Zero Energy Ready Modular Housing for 'Missing Teeth' Infill Projects

www.phrc.psu.edu

PennState College of Engineering | PENNSYLVANIA HOUSING RESEARCH CENTER

NARI CEU Approved | PREFERRED EDUCATION PROVIDER

PHRC

1

Pennsylvania Housing Research Center

- The PHRC collaboratively engages with the residential construction industry to catalyze advancements in homebuilding through education, training, innovation, research, and dissemination.
- The PHRC envisions a residential construction industry equipped with the knowledge, skills, and technology to build better homes.
- Administered within the Department of Civil & Environmental Engineering at Penn State, you can learn more at phrc.psu.edu.

@PHRCPennState

PHRC

2

2

Program Description

- As cities look to fill their affordable housing gaps, 'Missing Teeth' or 'Infill' housing is gathering a lot of attention. Communities look for solutions that can be replicated over scattered sites in the neighborhood. The requirements not only include fitting the fabric of the neighborhood but also be a safe and healthy environment for its occupants. This session is focused on challenges of design and building urban infill housing using modular construction methods. Insights will also be drawn from experience building single family, energy efficient, modular housing in rust belt cities like Pittsburgh.

PHRC

9

9

Learning Objectives

- Understand current housing needs of rustbelt cities such as Pittsburgh as they see a new influx of technology jobs
- Discuss what affordable housing means and looks like for such communities. What are current challenges in providing good quality affordable housing?
- Look into design insights that help deliver Zero Energy Ready housing to the affordable housing market. How do these compare to current energy code requirements?
- Discuss modular specific challenges for the urban environment. How to ensure safety and the least amount of hindrance for the neighboring occupants as these modular homes are built, set, and completed.

10

10

Intros

MODULE

https://www.modulehousing.com/

Drew Brisley
Chief Product Officer

Ankur Dobriyal
Director of Off-Site Innovation

11

What we'll cover

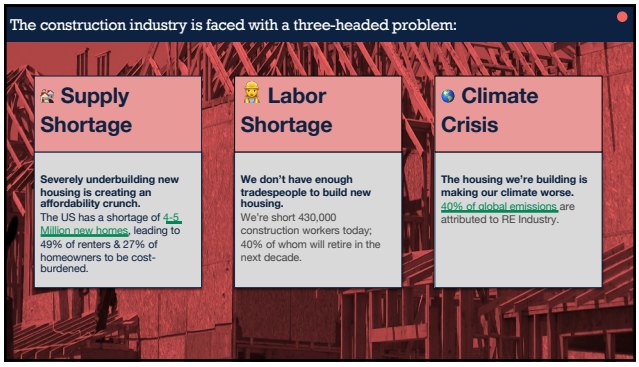
- **Intro**
- **Overview of Off-Site**
- **Learnings from Module**
- **The Future**
- **Q&A**

12

12


MODULE
Everyone deserves to live in a well-designed space they're proud to call home.
www.modulehousing.com

13


The construction industry is faced with a three-headed problem:
Supply Shortage
Severely underbuilding new housing is creating an affordability crunch.
The US has a shortage of 4-5 Million new homes, leading to 49% of renters & 27% of homeowners to be cost-burdened.
Labor Shortage
We don't have enough tradespeople to build new housing.
We're short 430,000 construction workers today; 40% of whom will retire in the next decade.
Climate Crisis
The housing we're building is making our climate worse.
40% of global emissions are attributed to RE Industry.

14


ZERO
Solution: an all-electric, urban housing product, 40% faster to build, upto 80% more energy efficient, and 10% lower lifecycle cost.

15

16

Built using the power of off-site construction

MODULE

17

18

What we have learned from doing Infill Zero Energy Ready Modular Projects

MODULE PHRC

19

Module Learnings: Off-Site is misunderstood

Off-Site Construction: The planning, design, fabrication and assembly of **building elements at a location other than their final installed location** to support the rapid and efficient construction of a permanent structure.

- Volumetric
  - Modules
  - Bathroom or Kitchen Pods
  - Tiny Homes
  - Shipping Containers
- Non-Volumetric
  - Closed Panels
  - Open Panels

MODULE PHRC

20

Module Learnings: Off-Site is misunderstood

How we define a 'module'

one module

Completion Level from the Factory

MODULE PHRC

21

Module Learnings: Off-Site is misunderstood

A Modular home is NOT a Manufactured home

Modular Home ≠ Manufactured Home

IBC IRC

Modular home or modular construction is built in a factory controlled environment, built to meet International Residential Code or International Building Code

Manufactured home is a single-family house constructed n a controlled factory environment, built to the federal Manufactured Home Construction and Safety Standards (better known as the HUD Code).

MODULE PHRC

22

Module Learnings: Off-Site is misunderstood

PHRC

23

Module Learnings: Off-Site is misunderstood

24

Module Learnings: Design Matters

In our process, we think about *how* the modules will be built when we design them. We also think about how we to complete as much in the factory as possible

- x Lower Cost of Installation
- x Easier Install on Set Day
- x Less neighborhood disruption

MODULE PHRC

25

Module Learnings: Design Matters

Many manufacturers have product catalogs they can build from but the designs are not typically optimized for urban infill or contemporary living. We've developed our own catalog that is optimized for all stakeholders, balancing customer needs with what can be built off-site

Finishes, Fixtures and Equipment drive what can be completed in the module at the factory vs. what has to be completed on-site after set

HVAC: Working with partners who can install in the factory

Cabinetry: Install in the factory

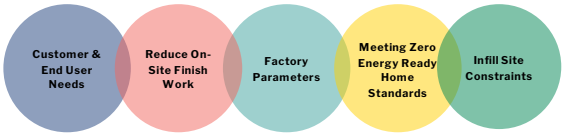
Flooring: Select materials that can be factory installed

MODULE PHRC

26

Module Learnings: Design Matters

Our designs balance the following



MODULE PHRC

27

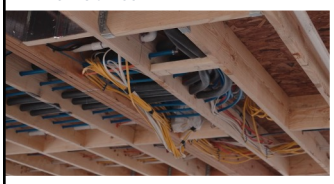
Module Learnings: Design Matters

Through customer feedback we continuously upgrade and improve our product catalog

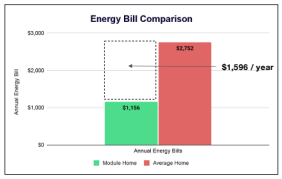
28

Module Learnings: Zero Energy Ready and Modular

We have consistently gotten better air infiltration results than site-built homes, scoring between 1-2 on an ACH 50 Test



Upto 80% more energy efficient home



$46,800 estimated savings over a 30 year mortgage

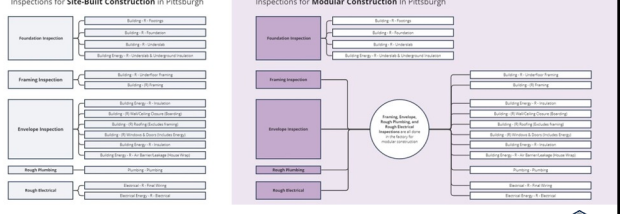
Read the case study

MODULE

29

Module Learnings: Inspections

Inspection Process Comparison: Site-Built Construction vs. Modular Construction in Pittsburgh



MODULE

30

Module Learnings: Scope Shifts in off-site vs. site built

	Sample Selections & Scope Updated: March 29, 2023		
	Included in the modules	**Set Crew Scope**	**On-Site Scope (GC)**
MODEL INFO			
Name			
Footprint			
Style			
ENVELOPE			
Foundation			Supply & Install
Foundation Insulation			Supply & Install (If Applicable)
Floor Insulation	Supply & Install		
Exterior Wall Assembly	Supply & Install		
Roof Assembly	Supply & Install		
Roof Slope	Supply & Install		
Overhangs	Install Front/Rear Ship Loose Rakes	Install Rakes	
Ceiling Heights	Install Front/Rear Ship Loose Rakes		
EXTERIOR MATERIALS			
Roofing	Install / Ship Loose	Install @ Rakes	
Vented Soffit	Install / Ship Loose	Install @ Rakes	
Fascia	Install / Ship Loose	Install @ Rakes	
Drip Edge	Install / Ship Loose	Install @ Rakes	

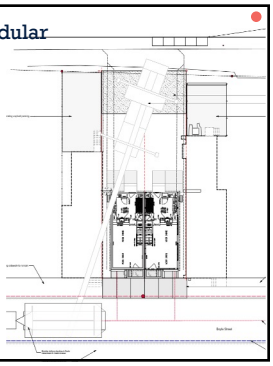
MODULE PHRC

31

Module Learnings: Infill and Modular

Understand Modular and Evaluate for Modular feasibility upfront

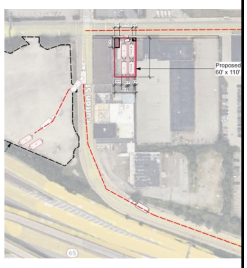
1. What route will the transportation company take to deliver the modules from the factory to the site?
2. Will a crane have enough space to stage and safely lift and set the modules?
3. Are there overhead or neighboring obstructions that could prevent the modules from being lifted? Trees, powerlines, or neighboring buildings
4. Does the desired programming and site lend itself to modular construction?



MODULE

32

Module Learnings: Infill and Modular



MODULE PHRC

33

Module Learnings: Pre-Con Tips for Off-Site

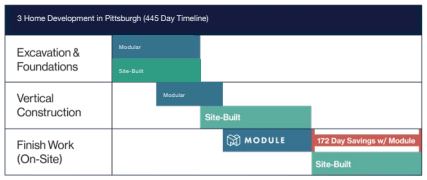
- Assemble a core team of designers and engineers
- **Every problem is first a 'Design' problem**
- Ask: *"how can this project be a win for everyone on the project team?"*
- **Map out all stakeholders in our projects and solve for key problems they face in their workflows**
- Understand the key hurdles for each stakeholder and solve for it. Speak their language.

MODULE PHRC

34

Module Learnings: Sequencing = Speed

- Timing of when modules are built and when sitework is being done is key
- Having on-site finish crews ready in the right order is key



MODULE PHRC

35

Building The Future

Taking what we have learned to build the future, focusing on:

Building the network of partners

Integrate Manufacturing

Creating playbooks to educate all stakeholders on how to do off-site

MODULE PHRC

36

Our Goal:
Open 3 last mile facilities
Produce 1000+ units of housing

Good Jobs & Local Ownership
Provide living wage and opportunities for local ownership at each facility.

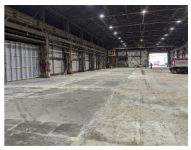
Focus on Equity
Fostering a culture where women & people of color thrive.

Prioritize Affordable Housing
Offer preferred terms to those building new affordable housing.

37

Phase 1 (PGH): 25,000 sq ft facility

- *150 Modules units/year in 2026, 300 Modules a year in year 2028*
- *Building market rate, affordable, and workforce housing Pro*



PGH Last Mile Factory
Carnegie, PA

PHRC

38

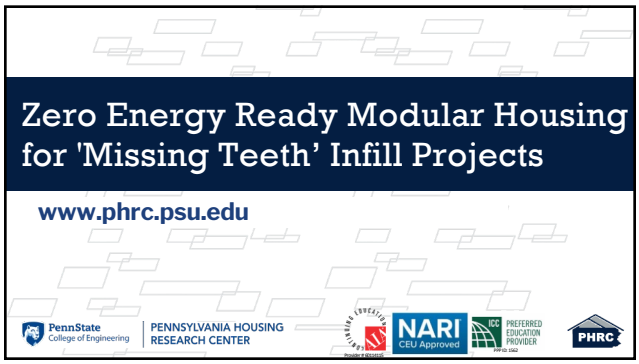
Questions?

www.phrc.psu.edu

40

PHRC

40


Zero Energy Ready Modular Housing for 'Missing Teeth' Infill Projects
www.phrc.psu.edu
PennState College of Engineering
PENNSYLVANIA HOUSING RESEARCH CENTER
NARI CEU Approved
PREFERRED EDUCATION PROVIDER
PHRC

43