BUILDINGENERGY BOSTON

Quality and Quantity: Strategies for Accelerating Single Family Passive Houses

Andy Allwine (Passive to Positive)
Matt Bowers (AUROS)
Michael Hindle (Passive to Positive)
John Loercher (Phius / Northeast Projects)

Curated by Danny Veerkamp (Woodhull) and Frank Stone (New Ecology)

Northeast Sustainable Energy Association (NESEA) | March 20, 2024

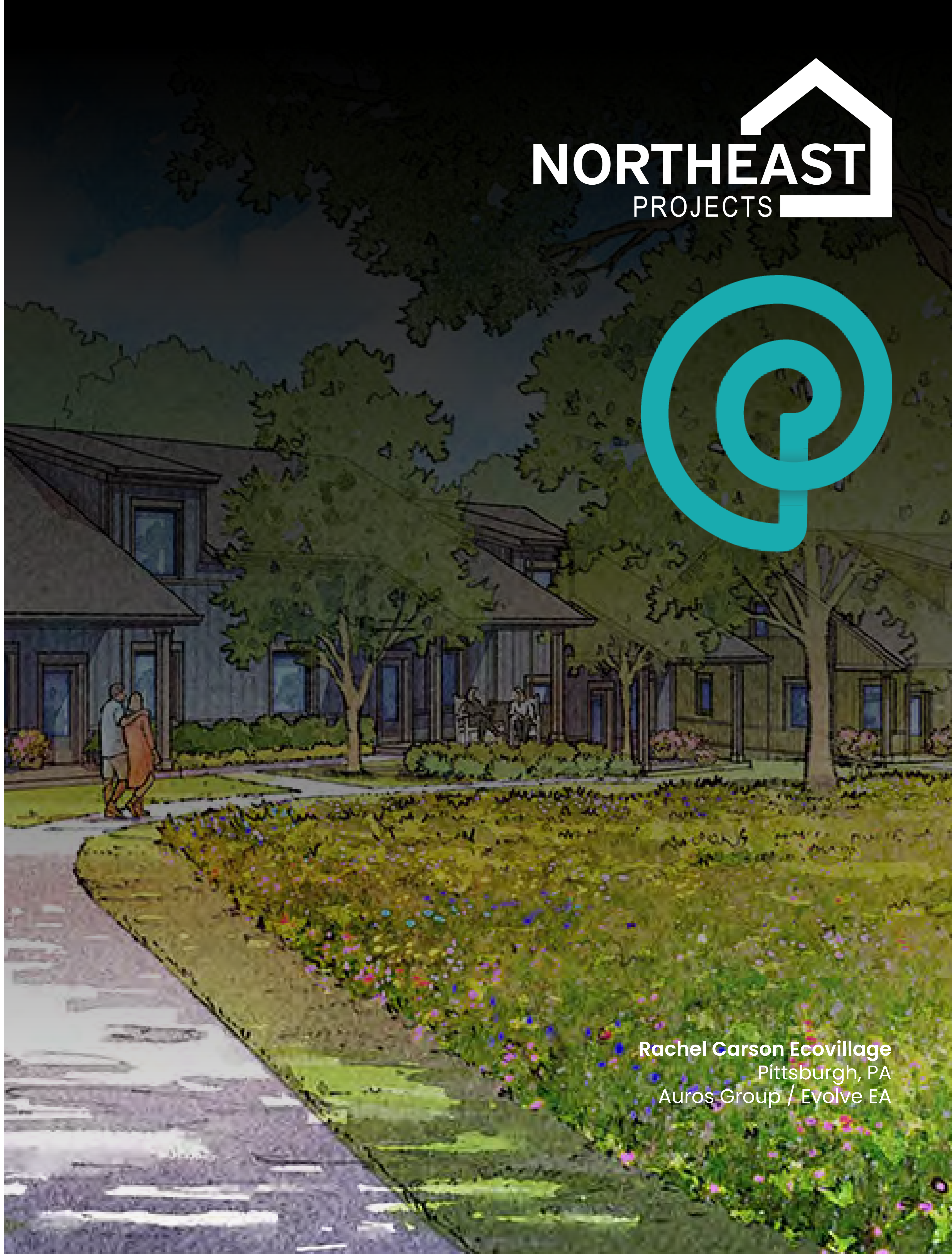
Quality *AND* Quantity

Case studies in advancing the single-family passive house market

Moderated Session (60 mins)
1- Introduction Presentation, John Loercher (5 mins)
2-Case 1: Eagle Rock, Passive to Positive – Andy Allwine (15 mins)
3-Case 2: Rachel Carson Ecovillage, Auros Group – Matt Bowers (15 mins)
4-Case 3: Flex House, Northeast Projects – John Loercher (15 mins)
5-Discussion + Q&A, (10 mins)

Learning Outcomes:
1. Expedite the process of certifying multiple single-family units within a development
2. Reduce the total cost/sq. foot of single-family homes to that seen in the multifamily market
3. Successfully prefabricate and construct entire communities of Phius certified buildings

NORTHEAST PROJECTS



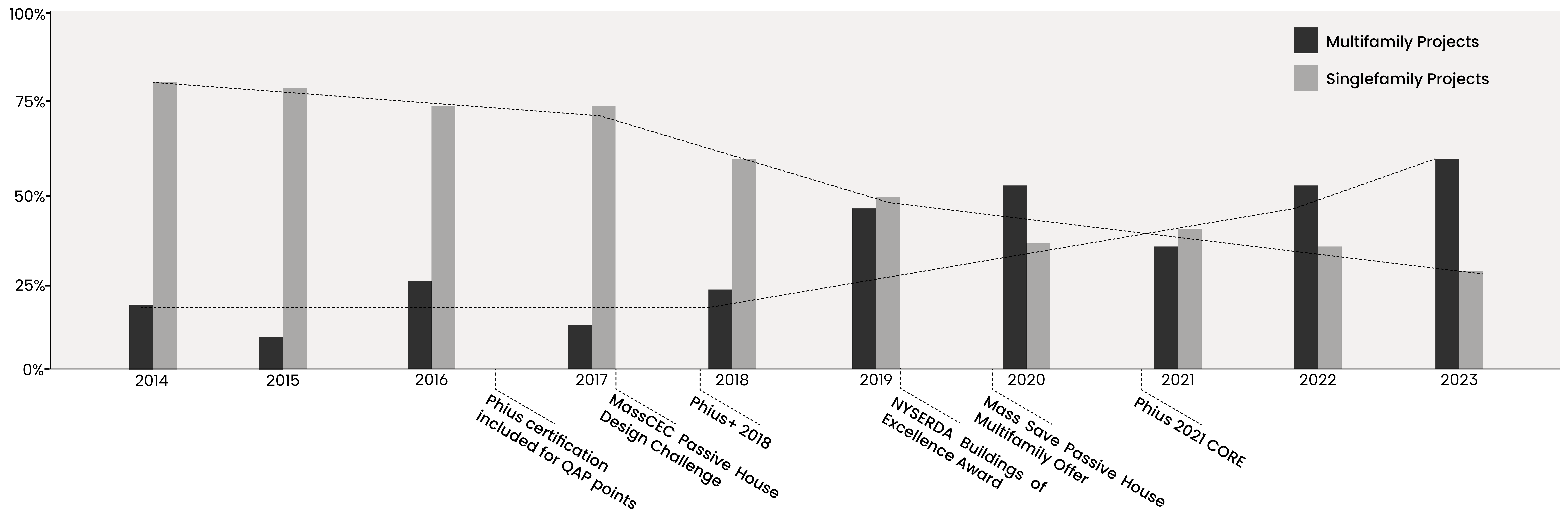
Rachel Carson Ecovillage
Pittsburgh, PA
Auros Group / Evolve EA

Certification Growth

Factors contributing to Multifamily adoption

- Better form factor - favorable building energy balance
- Proven to be only 2-5% above conventional costs
- Passive House included in QAPs across the country for LMI housing
- Updated buildings codes, stretch codes and local legislation (bottom-up approach)
- Incentives favor standardized, verifiable certifications

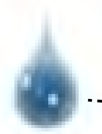
MULTIFAMILY AND SINGLEFAMILY PROJECTS
By percentage of certification, 2014 - 2023



Quality AND Quantity
(Case studies in advancing the SF Passive House Market)

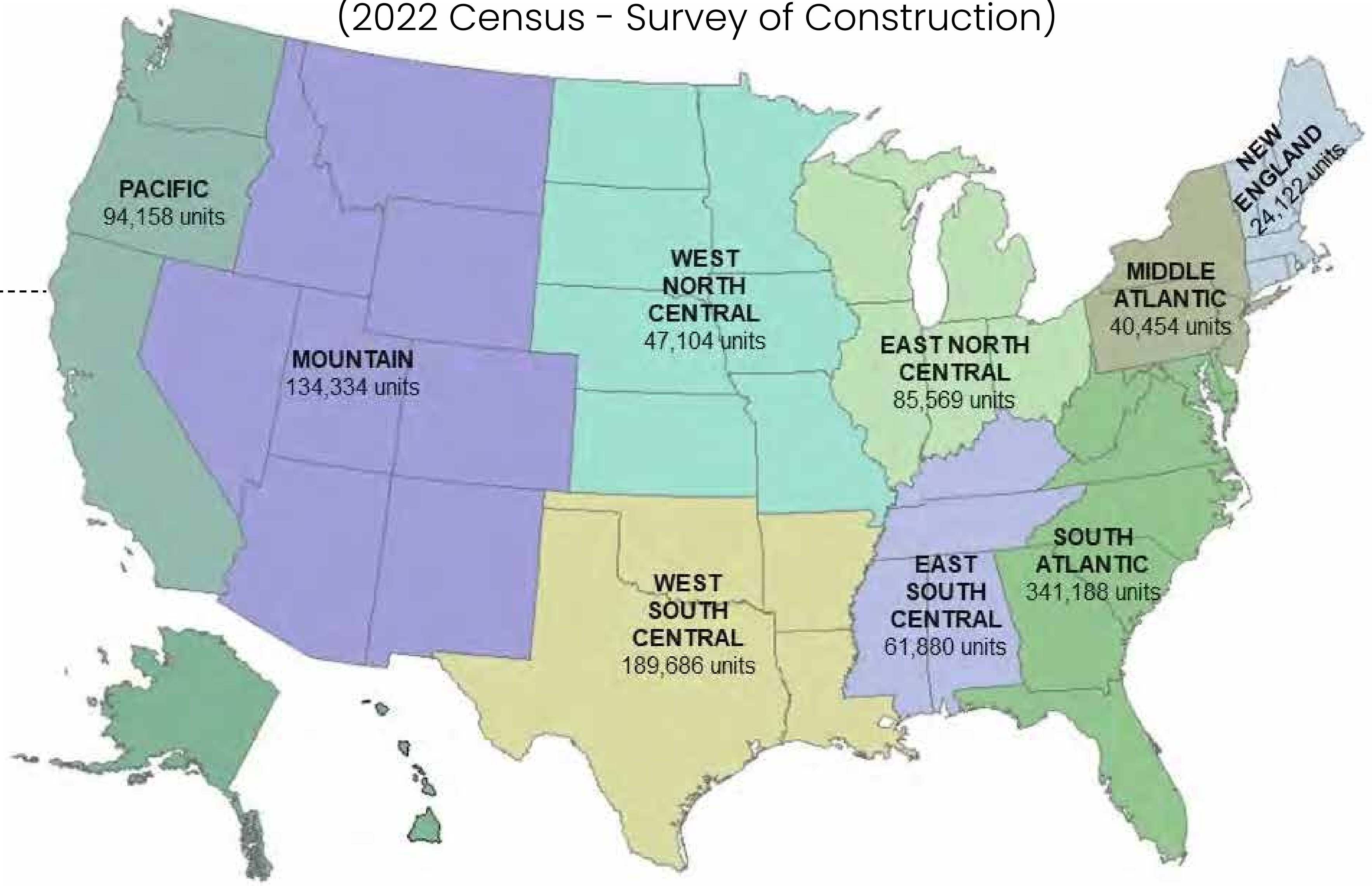
Let's make some waves

- Phius-certified single family homes make up about .02% of new construction in the US
- Custom, 'one-off' buildings have always been the focus, but not the way forward
- Retrofits are critical (new Revive program)
- We needs some accelerants in the single family market



230 Single Family Projects
(as of 2023)

1,019,495 New Single Family Projects
(2022 Census - Survey of Construction)



Accelerants

Adoptable

Prescriptive

Customizable

Alternative Construction Methods

- Prefabricated options - Modular and Panelized
- CNC fabrication
- Exciting new materials and products

Alternative Project Delivery Methods

- Integrated design development
- Design-build / Integrated Project Delivery
- Onsite training and certified professionals

Phius Protocols for Developments

- Phius offers ways to make certification for multiple buildings easier by offering:
  1. A site-source energy protocol
  2. A cumulative project review process

Phius 2021 CORE Prescriptive Path

- Significantly reduced review timeline
- Prescriptive requirements for all building components
- Not as site-dependent as the performance path

Architect: RODE Architects
CPHC: Passive to Positive
Builder: TBD

17 Individual residences integrated with complete site design and targetting Phius ZERO certification

Eagle Rock
Stoughton, MA

Architect: Evolve EA
CPHC: Auros Group / Northeast Projects
Builder: Blueprint Robotics

35 Phius 2021 CORE certified housing units across 16 buildings in a walkable ecovillage.

Rachel Carson Ecovillage
Pittsburgh, PA

Architect: North River Architecture + planning
CPHC: Northeast Projects
Builder: North River Design + Build

An adaptive design tied to the Phius prescriptive path, executed in a design-build-develop method

Flex House
Various sites, NY

Case Studies

Phius Certified
Integrated Design
Economy of Scale

Passive to POSITIVE
PASSIVE HOUSE AND LOW IMPACT DESIGN

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PHIUS
Passive House Institute US

PASSIVE HOUSE ALLIANCE UNITED STATES

Quality and Quantity SINGLE FAMILY PROJECT COMPARISON

EAGLE ROCK

DEVELOPER / BUILDER: DMITRY BASKIN
ARCHITECT: RODE
STRUCTURAL: TLH CONSULTING
MEP: TBD - DESIGN/BUILD
CPHC: PASSIVE TO POSITIVE

RODE

Passive to POSITIVE
PASSIVE HOUSE AND LOW IMPACT DESIGN

SINGLE FAMILY DEVELOPMENT - **3** BUILDING TYPES ACROSS **17** SITES

CONSISTENCY OF CONSTRUCTION ACROSS BUILDING TYPES
Variety of building form aesthetic within standardization

PASSIVE HOUSE INTEGRATION
Passive House consultants included from the beginning

INTEGRATED DESIGN & CONSTRUCTION TEAM
Experienced architect & developer with immediate past project experience

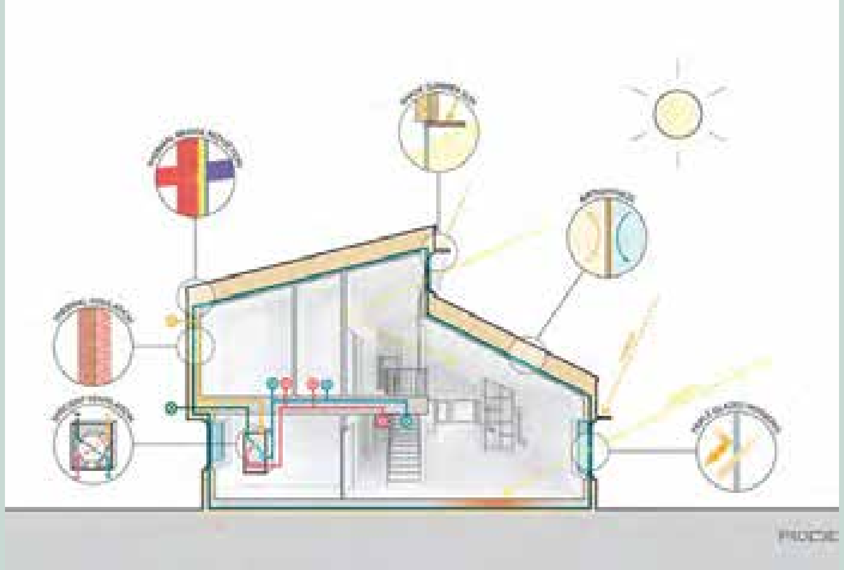
INTEGRATED DESIGN BONUS!
Low Embodied Carbon, Resilience

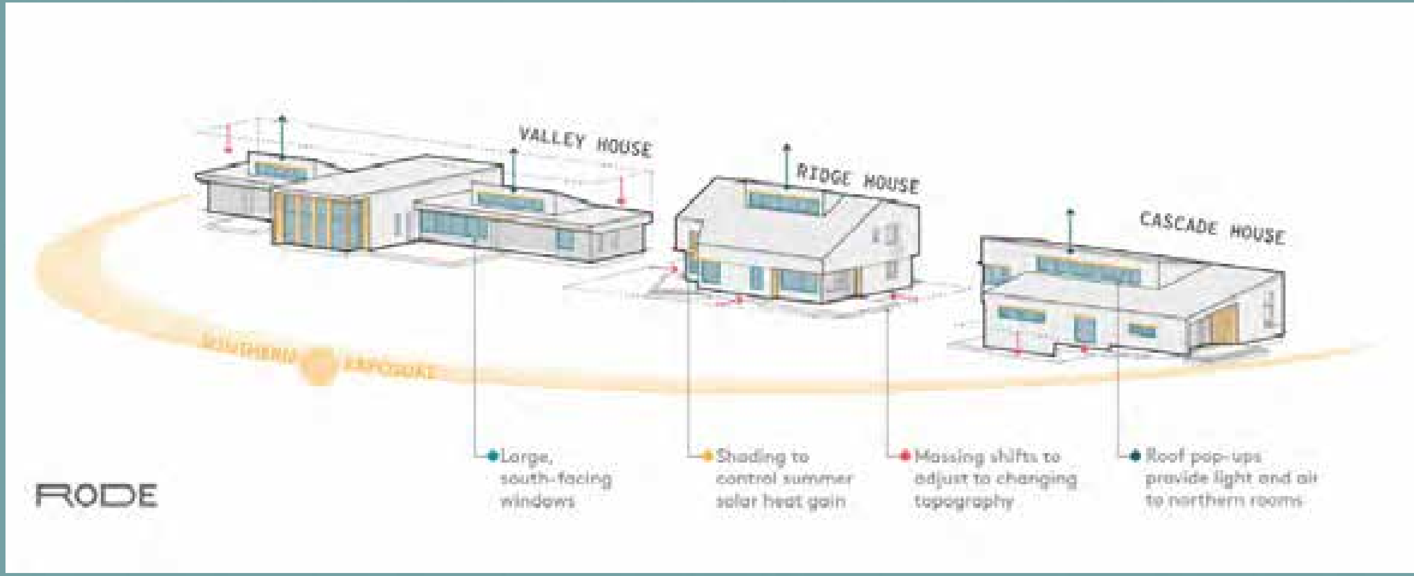
Integrated Design
Team & Process

Early CPHC integration starting at site planning

Passive House Experienced Developer & Architectural team

Optimized site orientation determined design for Passive measures





PUT THE PASSIVE BACK IN PASSIVE HOUSE

Site Design Challenges

Variable Landscape per Site
Passive design w/o consistent site shading

Site Orientation
All instances of the building are oriented within 15° of south

Variable Topography per Site
Building forms reflect the ‘optimized compromise’ between site topo and solar orientation (stack house vs split house)

Glazing Ratios & Shading
Reviews built into Architect’s design process

EAGLE ROCK FLAT HOUSE

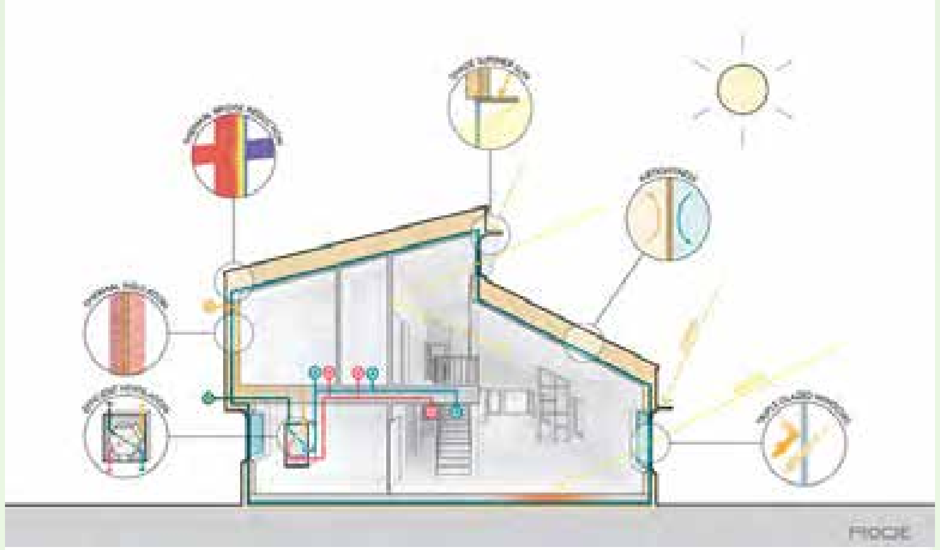
DEVELOPER / BUILDER: DMITRY BASKIN
ARCHITECT: RODE
STRUCTURAL: TLH CONSULTING
MEP: TBD - DESIGN/BUILD
CPHC: PASSIVE TO POSITIVE

RODE

Passive to POSITIVE
PASSIVE HOUSE AND LOW IMPACT DESIGN

MODELED ALL THREE HOUSES TO FEASIBILITY LEVEL TO DETERMINE WORST CASE SCENARIO

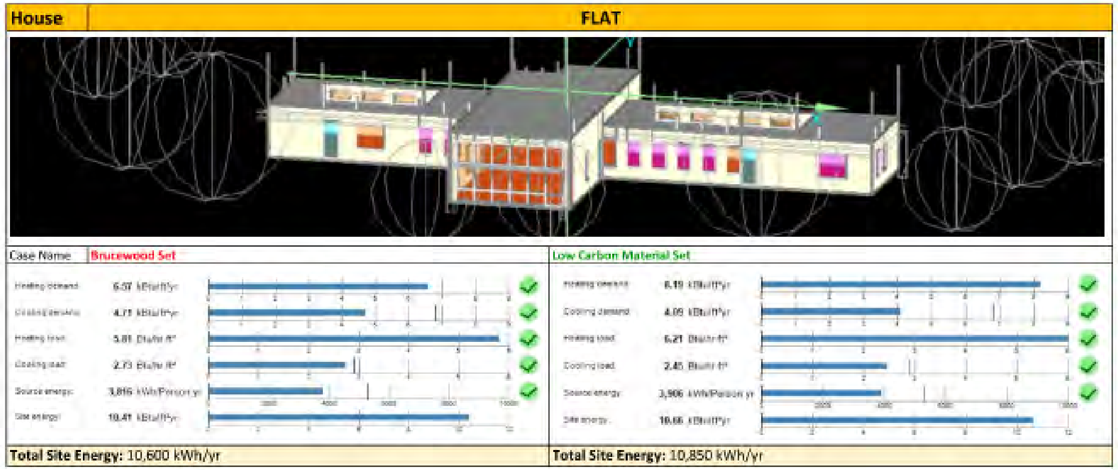
DESIGN TO THE WORST CASE SCENARIO
- **Long Linear Layout**
- **Largest iCFA/Occupant**
- **Large Southern Glass Wall**
- **Architecturally open interiors – cathedral ceilings**
- **Hidden systems**

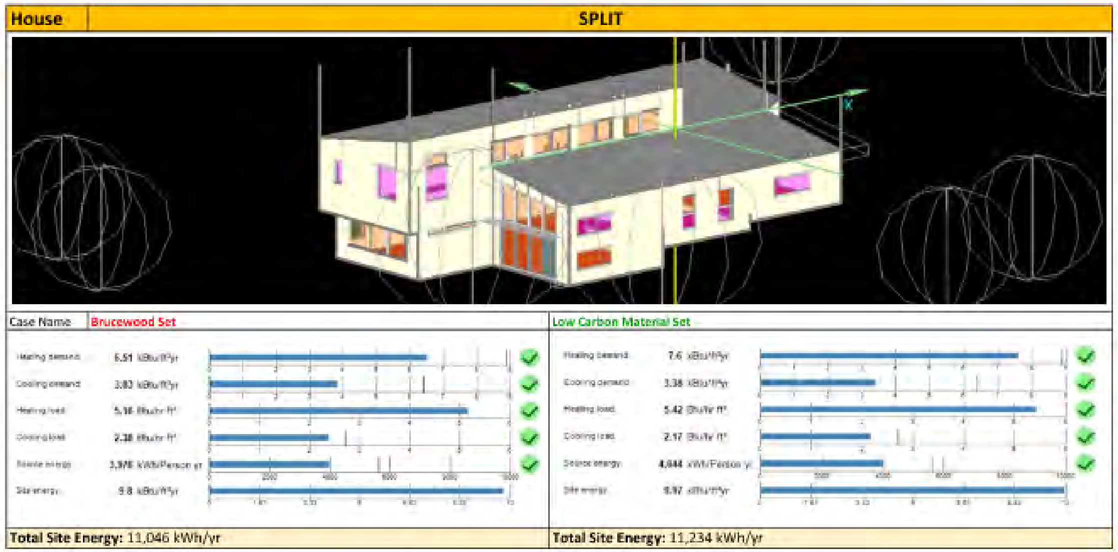


ASSEMBLIES OPTIONS AND ANALYSIS: SELECTION

Simplification by designing for the worst case

Criteria: Thermal and Airtight Performance – Constructability – Team Familiarity – Product Availability – Embodied Carbon





Passive House Results

PHIUS Passive House Criteria	Units	Split Target*	Split Results	Stacked Target*	Stacked Results	Flat Target*	Flat Results
ICFA	sf	n/a	3,845.50	n/a	3,042.30	n/a	5,473.30
Occupant Quantity	occ	n/a	5	n/a	5	n/a	5
Envelope Area	sf	n/a	11,466.10	n/a	8657.9	n/a	[illegible]
Heating demand	kBtu/sf yr	8.9	8.32	8.4	7.42	9.2	[illegible]
Cooling demand	kBtu/sf yr	6.4	2.70	6.1	7.61	5.8	1.88
Heating load	Btu/hr.sf	6.4	5.60	6.1	5.17	6.7	[illegible]
Cooling load	Btu/hr.sf	2.7	1.81	2.6	1.88	2.9	1.55
Source energy before Solar PV**	kWh/person.yr	5600.0	4,010	4850.0	[illegible]	5300.0	3,830
Site energy before Solar PV	kWh/yr		11,139.80		8,276.40		10,582.90

Assemblies

Assembly Type	Split Effective R-Values	Stacked Effective R-Values	Flat Effective R-Values
Walls	R-50	R-50	R-55
Foundation Wall	R-30	n/a	n/a
Soffit	R-60	R-50	n/a
Slab on Grade	R-30	R-30	R-33
Roof	R-60	R-60	R-79
Windows	U-Glass: 0.088, Frame U-Value: 0.176, SHGC: 0.35		
Door	U-Glass: 0.088, Frame U-Value: 0.211, SHGC: 0.35		

System Assumptions

	System Type	Location/Served and Parameters		
HVAC	Energy Recovery Ventilator	All spaces are ventilated by an ERV with a 80% sensible recovery efficiency and 68% humidity efficiency.		
HVAC	Space Conditioning	Whole building is assumed to be served by a heat pump with placeholder values. The placeholders are the following: COP of 3.2 at 17 degrees and COP of 4.25 at 47 degrees. Cooling COP is 4.79.		
DHW	Heat Pump Water Heater	The building is currently using a HPWH with the following placeholder values: COP of 3.2 and HPWH EF of 4.25. The DHW consumption is 6.6 gal/Person/day.		
VENTILATION	Room Ventilation	Total supply air rate: 143 cfm	Total supply air rate: 119 cfm	Total supply air rate: 119 cfm
VENTILATION	Room Ventilation	Total exhaust air rate: 143 cfm	Total exhaust air rate: 119 cfm	Total exhaust air rate: 119 cfm
VENTILATION	Exhaust Ventilation	No exhaust ventilation; however, all models would still pass with a range hood that has an exhaust volume air flow rate of 150 cfm.		
PV	Photovoltaic Array	All models reflect no PV production.		

Envelope Airtightness

Envelope Airtightness at 50 Pa (cfm/sqft)	0.06 cfm/sqft

Notes

* The provided PHIUS targets were created based on the envelope area, ICFA, dwelling units and total bedrooms.

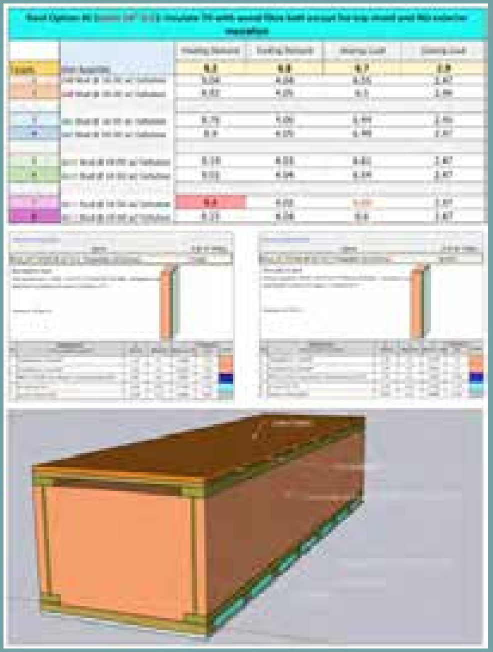
** These results reflect no PV input.

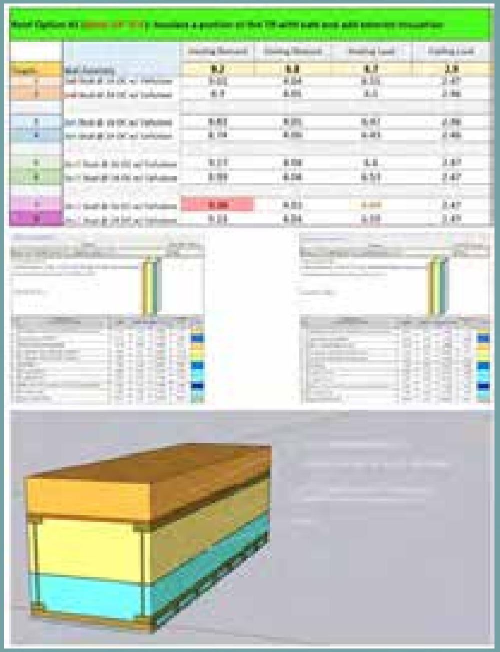
ASSEMBLIES
ROOF OPTIONS

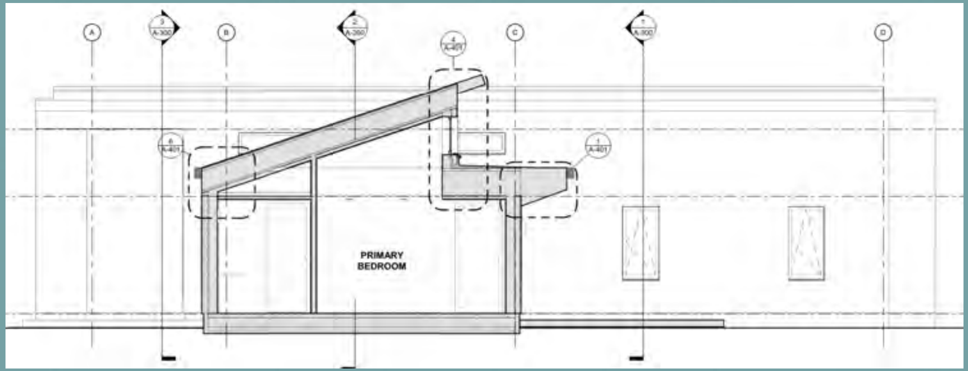
Various roof forms on the project:
- Shed
- Gable
- Dormers
- Flat roof

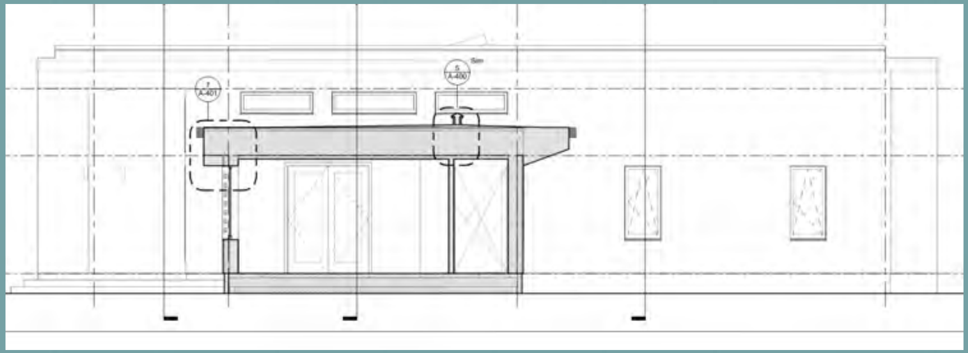
Attempt to use one roof assembly concept

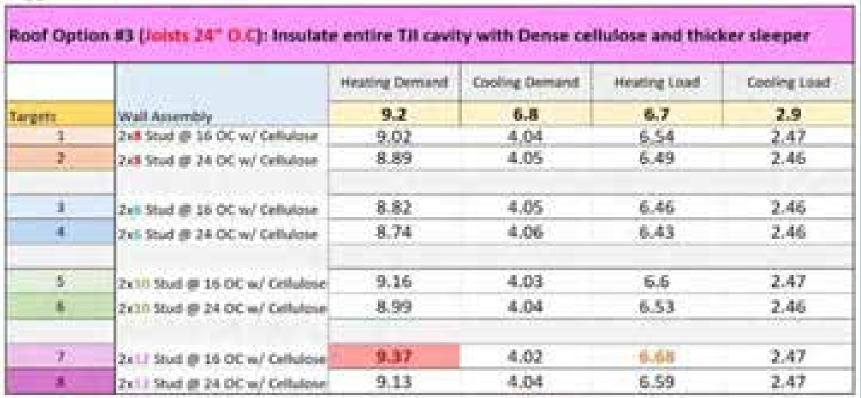
Low slope vented roof is cost savings that we can leverage.





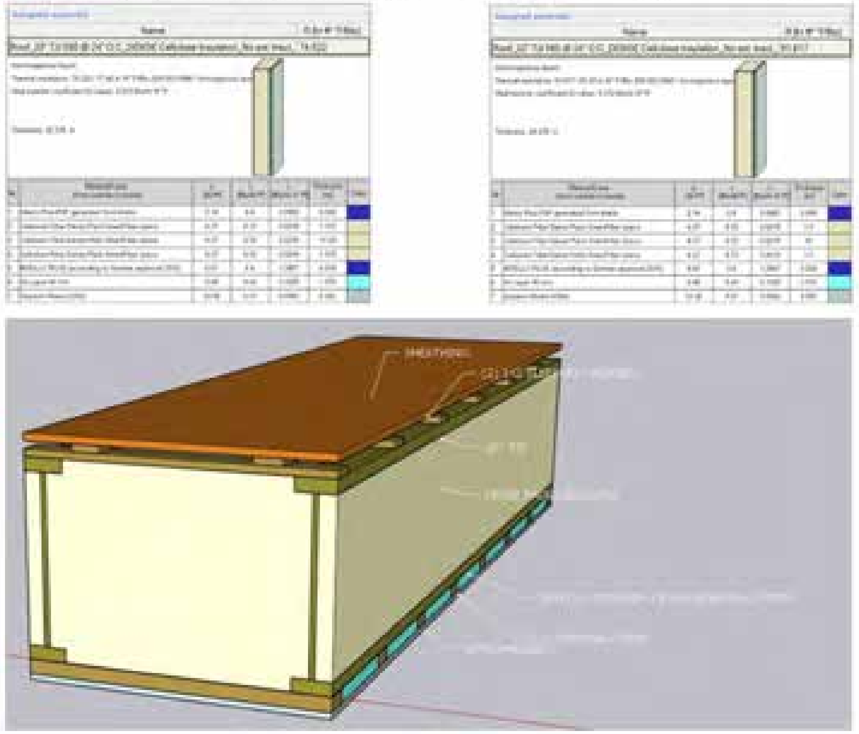


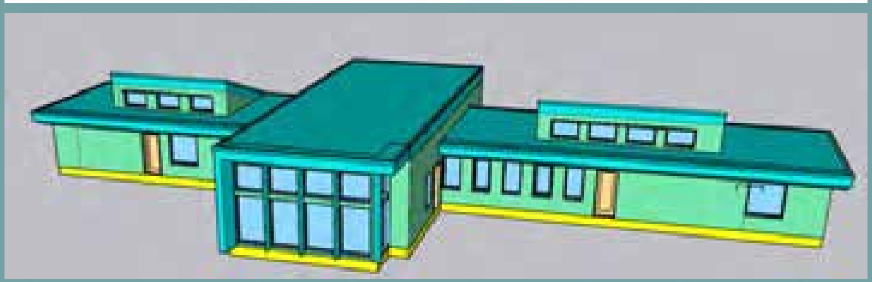




Roof Option #3 (Joists 24" O.C): Insulate entire TJI cavity with Dense cellulose and thicker sleeper

Targets	Wall Assembly	Heating Demand	Cooling Demand	Heating Load	Cooling Load
		9.2	6.8	6.7	2.9
1	2x8 Stud @ 16 OC w/ Cellulose	9.02	4.04	6.54	2.47
2	2x8 Stud @ 24 OC w/ Cellulose	8.89	4.05	6.49	2.46
3	2x6 Stud @ 16 OC w/ Cellulose	8.82	4.05	6.46	2.46
4	2x6 Stud @ 24 OC w/ Cellulose	8.74	4.06	6.43	2.46
5	2x10 Stud @ 16 OC w/ Cellulose	9.16	4.03	6.6	2.47
6	2x10 Stud @ 24 OC w/ Cellulose	8.99	4.04	6.53	2.46
7	2x12 Stud @ 16 OC w/ Cellulose	9.37	4.02	6.68	2.47
8	2x12 Stud @ 24 OC w/ Cellulose	9.13	4.04	6.59	2.47

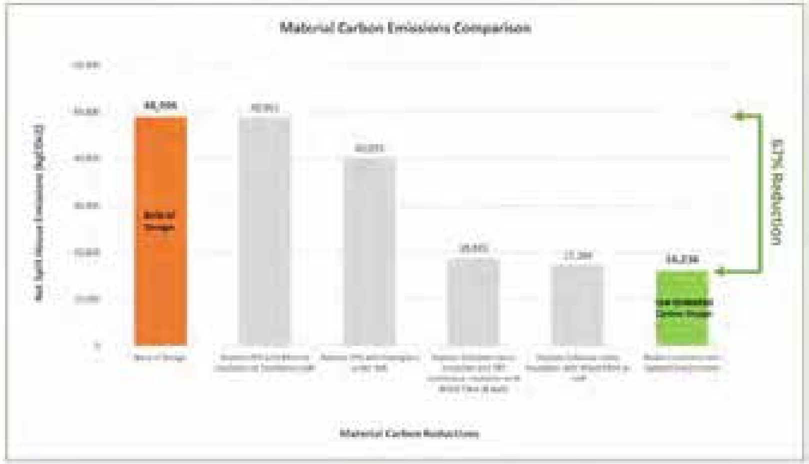


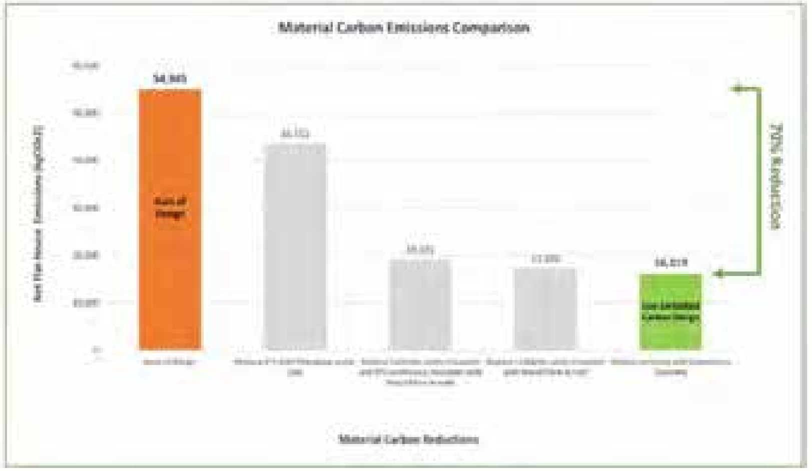


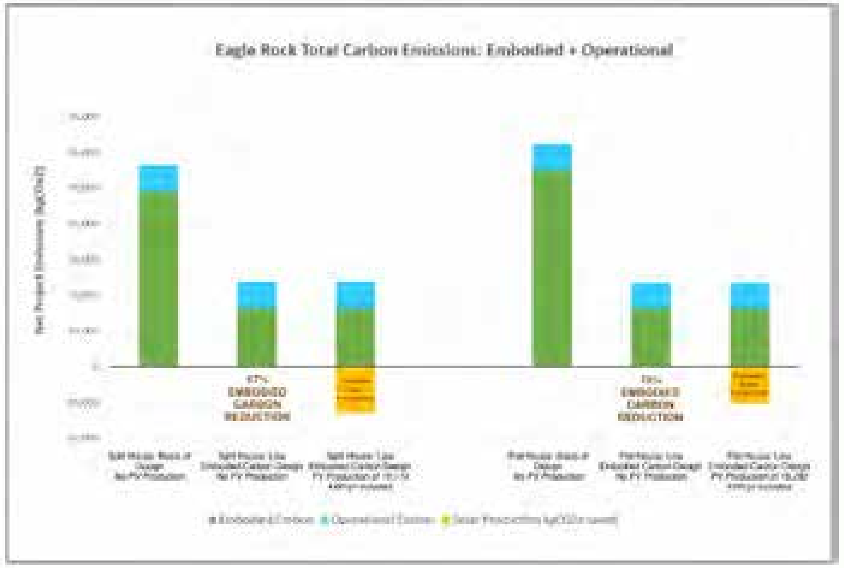
ASSEMBLIES OPTIONS AND ANALYSIS: EMBODIED CARBON

Information as **Power** and **Leverage.**

Early iterative studies of **Embodied Carbon** research and analysis led to new opportunities and added project goals.







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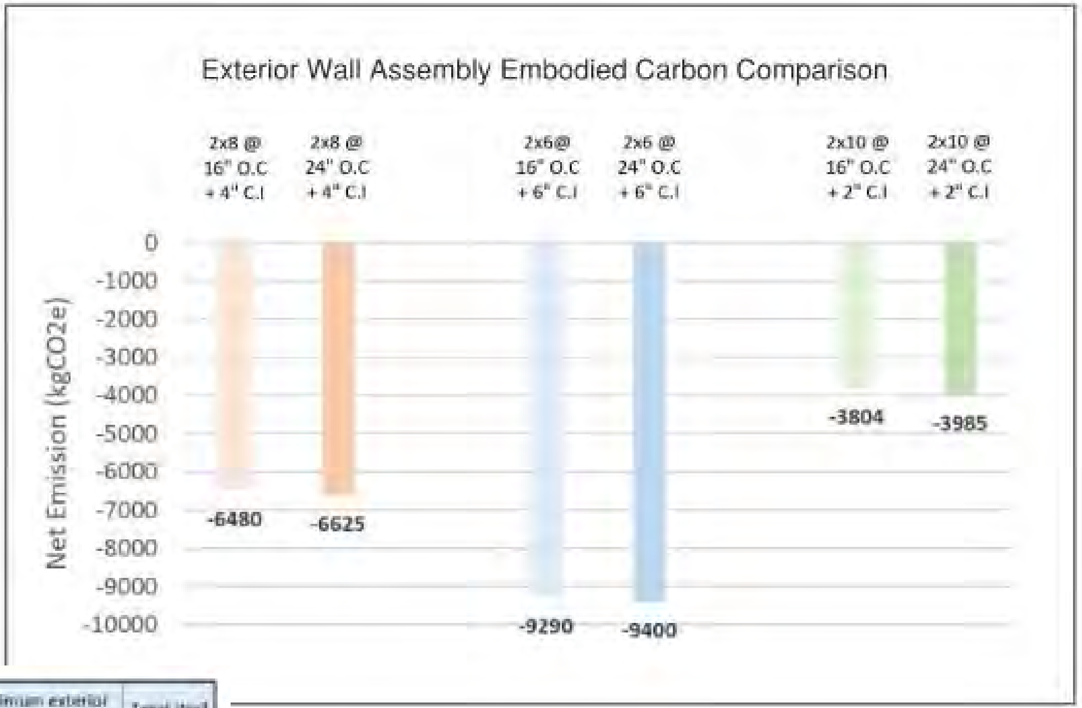
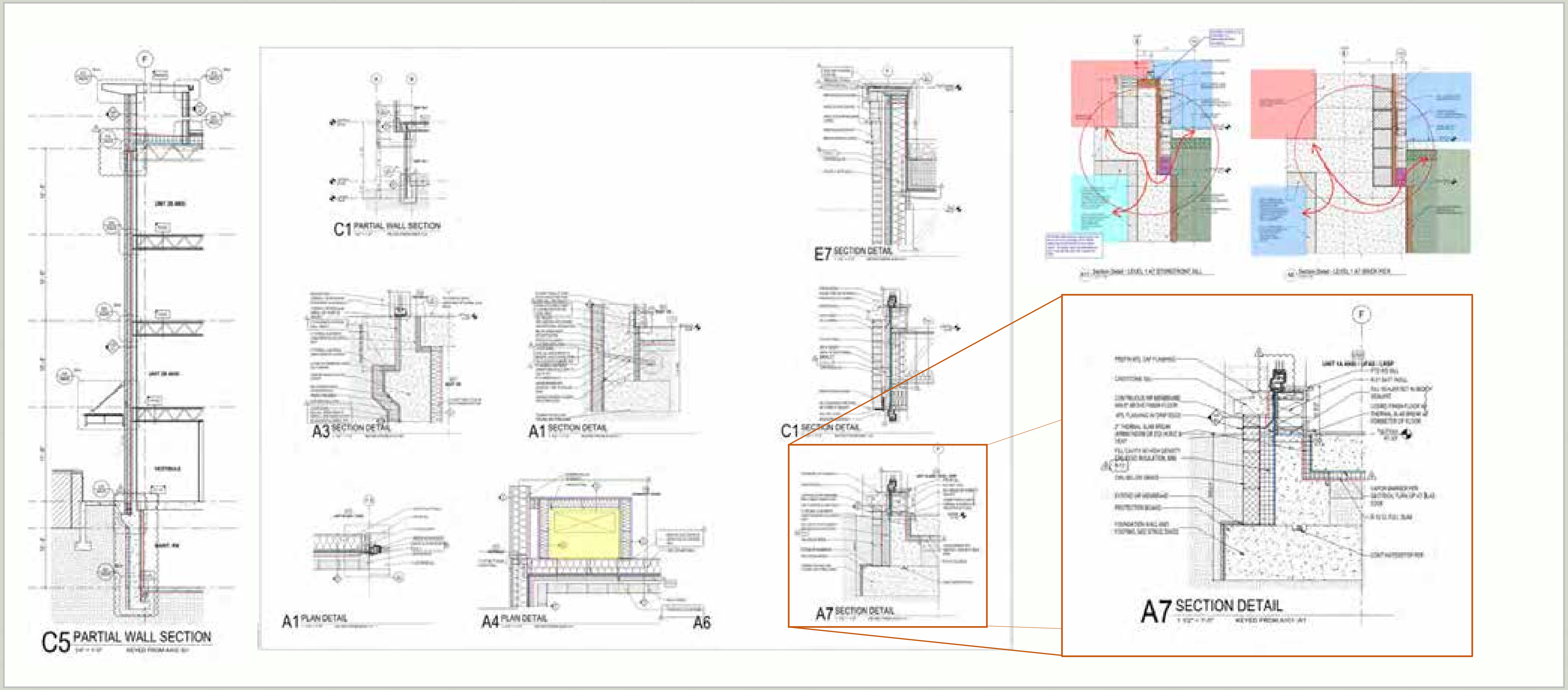


	Wall Assembly	Minimum exterior insulation needed to Pass PHIUS (inches)	Total Wall R-Value
1	2x8 Stud @ 16 OC w/ Cellulose	4	38.485
2	2x8 Stud @ 24 OC w/ Cellulose	4	39.529
3	2x6 Stud @ 16 OC w/ Cellulose	6	40.207
4	2x6 Stud @ 24 OC w/ Cellulose	6	40.961
5	2x10 Stud @ 16 OC w/ Cellulose	2	37.294
6	2x10 Stud @ 24 OC w/ Cellulose	2	38.712

THERMAL BRIDGING ANALYSIS

Varying house types and topography = Unique conditions for each house => Quick analysis of thermal bridge worst case scenarios.

Design team buy-in meant early conversations with the architectural and structural teams.



RESILIENCE CONCEPTS

- CPHC led conversation – potential for 'Resilience Upgrade' Packages.
- Can be an easy add-on for the developer – 3 solar/battery studies, 17 possible upgrades.

Eagle Rock 'Resiliency Packages'

Basis of Design: Passive Survivability: High Performance Building Envelope & Systems - Passive House design principles provide a house that will maintain comfort and occupant safety year-round, with minimal energy inputs. - Deep and meaningful energy use reductions. - Robust thermal and airtight envelope, controlled ventilation and use of efficient MEP systems.	
Package 1: Net Zero - Solar PV provided on the roof to meet Net Zero Energy target.	
Package 2: Balanced PV and Energy Storage (Resilience) - Solar PV provided on the roof. - PV power production is balanced between everyday use and battery storage. - Includes critical loads review for storage system sizing.	
Package 3: Full Zero Energy and Resilience - Solar PV provided on the roof to meet Net Zero Energy target. - Additional PV for battery storage. - Includes critical loads review for storage system sizing. - Includes possible bi-directional EV charging / EV as house battery system.	


Building COMMUNITY
MORE THAN A DEVELOPMENT – PLACEMAKING
What makes this community unique?
What ties these houses together?
How is this place marketable?

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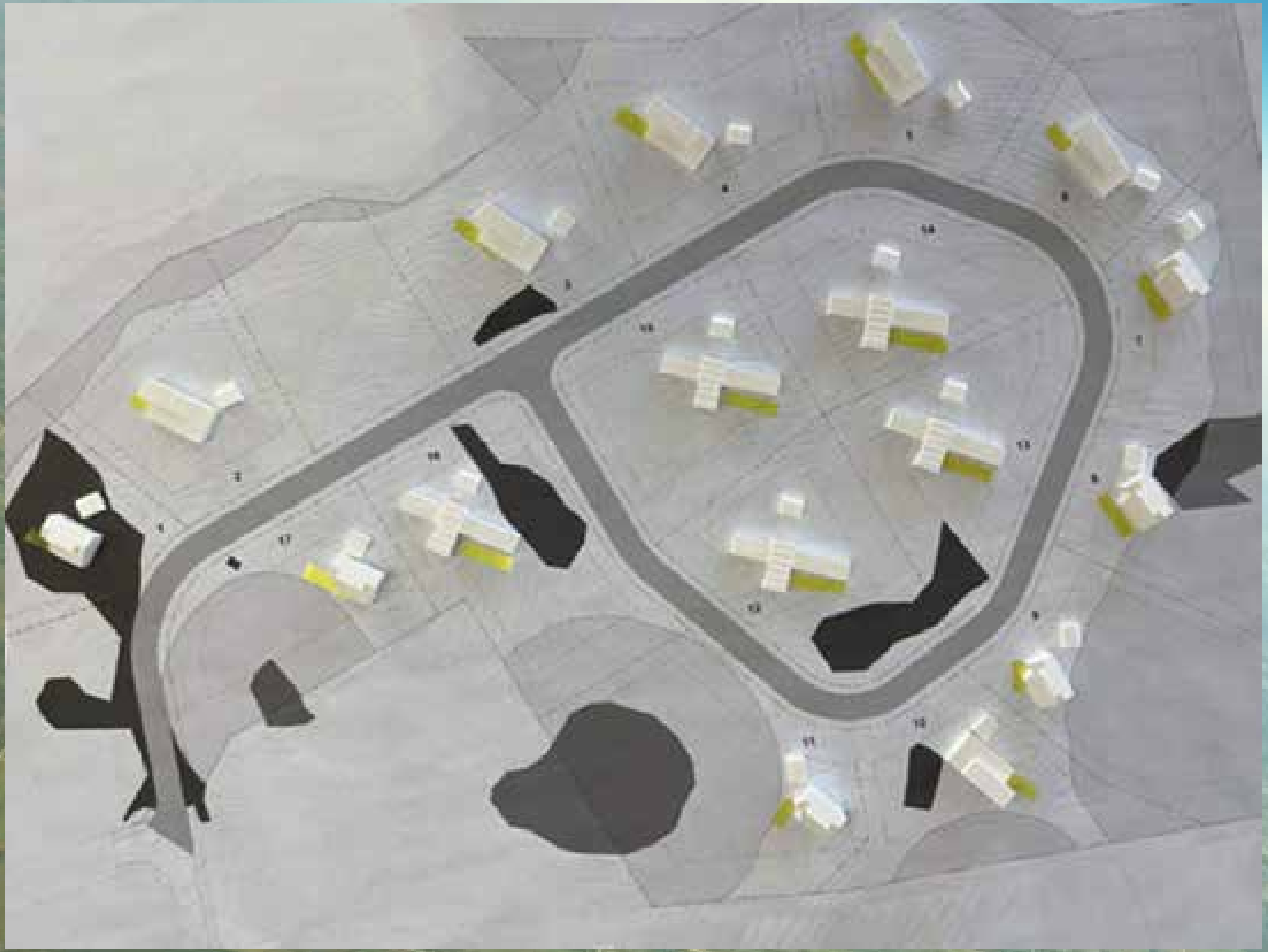
SHARED DESIGN AESTHETIC

USONION CONCEPT



Building COMMUNITY

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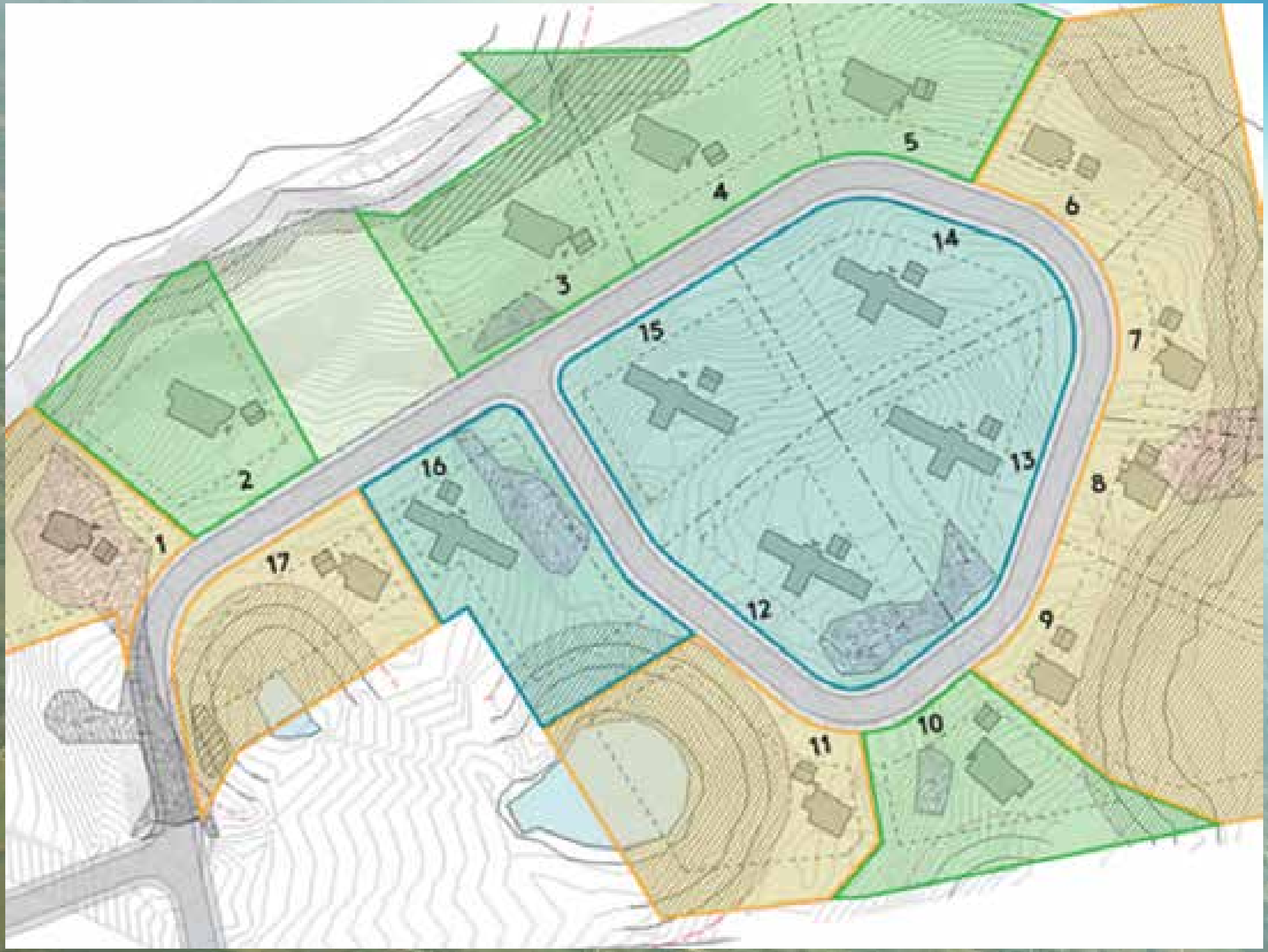

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SHARED DESIGN AESTHETIC

USONION CONCEPT

LOW-IMPACT ETHIC

CONSERVATION FIRST – DO NO HARM

EMBODIED CARBON REDUCTION

Building COMMUNITY

MORE THAN A DEVELOPMENT – PLACEMAKING

What makes this community unique?

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SHARED DESIGN AESTHETIC

USONION CONCEPT

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CONSERVATION FIRST – DO NO HARM

EMBODIED CARBON REDUCTION

HEALTH AND COMFORT

RESILIENT HOMES, RESILIENT COMMUNITY

SHARED RESOURCES

SHARED PURPOSE

Passive to POSITIVE
PASSIVE HOUSE AND LOW IMPACT DESIGN

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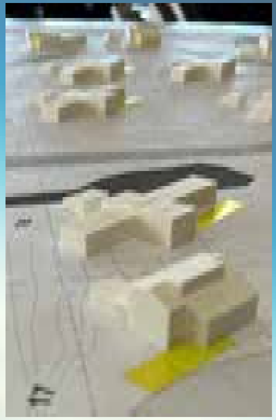
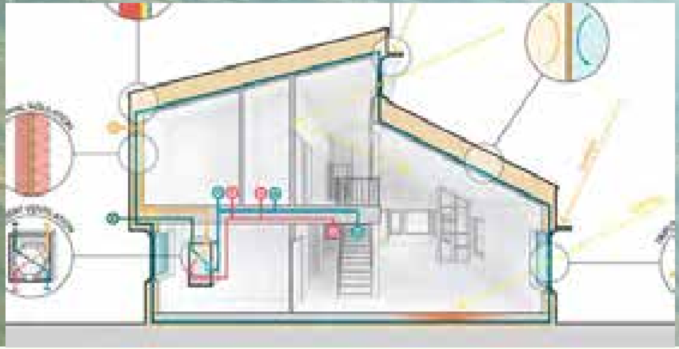










Joe Skibba, Depiction LLC

“There was once a town in the heart of America where all life seemed to live in harmony with its surroundings.”

Rachel Carson EcoVillage

Our design and construction team is experienced in integrated high-performance design for sustainability.

EcoVillage Design Team

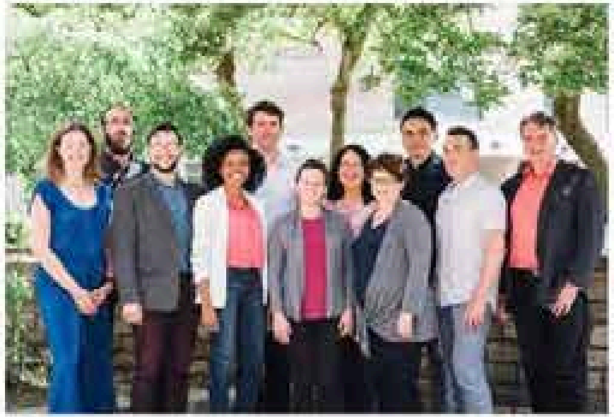
evolveEA, architecture
Fourth River Workers Guild, ecological construction
Larry Weaner Landscape Associates, natural landscape cultivation
Civil and Environmental Consultants, engineering
AUROS Group, CPHD/C, high performance building designers
Stefani Danes FAIA, project manager

Integrated Design Process

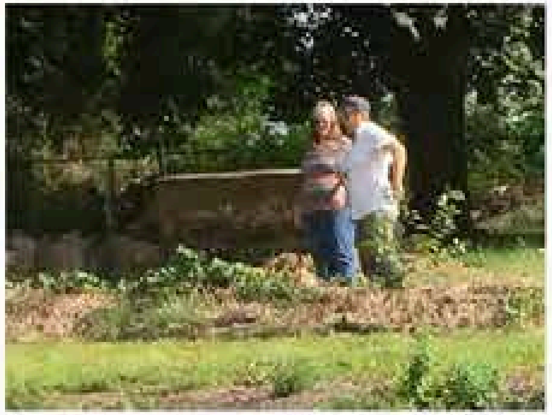
A multi-disciplinary collaborative process that encompasses design, construction, operation, and occupancy of a building over its lifecycle.

The best method for realizing high performance buildings and sustainable communities within a budget.

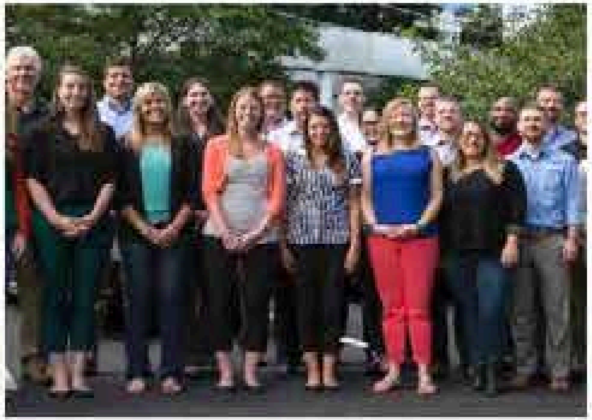
evolveEA, architecture



Fourth River Workers Guild, ecological construction



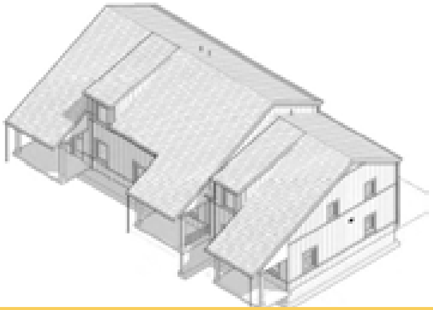
Civil & Environmental Consultants, civil engineering



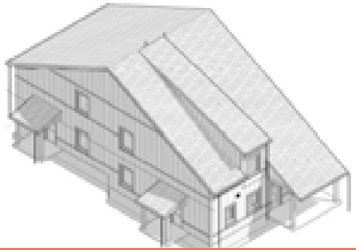
AUROS Group, CPHD/C, building performance

35 homeownership units and a common house

Four building types

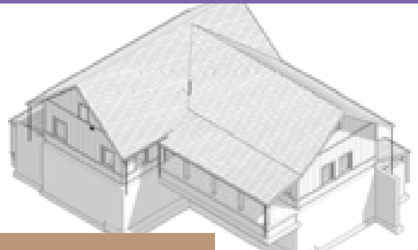


Three one-bedroom units (3)

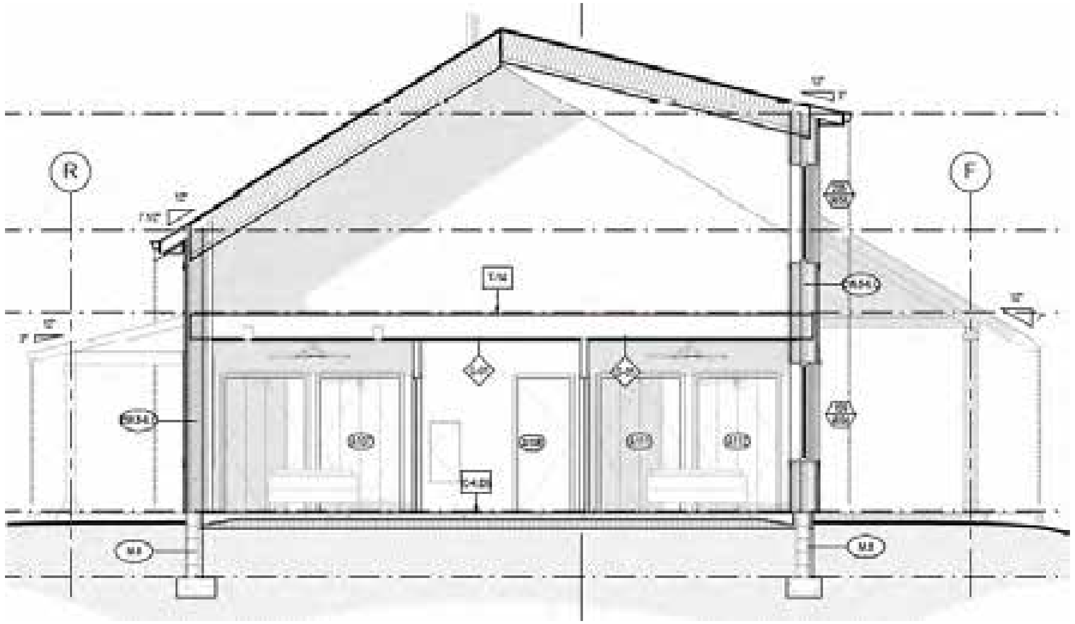


Two two-bedroom units (8)

Two two-bedroom units (4)



Common House



Energy modeling was integrated into the design process. Starting with early schematics, each design iteration was tested and costed before proceeding to the next.

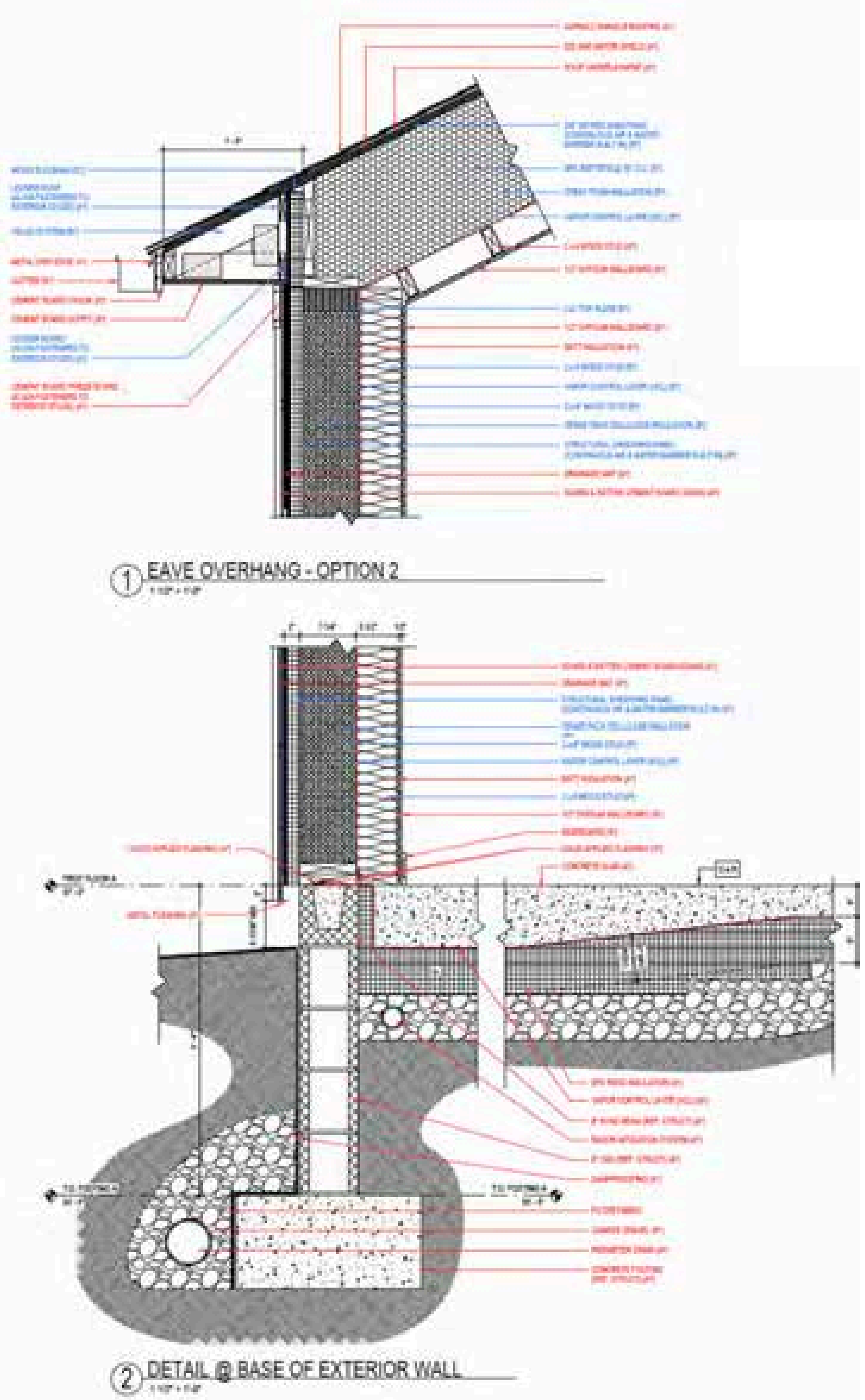
Hygrothermal modeling began during design development and guided construction detailing.

AUROS GROUP

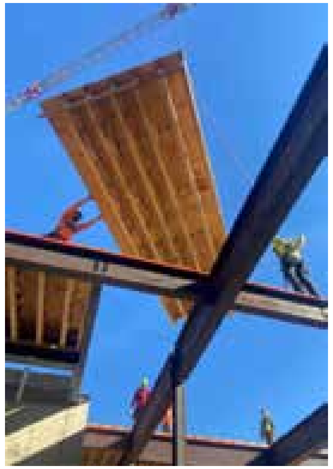
Passive House (PHIUS) Criteria

PHIUS Certification

	Phius #	Units	Phase	Azimuth	H. Demand	C. Demand	H. Load	C. Load	Source
Building X				Targets:	8	5.2	5.5	2	5425
X1	2358	X11	Design Cert	210	8.05	2.28	5.06	1.35	4907
		X12							
		X13							
X2 (prototype)	2064	X21	Design Cert	181	7.33	3.32	4.93	1.75	4878
		X22							
		X23							
X3	2359	X31	Design Cert	128	7.97	2	4.93	1.24	4870
		X32							
		X33							
Building Y				Targets:	8.4	5.6	5.9	2.1	5175
Y1 (prototype)	2062	Y11	Design Cert		7.8	2.02	5.08	1.6	3793
		Y12							
Y2	2360	Y21	Design Cert	232	8.39	1.31	5.17	1.25	3791
		Y22							
Y3	2361	Y31	Design Cert	232	8.39	1.22	5.16	1.19	3783
		Y32							
Y4	2362	Y41	Design Cert	174	8.38	1.45	5.18	1.29	3800
		Y42							
Y5	2363	Y51	Design Cert	254	8.39	1.16	5.16	1.14	3777
		Y52							
Y6	2364	Y61	Design Cert	238	8.09	1.3	5.11	1.25	3764
		Y62							
Y7	2365	Y71	Design Cert	290	8.24	1.24	5.13	1.19	3770
		Y72							
Y8	2366	Y81	Design Cert	266	8.09	1.22	5.09	1.19	3757
		Y82							
Building Z				Targets:	8.3	5.6	5.9	2.1	4675
Z1	2367	Z11	Design Cert	185	7.67	1.94	5.25	1.63	3672
		Z12							
Z2	2368	Z21	Design Cert	203	7.72	1.95	5.26	1.64	3677
		Z22							
Z3 (prototype)	2063	Z31	Design Cert		7.27	2.45	5.02	1.84	3669
		Z32							
Z4	2369	Z41	Design Cert	262	7.78	2.58	5.33	1.89	3726
		Z42							



The buildings are panelized by Blueprint Robotics in their factory in Baltimore MD with windows, ductwork, pipes, and wiring.



Images courtesy of Blueprint Robotics

Offsite Fabrication

Risk Reduction

Single point of contact for the most demanding areas of the project's scope.

Fully coordinated interfaces and conflict resolution, including rough and finish, for:

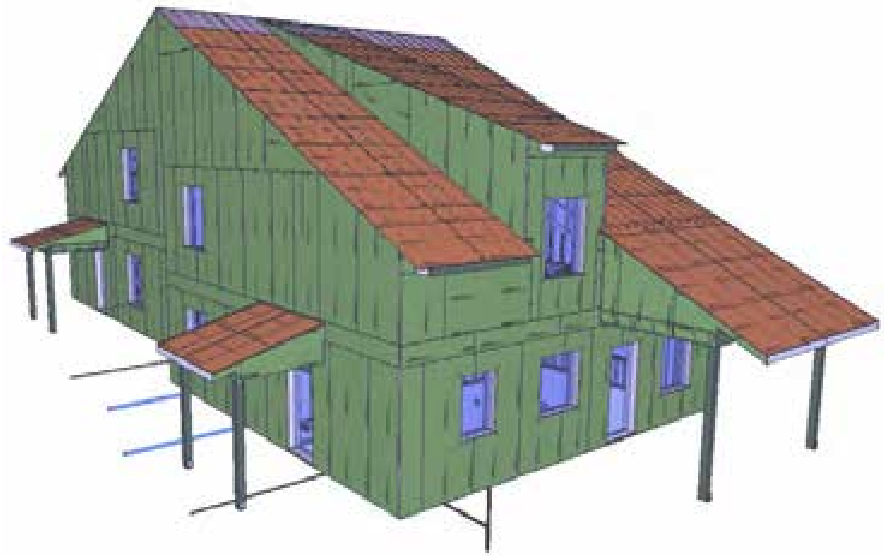
- Framing and Envelope
- Structural
- Mechanical
- Plumbing
- Electrical
- Fire Protection

High Quality

- Factory installed windows/doors.
- Precision manufacturing combining CNC machinery and skilled craftsmanship.
- Cross Laminated Timber to replace traditional CMU cores
- Standard default to high quality materials
- QA/QC for PHI/PHIUS details, framing, and MEP

Sustainability

- Zero wood waste to landfills
- Material optimization
- Coordination and clash detection reduce change orders

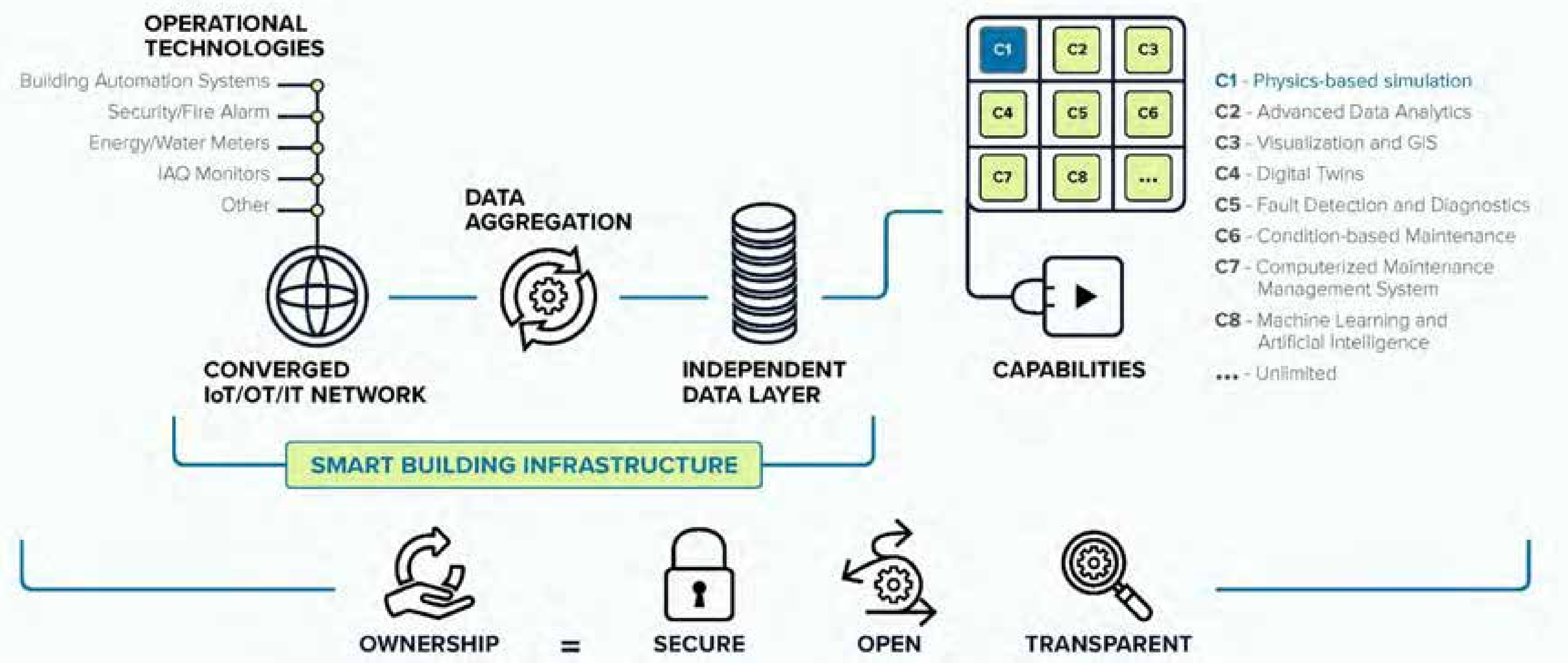


Project is constructed directly from 3D model

Images courtesy of Blueprint Robotics

Democratizing Building Data

Smart Building Infrastructure



Smart Building Infrastructure

Controlling Your Building Data

Generate Data

Power Meter

Natural Gas Meter

Potable Water Meter

Indoor Air Quality Monitor

Aggregate Data

JACE Devices

Manage Data

Time-Series Data Intake & Normalization

Data Storage Historian

Unified User Interface

-Visualization & GIS

Use Cases

Data Analytics

-Decarbonization & CO2e Accounting

Operationalize Physics-based Simulation

-Monitoring-based Commissioning

-Whole-Building Decarbonization Plan

Minimum Viable Product

Smart Building Infrastructure

JACE Device
= $1,200

Power Meter
= $250

Primary Source Electric
Ephoca Heat Pump/ERV
State Heat Pump Water Heater

Indoor Air Quality Monitor
= $400

Digital Twin
= $500 per year

For more information about Rachel Carson EcoVillage, please contact us.

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Prescriptive Pathways

Scaling Up
Single Family
Residential
Design
in
New York's
Hudson Valley

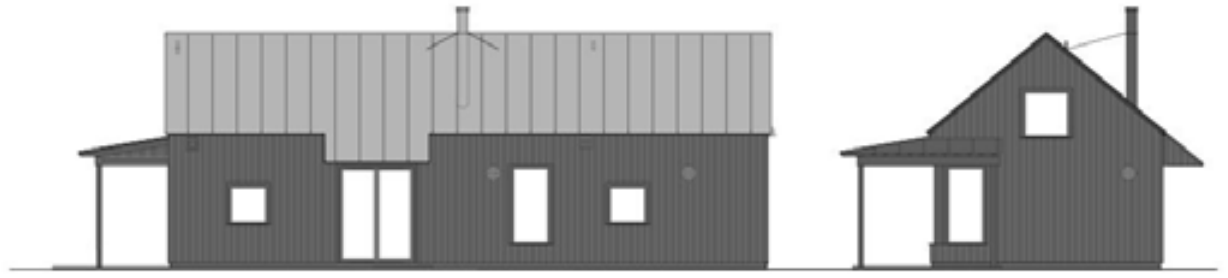
NORTH RIVER

NORTHEAST PROJECTS

FLEXHOUSE I

1000 sf

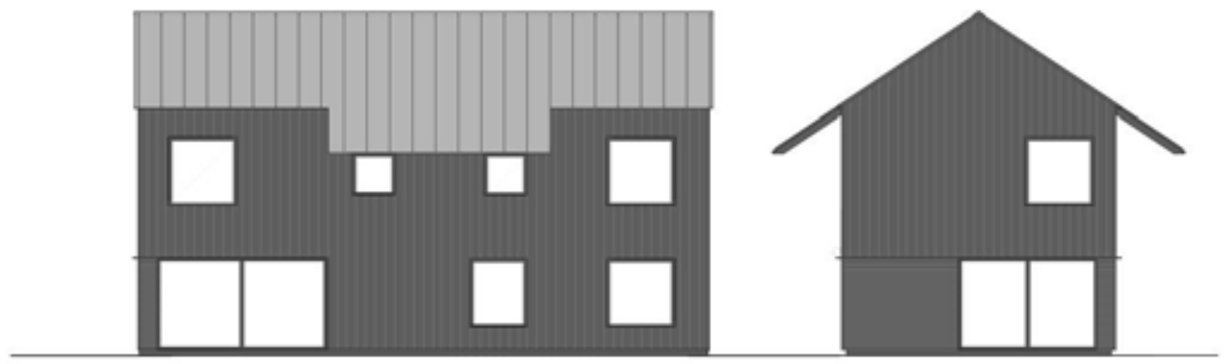
1 bedroom, 1 full bath



FLEXHOUSE II

1200 sf

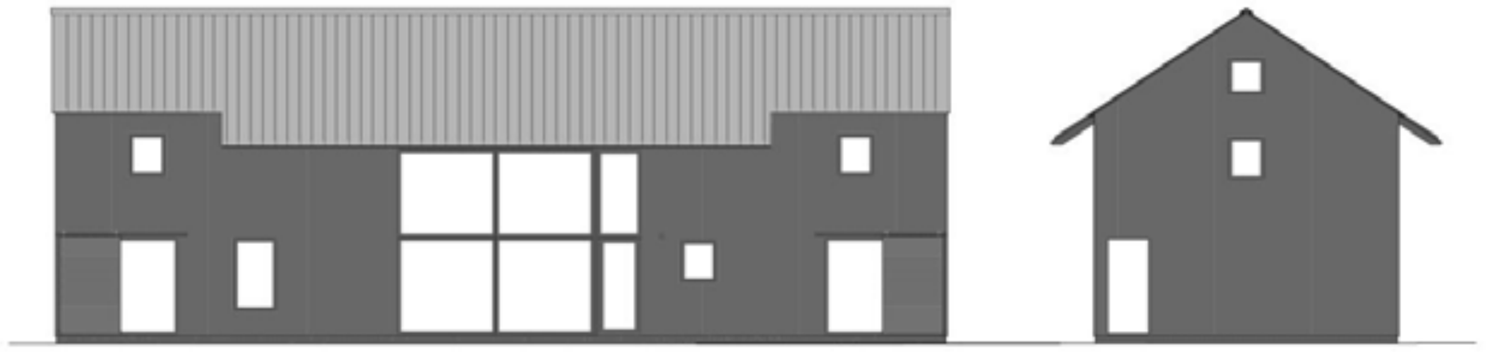
2 bedrooms with sleeping loft, 1 full bath



FLEXHOUSE III

2400 sf

3-4 bedrooms, 3 full baths



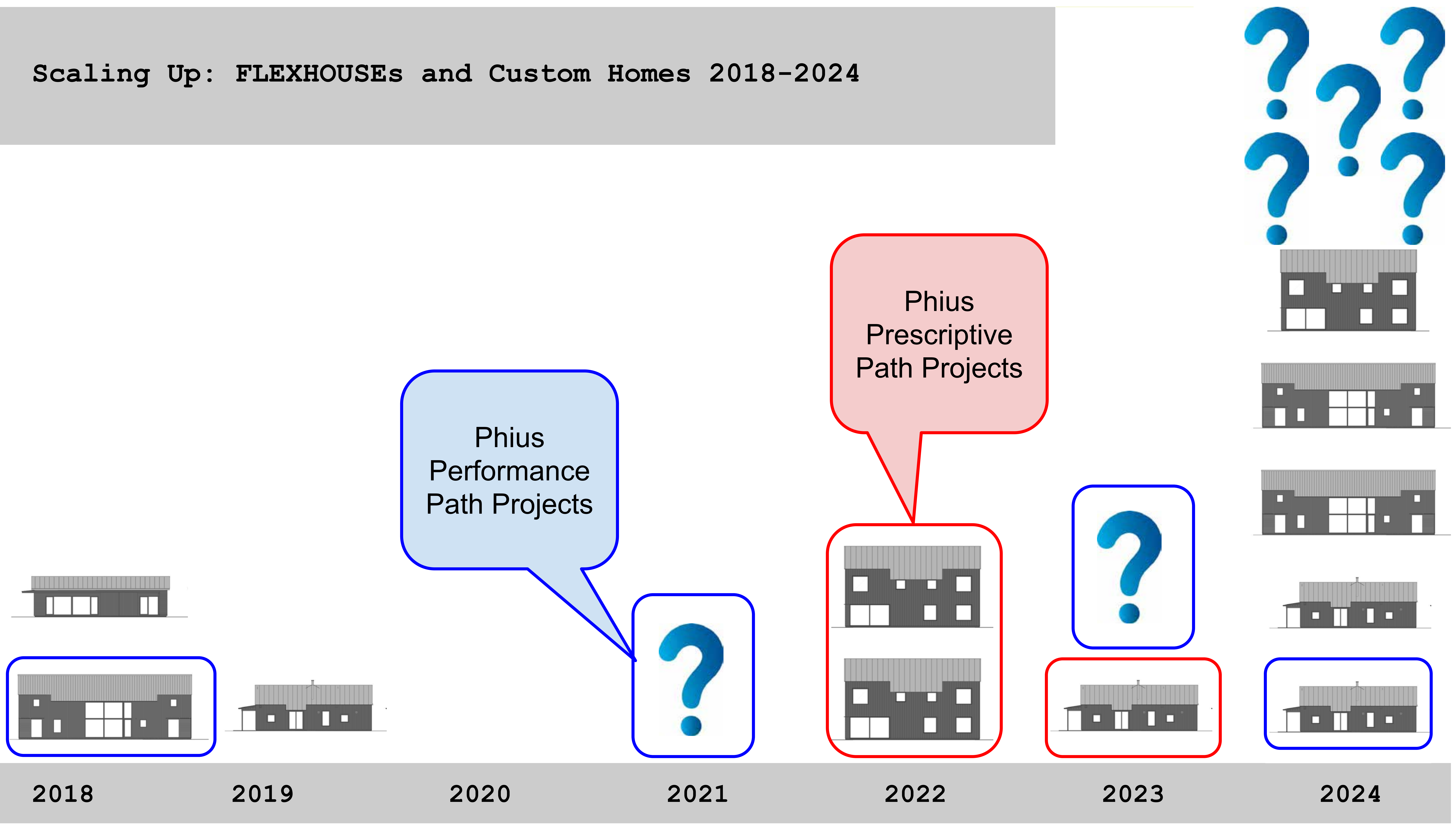
FLEXHOUSE IV

2880 sf

3-4 bedrooms with sleeping loft, 3 full baths

Custom Design

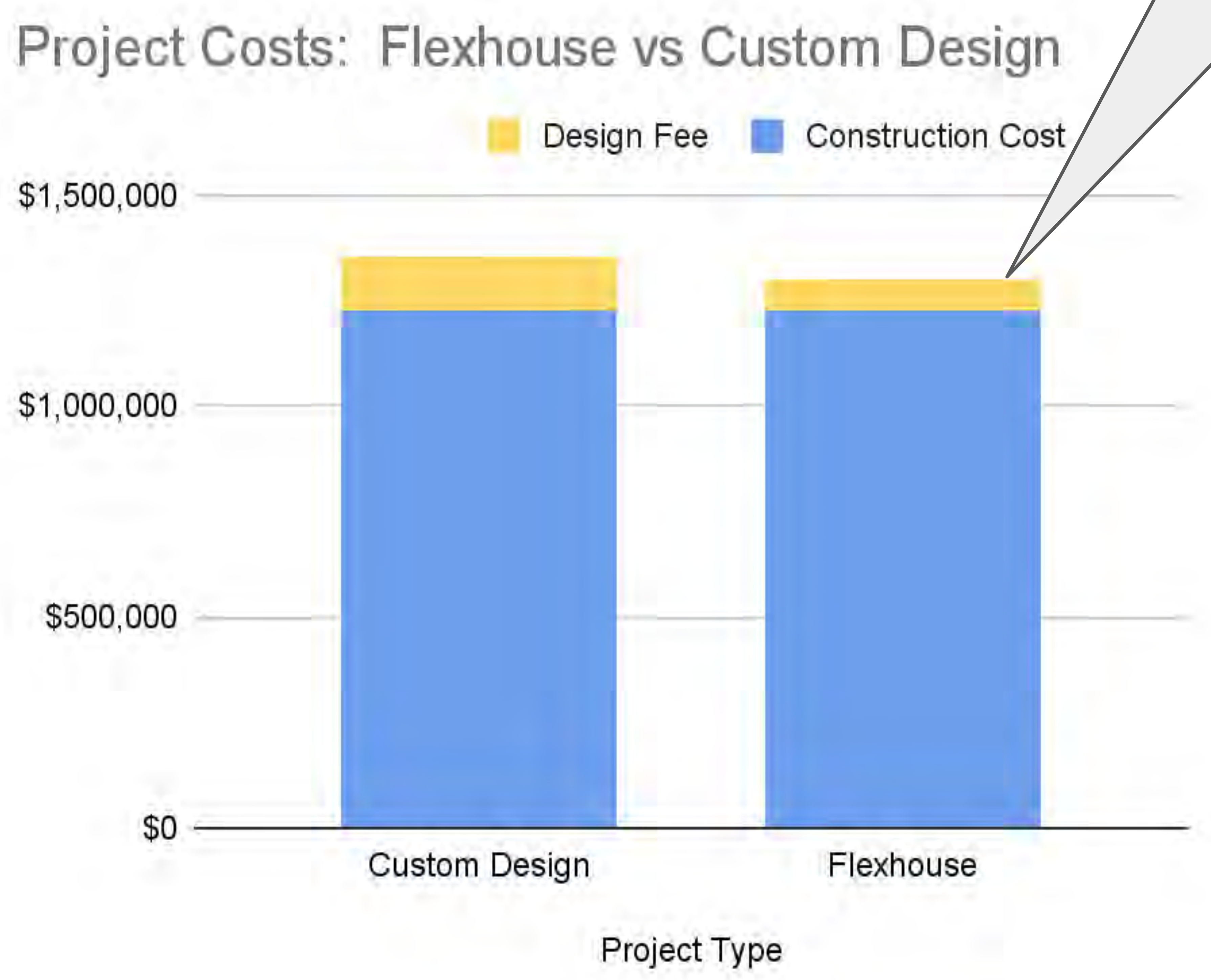
Scaling Up: FLEXHOUSEs and Custom Homes 2018-2024

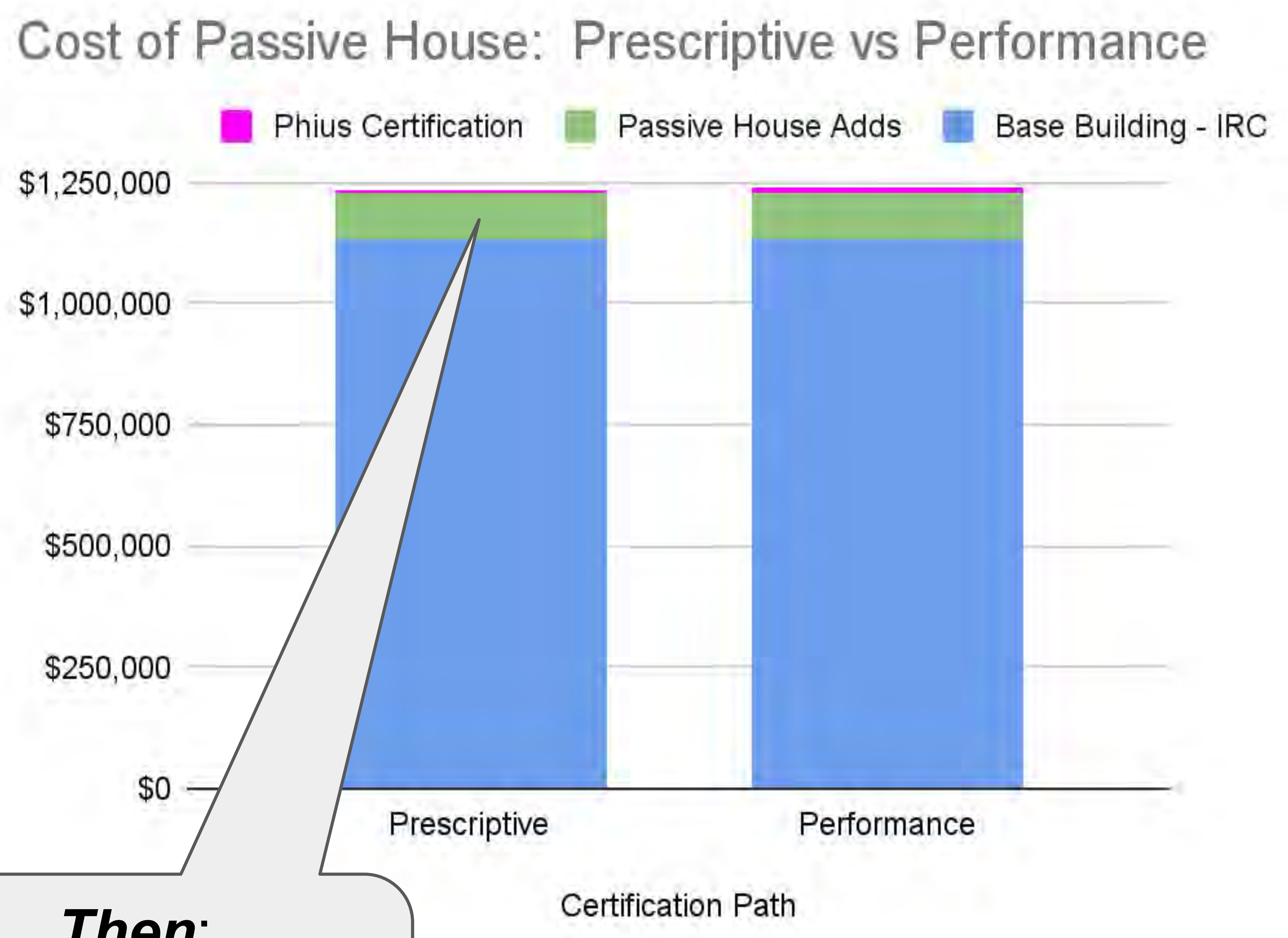


Quality *AND* Quantity
(Case studies in advancing the SF Passive House Market)

Psst:
Certification is
not a primary
cost driver

First:
Save +/- $50,000 in
design fees





Then:
Partial offset of +/-
$90k in Passive
House Add Costs

*** Money goes to hard-costs, not soft-costs**

Phius CORE Prescriptive 2021 Snapshot

Input or select data in teal cells

State	NEW YORK
City	STEWART FIELD
ASHRAE (169-2021) Climate Zone	5A
iCFA* (ft²)	2287
Number of Bedrooms*	3
Number of Stories	2

**per dwelling unit*

1	**General**			
1.1.2	iCFA divided by Number of Bedrooms	Maximum Limit	900	ft²
	(Calculated Value based on Inputs)	*OK, Meets Limit*	762	ft²
3	**Compactness**			
3.1.1	Envelope Area	Maximum	6548	ft²
	(Maximum Envelope to Floor Area Ratio)		2.86	
4	**Solar Protection**			
4.1.1	Whole Window SHGC	Maximum	NR	
4.4.1	Projection Factor for Fixed Overhangs	Minimum	NR	
5	**Thermal Enclosure**			
5.1.1a	Fenestration / Openings	Maximum Whole U-Value	0.17	(BTU/h.ft².°F)
5.1.1b	Walls & Overhang Floors - Effective R-value	Minimum Effective R-Value	41	(ft².°F.h/BTU)
5.1.1c	Roofs / Ceilings	Minimum Effective R-Value	72	(ft².°F.h/BTU)
5.1.1d	Whole Slab Foundations, Below-Grade Walls, Floors of Conditioned Basements & Crawl Spaces	Minimum Effective R-Value	21	(ft².°F.h/BTU)
5.1.1e	Ceilings of Unconditioned Basements or Crawl Spaces & Pier and Beam Floors	Minimum Effective R-Value	26	(ft².°F.h/BTU)
6	**Moisture Risk Limitation**			
6.2.1	Fenestration Condensation Resistance	Minimum	63%	
7	**Mechanical Ventilation**			
7.2.1	Sensible Recovery Efficiency, Heating Mode	Minimum	80%	
7.2.2	Total Recovery Efficiency, Cooling Mode	Minimum	NR	
7.2.5	Total Length of Fresh Air Ducts to Outside	Maximum	27	ft
8	**Mechanical Systems**			
	Select System Type			
8.2.1	Air Source Heat Pump	Minimum COP @ 5F	1.8	
		Minimum SEER	15.0	

Phius CORE Prescriptive 2021 Snapshot

Input or select data in teal cells

State	NEW YORK
City	STEWART FIELD
ASHRAE (169-2021) Climate Zone	5A
iCFA* (ft²)	2094
Number of Bedrooms*	3
Number of Stories	2

**per dwelling unit*

1	**General**			
1.1.2	iCFA divided by Number of Bedrooms	Maximum Limit	900	ft²
	(Calculated Value based on Inputs)	*OK, Meets Limit*	698	ft²
3	**Compactness**			
3.1.1	Envelope Area	Maximum	6180	ft²
	(Maximum Envelope to Floor Area Ratio)		2.95	
4	**Solar Protection**			
4.1.1	Whole Window SHGC	Maximum	NR	
4.4.1	Projection Factor for Fixed Overhangs	Minimum	NR	
5	**Thermal Enclosure**			
5.1.1a	Fenestration / Openings	Maximum Whole U-Value	0.17	(BTU/h.ft².°F)
5.1.1b	Walls & Overhang Floors - Effective R-value	Minimum Effective R-Value	41	(ft².°F.h/BTU)
5.1.1c	Roofs / Ceilings	Minimum Effective R-Value	72	(ft².°F.h/BTU)
5.1.1d	Whole Slab Foundations, Below-Grade Walls, Floors of Conditioned Basements & Crawl Spaces	Minimum Effective R-Value	21	(ft².°F.h/BTU)
5.1.1e	Ceilings of Unconditioned Basements or Crawl Spaces & Pier and Beam Floors	Minimum Effective R-Value	26	(ft².°F.h/BTU)
6	**Moisture Risk Limitation**			
6.2.1	Fenestration Condensation Resistance	Minimum	63%	
7	**Mechanical Ventilation**			
7.2.1	Sensible Recovery Efficiency, Heating Mode	Minimum	80%	
7.2.2	Total Recovery Efficiency, Cooling Mode	Minimum	NR	
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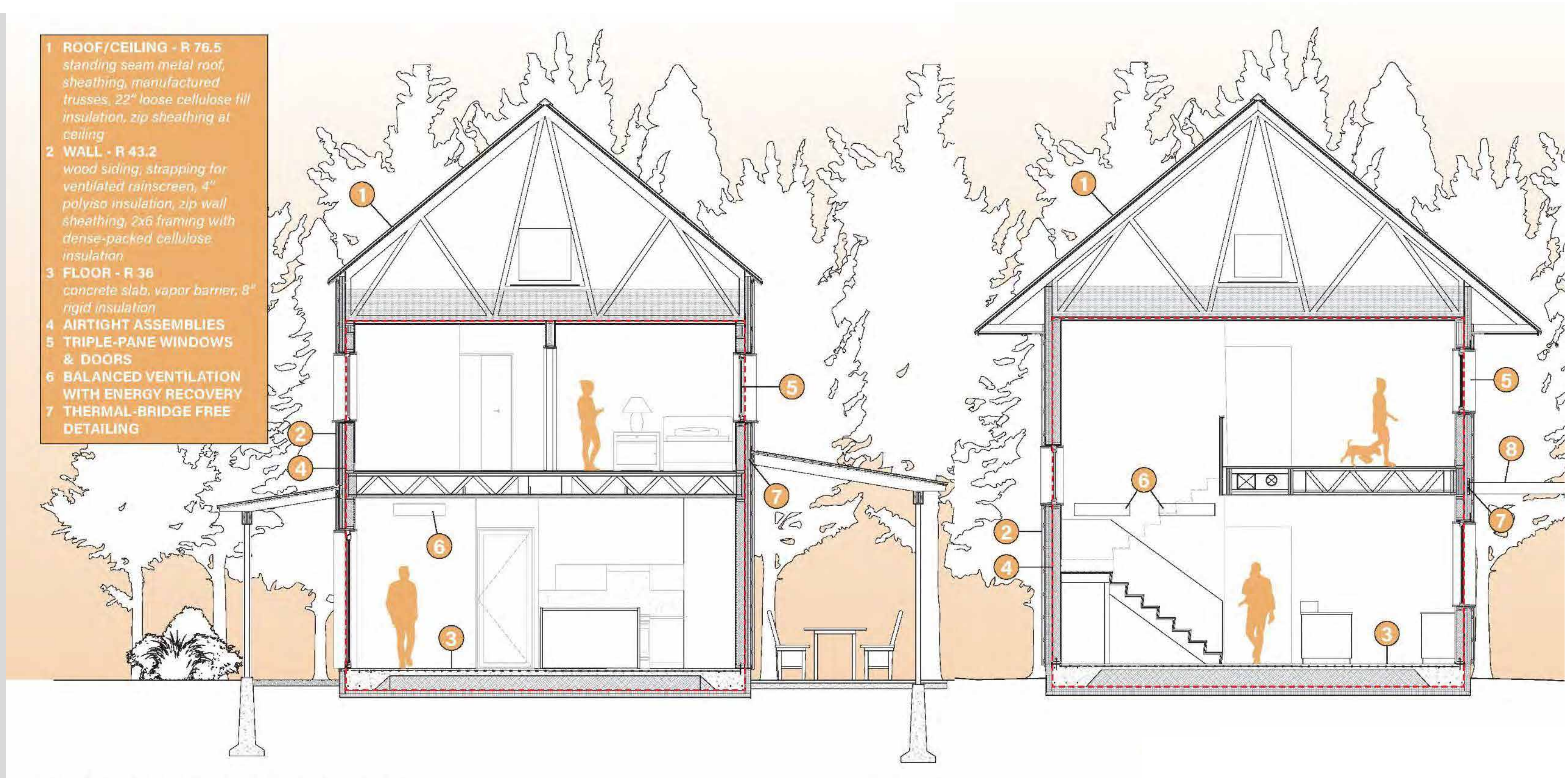
8	**Mechanical Systems**			
	Select System Type			
8.2.1	Air Source Heat Pump	Minimum COP @ 5F	1.8	
		Minimum SEER	15.0	

Basten Farm North - Flexhouse III | **Basten Farm South - Flexhouse III**


1 ROOF/CEILING - R 76.5
standing seam metal roof, sheathing, manufactured trusses, 22" loose cellulose fill insulation, zip sheathing at ceiling
2 WALL - R 43.2
wood siding, strapping for ventilated rainscreen, 4" polyiso insulation, zip wall sheathing, 2x6 framing with dense-packed cellulose insulation
3 FLOOR - R 36
concrete slab, vapor barrier, 8" rigid insulation
4 AIRTIGHT ASSEMBLIES
5 TRIPLE-PANE WINDOWS & DOORS
6 BALANCED VENTILATION WITH ENERGY RECOVERY
7 THERMAL-BRIDGE FREE DETAILING
1
2
3
4
5
6
7
8

Basten Farm North - Flexhouse III Stone Ridge, NY

Basten Farm South - Flexhouse III Stone Ridge, NY

Basten Farm South - Flexhouse III

Climate Zone 5A
iCFA 2,094 ft2

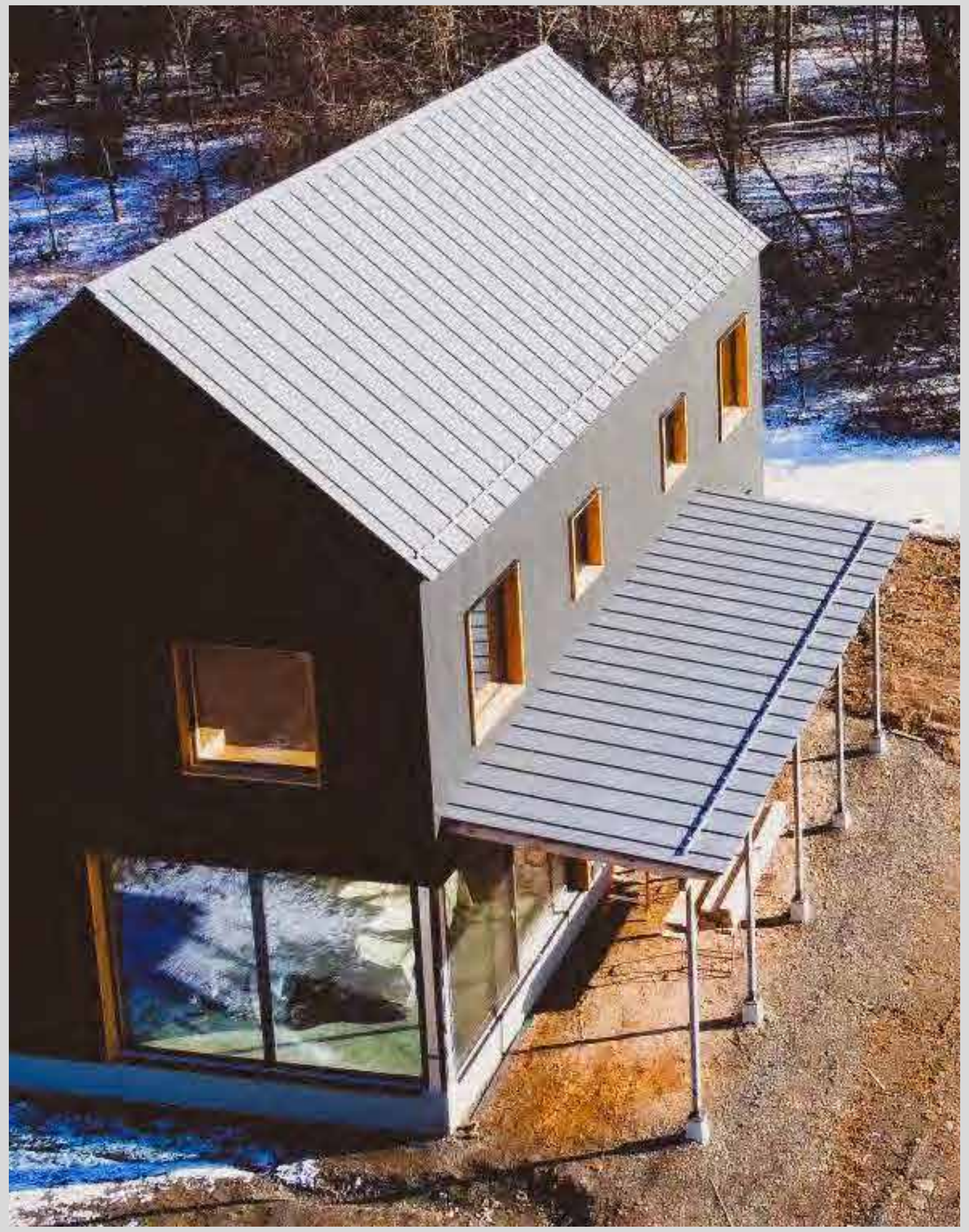
Prescriptive Path	**Target**	**Actual**
Building Enclosure Area	6,180 ft2	5,830 ft2
Window-to-Wall Ratio (WWR)	≤18%	18%
Fenestration U-Value (max)	0.17	0.17
Exterior Walls R-Value (min)	44	43
Roof/ceiling R-Value (min)	74	76.5
Slab R-Value (min)	22	52
ERV Efficiency (max)	720 W/cfm	468 W/cfm
ERV total duct length	26 ft	20 ft
Heat Pump Efficiency (min)	1.75 COP @ 5F 15 SEER	1.69 COP 18.4

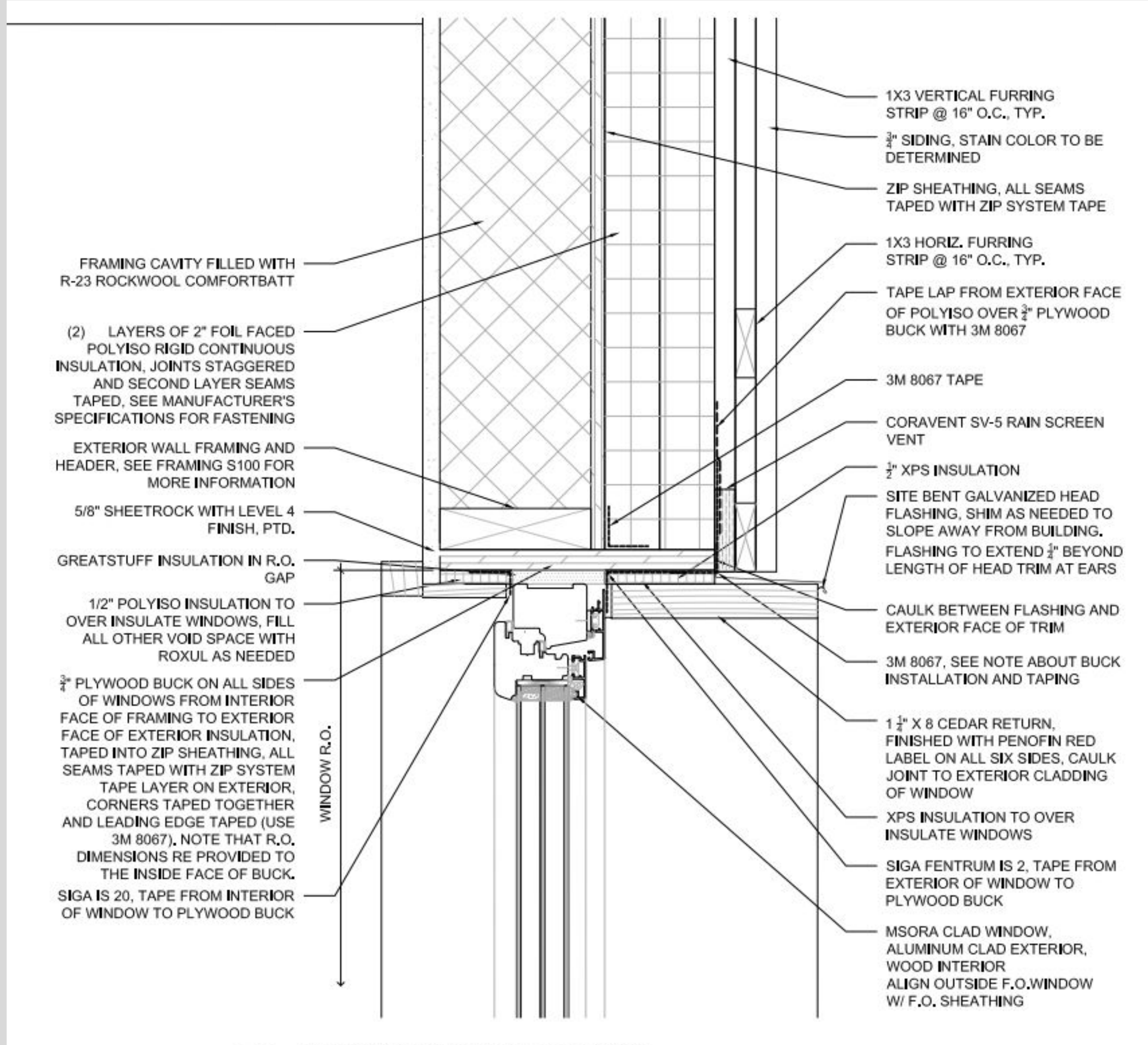
Basten Farm North - Flexhouse II

Climate Zone 5A
iCFA 2,287 ft2

Prescriptive Path	**Target**	**Actual**
Building Enclosure Area	6,550 ft2	6,424 ft2
Window-to-Wall Ratio (WWR)	≤18%	18%
Fenestration U-Value (max)	0.17	0.165
Exterior Walls R-Value (min)	41	43
Roof/ceiling R-Value (min)	72	73
Slab R-Value (min)	22	52
ERV Efficiency	720 W/cfm	468 W/cfm
ERV total duct length	27 ft	20 ft
Heat Pump Efficiency (min)	1.75 COP @ 5F 15 SEER	1.66 COP 17.8

Prescriptive Certification - Design Stress Points





1 FIRST FLOOR WINDOW HEAD DETAIL
SCALE: 3" = 1'-0"

Air Source Heat Pump Efficiency

Minimum 1.75 COP at 5F

Problem: Hyperheat models' efficiency too low, 1.66 & 1.69 COP at 5F

Solution: Waiver from Phius was necessary

Exterior Wall R-value

Minimum R-44 for Basten Farm North, Checklist V2.1
Minimum R-41 for Basten Farm South, Checklist V2.6

Problem: Dense-pack cellulose insulation resulted in R-43 wall

Solution: Prescriptive Path offers UA Alternative

Net Zero Energy - Sizing Renewables

Problem: Prescriptive Path does not generate an estimate of annual electrical usage

Solution: Recommend full coverage on south-facing roof slopes

Glazing Area & Orientation

Problem: Designs exceed Prescriptive limit of total glazing area - 33-37% vs 15% max

Solution: Adequate Exposure Diversity (AED) alternative compliance

Limited Design Optimization

Problem: Prescriptive Path does not reward airtightness above baseline (0.04 cfm/ft2)

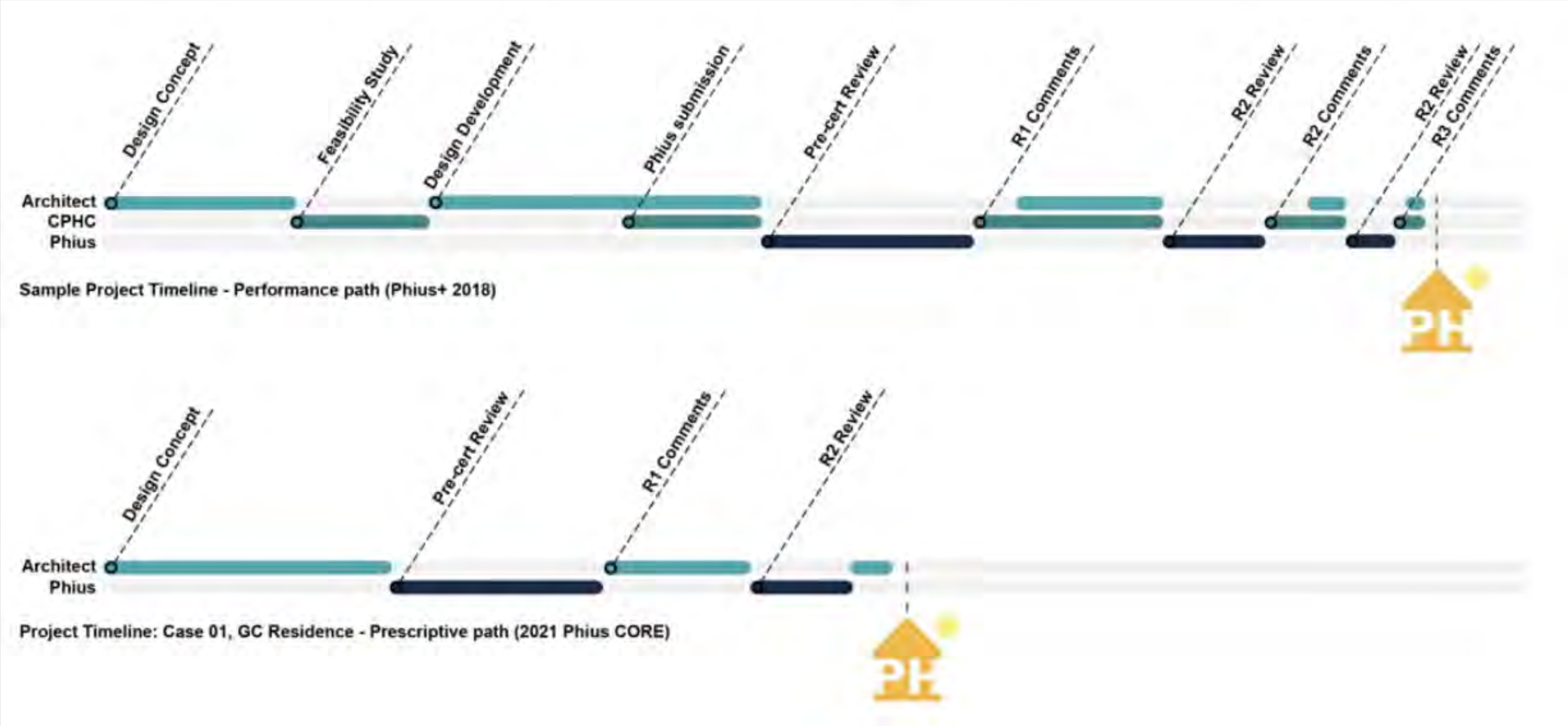
Performance Path allows envelope and/or HVAC modifications correlated with actual airtightness

Toolkit for Scaling Up Single Family Passive House

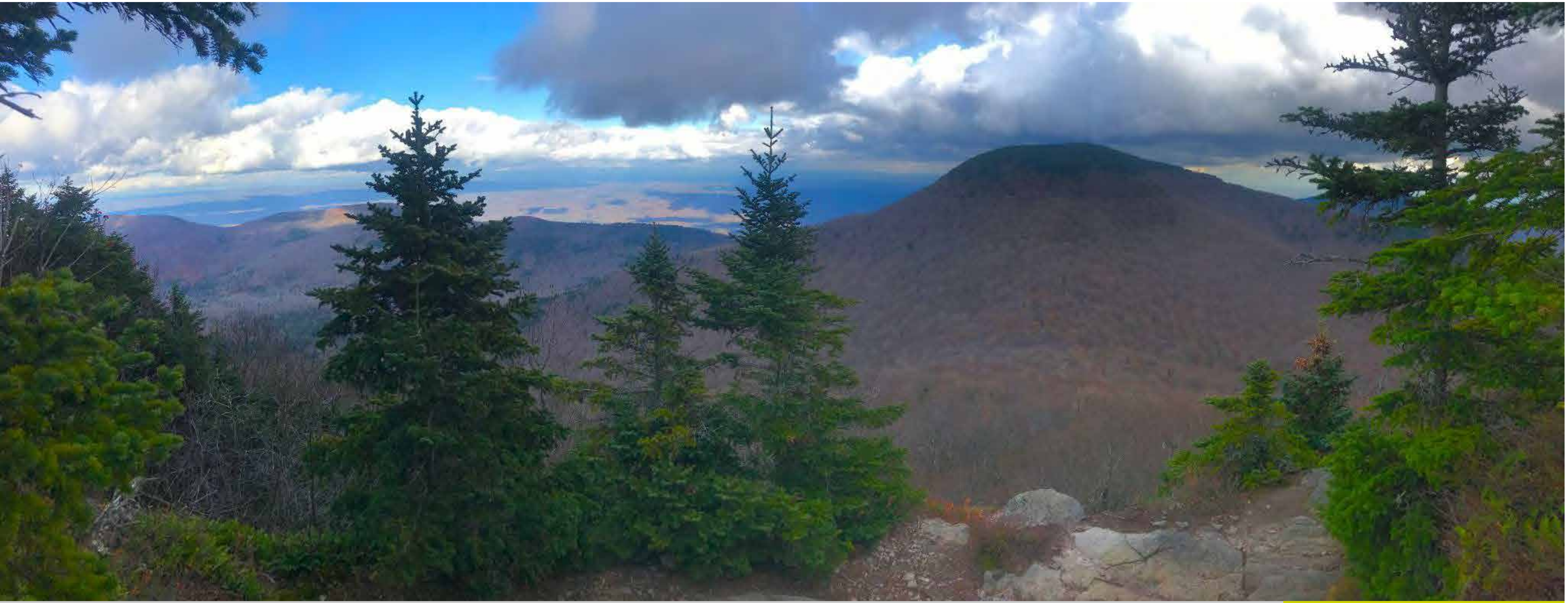
- Prescriptive Path Certification
- Patternbook design offerings
- Standard construction methods & materials
- Simplified HVAC
- Workforce training/Subcontractor buy-in

Passive House Wish List

- More Phius Raters!
- Restoration of incentive funding for single family
- Homeowner buy-in for ductless mini-splits
- Building code support for Passive House
- Green Appraisals
- Smaller mini-splits
- North American window manufacturers



QualityANDQuantity
(Case studies in advancing the SF Passive House Market)



Thank you.

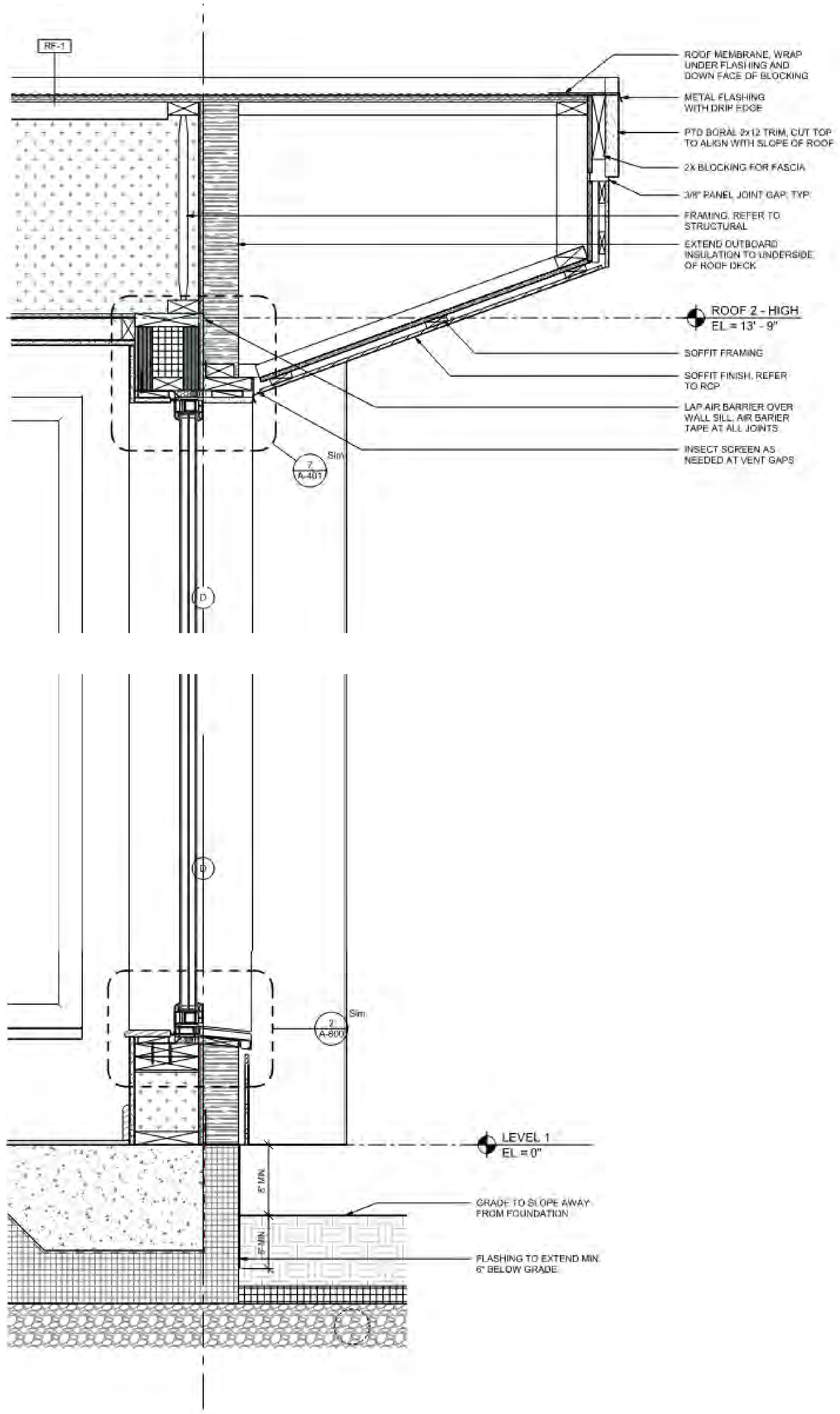
John Loercher, CPHC

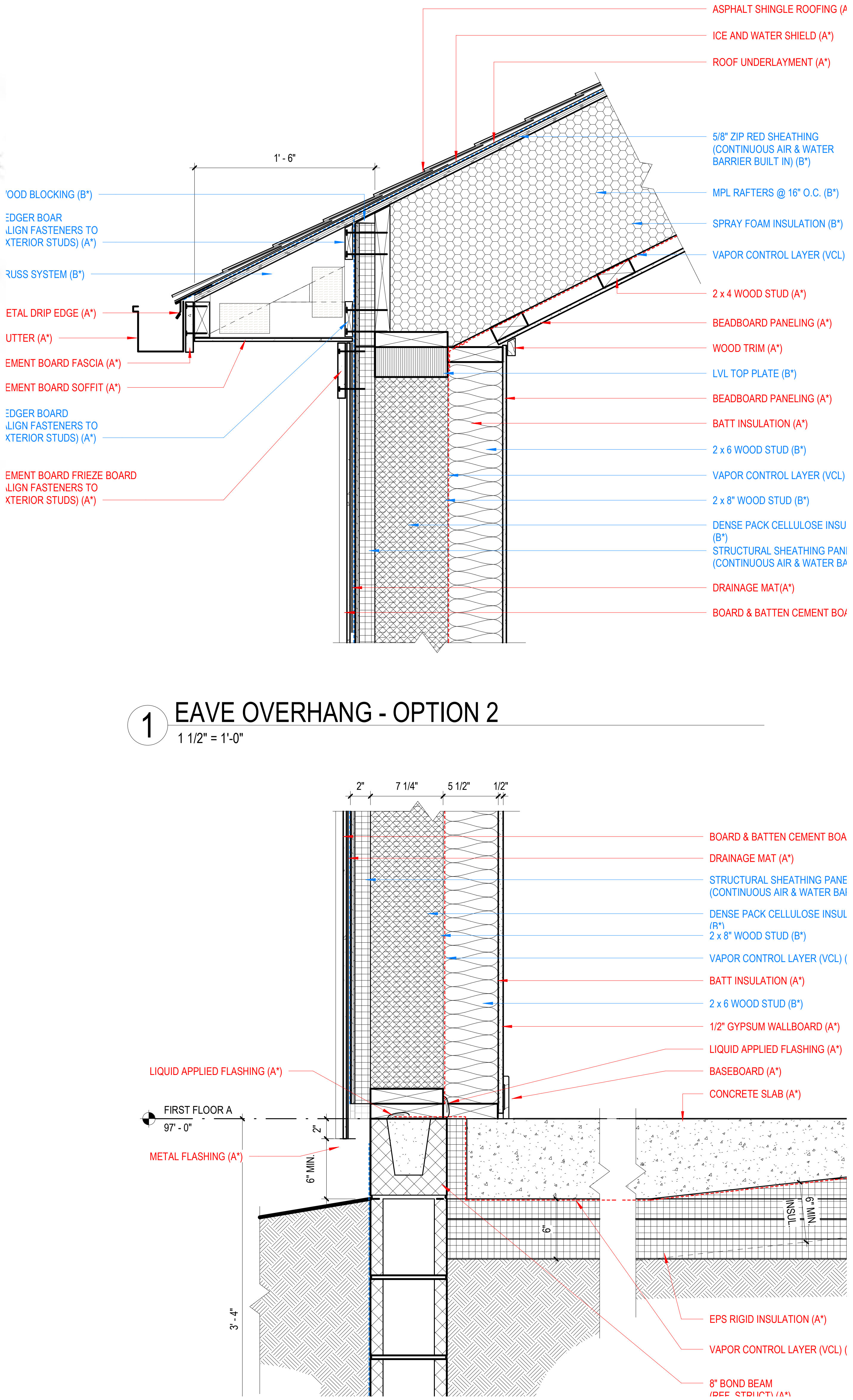
John@NE-Projects.com, JLoercher@Phius.org

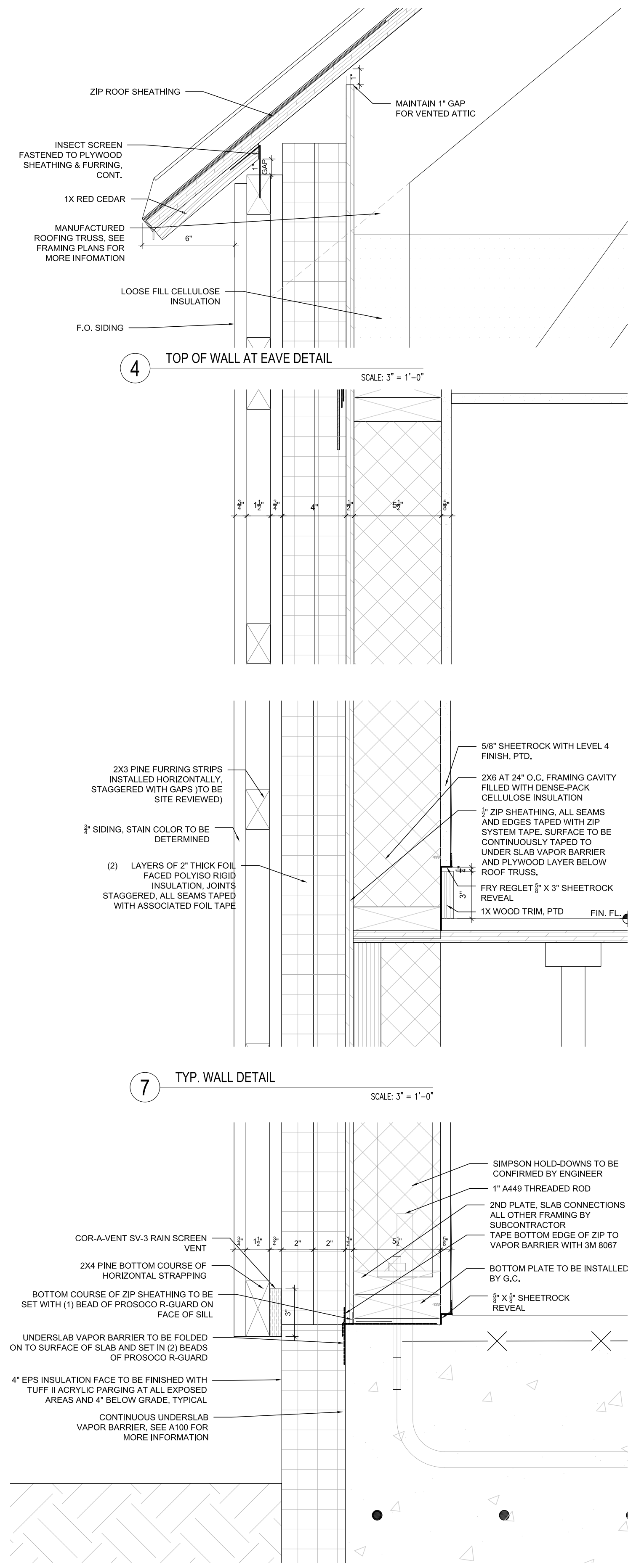
Stephanie Bassler, RA, CPHC
stephanie@bassler-architect.com

NORTHEAST PROJECTS

NORTH RIVER







Eagle Rock
Stoughton, MA

Rachel Carson Ecovillage
Gibsonia, PA

Flex House
Various sites, NY