

The EPA Small Business Innovation Research (SBIR) Program presents:

EPA SBIR Sustainable Materials Technologies Webinar



Wednesday April 13, 2022



Webinar Agenda

- 2:00 Introduction
 - April Richards, EPA SBIR
 - Timonie Hood, EPA R9
- 2:10 Technology presentations (~5 minutes each)
 - 7 small businesses
- 3:00 Q&A

Introduction

EPA Mission:

- Protect human health and the environment

EPA SMM priorities:

- Fulfilling human needs and prospering, while using less materials, reducing toxics and recovering more of the materials used

EPA SBIR:

- Seed technology innovations to meet Agency's mission
- One of 11 federal agencies with SBIR
- Focus is commercialization



EPA SBIR Sustainable Materials Projects

- **Anthony Dente** [Verdant Structural Engineers](#) (Berkeley, CA): Straw structural insulated panel (SIP) alternatives for homes and buildings to improve energy efficiency and have reduced embodied impacts.
- **Marianne Clayton** [IsoTruss Inc.](#) (Provo, UT): Reinforced concrete foundation for telecommunications towers to increase resiliency to natural disasters.
- **CeCe Smith** [Rheaply, Inc.](#) (Chicago, IL): Novel software technology to empower material reuse and embodied carbon reporting in the built environment.
- **Kathleen Draper** [Cinterest LLC](#) (East Rochester, NY): Low embodied carbon wallboard made with biochar.
- **Jacob Kumpon** [KLaw Industries LLC](#) (Binghamton, NY): Process to reuse waste glass for high performance, low carbon concrete.
- **Ella Csuka** [Ecotune, Inc.](#) (Irvine, CA): Fully compostable packaging film made from renewable resources.
- **Alison Rogers** [USEFULL Inc.](#) (Boston, MA): Tech-enabled circular economy solution designed to eliminate single-use food and beverage products.

Disclaimer

- The views expressed in this presentation are those of the speaker(s) and do not necessarily represent the views or policies of the Agency. Any mention of trade names or commercial products does not constitute EPA endorsement or recommendation for use.

Carbon Storing Straw Structural Insulated Panel (S-SIP) for Wide Scale Application

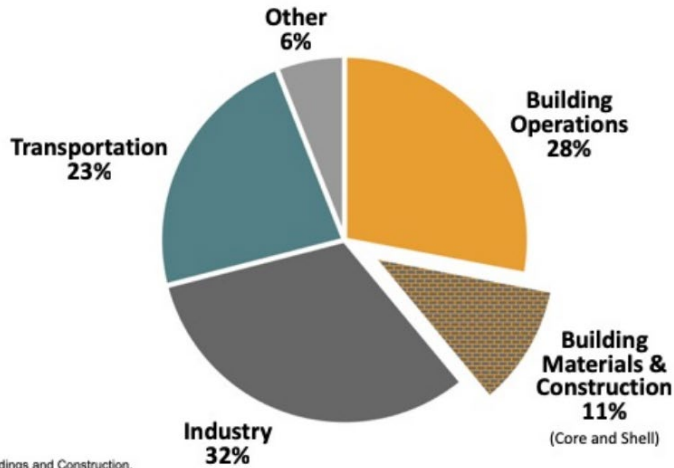


Verdant Structural Engineers

Green Engineering is good engineering.

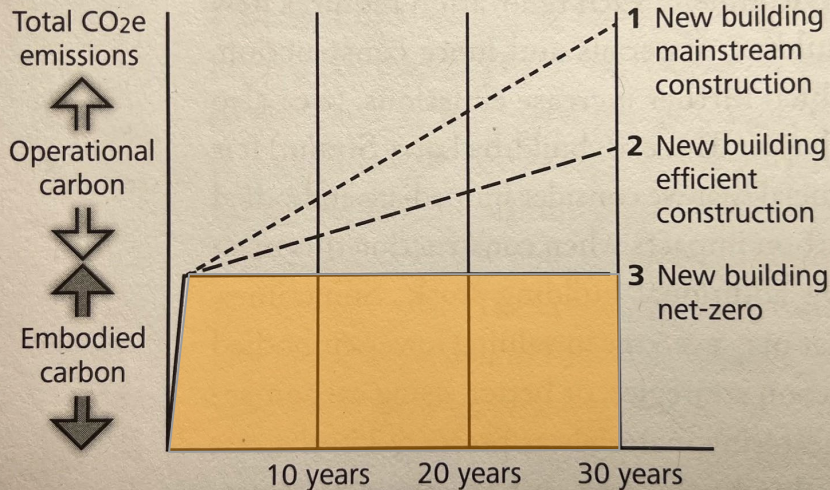
Problem: Building Material Carbon Emissions

Global CO₂ Emissions by Sector



Source: Global Alliance for Buildings and Construction, 2018 GLOBAL STATUS REPORT.

- Embodied carbon:
 - Greenhouse gas emissions associated with materials and construction processes
 - Embodied Carbon will be responsible for almost half of the total new construction emissions between now and 2050.¹



1. Architecture2030. <https://architecture2030.org/new-buildings-embodied/>

Existing Insulations

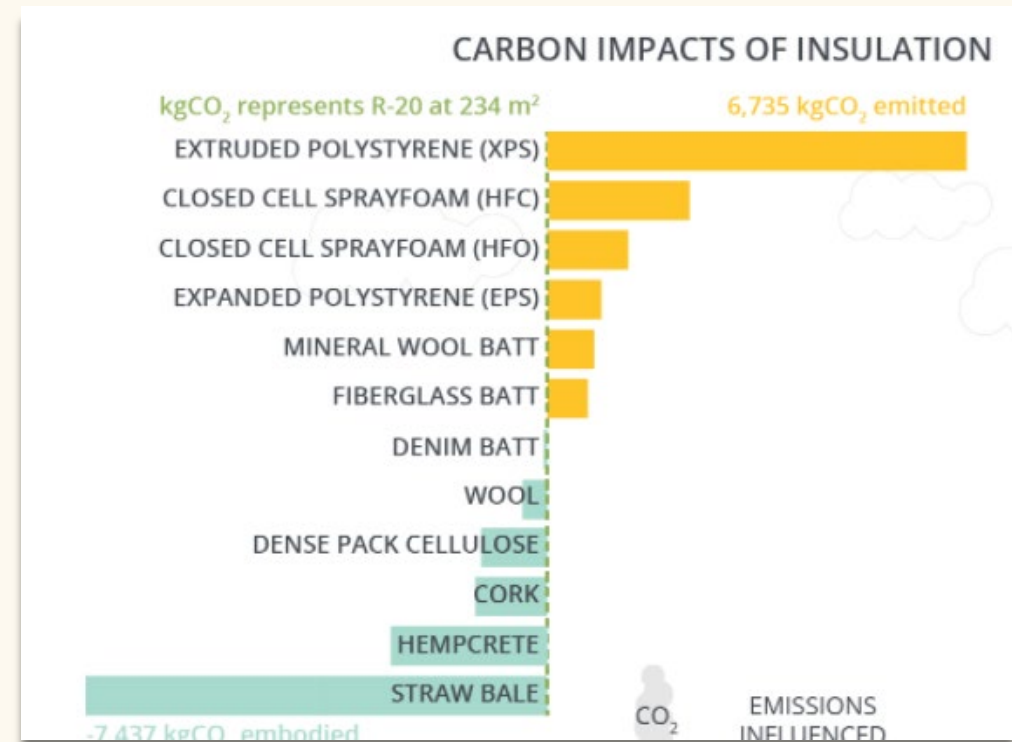
Prefab: Foam SIP's

- High manufacturing energy
- Difficult end-of-life disposal
- Petroleum product
- Carbon impacts from blowing agents
- R-values degrade as blowing agents diffuse
- Extremely flammable when exposed

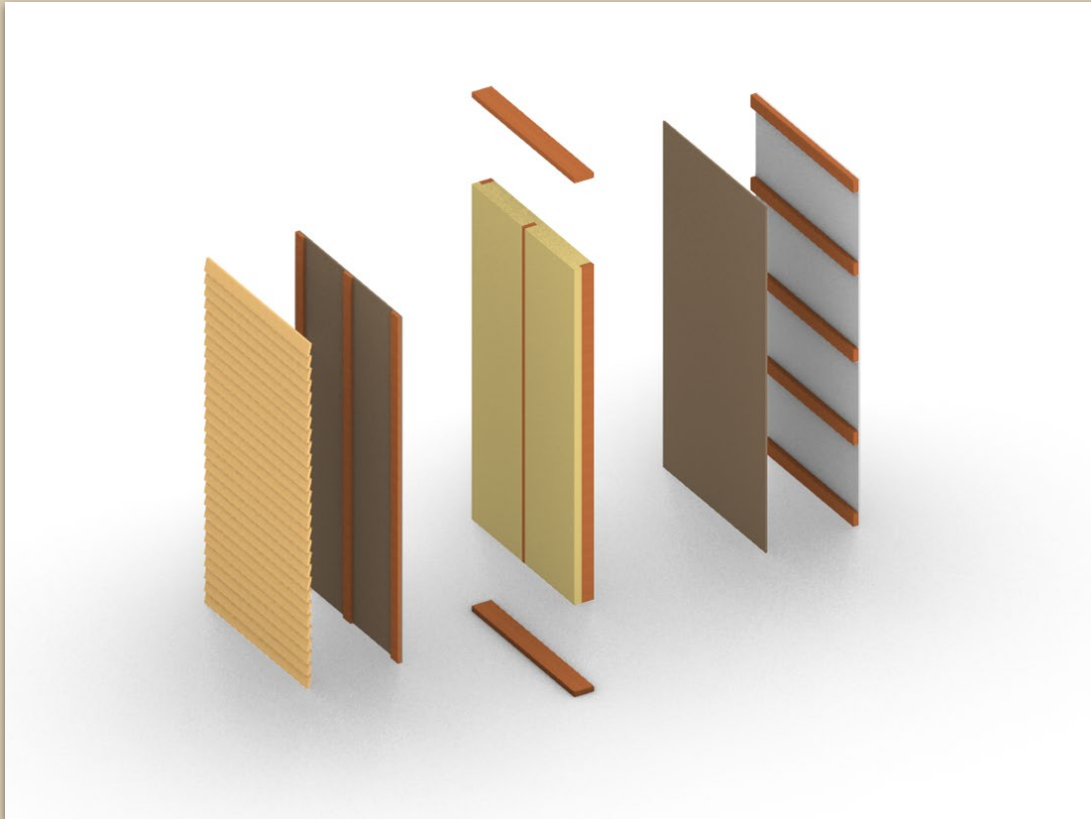


Site Built: Fiberglass & Mineral Wool

- High manufacturing energy
- Protective gear required for installation
- R-Values of Fiberglass decrease in cold
- Difficult end-of-life disposal



The Best Solution: Straw Structural Insulated Panel (S-SIP)



- Modular Panelized Prefabricated Wall Units
- Carbon Storing
- Non-Toxic Materials
- Non off-gassing
- Less manufacturing/on-site waste
- Circular economy: farming + construction
- Biobased: waste stream agricultural product
- Strong Insulator
- Simple = Fast to Market

Thermal and Moisture Performance of Straw

R-VALUE TESTING

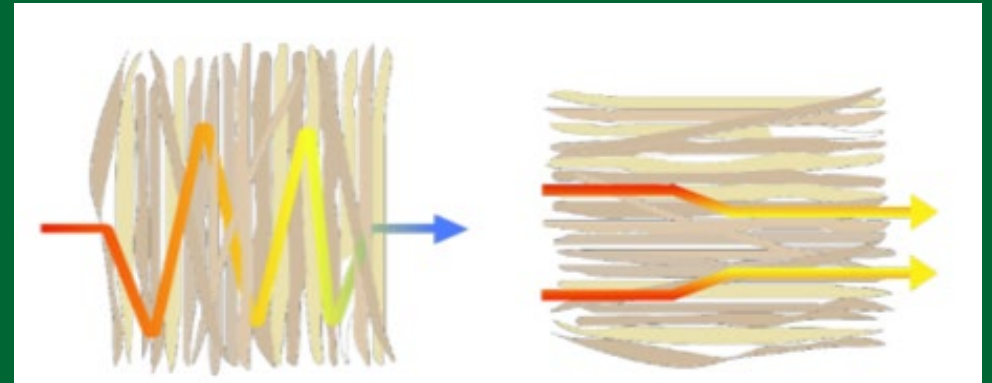
- Intertek Labs in Pennsylvania

STRAW AS AN INSULATIVE MATERIAL

- Straw bales are 90% air voids = good insulator
- Bales achieve R-1.8 per inch
- Existing S-SIP panels achieve R-2.2 to R-2.8 per inch
- Laboratory studies support that, R-3 to R-4 per inch is achievable

Moisture

Straw systems are “vapor open,” meaning moisture is able to move through the wall. A higher perm rating is desirable for breathable systems.

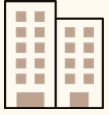


Strands oriented perpendicular to heat flow

Strands oriented parallel to heat flow

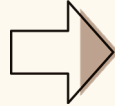
Manufacturing Process

From Farm to Building



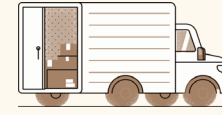
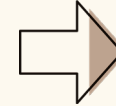
Straw Processing:

- Cleaning
- Chopping
- Collected into bale form



Panel Construction:

- Localized Manufacturing Facility
- Frame assembly
- Addition of Processed Straw
- Sheathing



Shipping:

- Placement of Completed Panels in Shipping configuration
- Panel configuration on truck
- Panel Storage On-Site
- Panel Placement

HUNDEGGER MACHINES



PBA Model:
Efficiently cuts
large panels and
beams

WEINMANN MACHINES



FRAMETEQ: Framing station that can be integrated into a production line
MOVETEQ: Transporting, clamping, aligning, turning, and setting up elements
WALLTEQ: Fastening, formatting and cutting all openings in the element

Structural Design

Model 1 Design

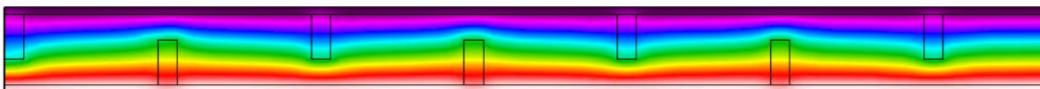
- Plywood shear walls
- Stud bearing system
- Testing happening next week at UC Berkeley Richmond Field Station

Key Design Considerations

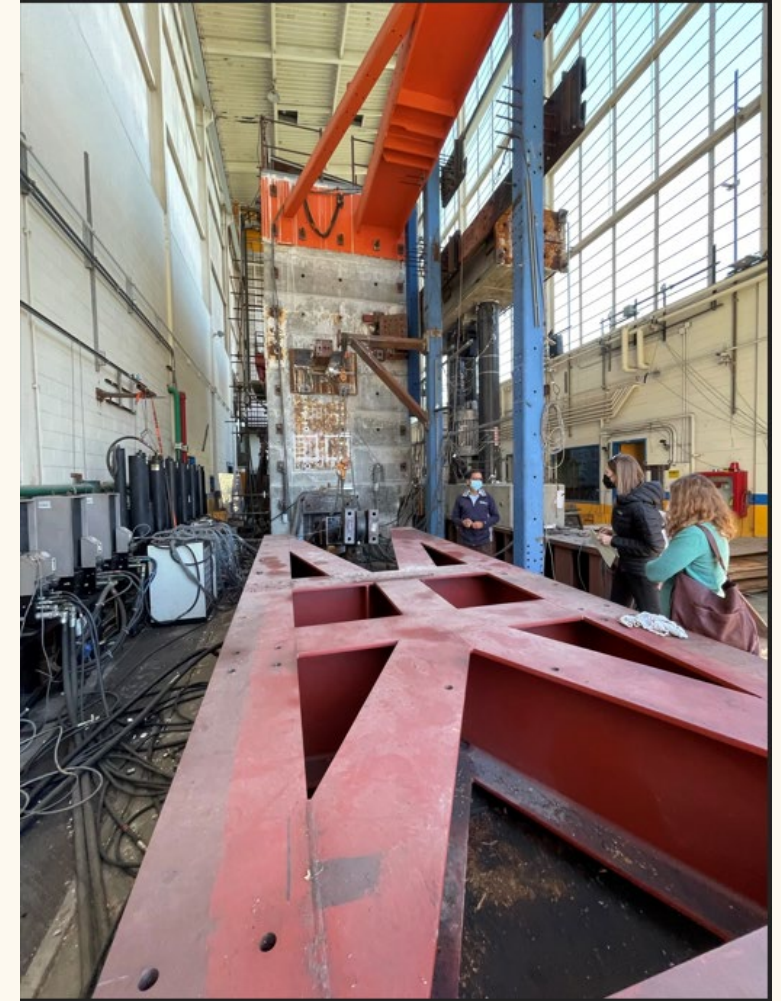
- Thermal bridging
- Buildability
- Blend with conventional framing
- Design software & guidelines

#5

1/2" Douglas fir plywood
(2) 2x4 staggered at 24", softwood w/ Cellulose fill R3.62/inch; 2x6 plates
1/2" gyp board



	U-factor Btu/h-ft ² -F	delta T F	Length inches	Rotation	Total Length
Edge	0.0514	23.0	81.5	N/A	<input type="text"/>



Verdant Structural Engineers

Over 100 Custom Straw Bale Buildings



Anthony Dente

Firm Principal
Project Lead



Massey Burke

Co-Director of CASBA
Natural Materials Specialist



Kevin Donahue

Firm Principal
Straw Bale Code Author



Elli Terwiel

MA of Mngt Innovation and
Entrepreneurship

Verdant Structural Engineers

Prefab Straw Bale



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Elli Terwiel

MA of Mngt Innovation and
Entrepreneurship

Market Potential



Market Size

US Building Construction Industry

\$1,428.5 Billion

Total Addressable Market

US Building Efficiency & Building Envelope Market

\$23.7 Billion

Serviceable Available Market

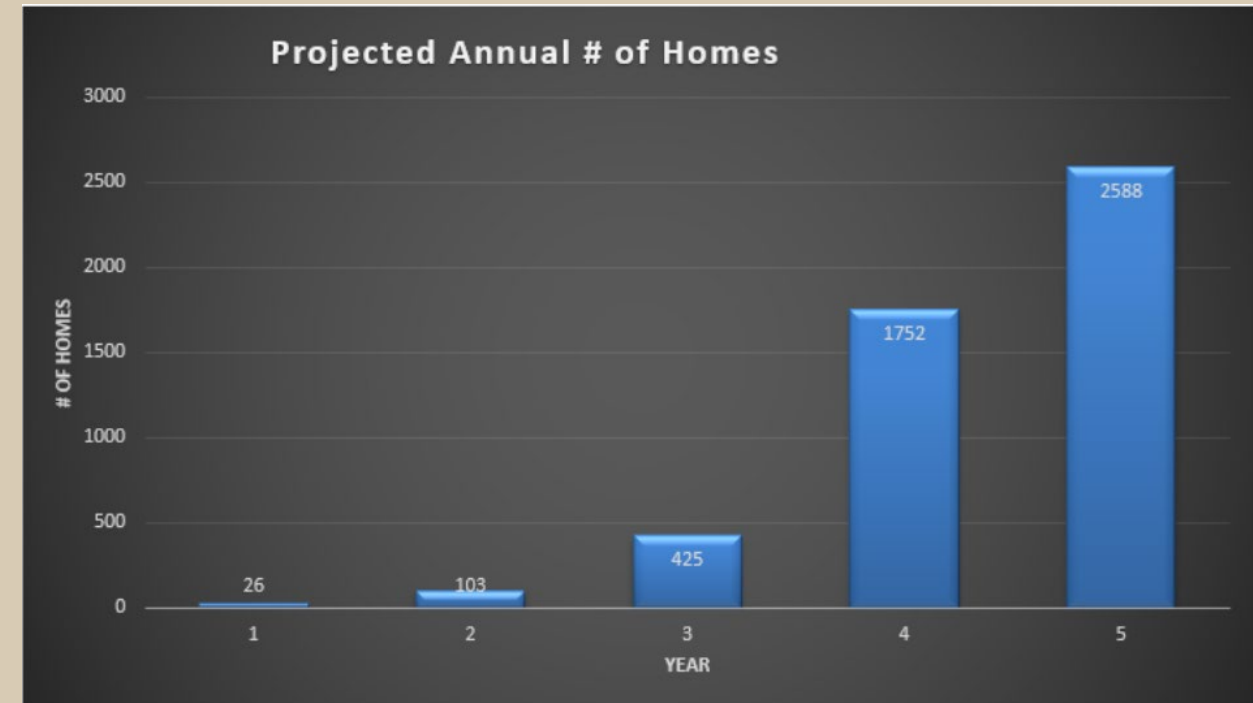
US Foam SIP Market

\$500 Million

Serviceable Obtainable Market

*Acumen Research, 2020

Sales Projections: 5000 homes in first 5 years



REVENUE POTENTIAL

Comparison of different building construction methods on value propositions

Sales Projections: 5000 homes in first 5 years

Material	Cost (\$/sq.ft.)	High Carbon-Storing Potential
Prefab	\$13-\$65	
Stick (Wood) Frame	\$7-\$16	
SIP	\$4-\$18	
Existing S-SIP	\$18-\$40	✓
VSE S-SIP	\$13-\$18	✓
Custom Straw Bale	Varies widely	✓

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Gross Revenue	\$ 748,800	\$ 2,966,400	\$ 12,240,000	\$ 50,457,600	\$ 74,534,400	\$ 140,947,200
Cost of Goods	\$ 331,809.60	\$ 1,283,720.80	\$ 4,518,650.00	\$ 18,135,185.84	\$ 26,452,388.92	\$ 50,721,755.15
Gross Margin	\$ 416,990.40	\$ 1,682,679.20	\$ 7,721,350.00	\$ 32,322,414.16	\$ 48,082,011.08	\$ 90,225,444.85
Operating Expenses						
<i>General & Administrative</i>	\$ 107,766.60	\$ 191,230.40	\$ 347,758.00	\$ 3,091,275.82	\$ 4,388,435.61	\$ 8,126,466.43
<i>Engineering & Development</i>	\$ 629,124.88	\$ 500,864.16	\$ 841,536.00	\$ 1,340,903.89	\$ 1,396,473.94	\$ 4,708,902.88
<i>Marketing & Sales</i>	\$ 485,336.64	\$ 927,531.20	\$ 1,319,928.00	\$ 2,948,686.72	\$ 3,828,007.68	\$ 9,509,490.24
Total Operating Expenses	\$ 1,222,228.12	\$ 1,619,625.76	\$ 2,509,222.00	\$ 7,380,866.43	\$ 9,612,917.23	\$ 22,344,859.54
Operating Margin	\$ (805,237.72)	\$ 63,053.44	\$ 5,212,128.00	\$ 24,941,547.73	\$ 38,469,093.85	\$ 67,880,585.31
Interest Expense	\$ 12,412.09	\$ 33,484.49	\$ 15,615.18	\$ 14,840.54	\$ 7,913.60	\$ 84,265.89
Other Income/Expenses	\$ 4,870.32	\$ 768.46	\$ 8,789.95	\$ 97,028.91	\$ 286,509.46	\$ 397,967.10
Earnings Before Taxes	\$ (812,779.50)	\$ 30,337.42	\$ 5,205,302.77	\$ 25,023,736.11	\$ 38,747,689.72	\$ 68,194,286.51
Income Taxes	\$ -	\$ -	\$ 1,901,830.10	\$ 10,760,206.53	\$ 16,661,506.58	\$ 29,323,543.20
Net Income	\$ (812,779)	\$ 30,337	\$ 3,303,473	\$ 14,263,530	\$ 22,086,183	\$ 38,870,743

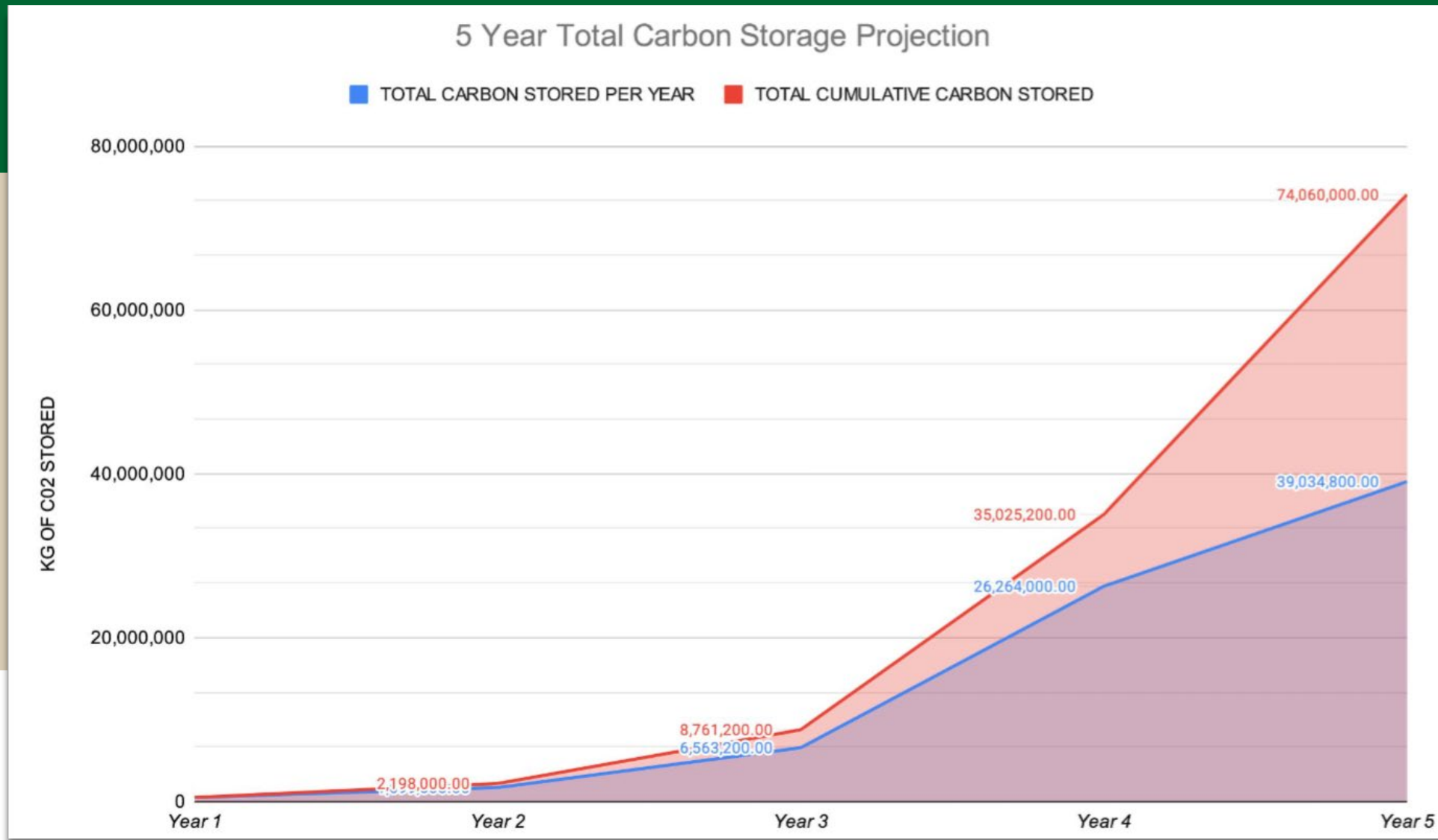
Key Performance Indicators

Total Carbon Stored over 5-Year Span

VSE estimates a 6" thick 4'x8' panel will store 56 kgs of CO₂.

Over the first five years, the S-SIP product could store 74,060,000 kg of CO₂ (81,638 US ton of CO₂)

Equivalent to saving 8,333,521 Gallons of gasoline from being consumed



More straw in buildings = Less carbon in the atmosphere.

Thank you for the opportunity.

verdantstructural.com
admin@[verdantstructural.com](mailto:admin@verdantstructural.com)

 Instagram: @verdantstructural

 Facebook: Verdant Structural Engineers

 LinkedIn: Verdant Structural Engineers

VERDANT
Structural Engineers

References:

King, B. (2018). Figure 1.4. New carbon architecture: Building to cool the climate. Gabriola Island, BC, Canada: New Society.

Deloitte, Mid Year 2020 Engineering Construction Industry Outlook: <http://bit.ly/DeloitteMidYear>

Statista, Revenue of the building efficiency market in the U.S. in 2018, by segment: <http://bit.ly/Statistica2018>

Business Wire, United States Construction Market Forecast to 2024: A \$1.4+ Trillion Opportunity - ResearchAndMarkets.com
<http://bit.ly/BWMarketForecast>

Acumen Research and Consulting, Structural Insulated Panels (SIP) Market Size Worth US \$500 Mn By 2026:
<http://bit.ly/AcumenSIPMarket>

IsoTruss-Reinforced Concrete Foundations for Increased Resiliency to Natural Disasters

EPA SBIR Phase I 2021



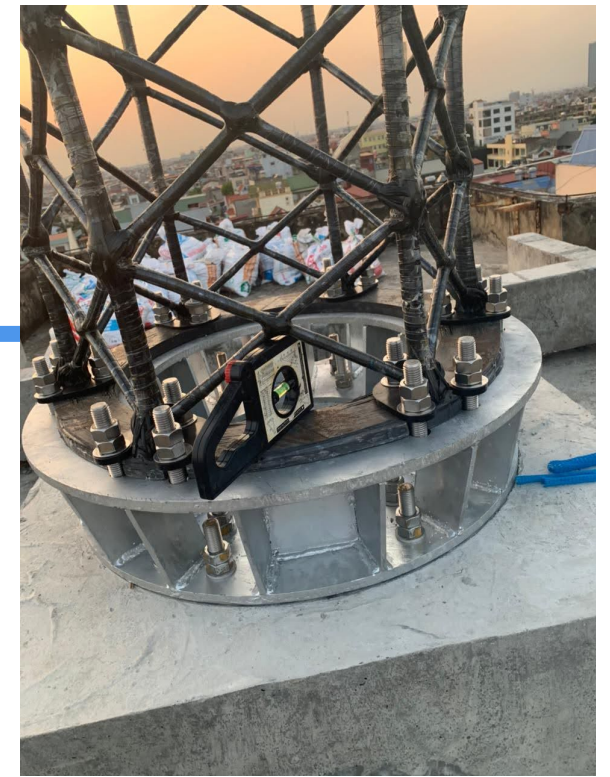
IsoTruss: The Technology

- Optimized lattice design to take full advantage of composite materials
- Excellent mechanical properties with reduced weight / material usage
- No corrosion, rot, rust
- Extended product lifetime
- 70% reduced carbon emissions



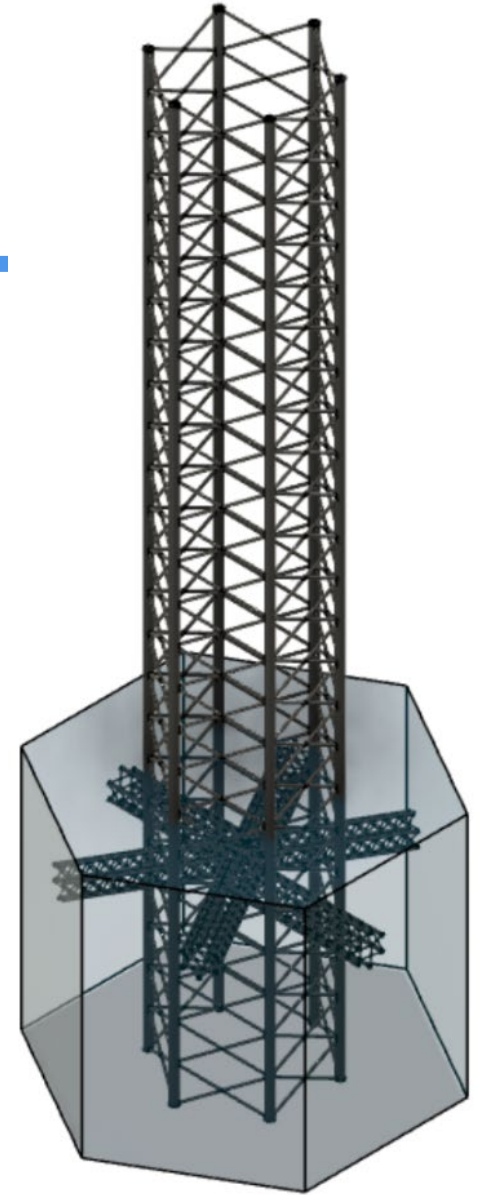
The Problem

- As natural disasters increase in intensity, infrastructure must become more resilient
- Standard foundations are expensive, time-intensive, and use large amount of concrete
- Benefits of composite towers such as easier installation and corrosion resistance are reduced with metal connections



The Innovation

- Resilient to natural disasters
 - Reduced wind load
 - Stiffer for same strength
 - No corrosion/water damage
- Only 2 materials (CFRP and concrete) for simpler debris cleanup
- Faster installation with less equipment

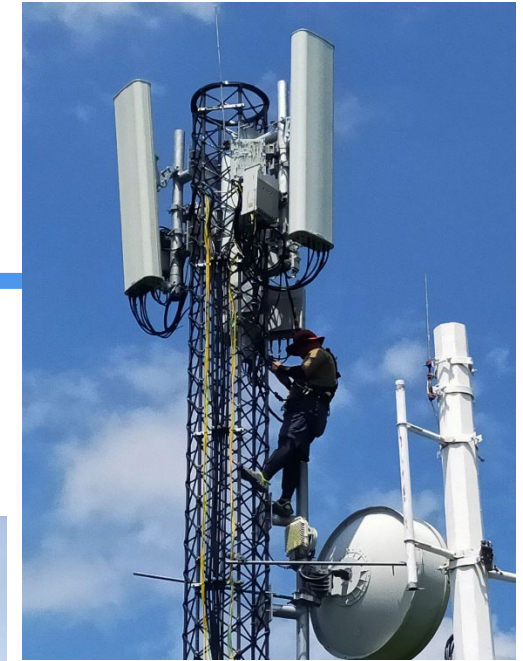


Commercialization

- IsoTruss towers currently in production
 - Customers in US and Philippines
 - Focus on rural and coastal areas
- Foundation design ready for testing validation and beta deployments
- Manufacturing in US (operational) and Philippines (under construction)
- Recently closed Series A funding



South Carolina, USA

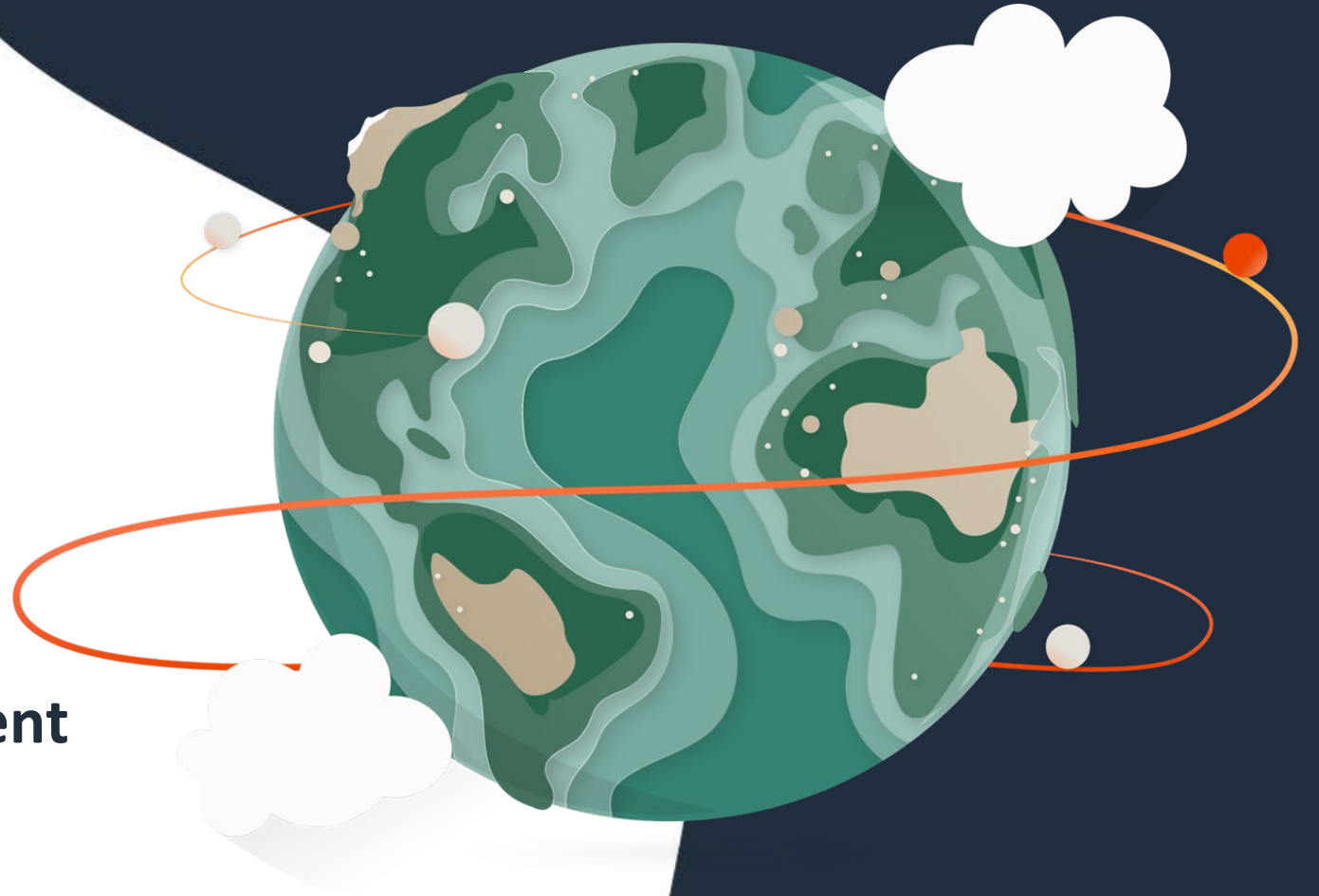


Philippines

Rheaply + EPA Built Environment Embodied Carbon Research

Program Overview

04/13/2022



Rheaply

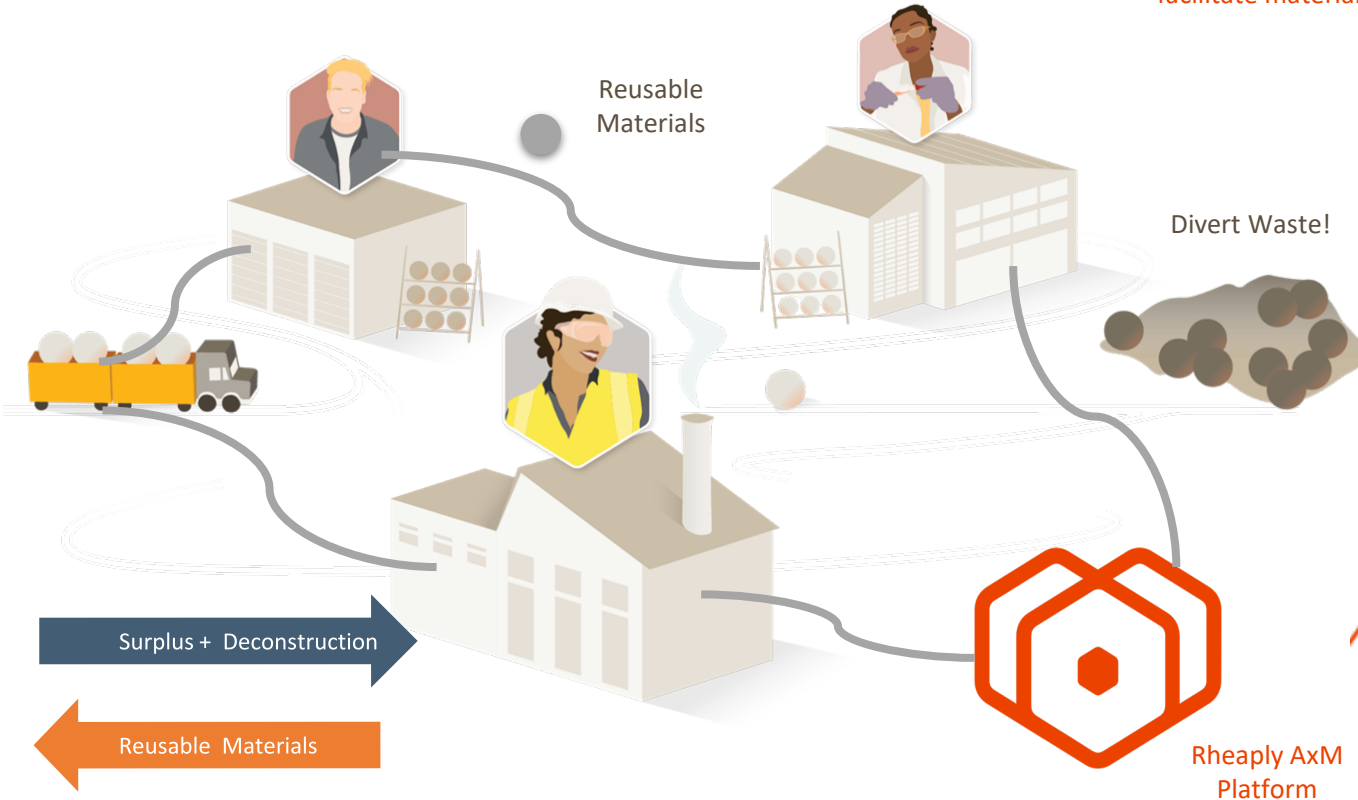
Leveraging Rheaply Technology to Empower Material Reuse and Embodied Carbon Reporting in the Built Environment

40%

of U.S. architecture firms have not used salvaged materials because they did not know where to source them

75%+

would be more inclined to use salvaged materials if there were more resources to facilitate material availability

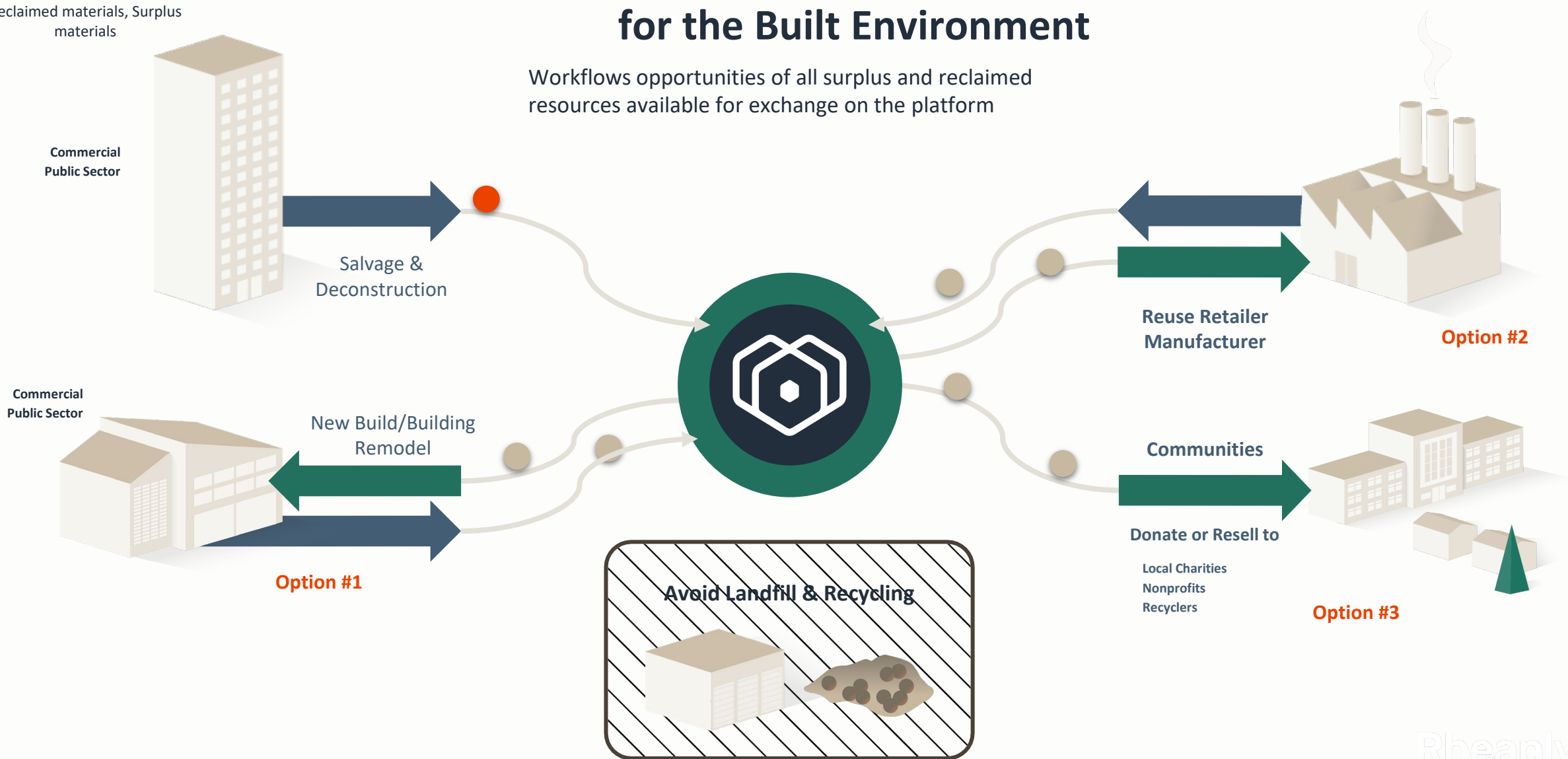


-  Connect Built Environment & Reuse Stakeholders
-  Enable & Empower Suppliers
-  Leverage Data to Facilitate Demand for Reusable Materials
-  Leverage Technology to Derive Embodied Carbon Reporting



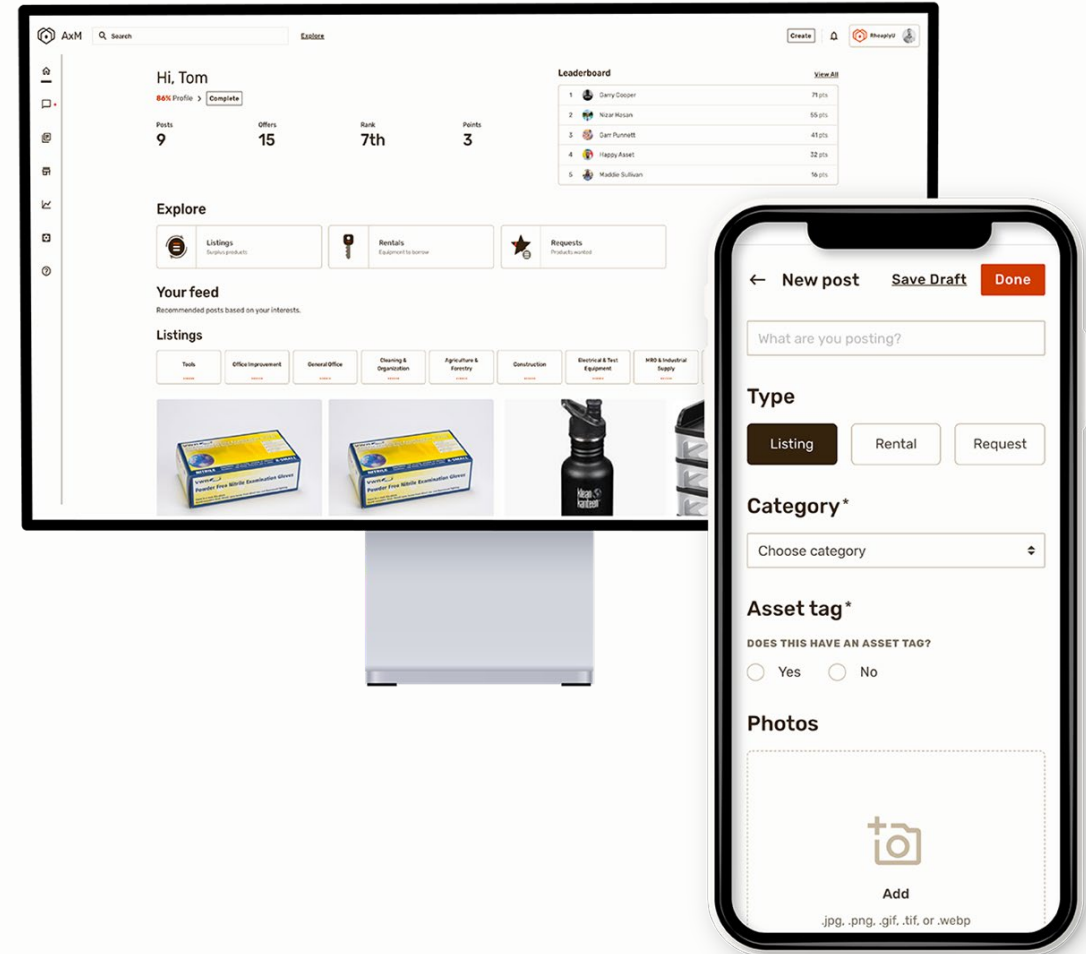
Facilitating Resource Exchange for the Built Environment

Workflows opportunities of all surplus and reclaimed resources available for exchange on the platform



Marketplace Features

- ✓ **Categorize Building Product & Surplus Inventory**
 - ↳ Receivers are notified based on their interests
- ✓ **Collect Product Stories & Data**
 - ↳ Obtain the data Receivers need from Suppliers:
 - ↳ Product Manufacturing & Design Specifications
 - ↳ Product History Story
- ✓ **Generate Reports**
 - ↳ Estimated cost savings through salvage workflows
 - ↳ Value diverted from landfill (in lbs)
 - ↳ Supply and Demand by Product Category
 - ↳ Embodied Carbon Reduction (coming soon!)



Themes we're exploring



Quantifying Embodied Carbon Avoidance

- choosing a reclaimed material vs a new equivalent material
- choosing a reclaimed material vs a recycled-content material



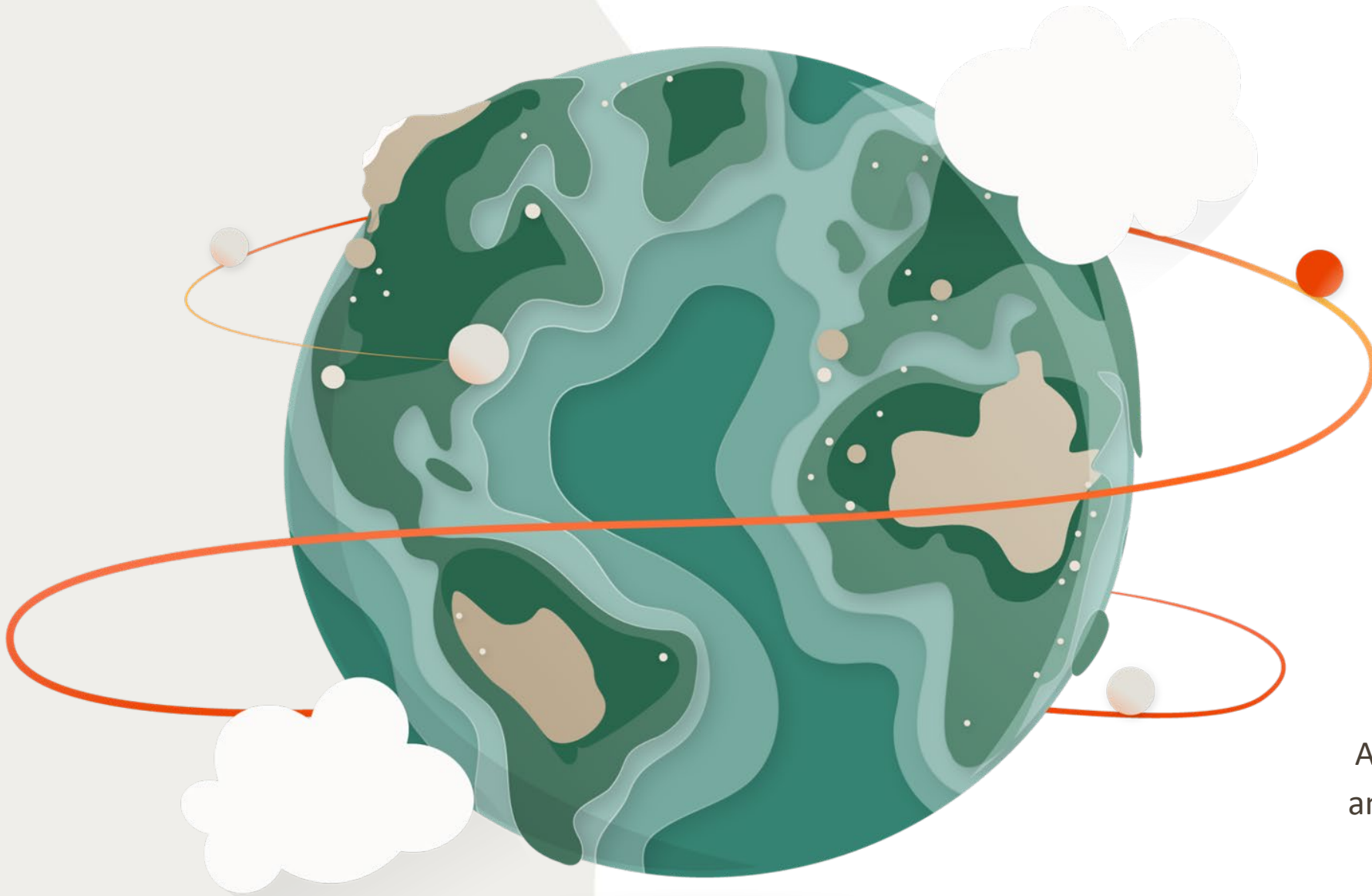
Monitoring Data Quality

Is key reclaimed material data available? How might we collect input data reliably and consistently?



The Role of Technology

What's the role of BIM and adjacent technologies in empowering data collection and data sharing?

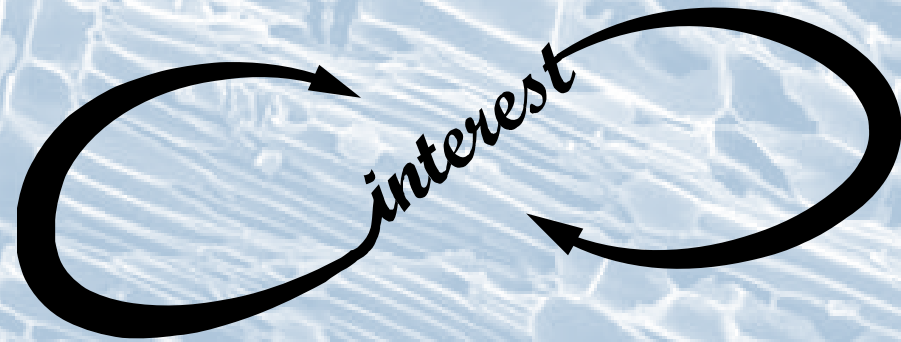


Thank you!

A circular world is in reach,
and we are going to build it.

Cinterest LLC

*Carbon negative
materials for
sustainable
manufacturing*



Advancing climate positive products

Cinterest aims to displace fossil derived and mined materials with products having *net-zero or negative* embodied carbon



How do we do this?

With a little something called

BIOCHAR!

biomass



+

High T
Low O₂



biochar

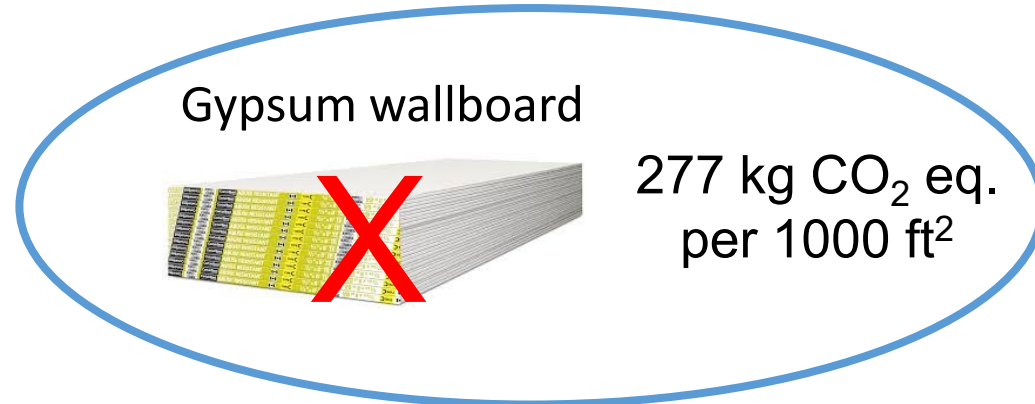


- One of a handful of carbon removal technologies recognized by the Intergovernmental Panel on Climate Change
- Safe, scalable and shovel-ready!

Initial carbon-negative products

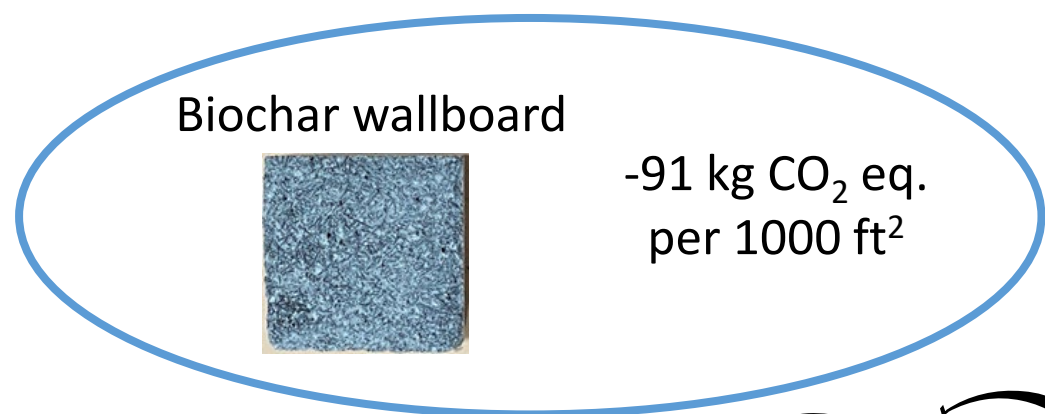
Wall board

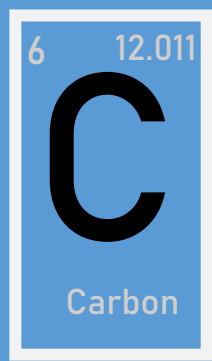
- \$37.8 billion actual global sales in 2020
- \$89.59 billion projected global sales by 2028
- CAGR 11.5%



Thermal packaging

- \$14.2 billion actual global sales in 2020
- \$19.7 billion projected global sales by 2028
- CAGR 5.7%





interest

*Questions, comments,
Or collaboration
opportunities:*

*Kathleen Draper
Cinterest CEO*

biocharro2@gmail.com

Mother Nature has a bank account, and the currency is carbon.

Living off the principal (fossil fuels) is no longer sustainable.

Living off the interest (biomass carbon) is not only good for the planet, it's good for your bottom line.

That's what we call cinteresting!





KLAW **Industries**

Build a Better Planet with Recycled Materials

The Life of a Glass Bottle



Status of Technology



RECYCLING

KLAW is paid to take
recycled glass

Benefits

- Low Cost
- The glass is recycled



OUR PROCESS

Through our patent-
pending process, we create
Pantheon™



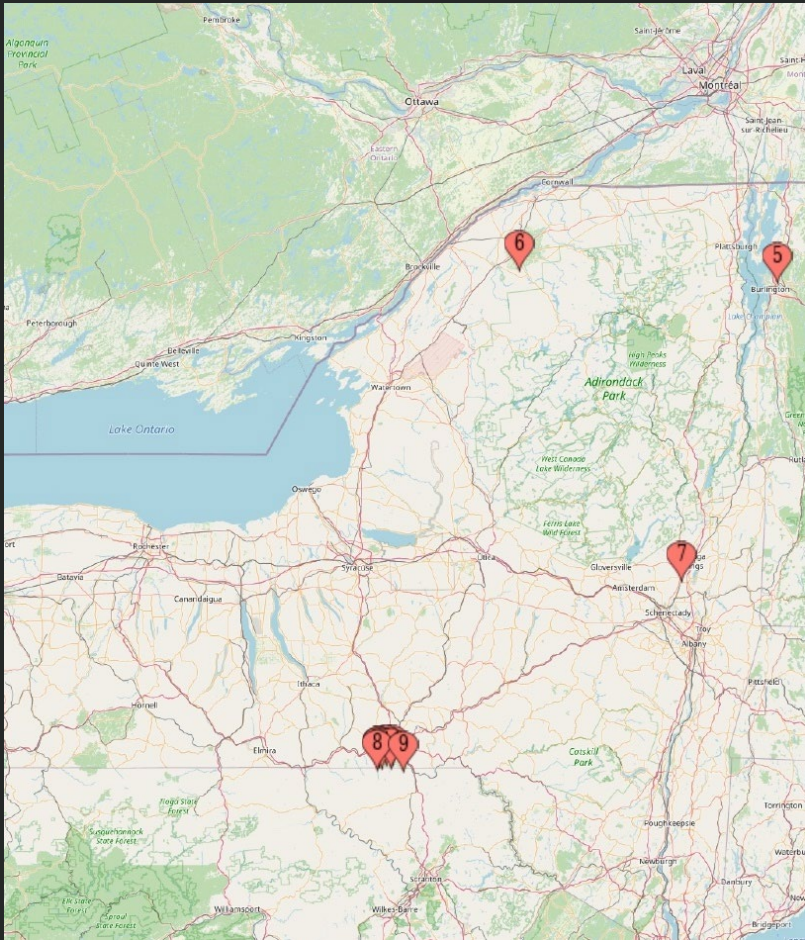
PANTHEON™

Pantheon™ is a partial
replacement for cement

Benefits

- Low Cost
- Environmentally Sustainable
- Stronger

Environmental Impact



Impact to Date
-3,276 kg CO₂e



US Impact
-8.1M Ton CO₂e per year



Global Impact
-10.8B Ton CO₂e by 2050

Why does the concrete industry care?

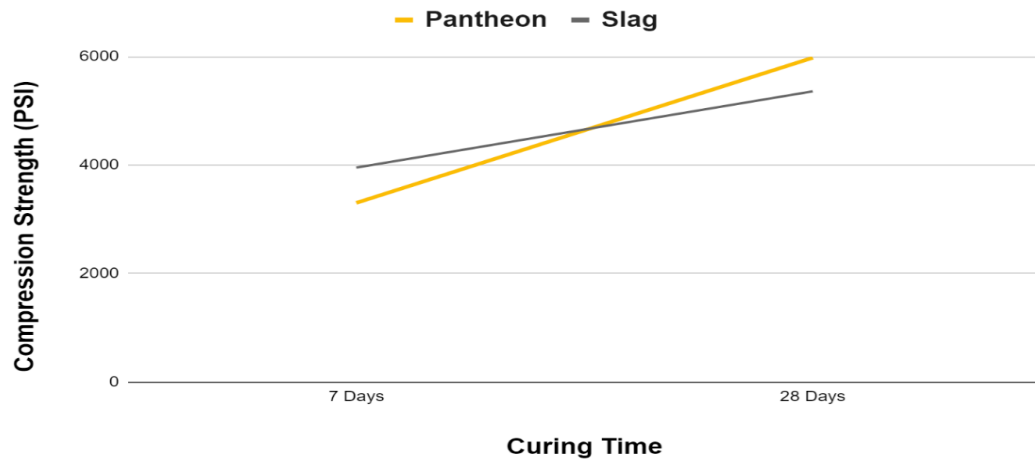
- Fly ash and slag are going away
- Shortages and price increases of 16%



Value Proposition

Curing Time (days)	Slag Strength (PSI)	Pantheon™ Strength (PSI)
7	3953	3303
28	5360	5980

Pantheon vs. Slag



Pilot Project for SBIR Phase I – Barney & Dickenson



Results and CO₂ Impact

-672 kg CO₂

ASTM C31 and C39



Quote from Tim Ruffo

“Utilizing glass as a cement replacement is the cutting edge in the concrete industry and the cost and performance benefits we get, are unmatched as we transition our industries' carbon regulation.”



Current State



Next Steps

- Secure a Letter of Intent
- Complete pilot plant in Binghamton
- 2000 tons per year





KLAW **Industries**

jacob@klawindustries.com




ecotune™


Fully Compostable Packaging Film
From Microfibrillated Cellulose

EPA SBIR Phase I 2022

9 billion tons of plastic on Earth

A silhouette of an industrial skyline with several smokestacks emitting thick plumes of white smoke against a bright, hazy sunset sky.

9% recycled, 12% incinerated, 79% in landfills & environment

A vast, sprawling pile of discarded plastic waste, including bottles, containers, and other debris, stretching across a flat landscape under a bright sky.

12.7 million tons of plastic enters oceans each year

An underwater view of the ocean surface showing significant plastic pollution, with large pieces of clear and blue plastic bags and debris floating in the water.



Fossil-based

PE PVC
PET PS
PA PP
PC

PBAT PEA
PBS PES
PCL PBSA
PVOH

Non-
biodegradable

Biodegradable

Bio-PE
Bio-PET
Bio-PA
Bio-PC

Cellulose-based
Starch-based
PHA
PLA

Bio-based



Cellulose



Microfibrillated Cellulose

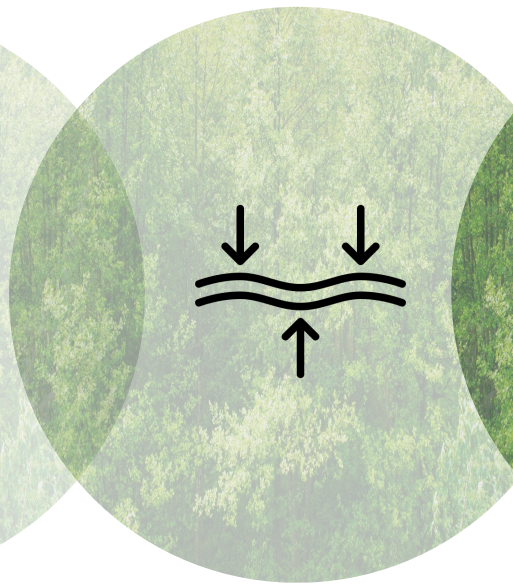
- 100 billion tons of cellulose are produced by plants every year
- The most abundant organic compound on Earth

- Nano-scale cellulose fibrils produced from cellulose pulp
- 100% renewable
- High-performance thin films

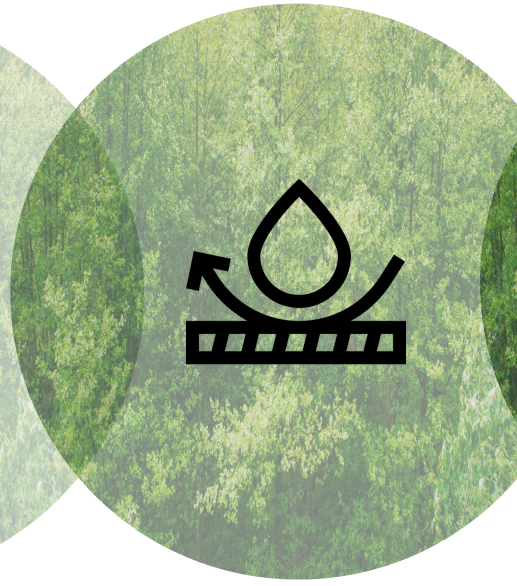
Developing Advances in Microfibrillated Cellulose Films



Strong



Flexible



Barrier



Transparent



Sustainable

Why compostable?

- Compostable fiber-based packaging creates fiber-rich, nutrient-filled compost
- Enriches agricultural soil
- Reduces need for chemical fertilizers
- Diverts organic matter away from landfills

Compostable packaging helps to divert food waste

From the landfill



To the compost bin



SBIR Phase I:

- Laboratory-scale feasibility and R&D for proof-of-concept

UCI Beall
Applied Innovation

UC IRVINE MATERIALS
RESEARCH INSTITUTE

UCI Research
Park

Next:

- Continued R&D to improve manufacturing efficiency
- Pilot-scale testing to accelerate commercialization
- Initial life cycle analysis to evaluate environmental impact





ecotune™

Ella Csuka

Founder, CEO

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Ecotune, Inc.

Irvine, CA

USEFUL



Alison Rogers

Founder + CEO

410-991-7651

Alison@usefull.us

www.USEFULL.us

"We enable
organizations and
communities to make
zero waste a reality."



Organizations are under pressure to go zero waste.

Organizations that have tried compostables and plastic reusables are now switching to **USEFULL**.



USEFULL is fulfilling demand in the market

USEFUL

MOUNT HOLYOKE
Carleton

COLLEGES



CLOSED LOOP
COMMUNITIES
(e.g. Block Island, Bar Harbor)

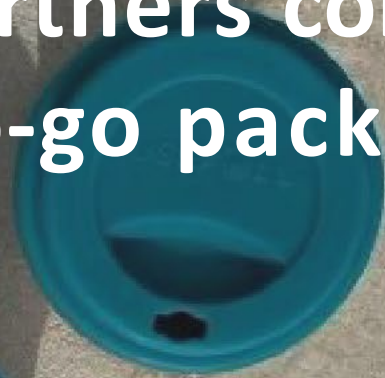


CORPORATES



All or nothing.

To be successful, our partners commit to USEFULL
being the default to-go packaging option

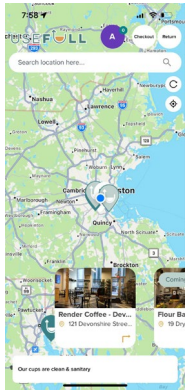


A hand in a grey sweater reaches for a book on a shelf. The entire image is overlaid with a teal tint. The text 'USEFULL has created a library-like solution for returnable cups and containers' is centered over the image.

USEFULL has created a library-like solution for returnable cups and containers

The process is managed through the app

simple, fast, and efficient



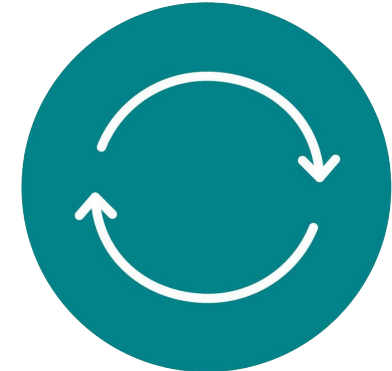
Step 1
**DOWNLOAD THE
APP & CREATE AN
ACCOUNT**



Step 2
ORDER



Step 3
**CHECKOUT &
ENJOY!**

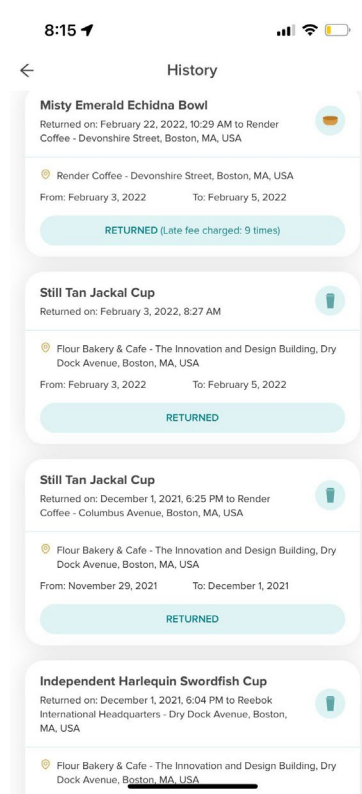
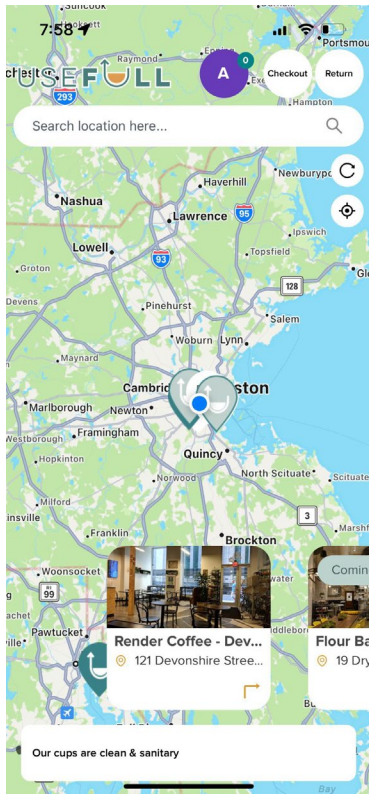


Step 4
**RETURN
ANYWHERE IN
NETWORK**

Each cup and container has a unique QR code and name. Inventory is checked out to a user via the app. Returns are also tracked via the app.



We're not just selling proprietary cups & containers, we are selling a **tech solution**



We provide an inventory and account management solution that quantifies impact in real time via TV, website, and app displays

- Tons of waste prevented
- Tons of CO2 emissions prevented
- Tons of plastic avoided



USEFULL

CLEAN AND SUSTAINABLE TO GO

Annual
Report 2023

473,616

cups checked out



473,616

bowls checked out



114 tons of CO2 mitigated
by switching to USEFULL



36.5 tons of waste mitigated
by switching to USEFULL

MOUNT HOLYOKE



Join Usefull
[USEFULL.US](https://usefull.us)




Download it from
APP STORE



Download it from
GOOGLE PLAY



A photograph of a spotted seal resting on a large, light-colored rock in an aquarium enclosure. The seal is facing right, with its head slightly turned towards the camera. Its fur is a mix of light brown and tan with numerous dark brown spots. The background shows a pool of water and more rocks.

USEFULL helps Mt Holyoke prevent 36.5 tons of waste annually

That's equivalent to the weight of **102 seals!**

We supply technology and inventory for clients to implement



USEFULL's own 16oz cup and 40oz bowl. Vacuum insulated, stackable, washable, durable. Patent pending.

Each piece of inventory has a unique QR code to track usage



"Stainless steel is the preferred choice... It can be used many more times than reusable plastic and is better for the environment and people all around."

Life Cycle Assessment (LCA) commissioned by
UPSTREAM Solutions. Assumes that
manufacturing takes place in China (pg. 6)

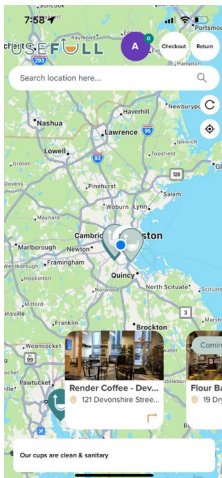


Three key competitive advantages over other return-based companies

1. CONVENIENCE

Easy checkout via our app. Other programs require a 1 for 1 swap, cash deposit, or give a token when inventory is returned.

USEFULL vs. No-Tech



2. ACCOUNTABILITY

Late and lost fees are charged if users don't return within the rental window. No incentive to get inventory back into circulation has resulted in tremendous loss rates for other programs.



3. DESIGNED FOR REUSE

Inventory is premium stainless steel; people don't mistake stainless for trash.

USEFULL vs. Plastic





More than just tech & containers

Organizations are marketing
their sustainability
commitment and saving
money on packaging



Alison Rogers

Founder + CEO

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www.USEFULL.us



Download app!



EPA SBIR Sustainable Materials Projects

- **Anthony Dente** [Verdant Structural Engineers](#) (Berkeley, CA): Straw structural insulated panel (SIP) alternatives for homes and buildings to improve energy efficiency and have reduced embodied impacts.
- **Marianne Clayton** [IsoTruss Inc.](#) (Provo, UT): Reinforced concrete foundation for telecommunications towers to increase resiliency to natural disasters.
- **CeCe Smith** [Rheaply, Inc.](#) (Chicago, IL): Novel software technology to empower material reuse and embodied carbon reporting in the built environment.
- **Kathleen Draper** [Cinterest LLC](#) (East Rochester, NY): Low embodied carbon wallboard made with biochar.
- **Jacob Kumpon** [KLAW Industries LLC](#) (Binghamton, NY): Process to reuse waste glass for high performance, low carbon concrete.
- **Ella Csuka** [Ecotune, Inc.](#) (Irvine, CA): Fully compostable packaging film made from renewable resources.
- **Alison Rogers** [USEFULL Inc.](#) (Boston, MA): Tech-enabled circular economy solution designed to eliminate single-use food and beverage products.

Coming soon

- **Annual EPA SBIR Solicitation**
 - Scheduled to open in June 2022
 - Plan to include SMM topics
 - Informational webinar prior to opening
 - Sign up here for to receive announcements:
www.epa.gov/sbir/sbir-listserv



For More Information

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Listserv: <https://www.epa.gov/sbir/sbir-listserv>

SBA SBIR website: www.SBIR.gov

Sustainable Materials Management @ EPA:

<https://www.epa.gov/smm>