

Cost-effective Interior Wall Retrofit Solutions for Commercial Building Shells

2014 Building Technologies Office Peer Review



Flexible Research Platform (FRP) at Oak Ridge National Laboratory

Project Summary

Timeline:

Start date & Planned end date:

Phase I June 1st, 2013 to Oct. 1st, 2014

Phase II May 1, 2014 to Apr 30, 2016

Key Milestones

1. Collect FRP baseline data (PHI - 6/14)
2. Research wall assembly & retrofit FRP (PHII- 5/15)
3. Collect post retrofit data & disseminate results (PHII – 6/16)

Budget:

Total DOE to Date: \$0.57M

Total Cost Share to Date: \$0.50M

Total future DOE: \$0.20M

Total future Cost Share: \$0.30M

Target Market/Audience:

Commercial buildings with masonry façade in climate zones 4 & 5 equaling technical potential savings of 0.61 quads.

Key Partners:

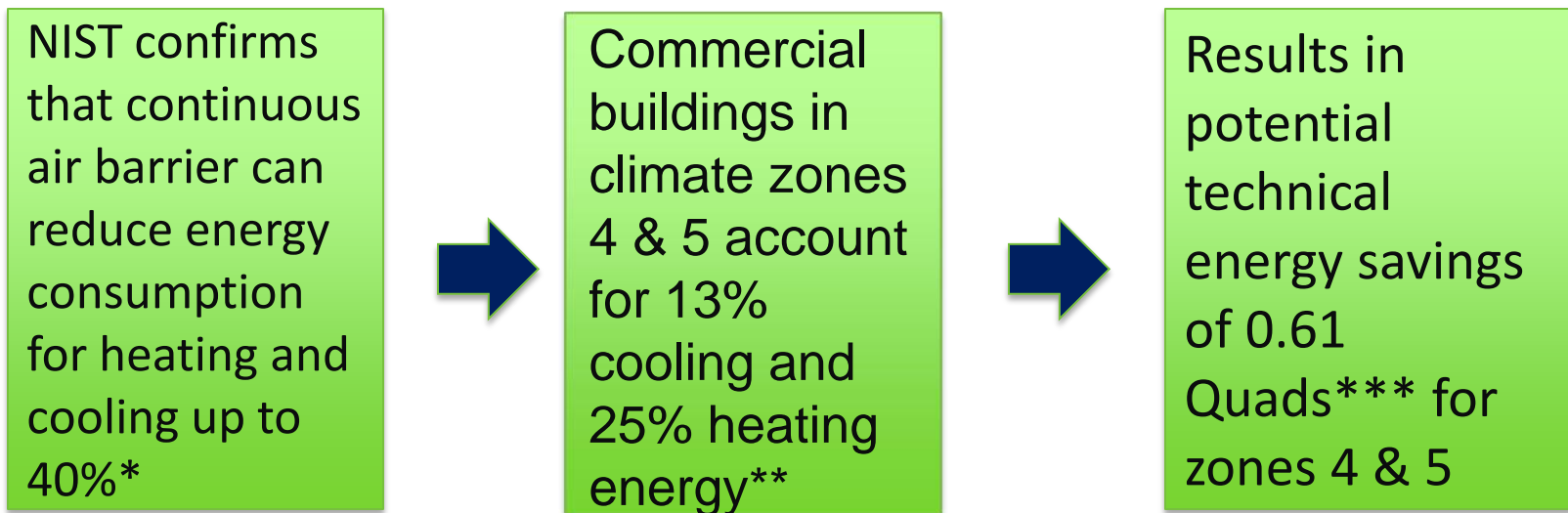
Penn State Consortium (PH I & II)
Bayer Material Science (PH I & II)
Oak Ridge National Laboratory (PHI & II)
Carlisle SynTec (PH II)
Air Barrier Assoc. of America (PHII)

Project Goal: develop effective energy efficient retrofit solutions for building envelope which can then be deployed to the commercial retrofit market and provide substantial energy and cost savings.

Purpose and Objectives

Problem Statement: Decision between vapor permeable or impermeable insulation for masonry buildings and the importance of a continuous insulation instead of conventional discontinuous insulation in order to achieve the required air-tight envelope.

Target Market and Audience: commercial buildings with masonry façade in climate zones 4 & 5 with potential to influence zone 6.



* Emmerich, McDowell, and Anis, 2005

** DOE Energy Databook

*** ORNL Energy Plus Simulation

Purpose and Objectives

Impact of Project: Where the existing, masonry façades will continue to be used, develop effective energy efficient retrofit solutions for building envelope which can then be deployed to the commercial retrofit market and provide substantial energy and cost savings.

- Will reduce air leakage
- Manage moisture
- Achieve good thermal performance in buildings
- Potential to create jobs

Project Deliverables: (Achieved thru end of Phase II)

- Mid-term component results
- Final report detailing the performance of the retrofitted FRP wall construction and recommendations for further study.
- Recommended potential retrofit strategy
- Best practice guide for retrofitting masonry wall systems to improve energy performance and air tightness
- Data to validate the recommendations of the best practice guide

Purpose and Objectives

Metric for Success: (Measure from end of Phase II)

Near Term:	Share report at Consortium and identify need for future research. Identify industry consensus on retrofit strategy to employ in bldgs.
Intermediate Term:	Present results at associations, show retrofit successful without compromising bldg., develop best practice guide for air tight shell for masonry bldg.
Long Term:	Commercialization plan by sharing best practice guide with decision makers, secure distribution strategy for materials and implement training plan if needed.

Approach

Key Issues: Improper insulation and disregard for air and moisture transfer through a masonry wall system can lead to faster deterioration of brick and poor thermal performance.



Buildingsciences.net

Distinctive Characteristics: Diverse team devise strategy in a risk adverse environment for implementation in small to mid size commercial buildings while ensuring proper and cost effective installation.



~~Too Risky
Interrupt Business~~

Progress and Accomplishments

Building 669 - Navy Yard Philadelphia, PA



Work done:

- Model building to compare different wall assemblies based on:
 - Energy savings
 - Saving in internal floor space
 - Reduced condensation risk/risk of mold probability
 - Cost effectiveness.

Learnings:

- Several months required to generate accurate baseline model and integrated design. Owner satisfied with results, but would not normally do this.
- The owner decided not to pursue the proposed retrofit due to a change in business strategy.
- Uncertainty in enclosure retrofits of real buildings led the team to use a risk free environment to test wall assemblies and speed up adoption.

Progress and Accomplishments

Variables Used to identify Most Effective Wall System :

- Climate Zone
- Insulation Type (permeable vs. impermeable)
- Air Barrier Type (permeable vs. impermeable)
- R Value
- Practicality
- Constructability
- Cost Effectiveness
- Life Cycle Analysis

Progress and Accomplishments

Market Impact:

- Consortium study of CoStar data found 2,250 Office buildings between 20 and 100 kft² in 10 county region (K. Otto, 2012)
- FRP built like small building in Philadelphia region, and collecting baseline data
- Determined modeled list of variables
- Will begin Phase II of project to identify proven wall retrofit assembly for masonry buildings in climate zones 4 & 5

Potential Path to Market:

- Share results of field demonstrations through associations
- Partners can identify distribution strategy for materials to wall contractors
- Develop training plan if necessary

Progress and Accomplishments

Potential Discoveries:

- Airtight roof and wall may lead to focused leakage through the junction and penetration areas
- May point to a hybrid insulation system that is not currently in practice
- New LCA metric for selecting retrofit systems

Accomplishments: (Projected)

- Thermal and moisture performance of the total envelope system for different insulation materials.
- Impact or effectiveness of permeable insulation v/s impermeable (semi -permeable) insulation.
- Cost-effectiveness and life cycle analysis for envelope retrofit options
- Air leakage for different retrofit scenarios

Project Integration and Collaboration

Project Integration & Partners: Teaming with ORNL, Bayer Material Science, Carlisle SynTec and the Air Barrier Association of America provides a direct route to material suppliers as well as applicators of these technologies and will accelerate findings into market practice.



Systems Supplier



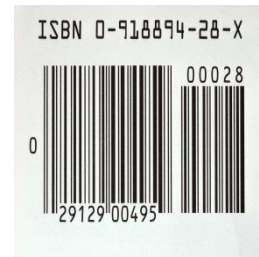
Raw Materials



3rd Party Analysis

**abaa
Installers**

Communications: None



**Market
Adoption**

Next Steps and Future Plans

Next Steps:

- 1) Industry expert panel develops and reviews list of potential scenarios (completed in FY14)
- 2) Models will lead to selection of top performing systems (completed in FY14)
- 3) Wall sections representing top performers tested in laboratory (completed in FY14)
- 4) Specification plan developed for retrofit of top performer into FRP (completed in FY14)
- 5) Retrofit completed and test data compiled (completed in FY14)
- 6) Test data summarized and disseminated (completed in FY15)
- 7) Develop best practice to retrofit (completed in FY15).

Next Steps and Future Plans

Dissemination Plan:

Results will be disseminated through BMS and Carlisle SynTec market channels and through association membership. Will also use partner networks to deploy via the following channels:

- AIA – American Institute of Architects
- PIMA – Polyisocyanurate Insulation Manufacturers Association
- CSI – Construction Specifiers Institute
- Project team will select team of experts to further expand deployment avenues and work with BTO to prepare a case study and relevant materials for Better Buildings.
- Also disseminate through Penn State Consortium for Building energy Innovation.

REFERENCE SLIDES

Project Budget

Project Budget: Phase I Budget (\$0.17M), Phase II budget (\$1.4M)

Variances: NA

Cost to Date: Phase I Budget expended. Phase II Budget will begin May 1st, 2014.

Additional Funding: NA

Budget History³

FY2013 (past)		FY2014 (current)		FY2015 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
\$0.17M	*	\$0.40M	\$0.50M	\$0.20M	\$0.30M

* Cost share minimal due to pass through of funds.

Project Plan and Schedule

Project Start: June 1st 2013	Completed Work											
Projected End: April 30th 2016	Active Task (in progress work)											
	◆ Milestone/Deliverable (Originally Planned)											
	◆ Milestone/Deliverable (Actual)											
	FY2013				FY2014				FY2015			
1) Industry experts develop list of scenarios 2) Models select top performing systems 3) Wall sections of top performers tested in laboratory 4) Plan developed for retrofit of top performer into FRP 5) Retrofit completed and test data compiled 6) Test data summarized and disseminated 7) Develop best practice to retrofit	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)
Past Work												
Milestone 1: Collect Baseline Data												
Milestone 2: Develop Component Recommendation												
Current/Future Work												
Milestone 3: Devise Research Plan												
Milestone: Complete modelling and test wall evaluation (Go/No Go)												
Milestone 5: Complete retrofit & begin data collection (Go/No Go)												
Milestone 6: Complete Data Collection & Disseminate Results												