	4000
Core Mandatory Impact Indicators											
GWP	kg CO ₂ e	205.10	471.44	342.12	288.55	288.30	313.92	314.25	366.48	366.69	340.17
ODP	kg CFC11e	9.06E-06	1.27E-05	1.05E-05	9.42E-06	9.36E-06	9.93E-06	1.03E-05	1.10E-05	1.09E-05	1.03E-05
AP	kg SO ₂ e	1.23	2.34	1.72	1.46	1.46	1.58	1.71	1.83	1.83	1.70
EP	kg Ne	0.28	0.57	0.42	0.36	0.36	0.39	0.42	0.45	0.45	0.42
SFP	kg O ₃ e	26.57	57.04	41.82	35.51	35.46	38.54	41.72	44.80	44.73	41.56
ADP _f	MJ, NCV	1616.99	3151.25	2344.37	1997.89	1995.28	2149.90	2339.64	2480.83	2486.49	2316.54
ADP _e	kg Sbe	9.71E-05	3.05E-04	1.90E-04	1.58E-04	1.58E-04	1.74E-04	1.90E-04	2.05E-04	2.05E-04	1.90E-04
FFD	MJ Surplus	161.19	276.46	210.40	180.60	180.30	192.36	209.91	219.81	220.90	206.51
Use of Primary Resources											
RPRE	MJ, NCV	64.60	124.68	90.52	77.07	77.01	82.97	90.45	95.79	96.15	89.58

Compressive Strength	Normal weight						Lightweight		
	2500 psi	3000 psi	4000 psi	5000 psi	6000 psi	8000 psi	3000 psi	4000 psi	5000 psi
Maryland Concrete GWP Limit	276 (211)	303 (232)	361 (276)	435 (333)	459 (351)	542 (414)	595 (453)	659 (504)	722 (552)

WEIGHTED AVERAGE $GWP_{PROJ} < GWP_{LIMITS}$

Type/ Strength	Total Volume used on project (yd ³)	Mix-Specific GWP per submitted EPD (kg CO ₂ e/yd ³)	Maryland Embodied Carbon Threshold (Table 2.4) (kg CO ₂ e/yd ³)
CGC 4500psi	500	320	305
HPC 5000psi	400	335	333
CGC 4000psi	1000	230	276

$$GWP_{limits} = (500 * 305) + (400 * 333) + (1,000 * 276) = 561,700$$

$$GWP_{proj} = (500 * 320) + (400 * 335) + (1,000 * 230) = 524,000$$

Confirmed. $GWP_{proj} < GWP_{limit}$

Concrete Class Schedule

Intended Use	Compressive Strength f'_c (psi)	Exposure Class				Maximum w/cm ratio	Maximum Aggregate Size	Target Air Content	Total Volume (yd ³)	GWP Design Target (KgCO ₂ e/yd ³)	GWP Threshold (KgCO ₂ e/yd ³)
		F	S	W	C						
Drilled Piers	4000psi NWC at 56 Days	F0	S0	W0	C0	-	1 ½"	-	XXXX	240	276
Spread Footings	4000psi NWC at 56 Days	F0	S0	W0	C0	-	1 ½"	-	XXXX	240	276
Foundation Walls	4000psi NWC at 56 Days	F0	S0	W0	C0	-	¾"	-	XXXX	240	276
Grade Beams	4500psi NWC at 56 Days	F2	S0	W1	C1	0.45	¾"	6%	XXXX	290	305*
Core, Shear, Bearing Walls	5000psi NWC at 56 Days	F0	S0	W0	C0	-	1"	-	XXXX	290	333
Interior SOG	3000psi NWC at 56 Days	F0	S0	W0	C0	-	1"	-	XXXX	205	232
Exterior/Garage SOG	5000psi NWC at 56 Days	F3	S0	W1	C2	0.40	¾"	6%	XXXX	330	333
Interior PT Elevated Slab	5000psi NWC at 28 Days (3000psi at stressing)	F0	S0	W0	C0	-	¾"	-	XXXX	429	333
Exterior / Garage PT Elevated Slab	5000psi NWC at 28 Days (3000psi at stressing)	F3	S0	W1	C2	0.40	¾"	6%	XXXX	429	333
Columns	7000psi NWC at 28 Days	F0	S0	W0	C0	-	¾"	-	XXXX	490	383*

Questions?

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