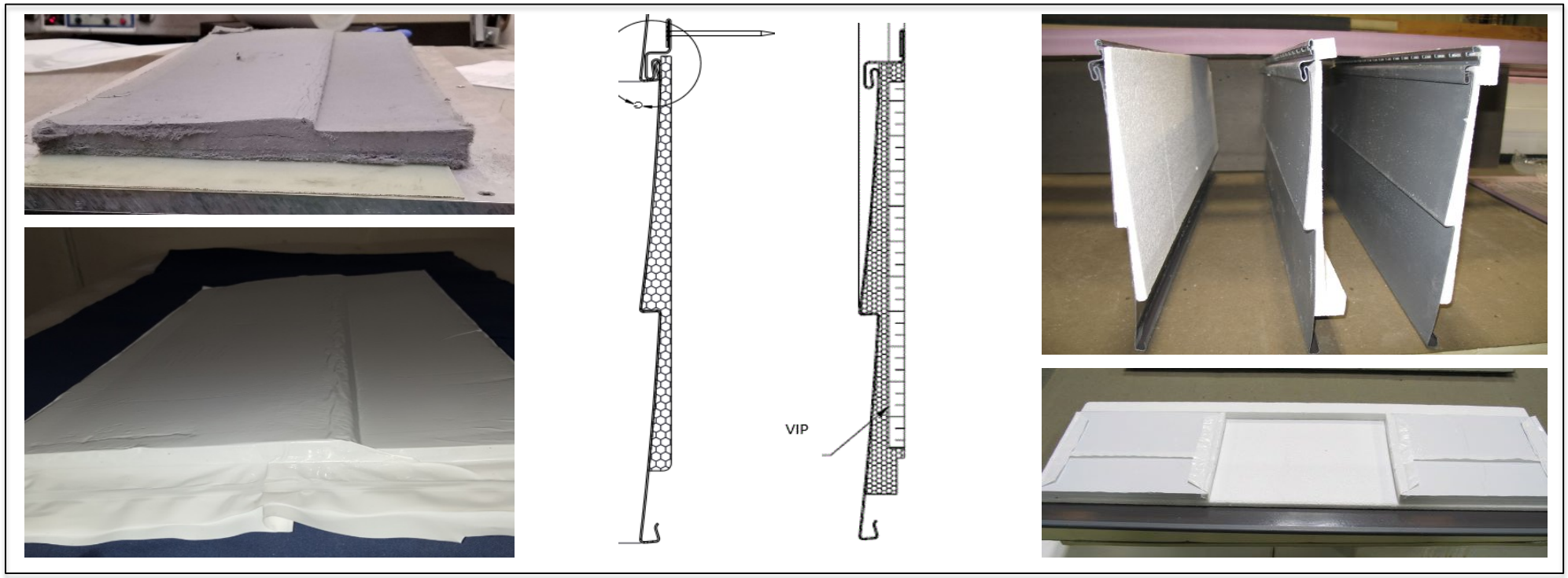
Field Study of Modified Atmosphere Insulation Technology for Vinyl Siding Retrofit



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Project Summary

Timeline:

Start date: 1 October 2018
Planned end date: 30 September 2021
Key Milestones

1. Undertake a virtual voice of the user session to receive feedback from suppliers, installers and contractors associated with the vinyl siding industry, 31 Jan 21.
2. Estimate cost savings due to use of thin VIP continuous insulation in lieu of low R/inch products 30 Apr 21.

Budget:

Total Project $ to Date: $1,554,000

- DOE: $1,504,000
- Cost Share: $50,000

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Key Partners:

NanoPore LLC
Kevothermal
Newport Partners
Royal Building Products

Project Outcome:

This project will produce vacuum-insulated vinyl siding that represents at least a 5-fold thermal improvement from currently available insulated siding products. It has sufficient R-value to meet the continuous insulation requirements of the IECC in all climate zones and has a thin 1.5-inch profile that facilitates its application to existing homes without the need for expensive re-trimming of the architectural details.

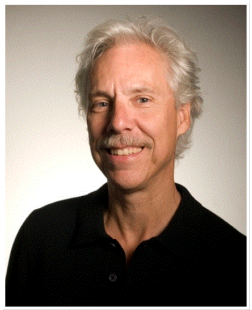
Team

Andre Desjarlais
Principal investigator

Mikael Salonvaara
Hygrothermal modeling

Antonio Aldykiewicz, PhD
Market analysis and aging

Jerry Atchley
Lab and field evaluations



Douglas Smith, PhD
VIP expert and entrepreneur

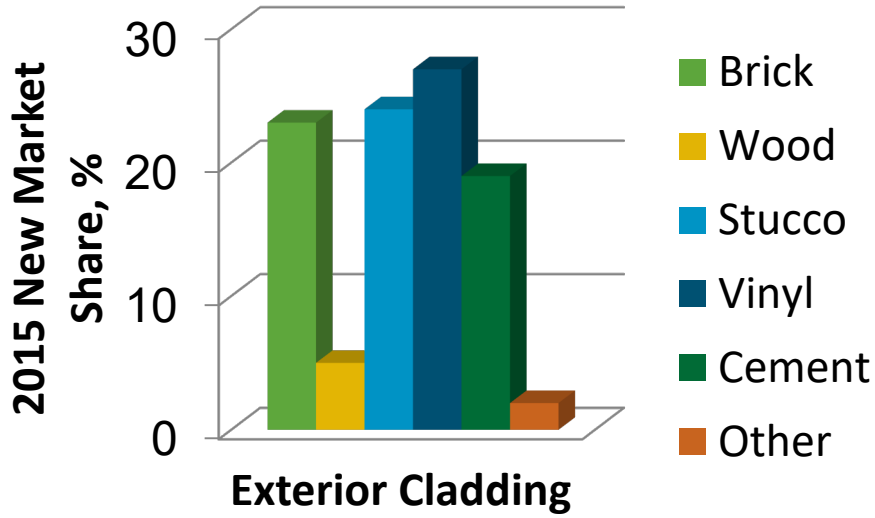
Chris Johnson
Insulated vinyl siding production and marketing

Liza Bowles
Residential building and market expert

- ORNL
  - Building science, numerical simulations, lab and field tests.
- NanoPore LLC
  - Inventor of numerous VIP technologies.
- Royal Building Products
  - Largest manufacturer of insulated vinyl siding.
- Newport Partners
  - Connected with residential builders, installers and contractors.

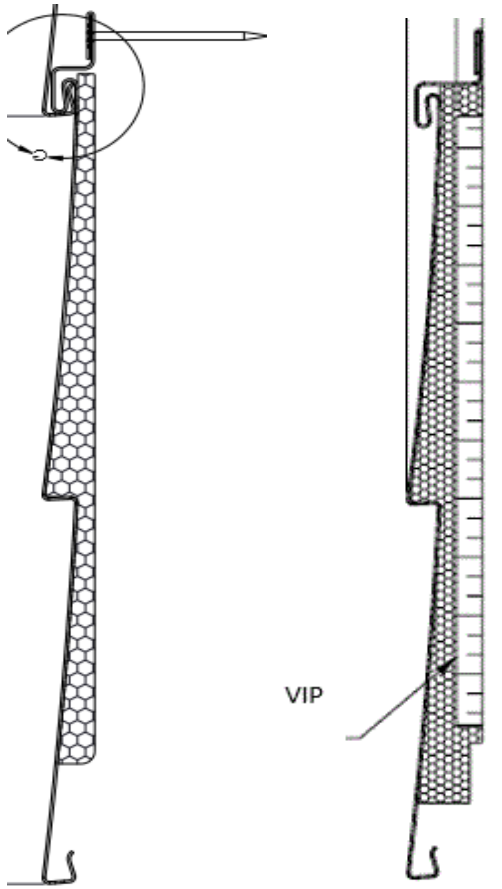
Challenge

- Improving energy efficiency of existing wall assemblies is the most difficult envelope improvement to justify cost effectively.
- The technical potential is 2.8 quads of energy saved if residential wall energy efficiency is improved.
- According to U.S. Census:
  - Vinyl siding is the most popular new construction cladding (200,000 units or 27% market share).
  - 1.1 million siding replacement projects yearly.
- The National Association of Realtors: vinyl siding replacement is one of the best investments (83% cost recovery).



Approach

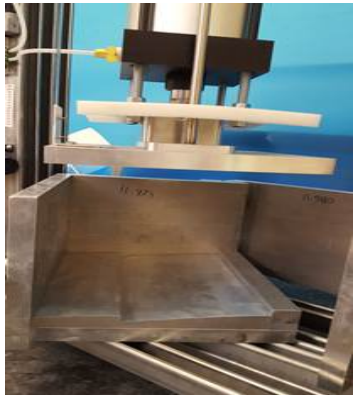
- Mate vinyl siding with Vacuum Insulation Panels (VIPs).
- VIP-vinyl composite siding can yield R10 with ~1.5-inch thickness, making it an attractive recladding option for homeowners and a replacement for continuous insulation.
- Addresses thickness-related issues associated with exterior retrofit options.
- Project is consistent and predates ABC Collaborative activities.

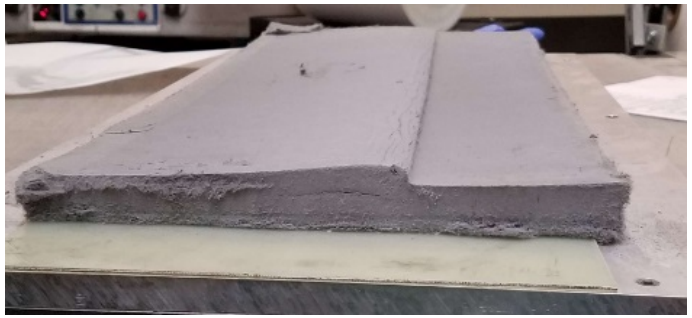


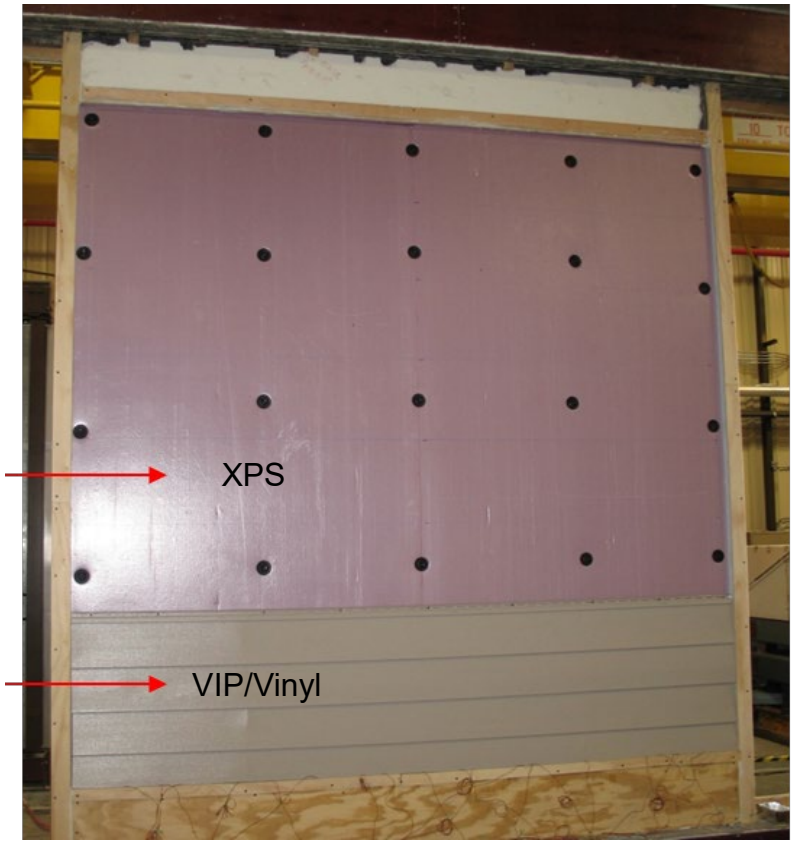
Impact

- Insulated siding represents small but growing share of siding market but are limited to an R3.
- Recent energy codes are accelerating the use of continuous insulation.
  - —Latest energy code recognizes insulated siding as a form of continuous insulation.
  - —Higher R-value levels of continuous insulation create “safer” walls hygrothermally.
- Higher performing cladding can penetrate new construction market by replacing the need for continuous insulation and revolutionize the retrofit market by providing a thin cost-effective option.
- Technical potential is 1.6 quads.

Progress



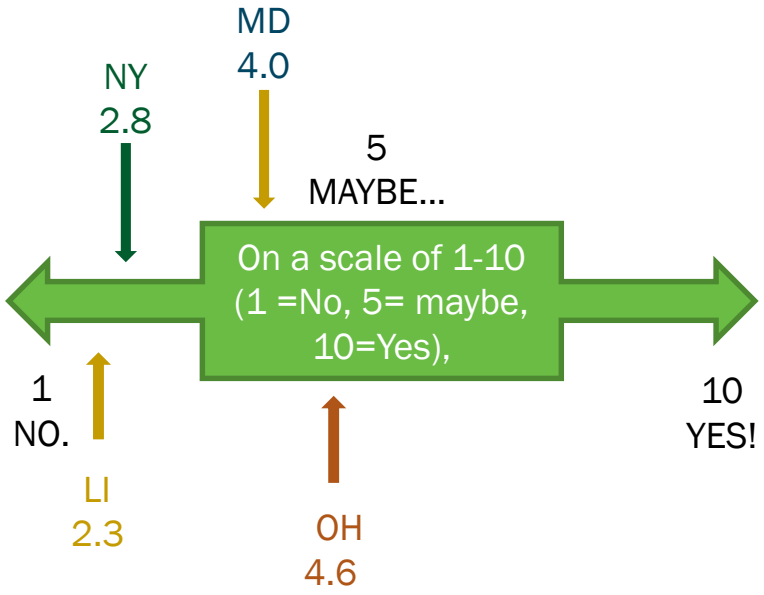




- **Initial prototype:** R-value of vinyl siding with VIP is R13.

Progress

LOCATION	DATE	PARTICIPANTS
Royal Building Products, Columbus, OH (OH)	Jul 25, 2019	3 Manufacturer Sales Reps; 1 Distributor; 2 Contractors; 1 Siding Installer
CRBRA, Clifton Park, NY ALBANY REGION (NY)	Aug 21, 2019	5 Suppliers; 2 Architects; 1 Builder; 3 NYSERDA reps
MBIA, Maple Lawn, MD BALTIMORE / WASHINGTON (MD)	Sep 9, 2019	5 Installers, 2 Manufacturer Sales Reps; 4 (1 each) Builder, Remodeler, Rater, Distributor, 2 Manufacturer Sales Reps
United Way, Deer Park, NY LONG ISLAND REGION (LI)	Sep 24, 2019	5 Installers; 3 General Contractors; 3 Weatherization and Home Performance; 2 United Way; 3 (1 each) Engineer, Building Supply, Manufacturer Sales Rep

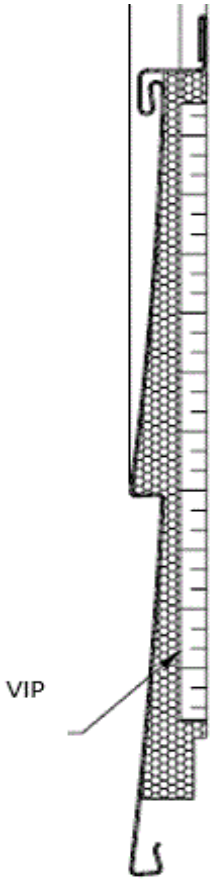


Progress

- 10-25% of siding sections are cut or ripped on location. How is this addressed?
- Can you reseal field cuts to avoid R-value loss and moisture penetration?
- Siding bends at VIP interfaces blemishing the surface.
- Insulation and cladding should be integral.
- Producing shaped VIPs limits their application to a single vinyl siding profile and increases cost.

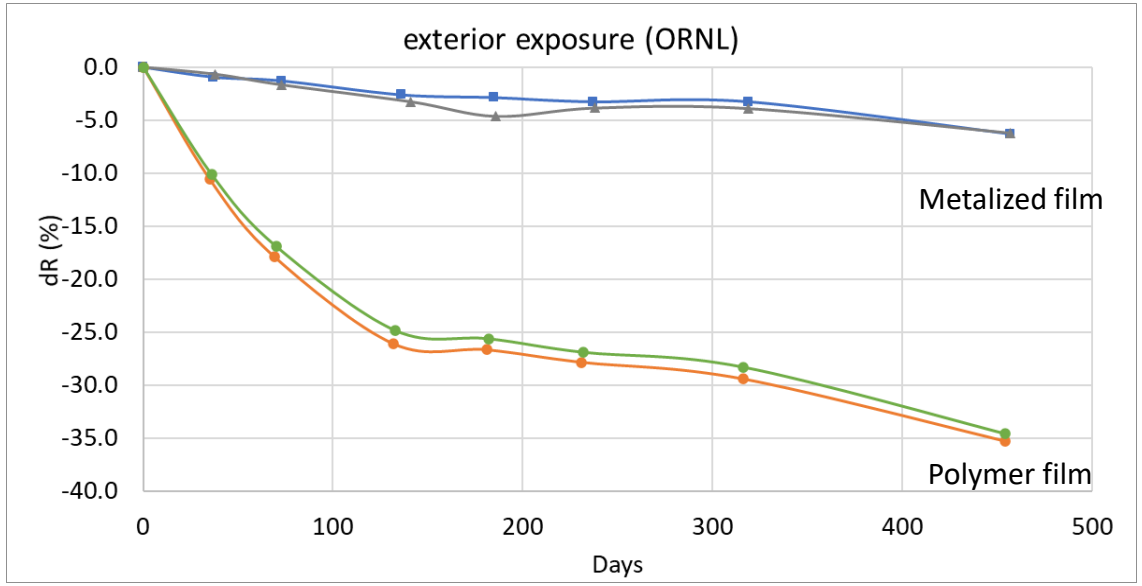
Progress

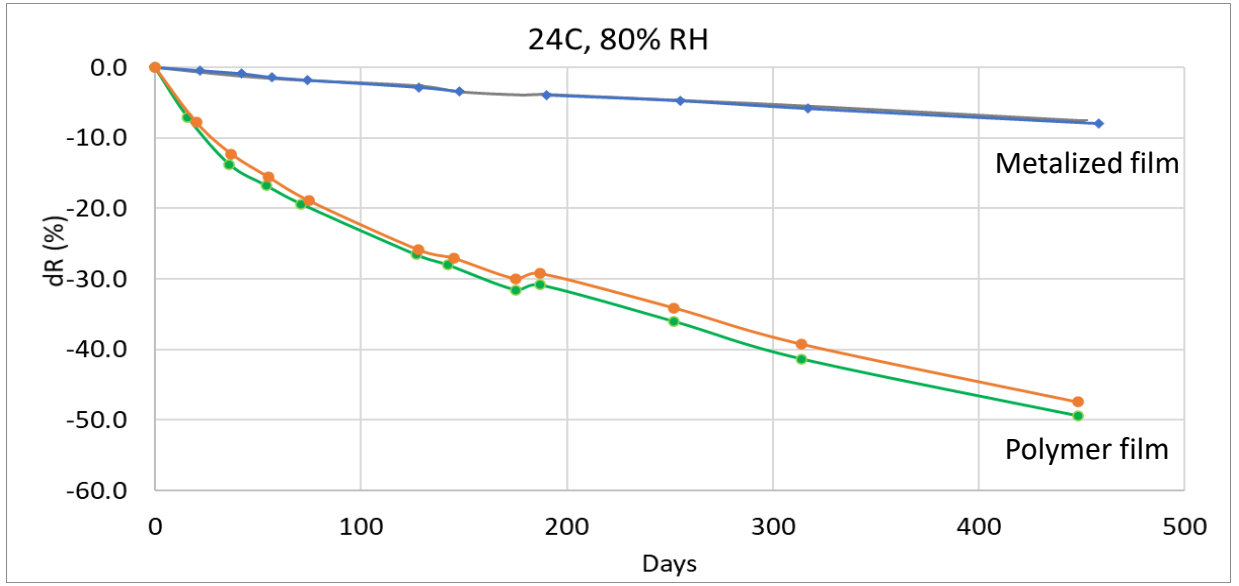
- **Second Prototype**
  - Easily removable VIPs simplifies cutting.
  - New prototype uses flat VIPs that can be incorporated into any vinyl siding profile.
  - Slight modifications to existing EPS foam profile reduces retooling costs.
  - Insulation and cladding installed in an identical manner to existing vinyl siding.
  - Overall thickness is 1½ inches max.
  - EPS foam resists vinyl siding bending.
  - Siding will weigh about 1 pound per foot.



Progress

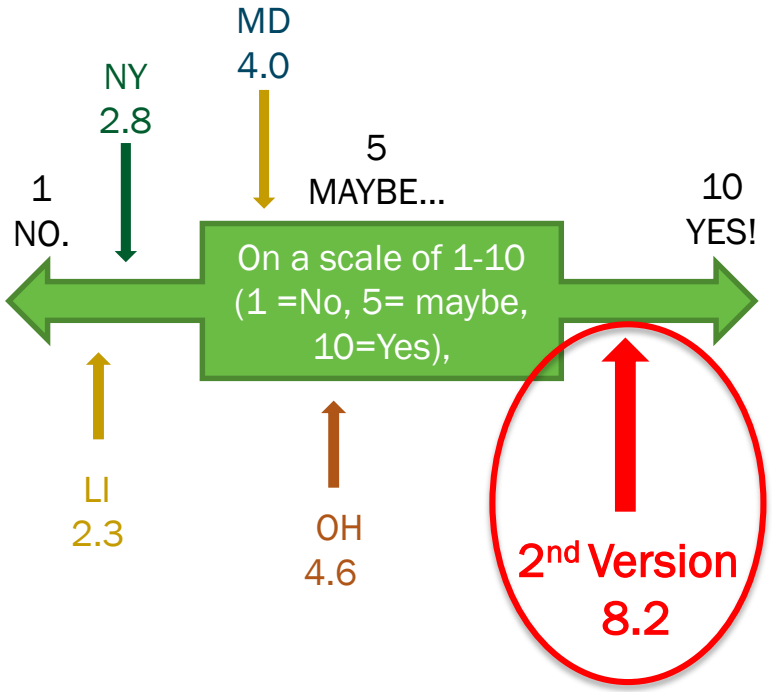
- Material cost
  - Existing insulated vinyl product: $180/SQ
  - VIP/vinyl composite product: $750/SQ
    - Assume the VIP ~ $350/SQ
    - Product from China available at $150/SQ
- Aging





Progress

- Second Prototype User Sessions
  - Five virtual sessions including twenty-one participants.
  - Participants were much more positive about the concept (average score of 8.2).
  - Participants have questions about fastening, wind, expansion and contraction, exterior corners, detailing, and replacing sections while elevated.
  - Participants would like to see field data from actual installations to develop confidence to try the product.



Stakeholder Engagement

- VIP (NanoPore and Kevothermal) and vinyl siding (Royal Building Products) manufacturers active partners.
- Builder access through partnership with Newport Partners.
- Applicator interaction through “Voice of User” sessions.
- Publication: Desjarlais et.al, 2019. Improving the Energy Efficiency of Insulated Siding by a Factor of Five. 2019 Buildings XIV Conference, Clearwater Beach, FL.

Remaining Project Work

- Develop cost information to compare installation of this technology to existing technologies of equal thermal performance.
  - Working with PNNL to obtain cost estimates from five specific exterior retrofit installations.
- Complete research plan to perform possible future field testing.
- Project at TRL 8-9. Develop information to support manufacturer's decision to invest more heavily in technology.

Field Demonstration and Evaluation

Field evaluation conducted in two stages:

- Small-scale field assessment (side of house) to assess if changes should be made prior to demonstration. Building must include windows, doors, gables.
- A larger demonstration with multiple contractors for application feedback and field performance validation.

The field evaluations are constructed to answer the following questions:

- Is installation doable and acceptable to contractors?
- Is prototype easier to handle than competition (e.g., fiber cement siding)?
- Is onsite cutting acceptable? Is adhesive the appropriate?
- What is the cost (labor and material) of adding continuous insulation compared to the prototype?

Thank you

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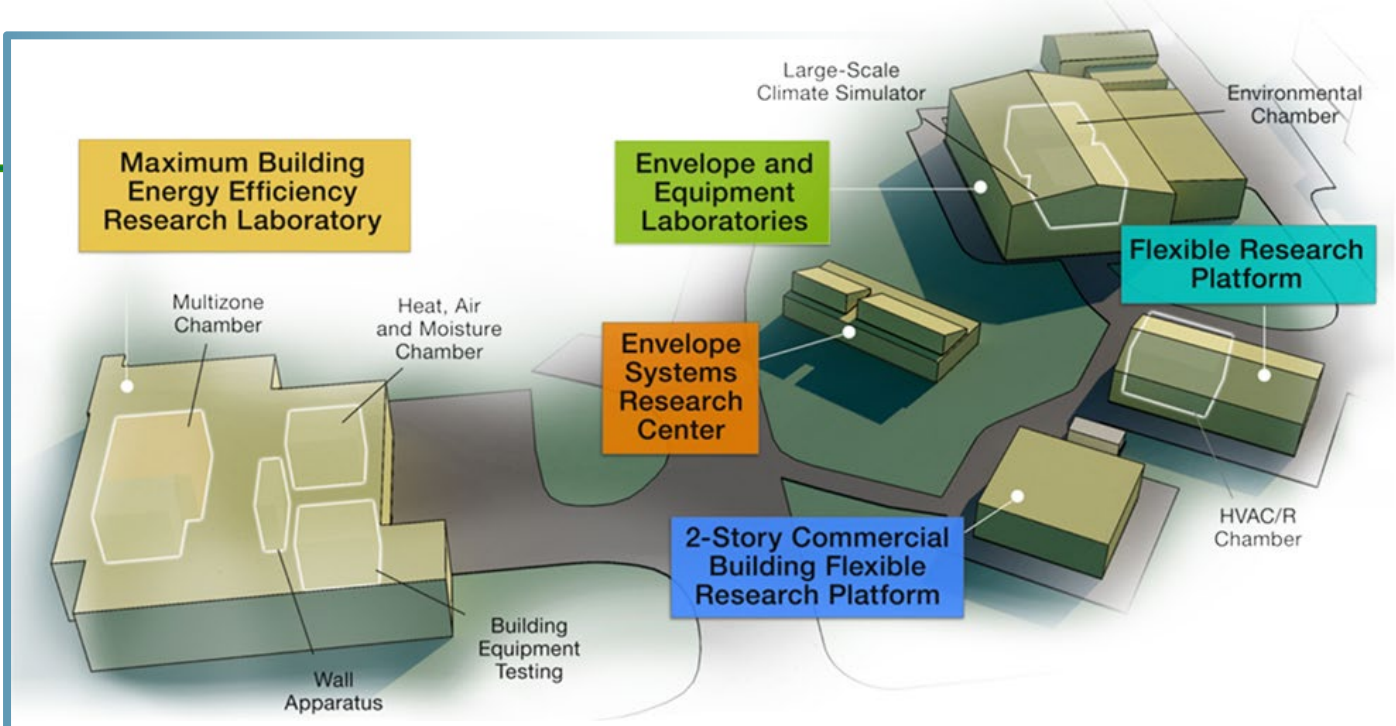

ORNL's Building Technologies Research and Integration Center (BTRIC) has supported DOE BTO since 1993. BTRIC is comprised of 50,000+ ft^2 of lab facilities conducting RD&D to support the DOE mission to equitably transition America to a carbon pollution-free electricity sector by 2035 and carbon free economy by 2050.

Scientific and Economic Results

238 publications in FY20
125 industry partners
27 university partners
10 R&D 100 awards
42 active CRADAs

BTRIC is a DOE-Designated National User Facility

REFERENCE SLIDES

Project Budget

Project Budget: FY19: $888K,
FY20: $984K
FY21: $765K

Variances: Second year funding reduced, and third year funding eliminated due to change of scope from manufacturing to prototype development.

Cost to Date: $1,050 (70 percent).

Additional Funding: Cost share not part of additional negotiation.

Budget History					
10/1/2018 – FY 2020 (past)		FY 2021 (current)		FY 2022 – 09/30/2021 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$1,504K	$25K	$0	$25K	$0	$0

Project Plan and Schedule