

# Concrete CO2 Limit Setting

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**PORT  
AUTHORITY  
NY NJ**  
AIR LAND RAIL SEA





# Clean Construction Background

PRESS  
RELEASE



*In September 2020, the PANYNJ Announced its Clean Construction Program*

- **Incorporation of LEED and Envision-equivalent standards** during infrastructure design
- **Specification for low carbon concrete:** reduces the required cement content in certain concrete mixes by 25%, significantly reducing its carbon intensity and allowing for lower-carbon alternatives
- **Pilot projects** to develop low carbon concrete and materials
- **Requirement for Environmental Product Declaration:** enables systematic collection of environmental data directly from construction contractors to help inform more environmentally focused material selection

## STAGE IV

- *Low Carbon Materials*
  - *EPDs*
- *Tier 4f diesel engines*
- *Landfill Diversion*

# Background

PRESS  
RELEASE



*In June 2021, the PANYNJ announced an award of an RFP to academia to support LCC pilots and research CO2 optimal mixes to maintain performance and durability with reduced embodied CO2*

## PA Cements Its Commitment to Clean Construction

By: Abigail Goldring, Media Relations Staff

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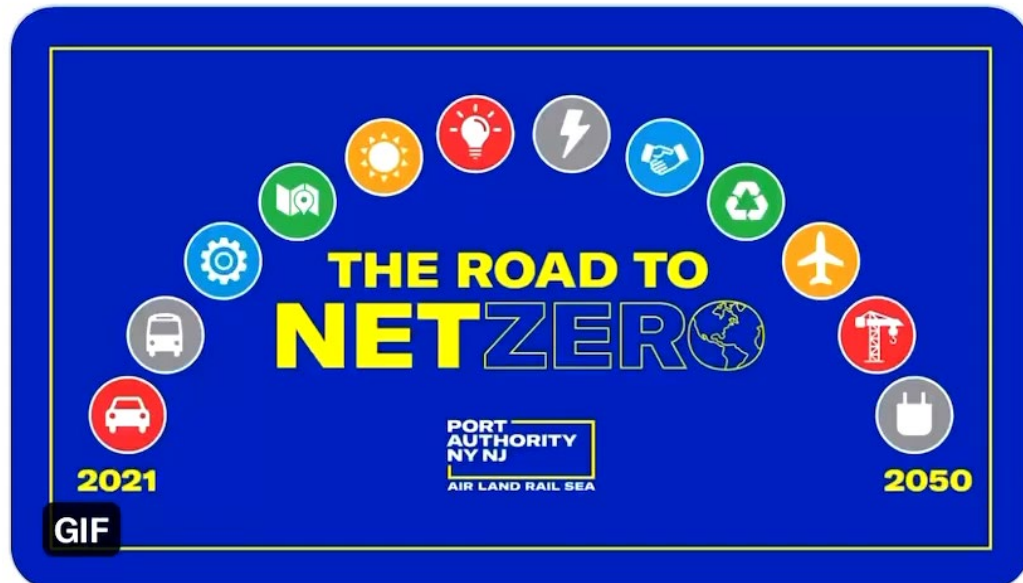
The Port Authority is taking concrete steps to reduce emissions through its construction practices – literally.

In 2020, the agency launched an industry-leading [Clean Construction Program](#), laying out initiatives to make PA construction processes more sustainable. Now, the agency is delivering on one of those key initiatives with the launch of a new Low Carbon Concrete Program. Through this program, the Port Authority will be working with Rutgers University and New York University to develop and test new low-carbon concrete mixes. The program is designed to lead the industry as a whole towards the use of more sustainable concrete mixes.

# Background

*In October 2021, the PANYNJ Announced its Net Zero Goals – Climate Crisis Commitments*

PRESS  
RELEASE



## Net Zero Sustainability Efforts by 2050 Announcement

Watch the virtual event which took place on October 28, 2021 where the Port Authority announced its plans to formally adopt a goal of achieving net zero greenhouse gas emissions by 2050, in alignment with goals set by the Biden administration. In addition, the agency announced its new target to reduce its direct emissions by 50 percent by 2030.

# CAIT Study of Embodied Carbon Emissions from PANYNJ Concrete Mixes

- ❖ Part of a larger academic study on low carbon concrete mixes, CAIT first quantified the CO2 impacts from possible SCMs and mix constituents



## Low Carbon Concrete Pilot Program: Task A Report

Evaluating the Port Authority of NY and NJ's Current Embodied Carbon in Concrete Mixtures

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## GWP Formula:

Concrete GWP

$$= 1.048 * m_{cement} + 0.328 * m_{flyash} + 0.263 * m_{slag} + 0.00258 * m_{coarse\ aggregate} + 0.00372 * m_{fine\ aggregate}$$

Raw materials	GHG emission coefficient (lb/lb)	References
Portland cement	1.048	[12]
Portland-limestone cement (12% limestone) (PLC)	0.951	Calculation based on EPD, [121-122]
Calcium sulfoaluminate (CSA)	0.7336	[115]
Fly ash (FA)	0.328	[12]
Carbonated Fly Ash [CFA]	0.279	[58]
Granulated blast furnace slag (GBFS)	0.264	[12]
Ground glass pozzolan (GGP)	0.0556	[120]
Crushed aggregate (CA)	0.00372	[12]
Sand & gravel (SG)	0.00258	[12]
Recycled aggregate (RCA)	0.0012	[124]
CarbonCuring	-0.001 (0.1% CO <sub>2</sub> utilization, with respect to the mass of cement)	[56]

# CAIT Study of PANYNJ Mixes – Use Case

- ❖ Only use when no EPD available for incoming mix approval
- ❖ Can be used to quantified past mix GWP
- ❖ Only comparable to A1 emissions from an EPD
- ❖ A1 listed in an EPD = Comparable to Calculated A1
  - ❖ *Determined to be statistically significant*

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# Embodied CO<sub>2</sub> in Concrete Limits

Values are based on compressive strength classes, except for flexural strength mixes

PANYNJ Carbon Limits and Incentivized Limits					
All values in lbs CO <sub>2</sub> e/cy		Limit	Incentive 1	Incentive 2	Notes
		lbs CO <sub>2</sub> e/cy	lbs CO <sub>2</sub> e/cy	lbs CO <sub>2</sub> e/cy	
PSI Range	PSI Ranking	50%	25%	10%	<-Percentiles
700	FLEX	415	400	375	Flexural Strength
0-2500	2500	345	330	320	
2501-3000	3000	415	410	410	
3001-4000	4000	425	335	310	<- 4k-6k PSI grouping
4001-5000	5000	425	335	310	<- 4k-6k PSI grouping
5001-6000	6000	425	335	310	<- 4k-6k PSI grouping
6001-8000	8000	520	495	495	
8000+	+	630	610	490	

- For ready-mix only
- These values are compared to A1 EPD CO<sub>2</sub> or raw mix constituent factors
- Incentive structure for especially low CO<sub>2</sub> mixes still being discussed internally

- Evaluated the 50th Percentile GWP of mixes per PSI rankings, grouped 4000-6000 PSI, and rounded up values to the nearest "5" pounds
- Approximately 79% of the cubic yardage of concrete poured between 2018 and 2021 passed these GWP limits. This will bring in the other 21% and get us to drive down CO<sub>2</sub> content further by using an incentive structure to stimulate R&D.



# Scope of Limits – What is being affected?

- “Cradle to gate” of producer emissions from LCA stages A1-A3.
- Proposed concrete limits are tied exclusively to A1 emissions.
- Also captures other environmental impacts per declared quantity
- 203 kg/m<sup>3</sup> to 342 lbs/yd<sup>3</sup> (÷0.593 to go from kg CO<sub>2</sub>e/m<sup>3</sup> -> lbs CO<sub>2</sub>e/cy)

This mix equals 258 lbs CO<sub>2</sub>e/cy A1 emissions

**EASTERN CONCRETE**  
ENVIRONMENTAL PRODUCT DECLARATION  
Mix 46A115N9 • Newark Plant

This Environmental Product Declaration (EPD) reports the impacts for 1 m<sup>3</sup> of ready mixed concrete mix, 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**  
Eastern Concrete  
250 Pehle Ave, Plaza One, Suite 503  
Saddle Brook, NJ 07663

**PLANT**  
Newark Plant  
1196 McCarter Highway  
Newark, NJ 7104

**EPD PROGRAM OPERATOR**  
ASTM International  
100 Barr Harbor Drive  
West Conshohocken, PA 19428

**DATE OF ISSUE**  
10/04/2021 (valid for 5 years until 10/04/2026)

**ENVIRONMENTAL IMPACTS**

**Declared Product:**  
Mix 46A115N9 • Newark Plant  
Description: 5000 REG/PM SP LOW HEAT  
Compressive strength: 4000 PSI at 28 days


**Declared Unit:** 1 m<sup>3</sup> of concrete

Global Warming Potential (kg CO <sub>2</sub> -eq)	203
Ozone Depletion Potential (kg CFC-11-eq)	7.80E-6
Acidification Potential (kg SO <sub>2</sub> -eq)	1.49
Eutrophication Potential (kg N-eq)	0.27
Photochemical Ozone Creation Potential (kg O <sub>3</sub> -eq)	30.3
Abiotic Depletion, non-fossil (kg Sb-eq)	2.54E-5
Abiotic Depletion, fossil (MJ)	878
Total Waste Disposed (kg)	34.8
Consumption of Freshwater (m <sup>3</sup> )	3.07

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

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

**EASTERN CONCRETE**  
ENVIRONMENTAL PRODUCT DECLARATION  
Mix 46A115N9 • Newark Plant



**DECLARATION OF ENVIRONMENTAL INDICATORS DERIVED FROM LCA**

Impact Assessment	Unit	A1	A2	A3	Total
Global warming potential	kg CO <sub>2</sub> -eq	153	44.1	5.54	203
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11-eq	7.54E-6	1.79E-9	2.59E-7	7.80E-6
Eutrophication potential	kg N-eq	0.21	0.04	0.03	0.27
Acidification potential of soil and water sources (AP)	kg SO <sub>2</sub> -eq	0.80	0.65	0.04	1.49
Formation potential of tropospheric ozone (FOOP)	kg O <sub>3</sub> -eq	11.5	17.7	1.05	30.3



# External Bench Marking

Comparing Concrete Carbon Limits Within the United States								
Agency	Portland OR	Colorado DOT	Marin County CA	NRMCA-Eastern	GSA	PANYNJ	Agency	
Datasource	NRMCA-Pacific NW	CLF-Median	NRMCA-Pacific SW*	NRMCA-Eastern		Limit	Datasource	
PSI Class	ALL VALUES SHOWN IN lbs CO <sub>2</sub> e/CY for A1 GWPs							PSI Class
FLEX	-	-	-	-	-	415	FLEX	
2500	365	359	351	349	407	345	2500	
3000	403	393	390	385	515	415	3000	
4000	485	463	422	461	583	425	4000	
5000	589	548	456	557	649	425	5000	
6000	623	579	480	589	681	425	6000	
8000	742	672	532	698	699	520	8000	
8000+	-	722	584	-	699	630	8000+	

- The green cells indicate lowest GWP value among all other represented entities
- All GWPs from various agencies are in lbs CO<sub>2</sub>e/cy and scaled to A1 = ~ 80% of the emissions of a mix
  - Apples to apples
  - We are lower than other entities, but all are in the same ballpark

# Thank You!

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