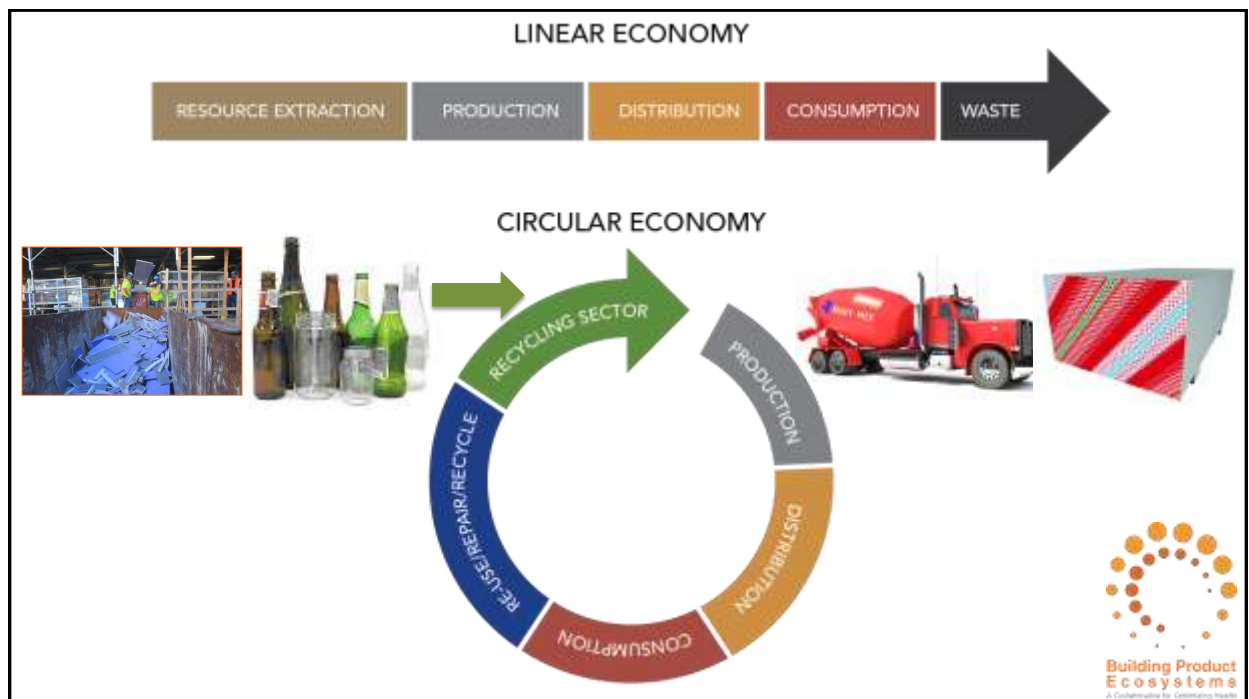


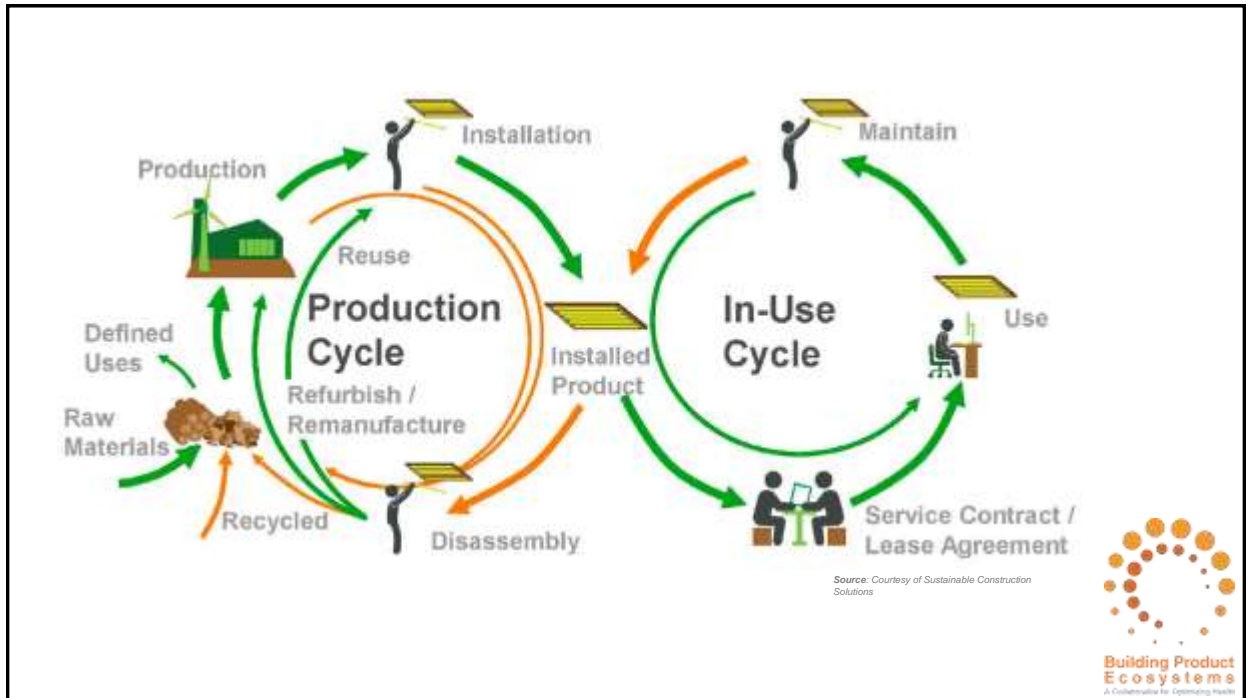
EWG Body Burden Study: The Pollution in Newborns, 2005

- Hg** **Mercury (Hg) - tested for 1, found 1**
Pollutant from coal-fired power plants, mercury-containing products, and certain industrial processes. Accumulates in seafood. Harms brain development and function.
- PAH** **Polyaromatic hydrocarbons (PAHs) - tested for 18, found 9**
Pollutants from burning gasoline and garbage. Linked to cancer. Accumulates in food chain.
- BD/F** **Polybrominated dibenzodioxins and furans (PBDD/F) - tested for 12, found 7**
Contaminants in brominated flame retardants. Pollutants and byproducts from plastic production and incineration. Accumulate in food chain. Toxic to developing endocrine (hormone) system.
- PFC** **Perfluorinated chemicals (PFCs) - tested for 12, found 9**
Active ingredients or breakdown products of Teflon, Scotchgard, fabric and carpet protectors, food wrap coatings. Global contaminants. Accumulate in the environment and the food chain. Linked to cancer, birth defects, and more.
- D/F** **Polychlorinated dibenzodioxins and furans (PCDD/F) - tested for 17, found 11**
Pollutants, by-products of PVC production, industrial bleaching, and incineration. Cause cancer in humans. Persist for decades in the environment. Very toxic to developing endocrine (hormone) system.

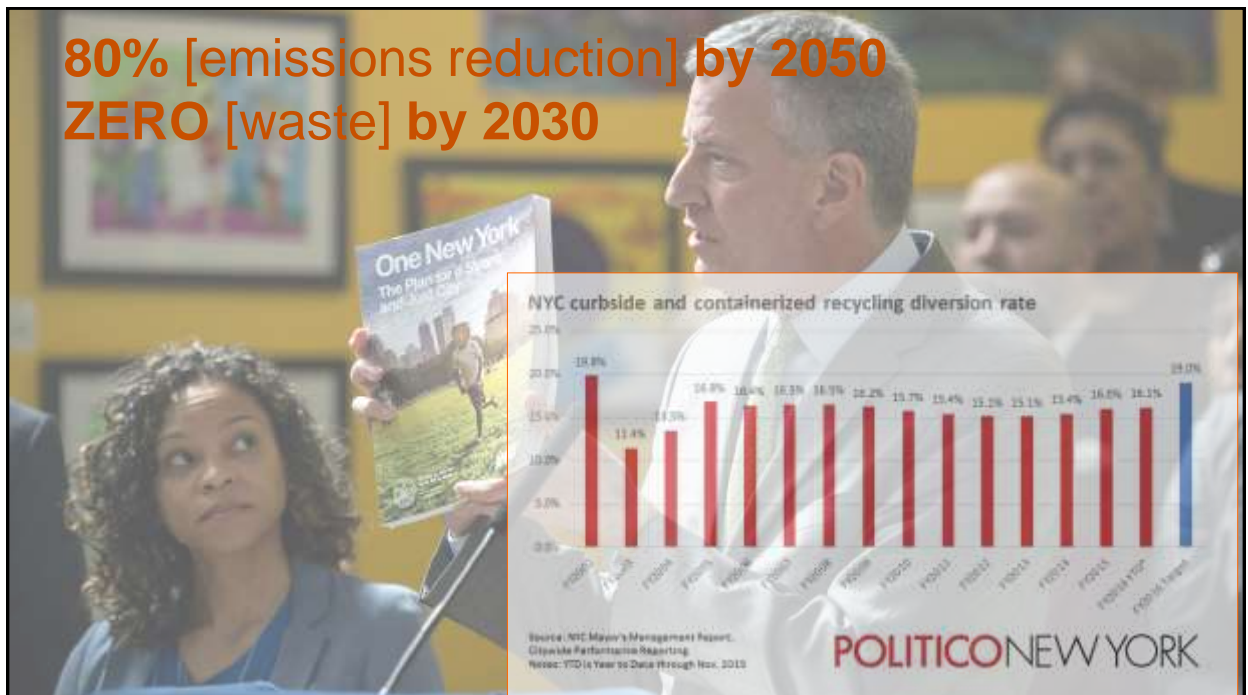
- OC** **Organochlorine pesticides (OCs) - tested for 28, found 21**
DDT, chlordane and other pesticides. Largely banned in the U.S. Persist for decades in the environment. Accumulate up the food chain, to man. Cause cancer and numerous reproductive effects.
- PBDE** **Polybrominated diphenyl ethers (PBDEs) - tested for 46, found 32**
Flame retardant in furniture foam, computers, and televisions. Accumulates in the food chain and human tissues. Adversely affects brain development and the thyroid.
- CN** **Polychlorinated Naphthalenes (PCNs) - tested for 70, found 50**
Wood preservatives, varnishes, machine lubricating oils, waste incineration. Common PCB contaminant. Contaminate the food chain. Cause liver and kidney damage.
- PCB** **Polychlorinated biphenyls (PCBs) - tested for 209, found 147**
Industrial insulators and lubricants. Banned in the U.S. in 1976. Persist for decades in the environment. Accumulate up the food chain, to man. Cause cancer and nervous system problems.

Source: Chemical analyses of 10 umbilical cord blood samples were conducted by AXYS Analytical Services (Sydney, BC) and Flett Research Ltd. (Winnipeg, MB).





80% [emissions reduction] by 2050
ZERO [waste] by 2030



Building Product Ecosystems | Working Groups

Evolving Wallboard Systems

Optimizing wallboard cycles, to establish closed-loop wallboard post-consumer recycling process and infrastructure.



Flame Retardants & Codes

Evaluating appropriate Code requirements for building products and assemblies to best balance fire safety with minimized health impacts from flame retardant use.



Glass in Concrete

Piloting cast-in-place concrete Portland cement replacement with city post-consumer recycled glass pozzolan.



Transparency.

Collaboration between Buyers, Makers, Designers, Recyclers, Policy, + Academia.

Pragmatic Application for Real Project Challenges.

Evolving the Holistic Health of Manufacturing + Recycling.



Building Product Ecosystems
A Collaborative for Sustainability



Implementing Closed-Loop Post-Consumer Gypsum Wallboard Recycling



Building Product Ecosystems
A Collaborative for Sustainability

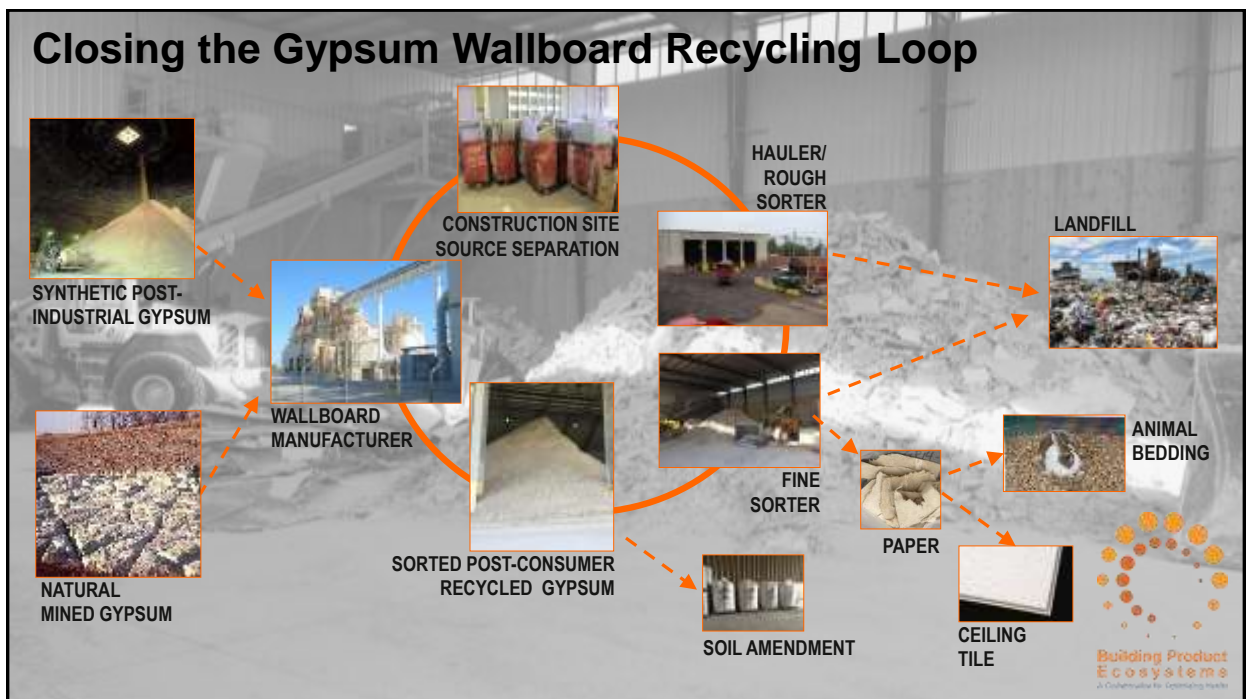
Why Closed Loop Gypsum Wallboard Recycling?

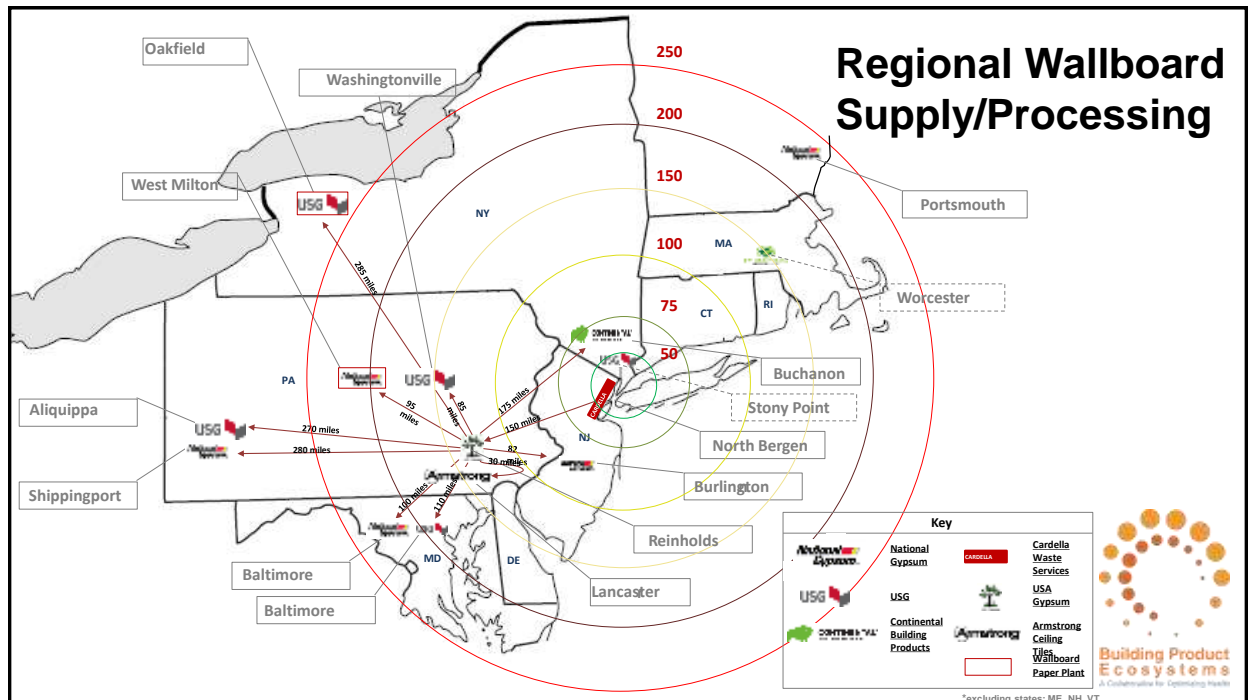


- 9 Million tons drywall waste generated each year. Only 400,000 tons currently recycled.
- Avoid hydrogen sulfide emissions from wallboard in anaerobic landfill conditions (exacerbates asthma)
- Minimize generation of methane GHG resulting from paper facing interaction with bacteria in landfill environment.
- Minimize gypsum fines contamination (via SO₂) of low-carbon C+D wood waste biomass.
- Minimize Mining of land for Natural Gypsum
- Mercury (Hg) - Content, Emissions, Effluent from coal-fired power plants



Closing the Gypsum Wallboard Recycling Loop





Comingling in Packer Truck = Less Recyclable Gypsum



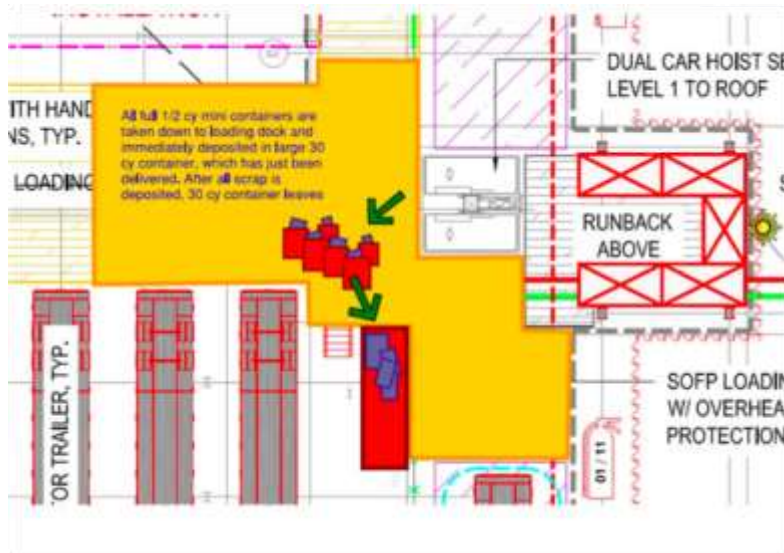
Pilot Source Separation Sites



Job Site Logistics



Job Site Logistics



Job Site Logistics

Click to view video of:

[job site workers talking about wallboard source separation logistics](#)



Evolving Wallboard Systems Pilots
Source-Separated Hauling to Transfer Station
Cardella – North Bergen, NJ



Evolving Wallboard Systems Pilots
Gypsum + Paper Facing Separation, Processing
USA Gypsum | Denver, PA





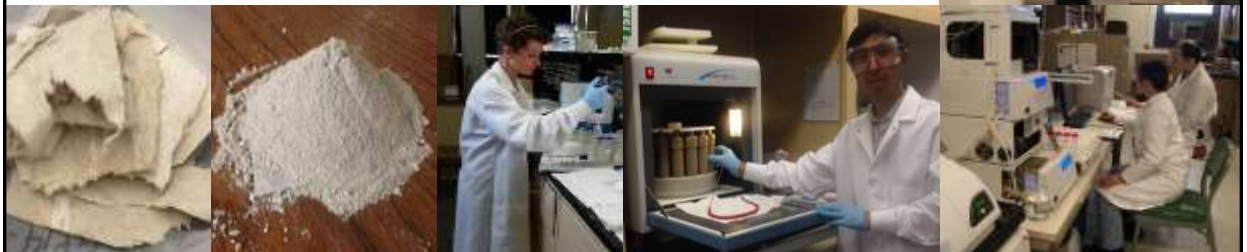
Evolving Wallboard Systems Pilots
Manufacturing w/ Post-Consumer Gypsum
USG | Washingtonville, PA



Research Goals

- Identify **contaminants, levels**
- Understand **release + exposure** in harvest, manufacture, processing, transportation, use, and disposal
- Establish industry-recognized transparent, consistent **quality control standards** + methods for remanufacturing gypsum wallboard

Brooklyn College
The City University of New York



Standardization for Streamlined Implementation



Designation: X XXXX-XX

Work Item Number: WK52269

Date: 01/21/2016

Include Ballot Rationale Here (Required for all Ballots)

Standard Practice for The Selection of Post-Consumer Gypsum Board for Closed-Loop Recycling¹

This standard is issued under the fixed designation X XXXX; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last ~~revision~~. A superscript symbol (¹) indicates an editorial change since the last revision or ~~revision~~.

1. Scope

1.1 This standard includes the physical condition and compositional criteria for selecting post-consumer gypsum board for use in manufacturing new board product.

1.2 This standard only applies to recycled material for use in interior gypsum board and not in exterior use panel products but in any specialty product such as type X, type C, impact resistant or mold and mildew resistant products.

1.3 This standard does not dictate the minimum amount of recycled board a manufacturer is to use in producing new board, but does define a minimum amount of recycled material in order



Amanda Ka... 2/20/2015 4:00 AM
Comment [1]: Type X + C account for a large swath of wallboard manufactured. Seems standard should allow collection of Type X and C as inputs into closed loop recycling. The resulting post-consumer processed material should be allowed to be fed into manufacture of these board types as well. In speaking with USG and National, they seem to agree.

urbangreencouncil.org/greencodestracker

NYC GREEN CODES PROPOSAL TRACKER

RC1	Recycle Construction Waste	Task Force Proposal	PROPOSED
<h3>Summary</h3> <p>Issue: While most waste from construction sites can be collected in dumpsters and then separated and recycled off-site, certain materials become damaged when comingled. They cannot be reused or recycled unless they are separated at the construction site.</p> <p>Recommendation: Require ceiling tiles, carpeting, new gypsum wallboard scrap, and large-dimension lumber to be sorted on-site and reused or recycled. Also, require construction-waste management plans for large projects.</p> <p>Proposed Legislation, Rule, or Study</p> <p><i>Amendments to the New York City Building Code:</i></p> <p>1. Add the following definitions to Section 3302.1:</p> <p>CONSTRUCTION WASTE MANAGEMENT PLAN. A plan outlining procedures for the reuse, including resale, or recycling of recoverable waste materials generated during construction and demolition.</p>			

Landfill Tipping



Implementing Closed-Loop Post-Consumer Gypsum Wallboard Recycling



Recycled Glass Pozzolan Replacing Cement in Concrete



Portland Cement Impact

- **90 million tons** produced in the US / year.*
- **3 million tons** used in NY / year.*
- **9.5 million tons** used in CA/year.*
- Per EPA, **1 ton** of production results in **1 ton CO2**.
- Per EPA, **annual Cement impact = GHG emissions of 16 million cars.**

* Source: Per [USGS Cement Statistics and Information](#)

Building Product Ecosystem

NYC Glass in Concrete Working Group



Supplementary Cementitious Materials [SCMs]

SCMs Replace X% of cement in concrete, reducing CO₂ emissions from cement production. SCMs can also improve performance.

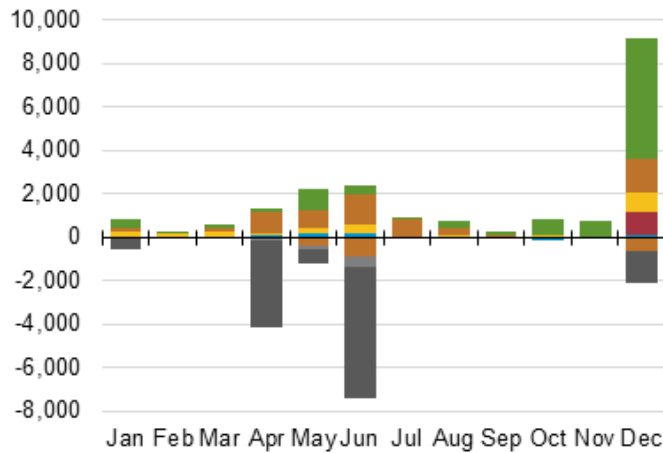
- **Fly Ash** | byproduct, coal-fired power
- **Slag** | byproduct, blast furnaces
- **Silica Fume** | byproduct, silicon manufacture
- **Natural Pozzolans** | calcined clays/shales, glass

Source: From PCA Design Manual Chap 3.

Building Product Ecosystems

Inconsistent Fly Ash Supply

Scheduled electricity generation capacity additions and retirements in 2015
megawatts



annual net change:

wind (9,811 MW)
natural gas (4,318 MW)
solar (2,235 MW)
nuclear (1,122 MW)
other renewables (471 MW)
petroleum and other (-800 MW)
coal (-12,922 MW)

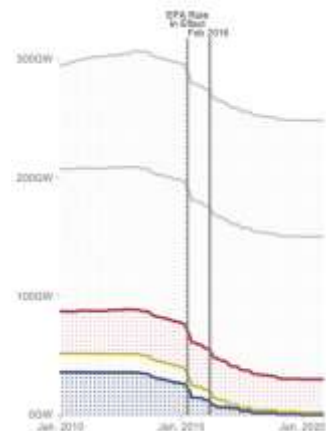
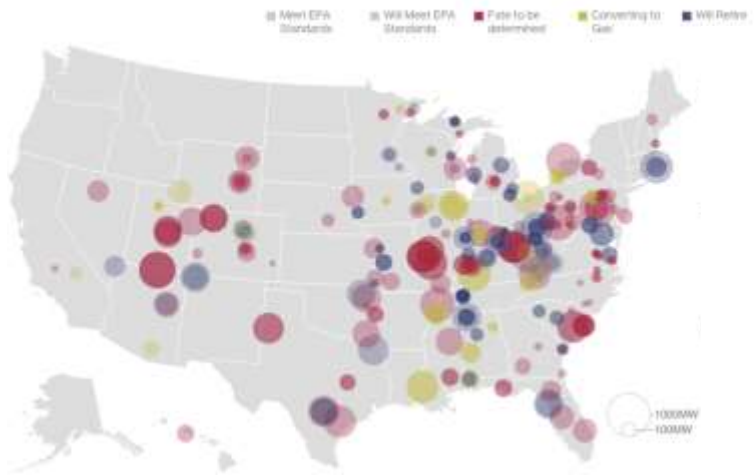
Source: [U.S. Energy Information Administration, Electric Power Monthly](http://www.eia.doe.gov)
Note: Other renewables include hydroelectric, biomass/wood, and geothermal.



Inconsistent Fly Ash Supply

Coal-fired generator retirements
primarily due to EPA's Mercury
and Air Toxics Standards (MATS).

U.S. Coal-Power Capacity After EPA Rule



Source: <http://www.bloomberg.com/graphics/2015-coal-plants/>

Inconsistent Regional Blast Furnace Slag Supply

IRON AND STEEL SLAG

Events, Trends, and Issues: The availability of blast furnace slag is becoming problematic in the United States because of the closure and (or) continued idling of a number of active U.S. blast furnaces in recent years, the lack of construction of new furnaces, and the depletion of old slag piles. At yearend 2014, granulation cooling was available at only three active U.S. blast furnaces. The supply of slag was in very limited supply (one source of slag was planned). Basic oxygen furnace (BOF) slag is produced by integrated iron and steel companies. BOF slag is sometimes been less volatile than that of natural aggregates. Domestic and import supply constraints appear to have limited U.S. demand for BOF slag in recent years, and sales have failed to match the relative volume and price increases that have characterized the overall U.S. cement market since 2010. Long-term demand for BOF slag will increase because its use as a cementitious additive for concrete. This has the potential to increase demand for BOF slag. Long-term growth in the supply of BOF slag may be constrained by increasing international demand for the same material and because not all granulated slag produced overseas is of the quality needed for use in concrete. BOF slag plants will likely reduce demand for fly ash as a replacement raw materials.

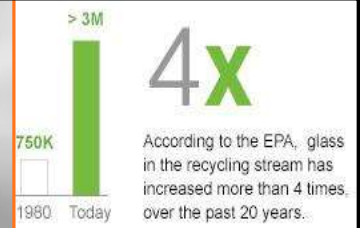
"The availability of blast furnace slag is becoming problematic in the U.S. because of:

- closure of a number of active U.S. blast furnaces in recent years,*
- lack of construction of new furnaces, and*
- depletion of old slag piles."*

Source: U.S. Geological Survey, Mineral Commodity Summaries, January 2015
http://minerals.usgs.gov/minerals/pubs/commodity/iron_&_steel_slag/mcs-2015-fesla.pdf



11.8 million tons of post-consumer glass is generated in the U.S. annually.



...only 28% is recycled.*

135,000 tons of post-consumer glass is generated in NYC annually...
60% is recycled.

*<http://www.epa.gov/osw/conserve/materials/glass.htm>



Sims Municipal Recycling Plant

- Located in Jersey City
- 8,000-10,000 tons glass per month
- Screens, Magnets, Eddy Current, Crushers
- Clear glass separation with optical sorters
- Removal of heat-resistant and leaded glass



Sims NYC Recycling Market [current]

~1,200 tons/month Clear Glass
sold to Container Market



~5,000 tons/month Mixed Color Glass
crushed for 3/8" Recycled Glass Aggregate
[RGA] Market



Recycled Glass Aggregate (RGA)

- **Pros:** Large bulk projects, modest processing costs, competitive with alternative aggregates
- **Cons:** Unpredictable demand, seasonality, low value

Average	
Sieve Size	% Finer
1/2"	100
3/8"	96
#4	61
#8	25
#16	14
#30	9
#40	8
#50	7
#60	7
#100	6
#200	6
LOI	2-3%

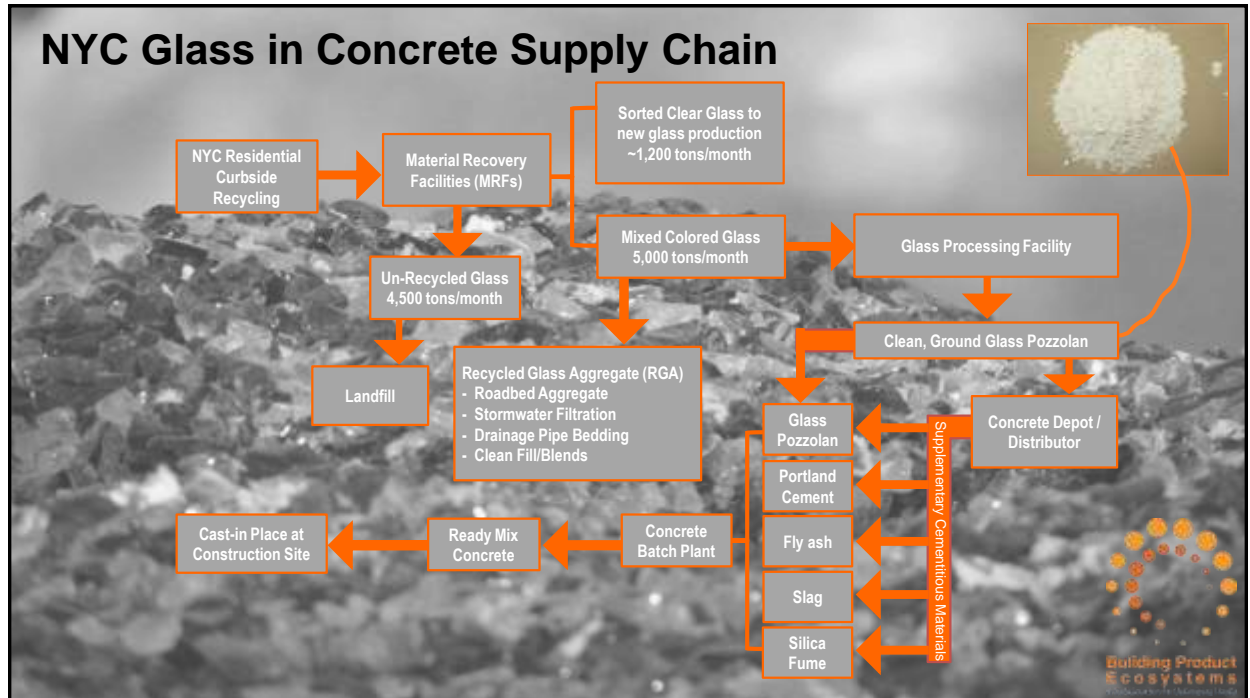


Structural Fill Blend, Brooklyn Pier

Clean Fill, Site Remediation Perth Amboy, NJ

Filtration Media, DOT Roadwork, Queens





Ground Glass meeting Code

Code Review:

ACI 318 Building Code Requirements, Chapter 3 allows use of SCMs that conform to the following ASTMs:

- **ASTM C989 (AASHTO M302)** - Ground granulated iron blast-furnace slags; Grade 80, 100, 120
- **ASTM C618 (AASHTO M295)** - Fly ash and natural pozzolans
 - Class N – Natural pozzolans
 - Class F – Fly ash with pozzolanic properties
 - Class C – Fly ash with pozzolanic and cementitious properties
- **ASTM C1240** - Silica fume



Batch Plant Operation, Silos



Halletts Point | Concrete Specification

2.4 CONCRETE MATERIALS

- A. Portland cement: ASTM C 150, Type I or II, ASTM C 1157, Type GU or LH. Concrete of 8,000 psi @ 28 days or higher strength requires the use of one brand of cement as approved by the Engineer.
- B. Supplementary Cementitious Materials:
1. Slag: ASTM C989, Grade 100 or 120, may be used up to a maximum of 35% of the total cement content.
 2. Pozzolans: ASTM C 618 -08 Class N, may be used up to a maximum of 35% of the total cement content
 3. At no point shall the sum of the Slag and Pozzolan quantities exceed 35% of the total cement content
 4. The exact percentages used shall be based on a successful test placement onsite.

This project is being used as a prototype to introduce the use of Post-Consumer Powdered Glass Pozzolans as a replacement to the above-specified Slag. All things being equal, physical properties, chemical properties and economics, the use of powdered glass pozzolans in lieu of Slag will be given preferential treatment.

Severud Associates
CONSULTING ENGINEERS P.C.
NEW YORK LONDON PARIS

Halletts Point | Technical Performance Testing



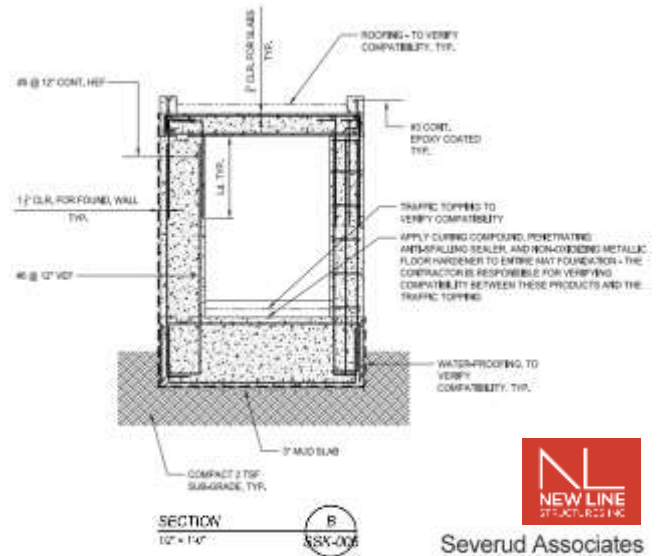
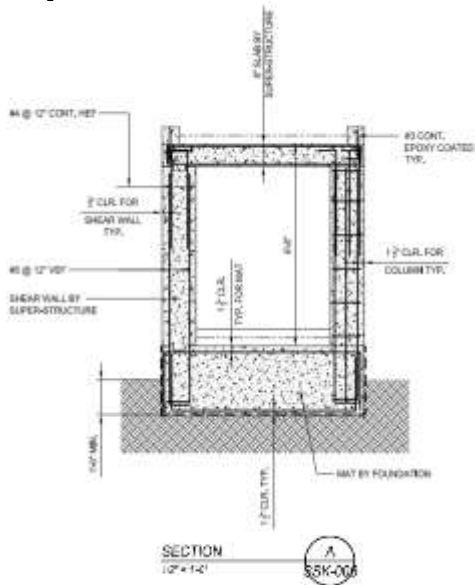
The Durst Organization Halletts Point Building 1

Mix	Source	650	775	850
		6000psi w/pozzo	8000psi w/pozzo	10000psi w/pozzo
Date Batched		7/1/2015	7/1/2015	7/1/2015
Cement (lbs.)	Essex Cement - Type III	429	505	553
Glass pozzolan	Pozzolan	227	270	297
Sand (lbs.)	Roanoke Sand & Gravel	1250	1300	1240
Stone # 1 (lbs.)	Ticon, Clinton Point #67	1250	1300	1300
Stone # 2 (lbs.)	Ticon, Clinton Point #6	540	500	500
Water (gal.)		29.8	29.8	29.7
Admixture 1 (oz.)	Eucrid / Air	9.8	n/a	n/a
Admixture 2 (oz.)	Eucrid / Plastol 5000	58.5	62.0	68.0
W/C		0.38	0.32	0.29
Slump (in.)		8.5	n/a	n/a
Spread (in.)		-	26.0	26.5
Air (%)		5.5	0.9	1.4
Theo. Unit Wt. (pcf.)		145.76	152.7	153.0
Actual Unit Weight (pcf.)		147.0	153.0	154.5
1 day results		2560	3740	5300
		2580	4000	6000
1 day average		2615	3870	5650
2 day results		3790	5690	7070
		3890	5630	6200
2 day average		3840	5660	6635
7 day results		6060	8030	9570
		6090	8650	9350
		6010	7660	8000
7 day average		6039	7860	9307



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