

Insulated Siding for Residential Retrofits



IBACOS

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FY 2022 SBIR/STTR Phase I Release 2 Award #DE-SC0022616

Project Summary - This Is A SBIR Phase I Project

Objective and outcome

Create an integrated siding product that provides a min. R-5 insulation with a rainscreen.

InsulClad was developed in Phase I and integrates three distinct functions into one product to provide R-6.5 continuous exterior insulation, rainscreen drainage, and a finished outer cladding.

Team and Partners

Phase I development has been accomplished with internal IBACOS personnel.

IBACOS has received commitments of support for SBIR Phase II development from product manufacturers, affordable housing providers, trades, and builders.



Stats

Performance Period: 6/27/22 - 6/26/23

DOE budget: \$200k, Cost Share: N/A

Milestone 1: Functioning prototype created

Milestone 2: Installation and durability testing completed

Milestone 3: Value proposition defined, and manufacturer engaged

Problem

Prior to 1979, 63.84 million homes were constructed prior with minimal or no insulation in the exterior walls.¹ The energy burden on residents caused by these pre-code building practices affect lower income and disadvantaged communities the most.

- Strategies for exterior wall retrofits available today are either too costly or can be invasive to the resident and destructive to the home environment.
- In most of these wall retrofits, continuous insulation is not included or even offered to residents, nor is any type of rainscreen offered to provide better bulk water drainage.
- More cost-effective, higher performing exterior wall retrofits are need to reduce the energy burden to lower income residents and disadvantaged communities.

¹ RESIDENTIAL ENERGY CONSUMPTION SURVEY (RECS), Table HC9.3. <https://www.eia.gov/consumption/residential/data/2020/#house>

Alignment and Impact

IBACOS Measures of Success for Phase I Work:

- Completed working prototype with material and labor costs compared to multi-layered approach
 - Material costs are neutral
 - Labor savings >30%
- Initial concept is validated by siding installers
- Secured initial interest from potential demonstration and commercialization partners

Alignment with EERE/BTO goals:

- Contribute to the nation's climate mitigation goals while prioritizing equity, affordability, and resilience in the form of improved energy efficiency and associated financial savings for homeowners.

When commercialized, InsulClad will provide residents with an affordable, durable exterior finish that improves the comfort and efficiency of the home, is less disruptive and requires less labor to install.

Ultimately, commercial success will be defined when InsulClad has been readily adopted by the retrofit industry and is being installed on homes across all socio-economic boundaries.

Approach

CURRENT MARKET SOLUTIONS

Insulated vinyl siding is the only available option to provide an integrated product.

- R-value varies due to rear profile of the vinyl siding.
- At best, achieves R-2 to R-3 with EPS foam.
- Does not provide any integrated drainage for water.

Another approach is to apply rigid foam sheets, mineral wool, or wood fiber panels to the wall followed by a woven mesh or furring to provide a rainscreen behind the siding.

- Effective approach, but costly due to the 3 individual materials and labor events (insulation, rainscreen, siding).

Furred out frame and spray foam approach.

- Very effective but requires extensive detailing at windows and doors.
- Material costs are very high.
- Very labor intensive.



Image courtesy of IBACOS

Approach

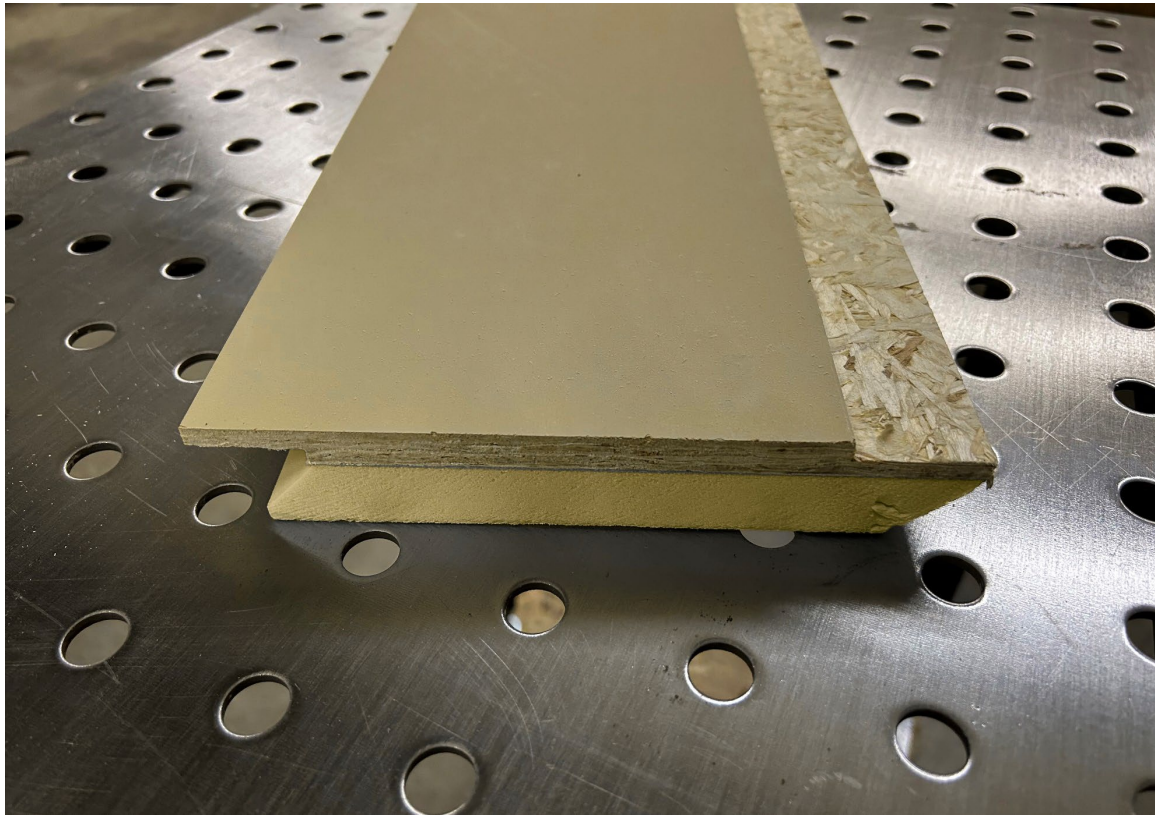
INSULCLAD SOLUTION

InsulClad provides a 3-in-1 product offering that provides insulation, rainscreen drainage, and the finished siding in one product.

- Current product achieves R-6.5 value with 1” polyisocyanurate insulation. Future designs could increase the R-value by increasing the insulation thickness.
- Integral rainscreen channels within the foam insulation.
- Durable engineered wood siding with shiplap design provides an aesthetic nickel gap reveal between courses.
- 2 trim options are in development: 1. pre-manufactured metal trims. 2. matching engineered wood trim with integrated insulation.
- Insulation cut with a “French cleat” (opposing angles) along horizontal edges provide a positive seal and easy alignment during installation.
- Faster and less labor to install due to the stacking and nesting of the planks to one another.

Approach

Profile of shiplap siding & insulation



Images courtesy of IBACOS

Top edge profile



Approach

Bottom edge profile



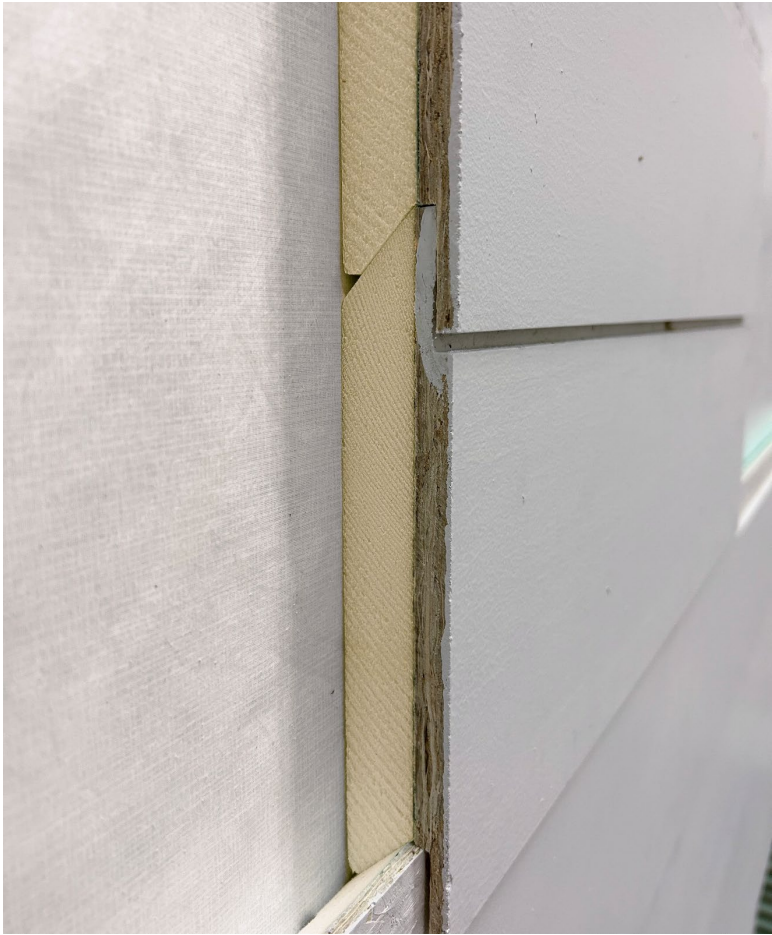
Images courtesy of IBACOS

Rainscreen drainage grooves



Approach

Stacked planks with drain channel



Images courtesy of IBACOS

Finished mockup with metal trim



Approach

Potential Risks:

- A manufacturing partner is not fully engaged with licensing and producing the product technology.
- Rising costs of materials making it less competitive than conventional methods.
- Durability testing shows issues with vapor and moisture transmission between materials.

To alleviate these risks, we are actively working with partner companies that have innovation and new product research and development as a core competency.

In SBIR Phase II and subsequent commercialization activities, IBACOS will complete the needed performance testing to validate durability of finished product.

Approach

Market Engagement:

IBACOS intends to secure a licensing agreement with a manufacturing partner to produce, distribute, and sell InsulClad to the market.

To fully engage all partners and stakeholders IBACOS will complete the following:

- Further refine the commercial product costing models in partnership with a manufacturer to validate and demonstrate the value proposition and economic story.
- Complete Demonstration Homes
 - Validate installation times and acquire direct feedback from the installing trades
 - Verify thermal performance with testing and monitoring
 - Identify needed durability testing prior to commercialization
 - Refine product value proposition through stakeholder feedback

Progress and Future Work

Energy Performance

BEopt™ modeling was completed to assess the benefit of adding R-6.5 continuous insulation to the exterior walls of identical house plans with various pre-retrofit insulation levels in Minneapolis (MIN), Phoenix (PHX), and Pittsburgh (PIT).

The following tables show the % improvement and associated bill savings:

	Heating and Cooling Energy Savings vs Base Case Walls (% kWh)		
	R-13 Insulated Wall + R-6.5 Insulated Cladding	R-11 Insulated Wall + R-6.5 Insulated Cladding	Un-insulated wall + R-6.5 Insulated Cladding
MIN	17.13%	17.73%	32.19%
PHX	11.46%	12.15%	28.56%
PIT	18.67%	19.25%	34.75%

	Potential Monetary Savings vs Base Case Walls (\$/year)		
	R-13 Insulated Wall + R-6.5 Insulated Cladding	R-11 Insulated Wall + R-6.5 Insulated Cladding	Un-insulated wall + R-6.5 Insulated Cladding
MIN	\$288.86	\$304.43	\$759.54
PHX	\$151.77	\$163.12	\$514.39
PIT	470.58	\$495.19	\$1,277.74

Progress and Future Work

Current Development and Commercialization Activities (SBIR Phase I)

InsulClad has met the goal of a working proof of concept and has received positive feedback from consumers, installers, and potential product manufacturers.

IBACOS has secured interest and letters of support to further development and demonstrate the product concept.

- Local Pittsburgh affordable housing providers that complete new construction and retrofits of low-income properties:
 - [City of Bridges Community Land Trust](#)
 - [ACTION-Housing, Inc.](#)
- Johns Manville Corporation – a leading national supplier of polyisocyanurate insulation.
- Allegheny Structural Composites – a leading engineered component manufacturer
- In discussion with:
 - Universal Forest Products a national manufacturer and supplier of engineered wood products.
 - Wausau Supply a secondary exterior products manufacturer

Progress and Future Work

Phase II work will be heavily involved with developing the manufacturing process of a finished product and the delivery of successful demonstration homes.

SBIR Phase II Major Activities

- Further refine trim options
- Source suitable finished metal trim suppliers to provide color matched trim
- Source and work with industrial manufacturing engineers to develop the equipment to fabricate the insulated siding product.
- Work with adhesive manufacturer/supplier to specify applicable adhesive.
- Outline appropriate product testing with credible testing lab.
- Coordinate efforts between all parties to manufacture the final product.

Following the Phase II, IBACOS plans to continue supporting the commercialization and market adoption of InsulClad in target low-income communities.

Future work with the manufacturer partner will focus on iterations on base product (e.g., thicker insulation, different profiles).

Thank You

IBACOS

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REFERENCE SLIDES

Project Execution

	FY2022				FY2023				FY2024			
Planned budget	\$100,000				\$100,000				-			
Spent budget	\$100,000				\$100,000				-			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Past Work												
Milestone 1: Functioning prototype created												
Milestone 2: Installation and durability testing completed												
Milestone 3: Value proposition defined, and manufacturer engaged												
Current/Future Work												
Phase II												

Team

Phase I IBACOS Team Members involved with this Phase I project:

Bruce Dickson Sr. Specialist – Project PI

Anthony Grisolia- Innovations Program Director – Architectural support

Ari Rapport – Business management

Andrew Poerschke – Engineering and modeling

Yifei Peng – Innovation Specialist - Architectural support

Katherine Zemanek – Engineering co-op student

Clem Newcamp – Building performance specialist, fabrication and installation assistance

John Koenig – Building performance specialist, fabrication and installation assistance

EERE/BTO goals

The nation's ambitious climate mitigation goals



Greenhouse gas emissions reductions
50-52% reduction by 2030 vs. 2005 levels
Net-zero emissions economy by 2050



Power system decarbonization
100% carbon pollution-free electricity by 2035



Energy justice
40% of benefits from federal climate and clean energy investments flow to disadvantaged communities

EERE/BTO's vision for a net-zero U.S. building sector by 2050



Support rapid decarbonization of the U.S. building stock in line with economywide net-zero emissions by 2050 while centering equity and benefits to communities



Increase building energy efficiency

Reduce onsite energy use intensity in buildings 30% by 2035 and 45% by 2050, compared to 2005



Accelerate building electrification

Reduce onsite fossil -based CO₂ emissions in buildings 25% by 2035 and 75% by 2050, compared to 2005



Transform the grid edge at buildings

Increase building demand flexibility potential 3X by 2050, compared to 2020, to enable a net-zero grid, reduce grid edge infrastructure costs, and improve resilience.



Prioritize equity, affordability, and resilience

Ensure that 40% of the benefits of federal building decarbonization investments flow to disadvantaged communities



Reduce the cost of decarbonizing key building segments 50% by 2035 while also reducing consumer energy burdens



Increase the ability of communities to withstand stress from climate change, extreme weather, and grid disruptions