Semplastics Carbon Conversion & Utilization Opportunity Overview

SE Regional Carbon Conversion/Utilization
Procurement Grants Workshop
August 2022

NATIONAL ENERGY TECHNOLOGY LABORATORY

U.S. DEPARTMENT OF ENERGY

USEA United States Energy Association

Semplastics

Agenda

- Carbon Utilization Framework
- Carbon Derived Building Material Development
- Lithium-Ion Battery Applications
- CO2 Based Building Materials

Kynos Carbon Framework

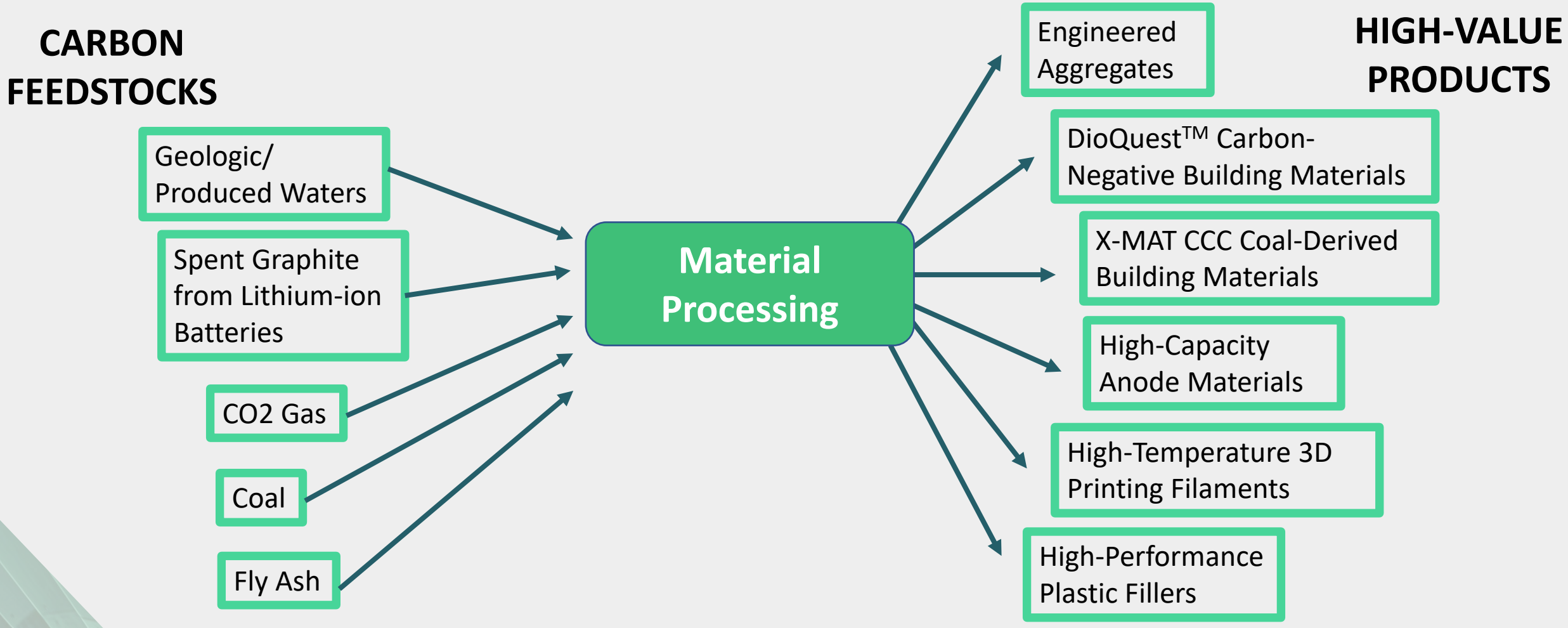
Repurposing both undervalued and waste carbon feedstocks to create valuable, customized, sustainable products.

SUSTAINABILITY =  + 

Economically Sustainable

Environmentally Sustainable

Kynos Carbon Framework



Carbon-Derived Building Materials Experience

X-MAT Building Material Benefits

Material Benefits


Fireproof


Light-weight


Stronger


More Insulating


Encapsulates Impurities

Economic Benefits


Job Creation


Carbon Utilization

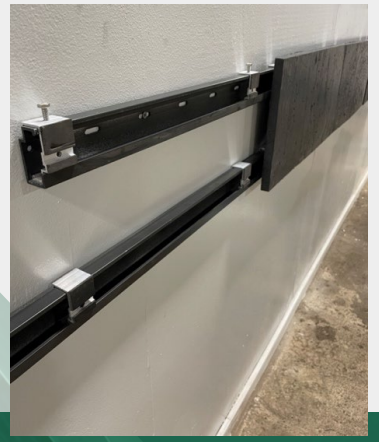
Carbon Sequestered

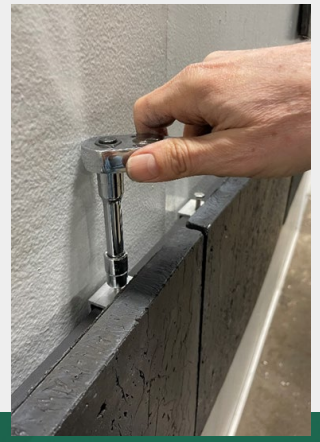

Improved Labor Productivity


Reduced Transportation Cost

X-PANEL™

16″ x 32″ Carbon-Derived Ceramic X-PANEL™ Rail Clips Fastened by concealed undercut anchors





Dark Features are the Light-weight Coal-Based Ceramic Aggregate (X-MATRIX™)

16″ x 32″ Polished X-MATRIX™ X-PANEL™ Rail Clips Fastened by concealed undercut anchors

X-TILES®

Coal-Derived Ceramic "Villa" Tiles Testing Results

- **PASSED** ANSI FM 4473 **Class 4** Hail Impact Resistance Standards
- **FAR EXCEEDED** Grade 1 Performance for Water Absorption and Saturation Coefficient according to ASTM C67 Standards
- **FAR EXCEEDED** Type I Wet/Dry Flexural Strength Testing according to ASTM C67/C1167 Standards

→ Side by Side with a Ludowici Clay Roof Tile

100 Square Feet of Coal-Derived Ceramic "Villa Tiles"

Examples of various colors and coating for the ceramic tiles

X-MATRIX™ Blocks

Standard Lightweight Block
14.36kg (31.66lbs)

X-MATRIX Lightweight Block
9.5kg (20.94lbs)

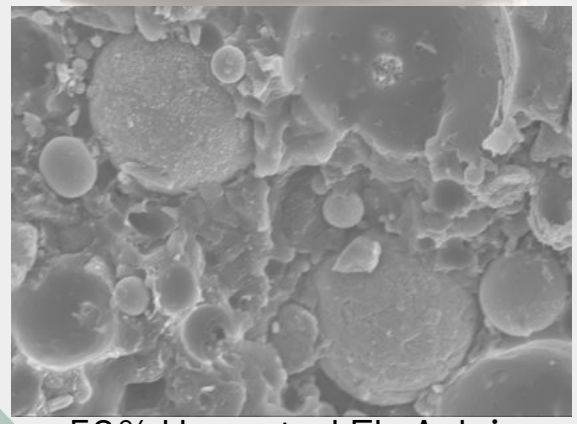
Over 33% Reduction in Weight

Standard Lightweight Block (Top)
X-MATRIX Lightweight Block (Bottom)

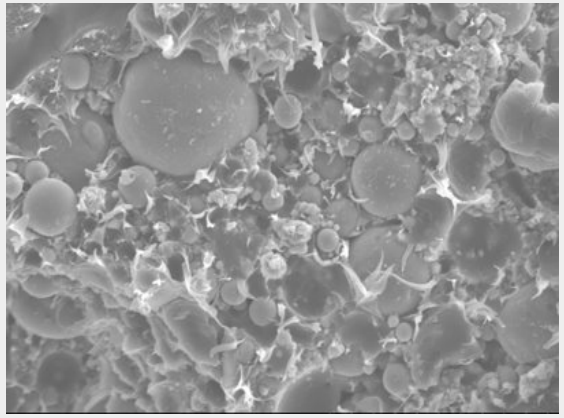
Standard Lightweight Block (Top)
X-MATRIX Lightweight Block (Bottom)

Fly Ash Products

50% Fly Ash /
50% Polypropylene Pellets



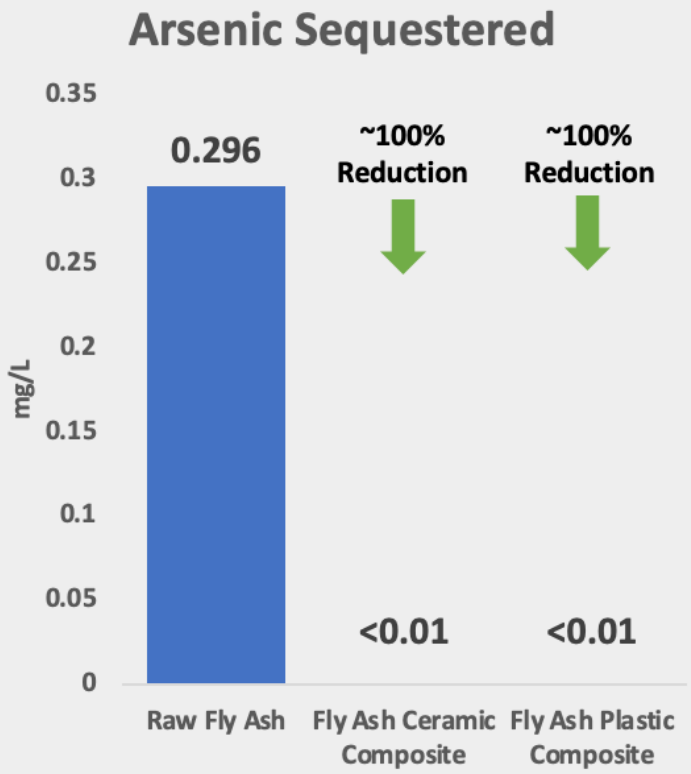
50% Uncoated Fly Ash in Polypropylene

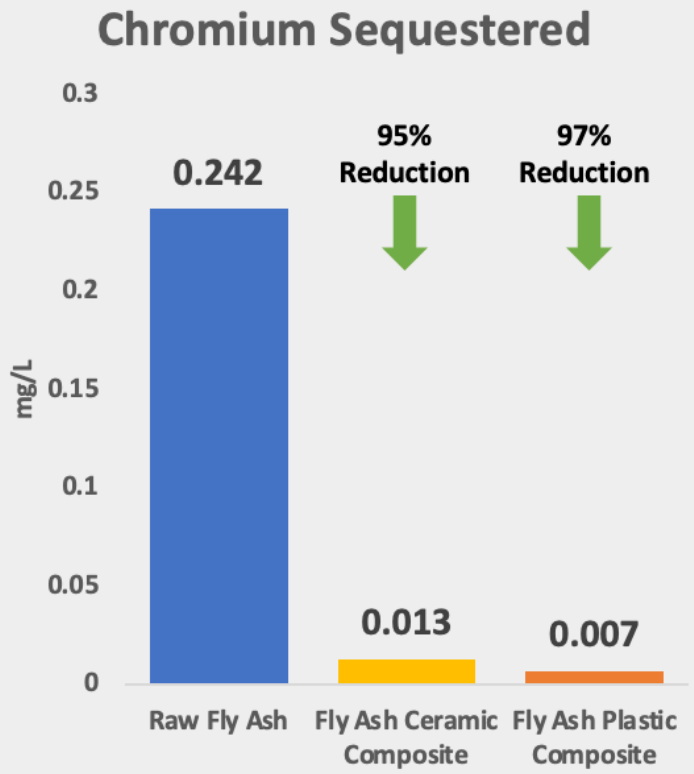


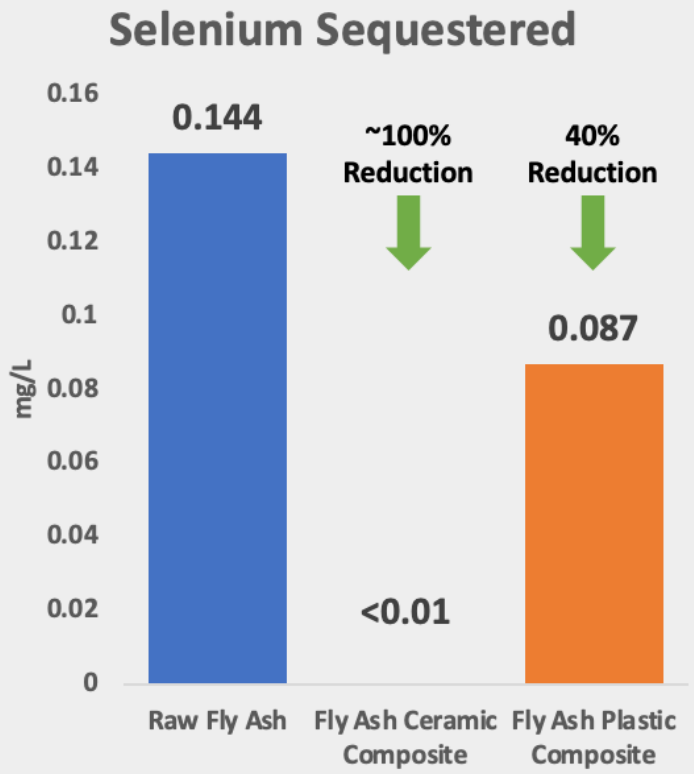
50% B178 Coated Fly Ash in Polypropylene

Fly Ash Ceramic Composite Structural Columns.
The Larger Columns are about 9in X 18in

Fly Ash Composite Leach Testing Results





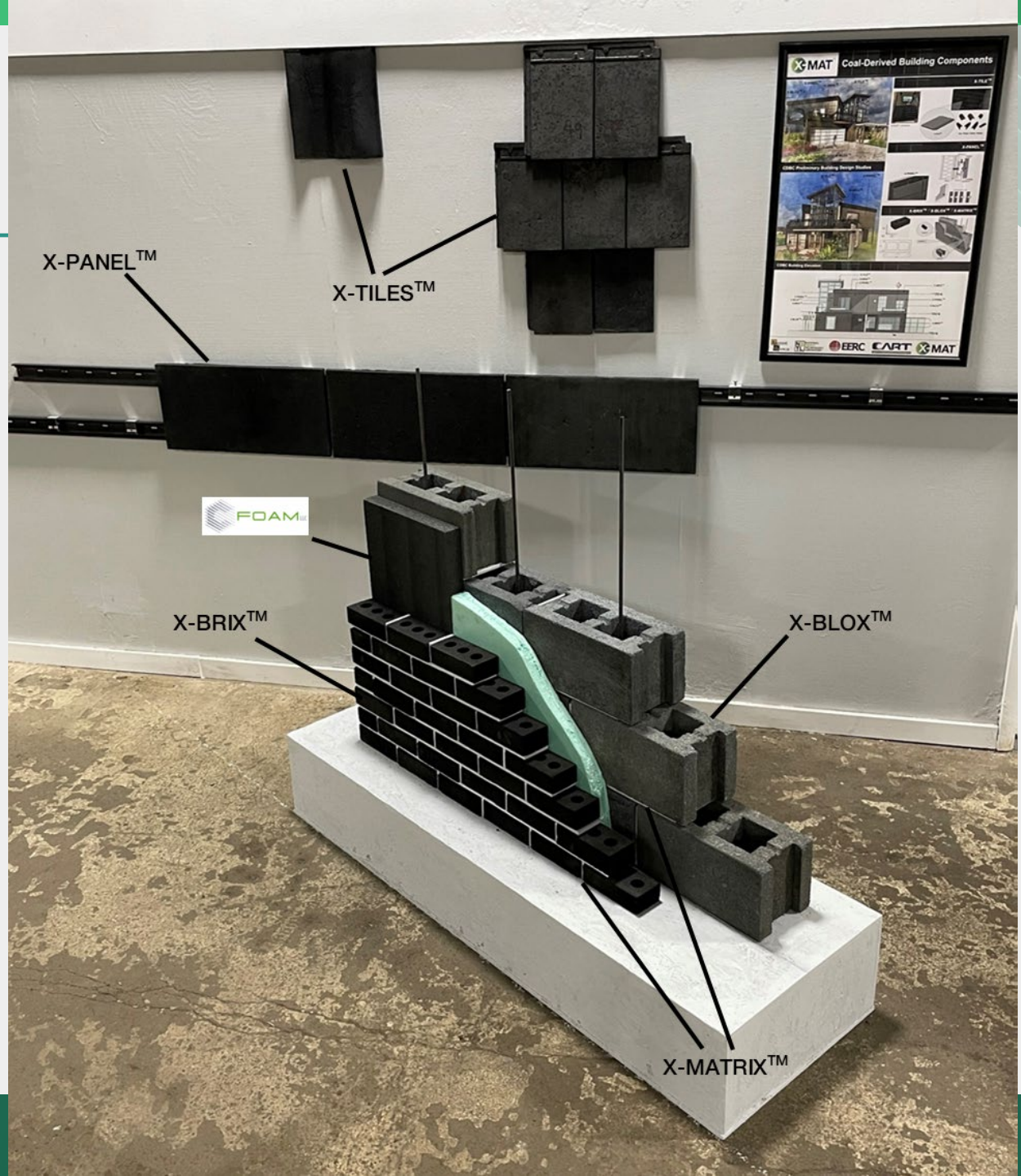


*All Materials are well below the allowable limits set by the EPA

Prototype Wall Section

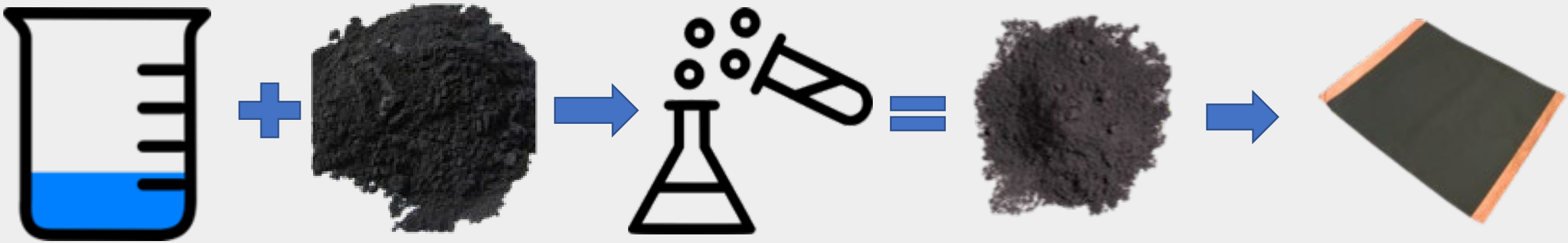
- Prototype wall section that utilizes the various carbon-derived building materials that have been developed.

X-MAT®
Carbon Core Composites



Lithium-Ion Battery Applications

Carbon-Based Ceramic Anode Composites



Proprietary Polymer Derived Ceramic (PDC) Resin

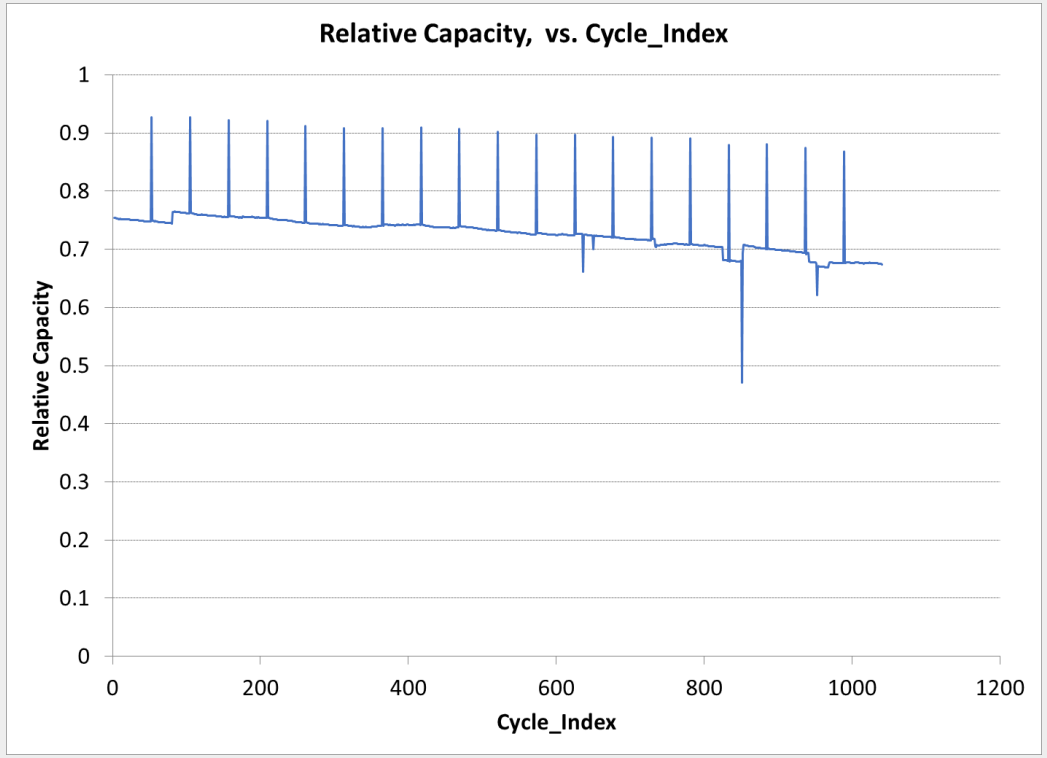
Coal or Coal Waste powder or virtually any carbon source irrespective of purity*

Proprietary synthesis and pyrolysis--less than 1000 C for a short duration

Carbon- based ceramic composite anode material

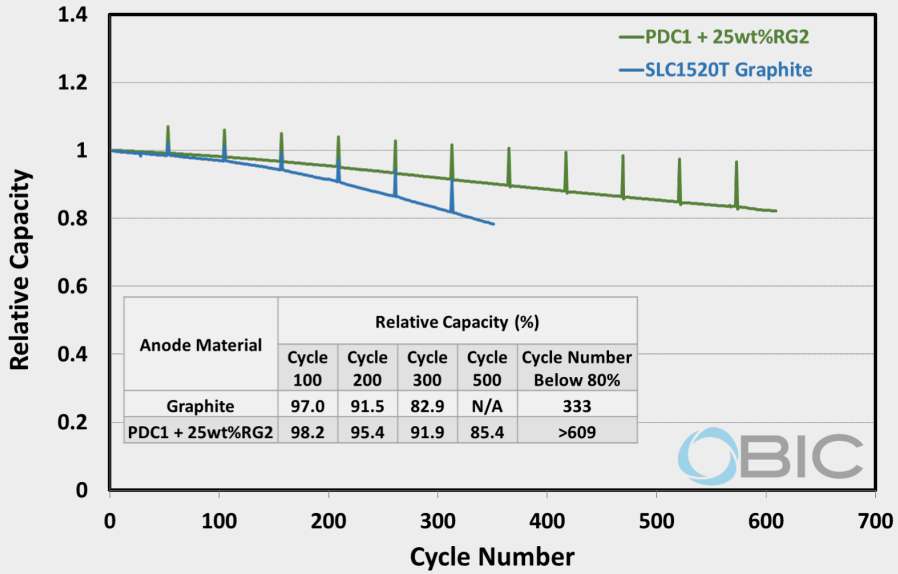
*We have shown this process to work with various sources of coal/coal waste and graphite from recycled batteries. We can tune the PDC Resin to the specific application

Performance of Carbon Composite Anodes



Long-Term Cycling Performance – Coal Anode

This cell has completed it's second profile of 1000 cycles (for a total of 2000 cycles) with minimal decay after the initial drop. It is expected that the decay is at a system level and not due to degradation of the anode.



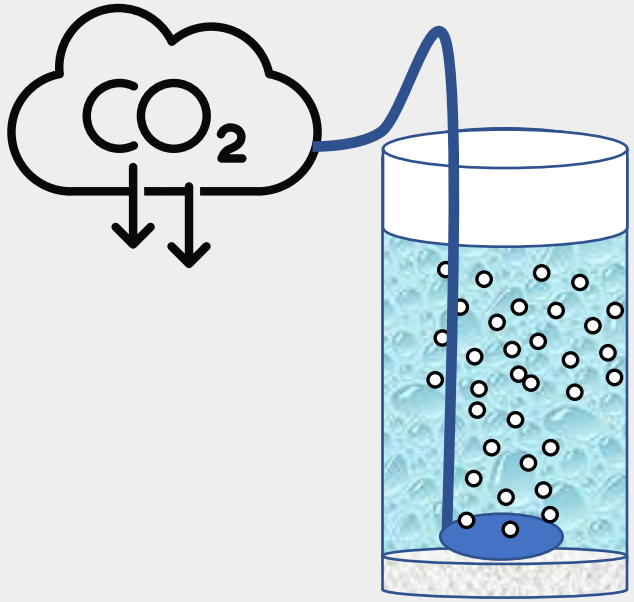
Anode Material	Relative Capacity (%)				
	Cycle 100	Cycle 200	Cycle 300	Cycle 500	Cycle Number Below 80%
Graphite	97.0	91.5	82.9	N/A	333
PDC1 + 25wt%RG2	98.2	95.4	91.9	85.4	>609

Cycling Performance of Pouch Cell containing a Recycled Graphite Composite Anode vs. a Graphite Control

CO2 Based Building Materials

High Level DioQuest™ Process

We bubble CO2 gas through waste water



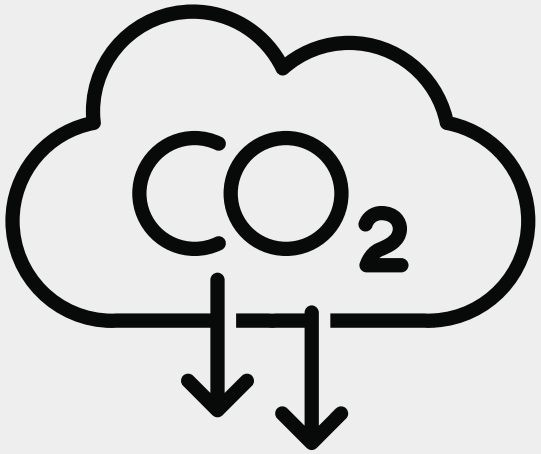
to create mixed carbonates that are dried and mixed with our

customized & proprietary resin system

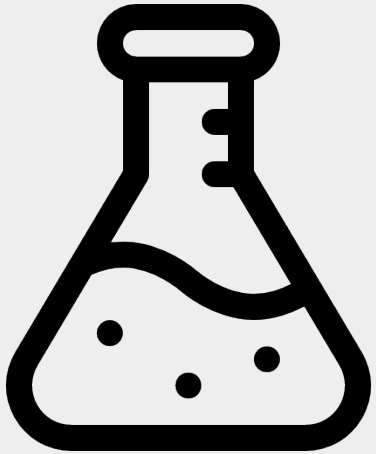
DioQuest

then cured at low temperatures to produce high performance materials.

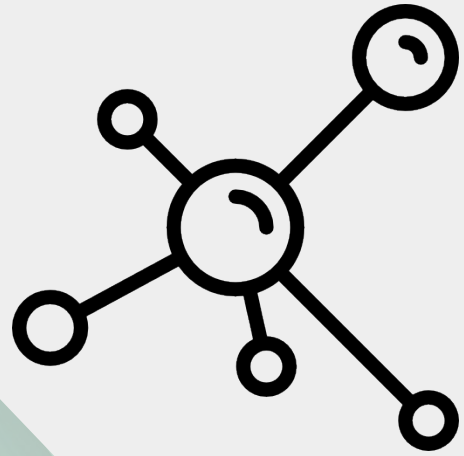
DioQuest™ Benefits



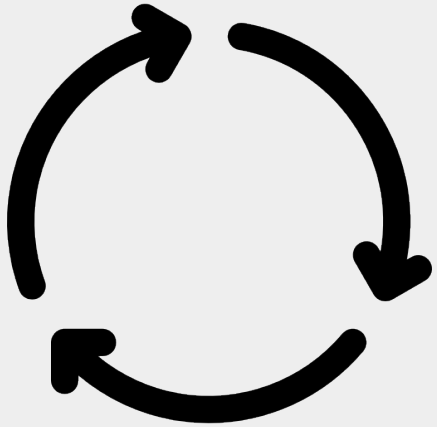
Our process can utilize CO2 gas from many sources whether that's direct air capture, point source emissions, etc. Our prototypes were made using CO2 gas from the tailpipe of a pickup truck. This CO2 is permanently captured.



Our proprietary resin is the backbone of our business and can be optimized at the atomic level for various end-use applications whether in building materials or as low-cost, high-performance fillers for paints or plastics.



Unlike other mineral carbonation efforts, our end product can use whatever mixed carbonates are produced through the process without any further separation or purification, saving time and resources.



This methodology promotes reuse and a circular economy. After the carbonates are removed from the water, additional critical minerals such as lithium can be mined, desalination becomes easier, and the water can be utilized in agricultural applications.

Thank you!

Bill Easter, CEO

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X-MAT® Carbon Core Composites

X-MAT® Reimagining high performance materials

X-BATT®

Semplastics