

# Next Generation Retrofit Wall Panels w/Integrated VIPs Phase 1 Overview – December 14, 2021

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Home Innovation Research Labs is an independent  
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# CORE Research Team

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## André Desjarlais

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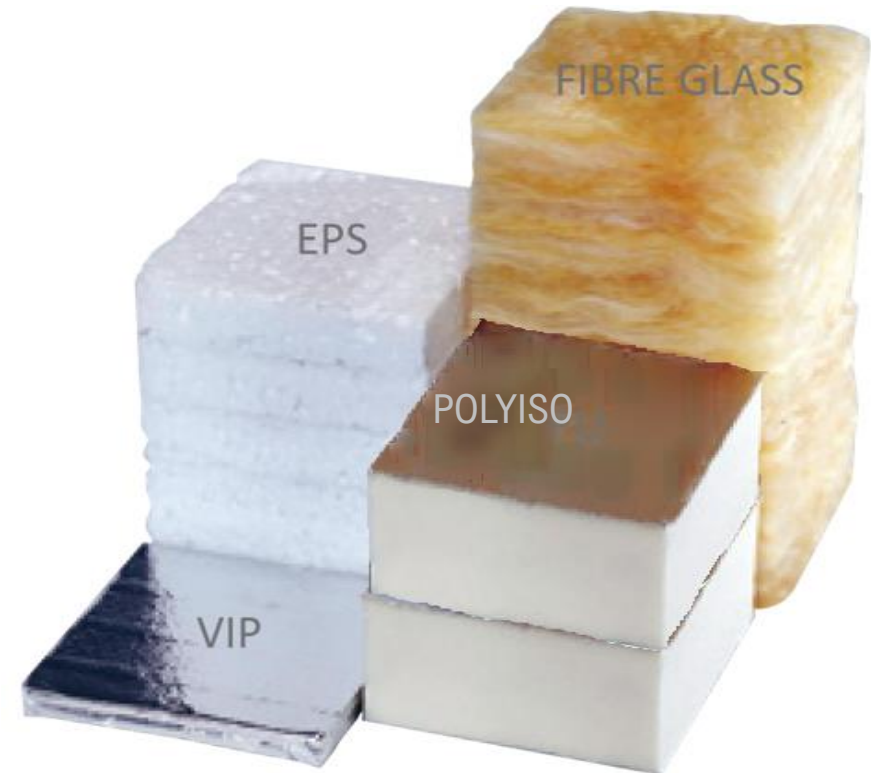
## Antonio J Aldykiewicz

Anthony is a PhD and a Senior R&D Staff Member for Building Envelope and Urban Systems Research; previously an R&D specialist for a building materials manufacturer.  
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# What is the Innovation?

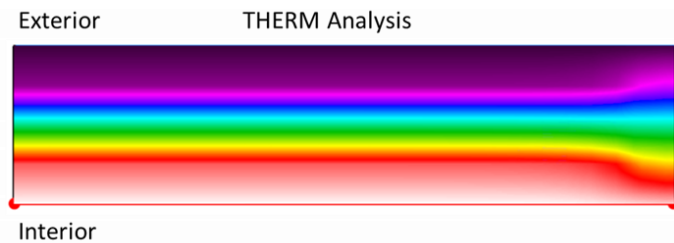
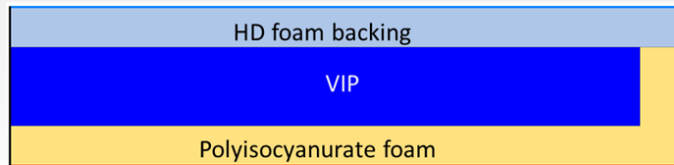
- Improve Insulating performance of existing wall system products by adding vacuum insulated panels (VIP).
- Wall Retrofits are the focus
- Consider Design Options
- Manufacturing & Fabrication
- Mock-Up Installation
- Quality Control
- Technical Results/Findings
- Phase 2 – Next Steps



# PROJECT OVERVIEW

## Design & Computer Modeling

- Prototype Designs
- Computer Modeling



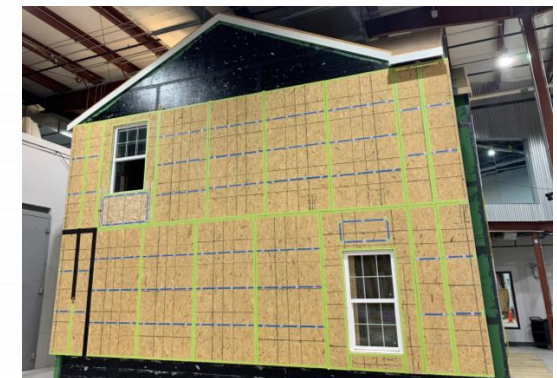
## Fabrication & Manufacturing

- Ease of Manufacturing
- Fabrication & Assembly



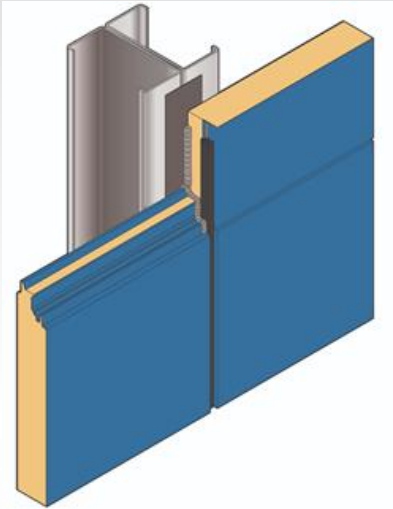
## Installation & Performance

- Mock-Up Installation
- Quality Control & Results

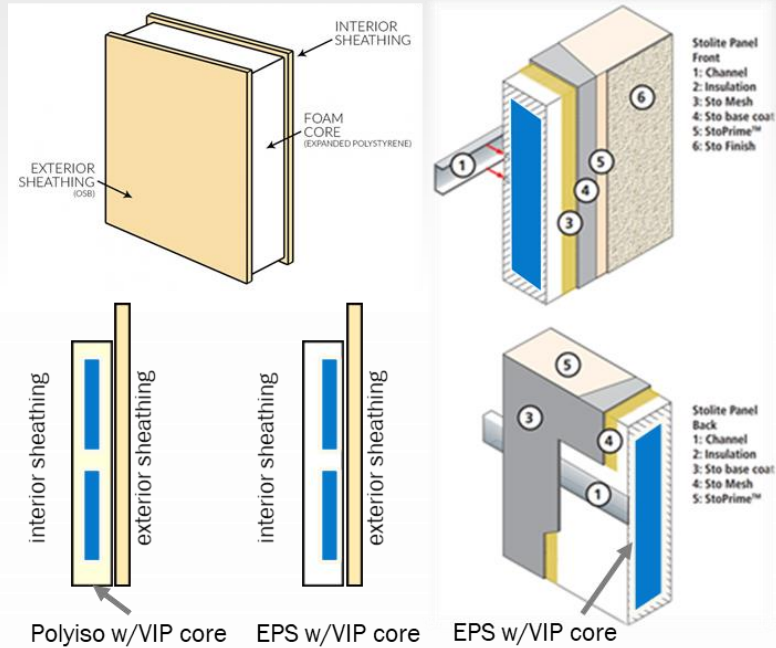


# Existing products we considered...

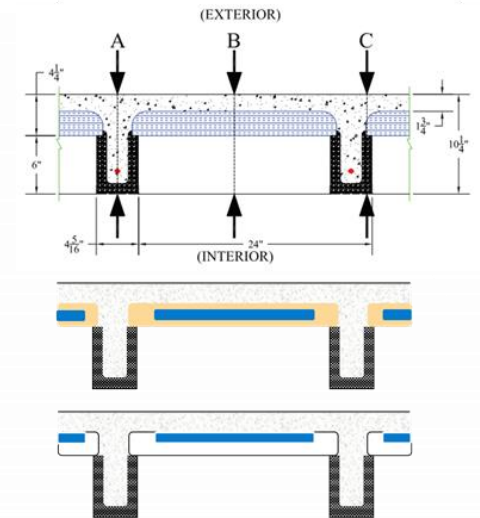
## Insulated Metal Panels



## Nail-Based & EIFS



## Insulated Concrete Panels



# Three Prototypes were selected...

## EIFS

- Exterior Insulation Finish Systems
- Incorporate VIPs into EIFS panel in combination with EPS



## RIPs (Nail-base) w/ EPS

- Retrofit Insulated Panels
- Incorporate VIPs into RIPs panel in combination and as a replacement for portion of EPS

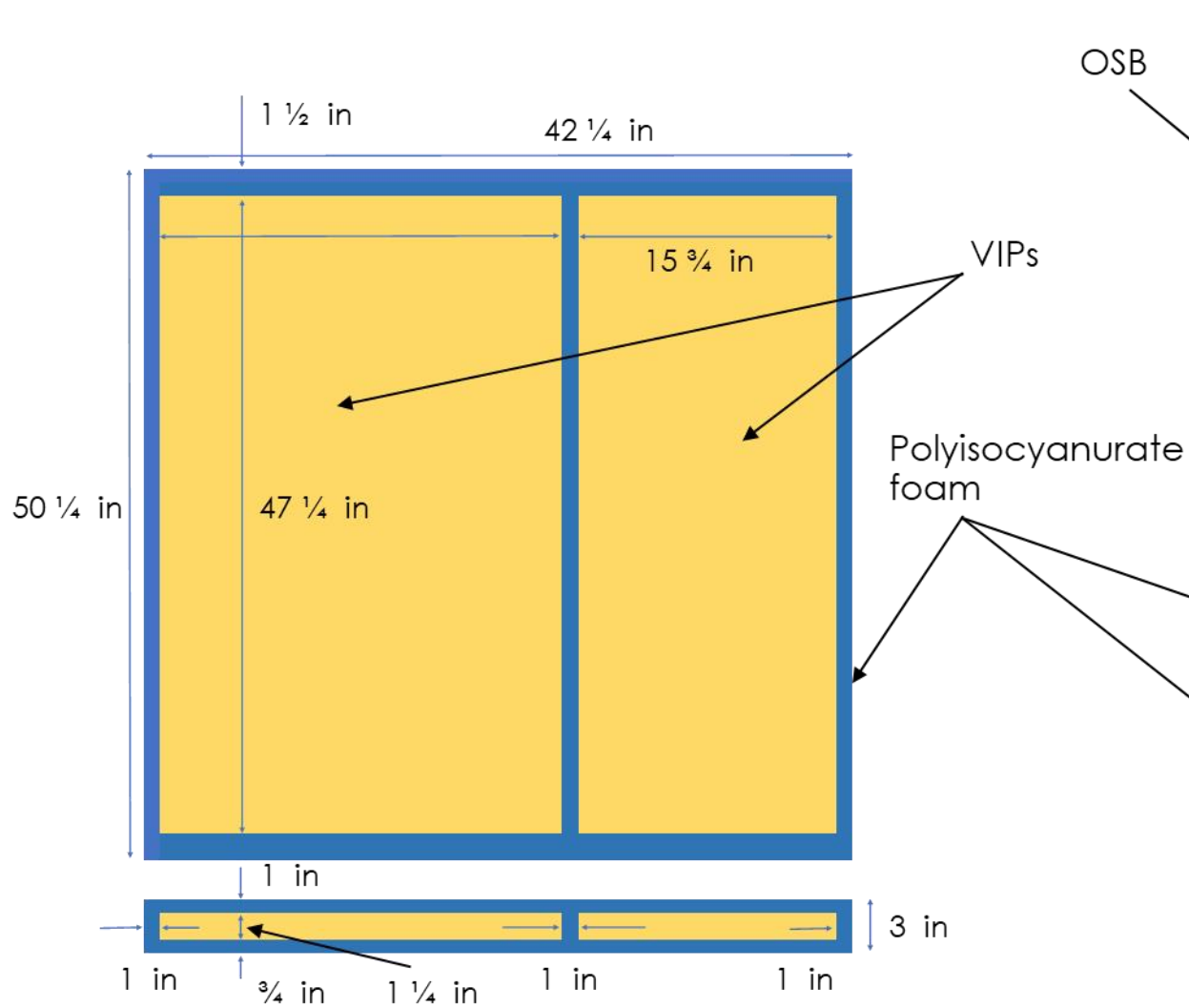


## Nail-based w/Polyiso

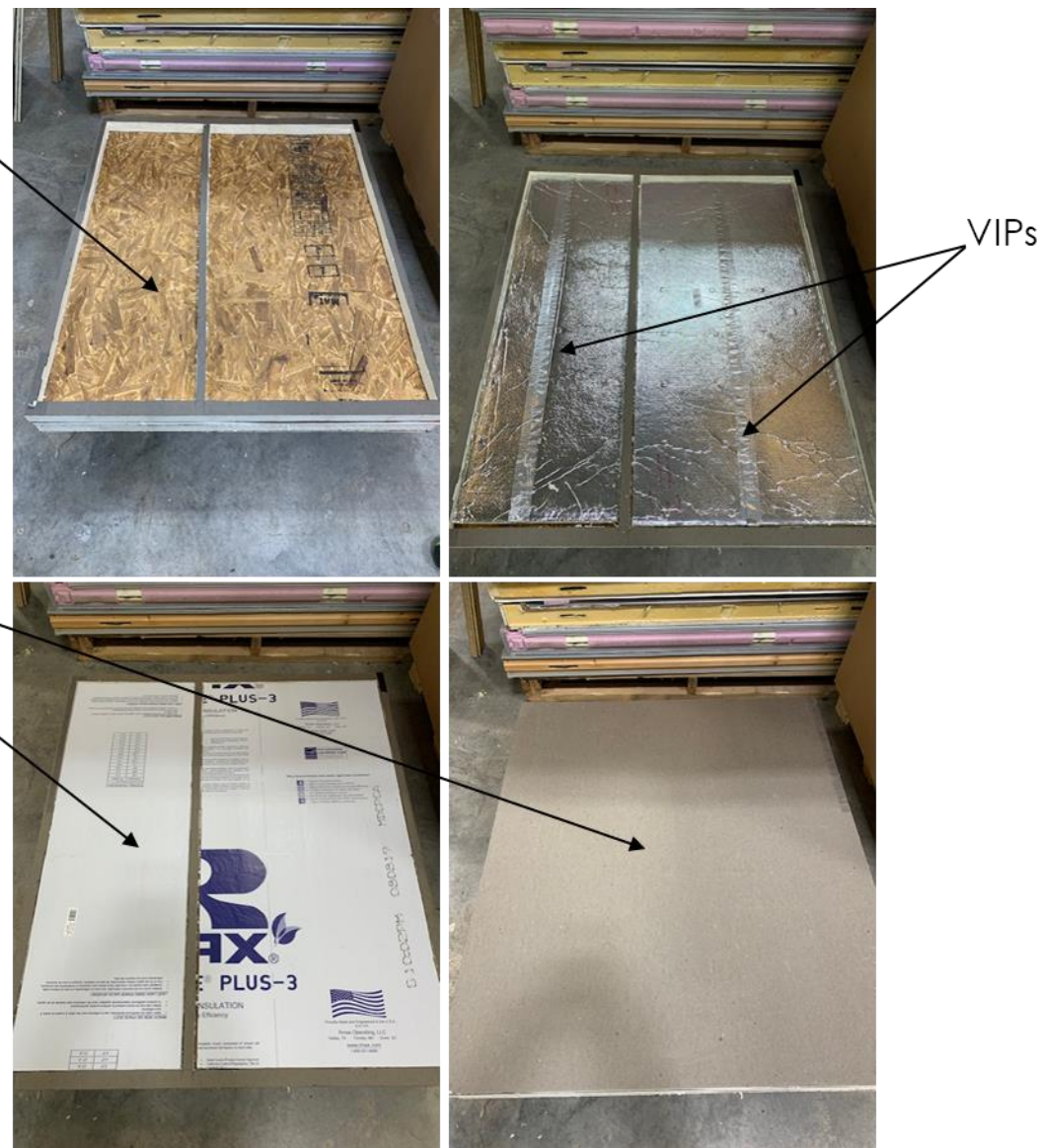
- Retrofit Insulated Panels
- Incorporate VIPs into RIPs panel in combination or as a replacement for a portion of Polyisocyanurate



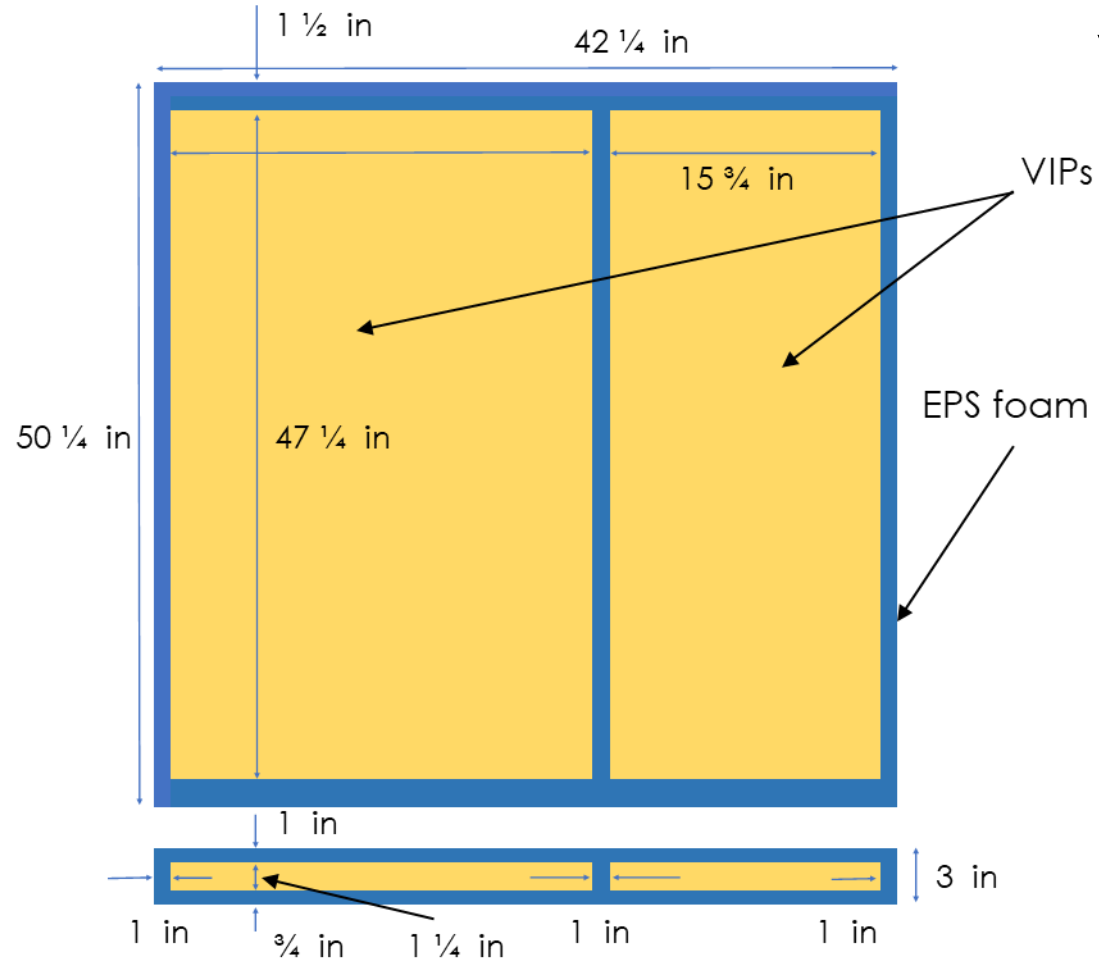
# Prototype 1: VIP/Polyisocyanurate Composite Panel



Dimensions of the VIP/Polyisocyanurate composite board



# Prototype 2: VIP/EPS Composite Panel

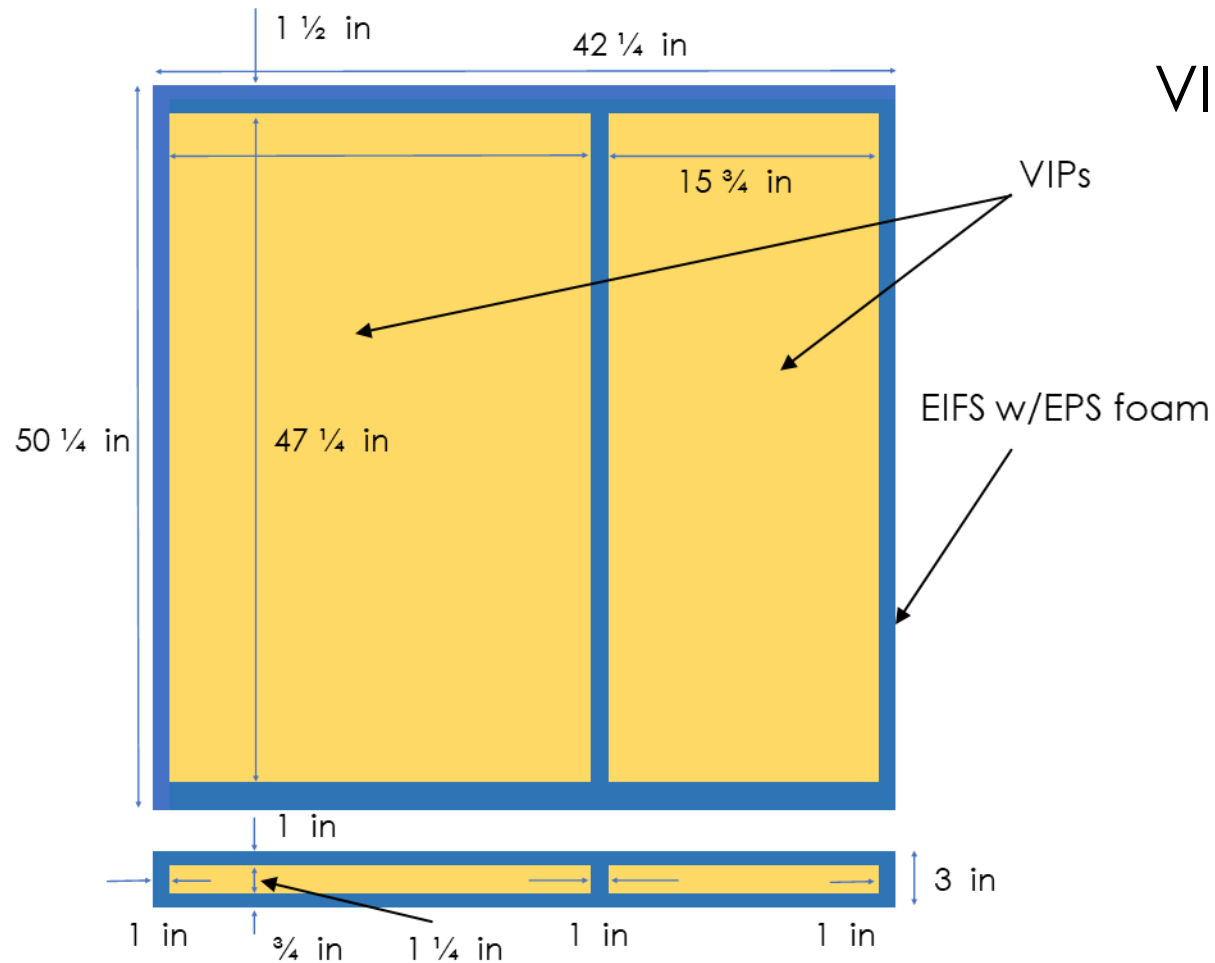


## VIP/EPS Composite Panel Assembled





# Prototype 3: VIP/EIFS Composite Panel



Dimensions of the VIP/EIFS composite board

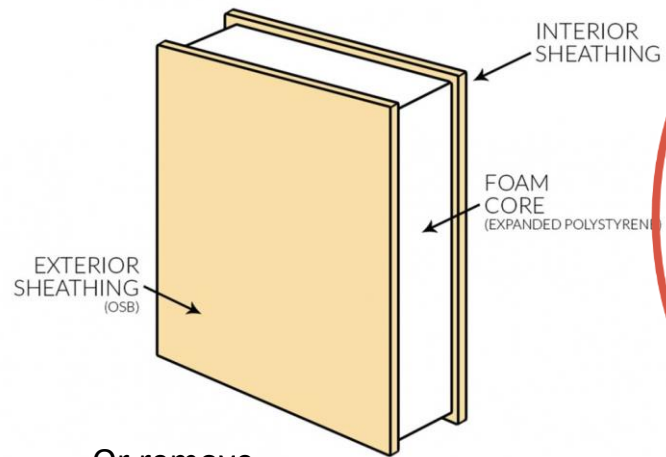
## VIPS/EIFS Composite Panel Assembly



# SIP or nail base panels with VIP foam composite boards

## SIPs panel

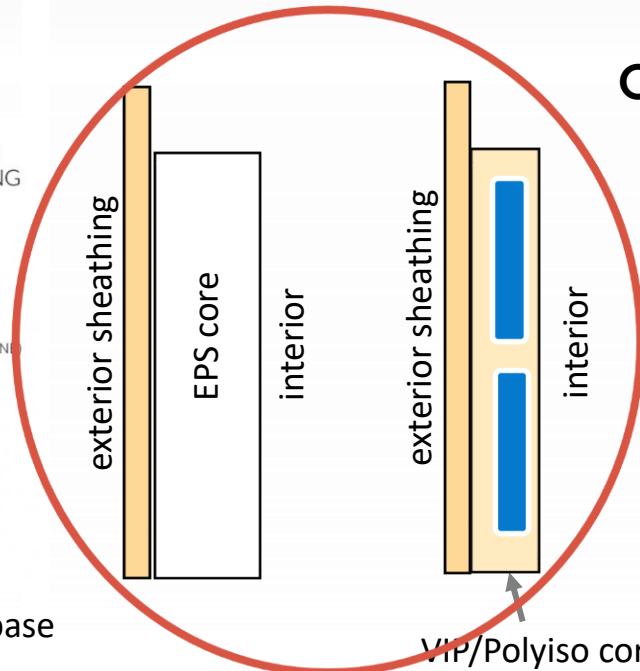
- SIPs (Structural Insulated Panels) is a building element used in new construction that is comprised of a foam core that is encased by interior and exterior sheathing boards to make a single or composite building element.



Or remove the interior sheathing to make nail base

## Option 1

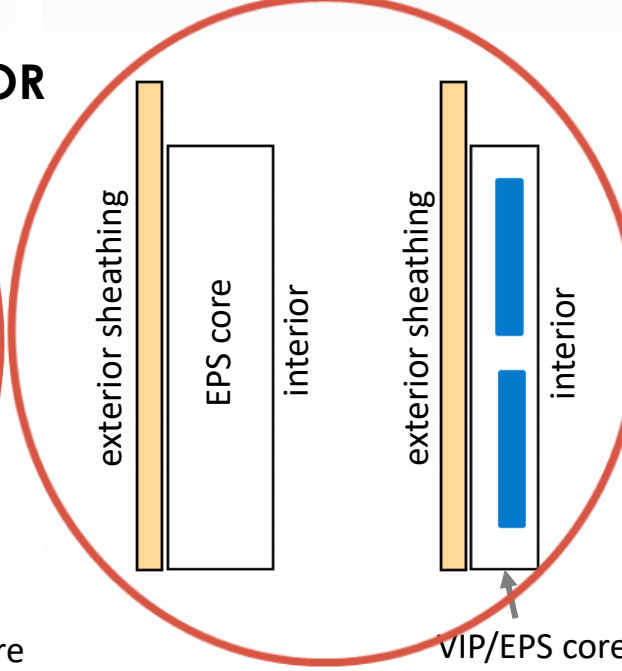
- Replace std core w/ VIP/polyiso composite board
- Benefit – thickness reduction and increased insulation value
- Challenge – adapt for retrofit



OR

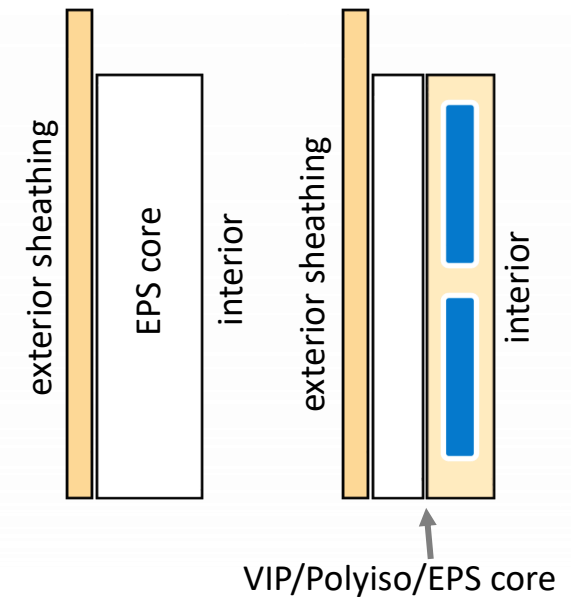
## Option 2

- Replace std core w/ VIP/EPS composite board
- Benefit – possibly easier and cheaper to produce
- Challenge – adaption and durability



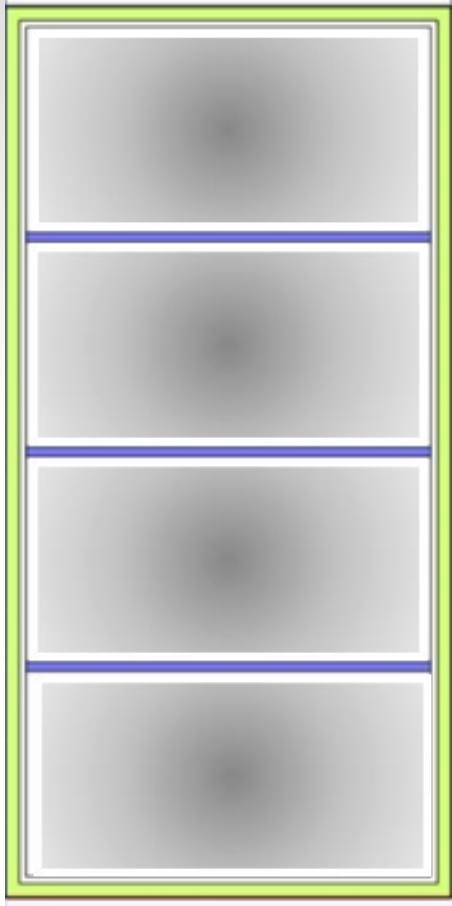
## Option 3

- Replace eps with VIP/polyiso/EPS composite board.
- Benefit – more VIPs protection
- Challenge – now more adhered locations where shear matters

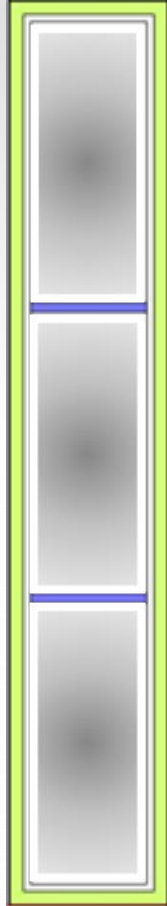


# New Panel System: 6 Panel Types

## Flat Panels

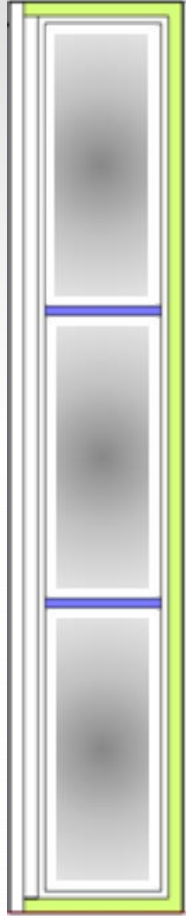


TYPE A

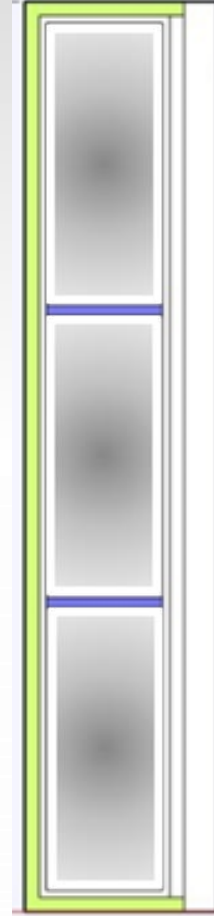


TYPE B

## Corner Panels

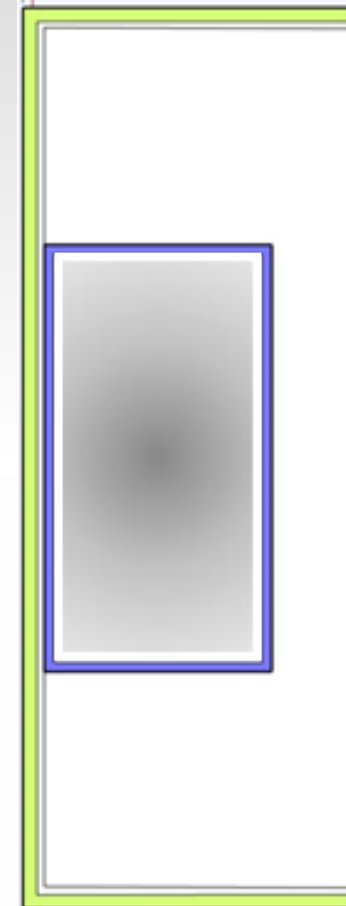


TYPE C

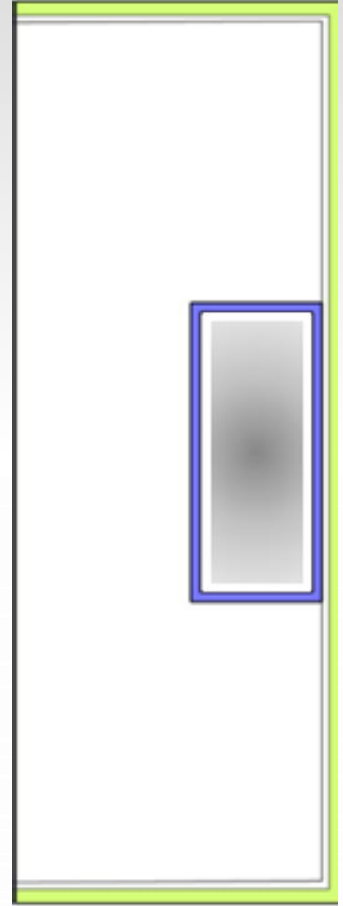


TYPE D

## Fill Panels



TYPE E

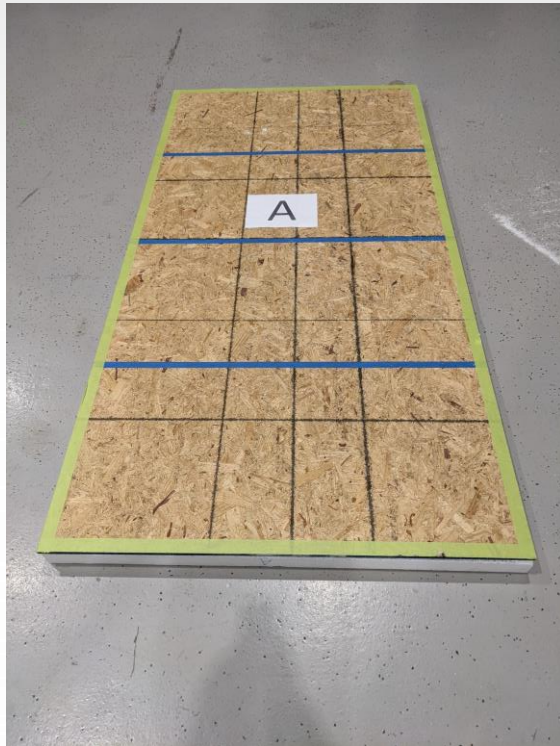


TYPE F

# Installation Process – The “Mock-Up” Installation

## Components

- (6) Panel Configurations
- Use Standard RIP Practices



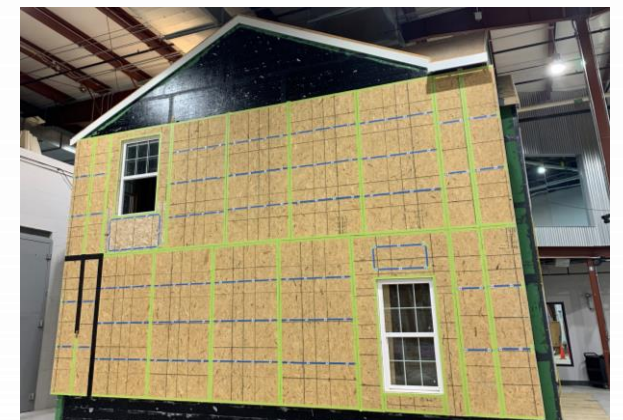
## Installation Details

- Preparing the Wall
- Installation



## Completion

- Mock-Up Installation



## Kingspan Visual Inspection

- Visual Quality Control



## Manufacturing Inspection

- Incoming material inspection



## Post Installation Inspection

- Field Inspection



# Technical Results/Findings

Performance Metric	VIP-Enhanced (RIP) <sup>1</sup> w/EPS Foam and OSB (3.5")
Test Method	Results
ASTM C518 - R Value	<b>47 R-Value</b> (Core Material - [1"ESP/VIP-Optim-R/1" ESP] - nominal 3.5")
ASTM C1363 - R Value	<b>Indeterminant</b> (Due to test sample size -or- Perhaps Damaged VIP)
ASTM E283 - Air Leakage	<b>4CFM</b> (The Baseline Wall was 11CFM)
ASTM E331 - Water Leakage	<b>None Observed</b> - Passes (no water present)
Thermal Simulation	<b>Therm Modeling Analysis</b> - Complete for Prototypes
Moisture Simulation	<b>WUFI Modeling Analysis</b> - Complete for Nutgrove and Creighton Storey
Energy Simulation	<b>REMRate Energy Modeling Analysis</b> - Complete for Nutgrove and Creighton Storey
Moisture Control Guidance	<b>Yes</b> - Provide with Retrofit Insulation Panel Guide/Buildng Code
Moisture Management Plan	<b>Yes</b> - Provide with Retrofit Insulation Panel Guide/Buildng Code/WUFI
Quality Assurance	<b>Yes</b> - Provided Step by Step QC/QA Procedures
Design Panel Layout	<b>Yes</b> - New System of (6) Panel Types
Installation <sup>1</sup>	<b>Yes</b> - Mock Up Installation Completed
Constructability <sup>2</sup>	<b>Yes</b> - Graphic Layout to Confirm Maximum Wall Area Coverage

<sup>1</sup>The prototype VIP-Enhanced (RIP) design was used for testing (not the final V-RIP Product)

<sup>2</sup>Installation and Constructability Evaluation was completed graphically and then with the mock-up (not the final V-RIP Product)

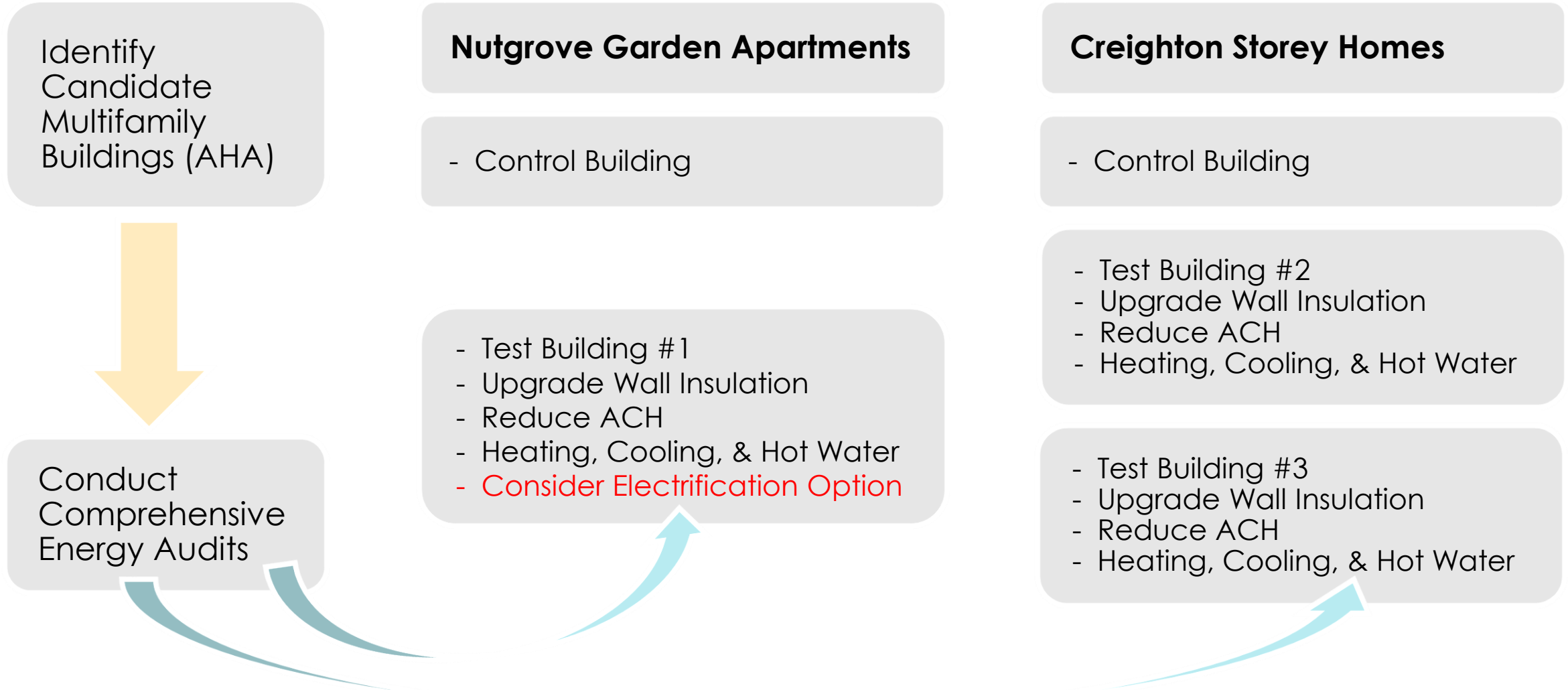
## In preparation for Phase 2 – The Field Study

- Surveying “Real” Multifamily Buildings
- Panel Layout: Maximizing Coverage
- Long-Term Monitoring
- Cost & Energy Savings Projections



Candidate Multifamily Building

# Surveying “Real” Multifamily Buildings





# Surveying “Real” Multifamily Buildings



# Panel Layout - Multifamily Buildings



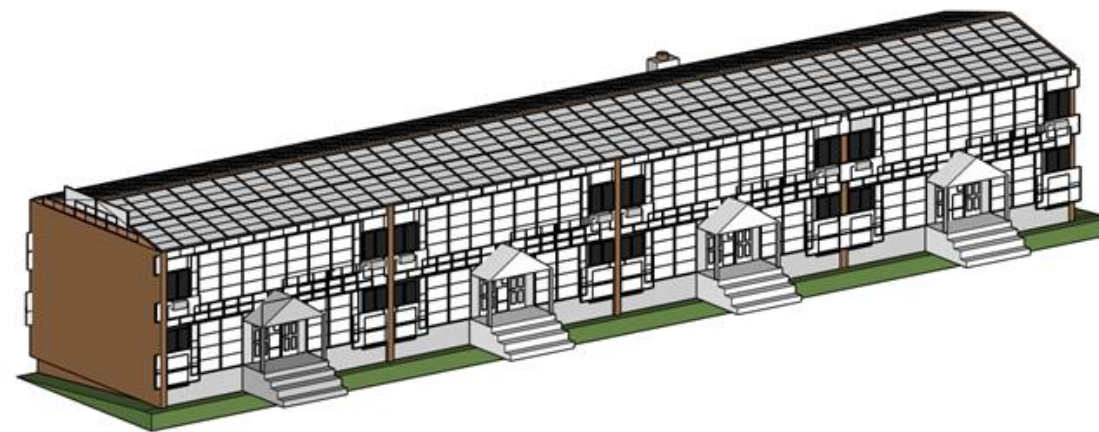
Nutgrove Garden Apartments - Albany, NY



# Panel Layout - Multifamily Buildings



Creighton Storey Homes - Albany, NY



# Next Generation Retrofit Wall Panels w/Integrated VIPs

## Preliminary Energy Savings

### Building Characteristics

Building Characteristics		
Feature	Nutgrove 1980s	Creighton 1973
Dwelling Units, qty	18	15
Bedrooms, qty	29	31
Stories, qty	3	3
Ceiling height, FT	8	8
Conditioned floor area, SF	15,957	15,028
Infiltration volume, CF	127,660	120,224
Foundation perimeter, LF	373	388
Ceiling area, SF	5,319	5,009
Slab area, SF	5,319	5,009
Gross frame wall area excluding rim area, SF	5,968	6,208
Gross foundation wall area above grade	2,238	2,328
Rim area, SF	746	776
Orientation, front	West	North
Windows, front	664	368
Windows, rear	666	920
Window area, left	0	20
Window area, right	150	20
Window area, total	1480	1328
Window to floor area ration, %	9.3%	8.8%
Door area, front	56	160
Door area, rear	0	160

Creighton Storey Homes Configuration	Site Energy: HVAC & Hot Water			Energy Cost
	MMBtu/yr	% saving	kBtu/sf	\$/yr
<b>Baseline 1:</b> R-7 walls, R-7 ceiling, R-0 slab, U-0.65 windows, 12 ach50; 90.5 AFUE gas boiler, 8.5 EER through wall AC, 0.51 EF gas water heater	1014.6		67.5	\$27,396
Upgrade 1: R-40 VIP walls, 9 ach50	771.4	24.0%	51.3	\$24,423
Upgrade 2: Upgrade 1 + R-60 ceiling, U-0.25 windows, 3 ach50	413.0	59.3%	27.5	\$19,611
Upgrade 3: Upgrade 2 + 95 AFUE, 15 CEER, 0.95 UEF WH, 0.65 SRE HRV	330.3	67.4%	22.0	\$16,976
<b>Baseline 2:</b> Baseline 1 except 60 AFUE gas boiler	1343.9		89.4	\$31,540
Upgrade 1: same as above	998.6	25.7%	66.4	\$27,281
Upgrade 2: same as above	494.0	63.2%	32.9	\$20,630
Upgrade 3: same as above	330.3	75.4%	22.0	\$16,976
<b>Baseline 3:</b> Baseline 2 except R-0 walls	1731.4		115.2	\$36,329
Upgrade 1: same as above	1039.1	40.0%	69.1	\$27,763
Upgrade 2: same as above	532.0	69.3%	35.4	\$21,073
Upgrade 3: same as above	354.2	79.5%	23.6	\$17,258
Nutgrove Garden Apartments Configuration	MMBtu/yr	% saving	kBtu/sf	\$/yr
<b>Baseline 1:</b> R-11 walls, R-19 ceiling, R-0 slab, U-0.50 windows, 10 ach50; 80 AFUE gas furnaces, 10 SEER AC, 0.56 EF gas water heaters	960.1		60.2	\$28,330
Upgrade 1: R-40 VIP walls, 8 ach50	760.6	20.8%	47.7	\$25,776
Upgrade 2: Upgrade 1 + R-60 ceiling, U-0.25 windows, 3 ach50	479.9	50.0%	30.1	\$22,262
Upgrade 3: Upgrade 2 + 95 AFUE, 16 SEER, 0.93 UEF WH, 0.65 SRE HRV	323.7	66.3%	20.3	\$18,342
<b>Baseline 2:</b> Baseline 1 except R-7 walls, R-13 ceiling, U-0.65, 12 ach50	1130.5		70.8	\$30,984
Upgrade 1: R-40 VIP walls, 9 ach50	868.8	23.1%	54.4	\$27,628
Upgrade 2: same as above	490.3	56.6%	30.7	\$22,388
Upgrade 3: same as above	330.2	70.8%	20.7	\$18,418
<b>Baseline 3:</b> Baseline 2 except R-0 walls, U-0.98 windows	1526.3		95.6	\$36,274
Upgrade 1: R-40 VIP walls, 9 ach50	981.7	35.7%	61.5	\$29,274
Upgrade 2: same as above	507	66.8%	31.8	\$22,591
Upgrade 3: same as above	348.1	77.2%	21.8	\$18,640

# Next Generation Retrofit Wall Panels w/Integrated VIPs

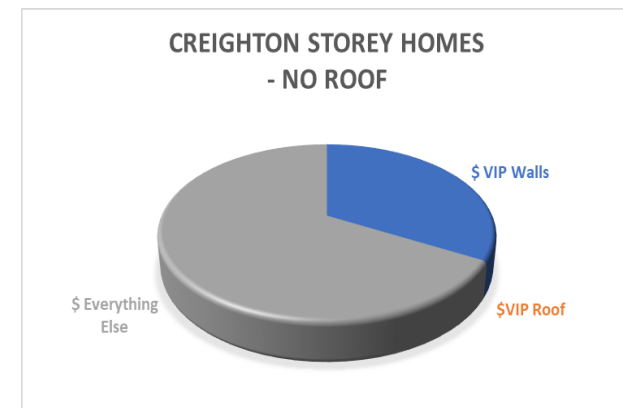
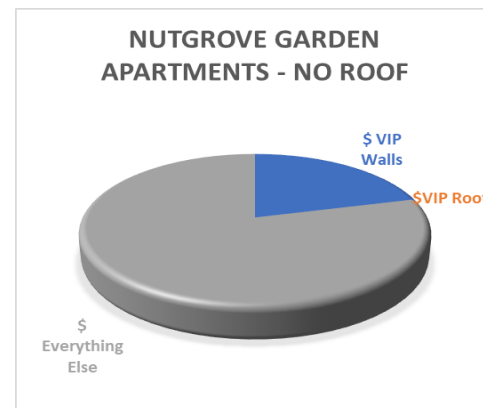
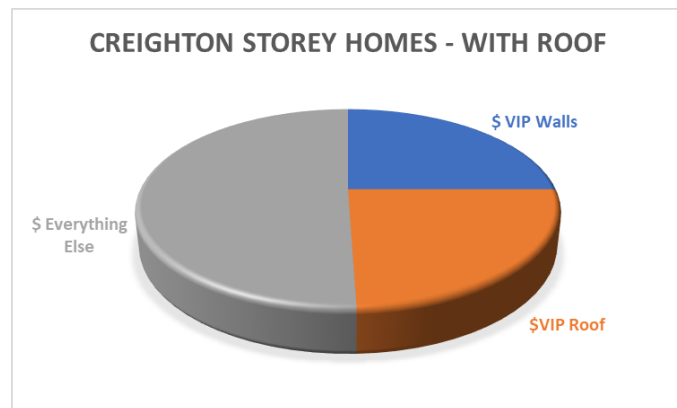
## Estimated Cost of Construction:

- Creighton Storey Homes
- Nutgrove Garden Apartments

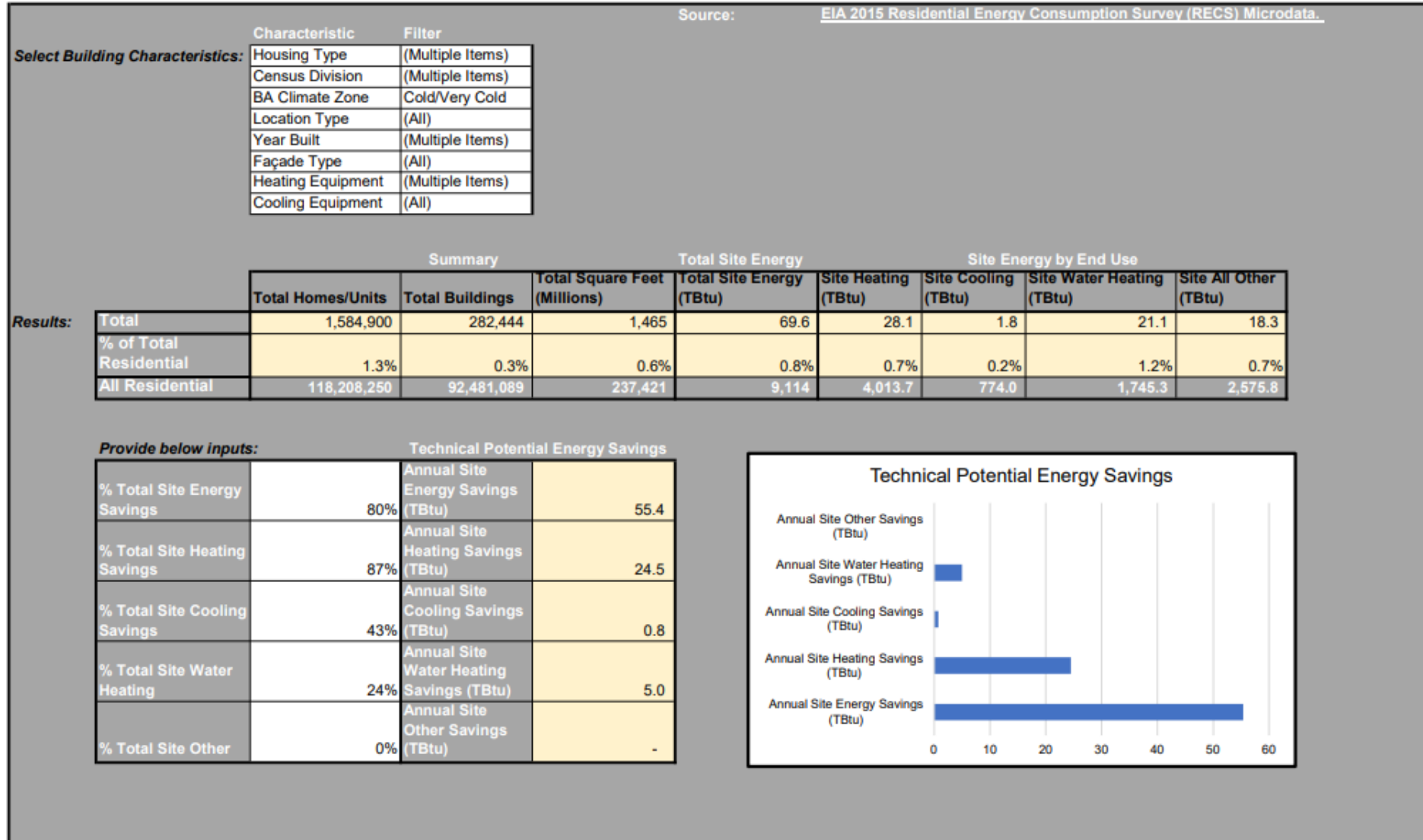
Estimated Cost of Construction: Rollup Table with Summary of Cost Details Provided in Tables Below, \$/building				
Component			Creighton	Nutgrove
VIP walls			\$161,859	\$155,892
VIP roofs (Creighton only)			\$158,590	na
Ceiling insulation (Nutgrove) & air sealing (both)			\$9,803	\$39,066
Windows			\$90,237	\$122,946
Siding (fiber cement at Creighton; vinyl at Nutgrove)			\$82,515	\$57,168
Heating			\$47,403	\$119,922
Cooling			\$33,891	\$115,265
Water heating			\$22,213	\$86,237
Mechanical Ventilation			\$41,301	\$49,562
<b>Total per Building</b>			<b>\$647,812</b>	<b>\$746,059</b>

# Next Generation Retrofit Wall Panels w/Integrated VIPs

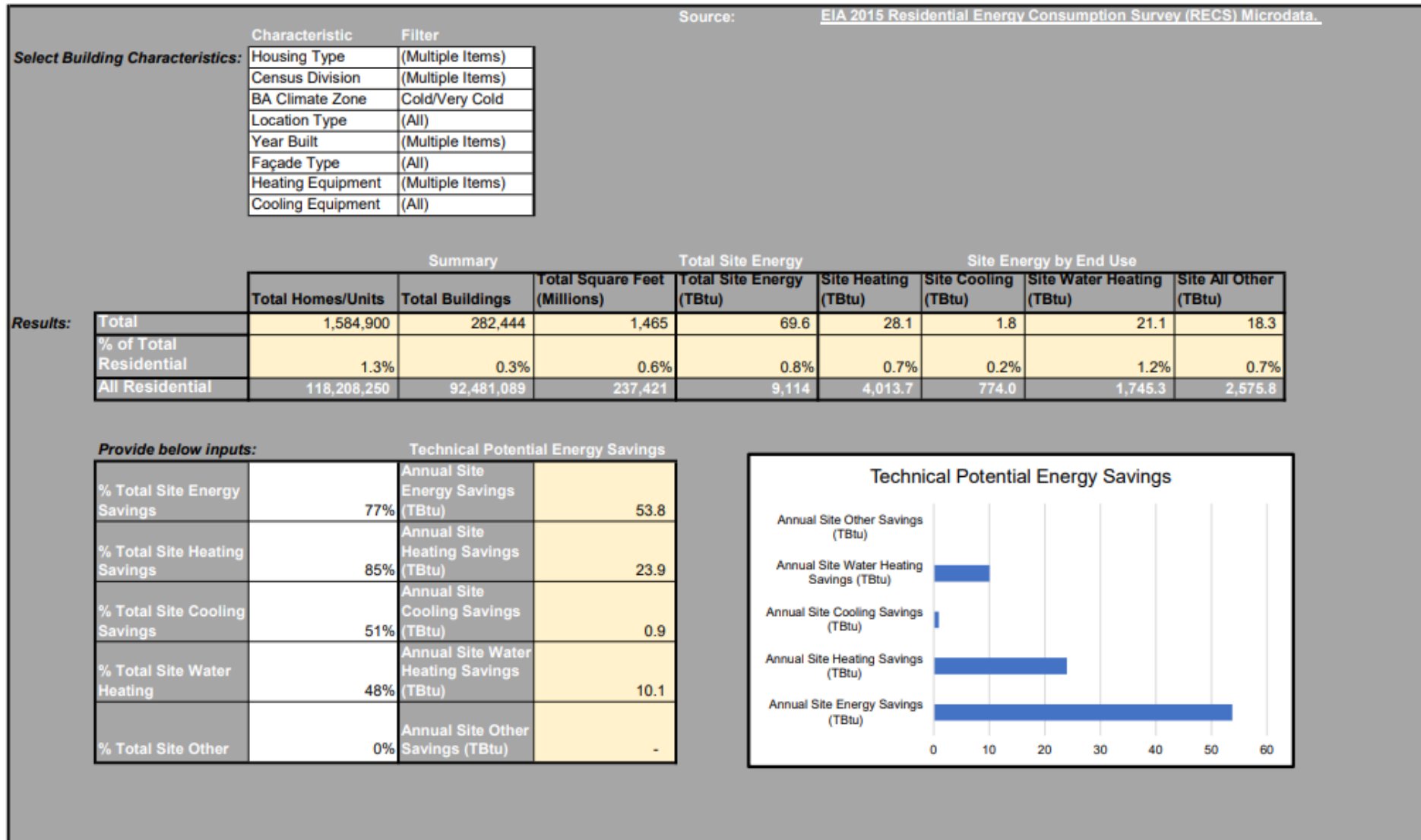
<u>Building</u>	<u>\$ Cost for Retrofit</u>	<u>No. of Units</u>	<u>\$ Cost per Unit</u>
Creighton Storey Homes	\$ 647,812.00	15	\$ 43,187.47
Nutgrove Garden Apartments	\$ 746,059.00	18	\$ 41,447.72
Creighton Storey Homes w/o Roof	\$ 489,222.00	15	\$ 32,614.80



# Next Generation Retrofit Wall Panel: Creighton Storey Homes



# Next Generation Retrofit Wall Panels: Nutgrove Garden Apartment





# Next Generation Retrofit Wall Panels w/Integrated VIPs

**QUESTIONS?**