



# Enabling Innovation Through Offsite Construction

Course Number EL141

June 21, 10:30-11:30 am & 2:15-3:15 pm

June 22, 12:30-1:30 pm & 4:00-5:00 pm

Learning Units [As Published]

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# Speaker

## Jim Lambach – Industrial Marketing Manager, Covestro, LLC

*Jim has worked for 30 years in the polyurethane industry in varying roles, but primarily focused on product development. In the Industrial Marketing role his primary focus remains on product development, but focused through the lens of strategic market analysis. Jim is formally trained as a chemist and polymer engineer.*



# Course / Learning Objectives

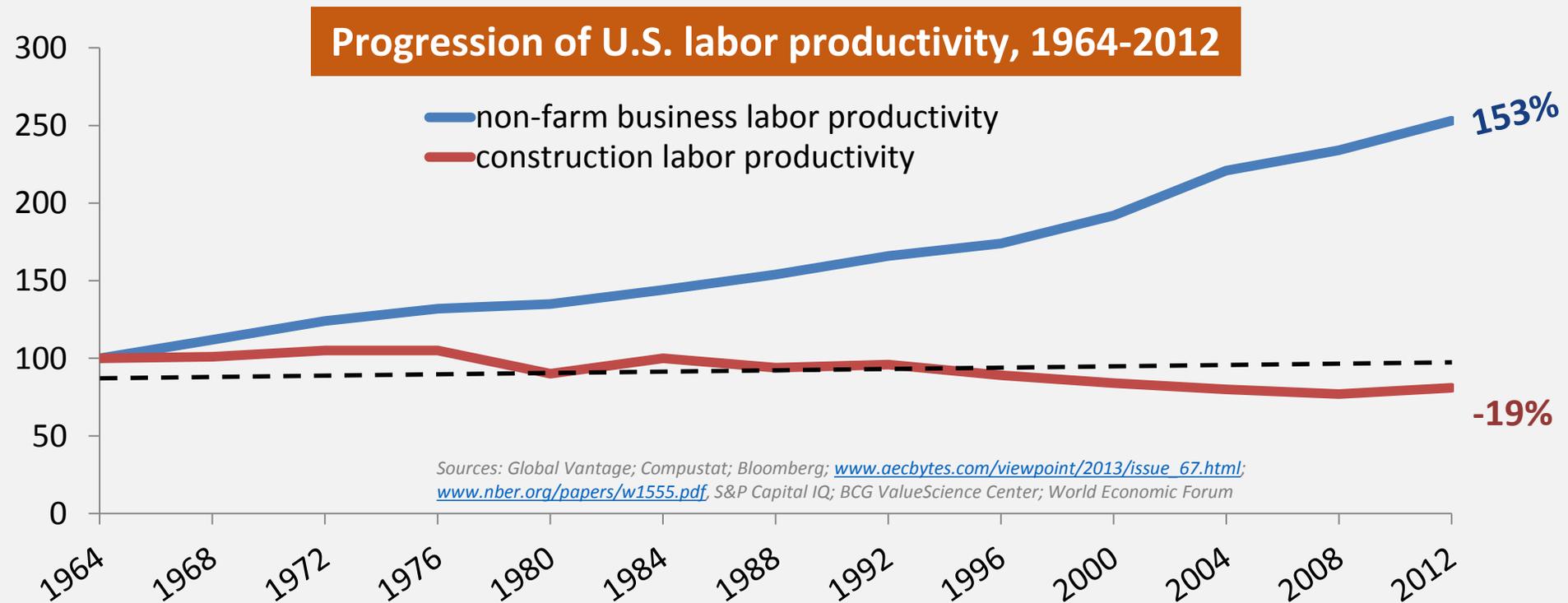
- Reveal underlying issues in building and construction that create the **need for innovative new technology and manufacturing processes**.
- **Compare offsite construction to site-built in a side-by-side demonstration.**
- Identify how **offsite production can boost construction productivity, quality, and sustainability.**
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# The construction industry is plagued with systemic inefficiencies.

Source: McKinsey Global Institute - REINVENTING CONSTRUCTION – Feb 2017

- **Building code is complex** – code is regional, and regional officials have ultimate authority.
- **Builders typically view their role as land developers** – home building is sub-contracted to others.
- **Most construction is custom or semi-custom** - repeatability is lacking.
- **Building process is fragmented & cyclical** - multiple trades must coordinate for successful execution.
- **Limited use of rigorous production planning** - creates delays, change orders, and cost over-runs.
- **Contractors aren't incentivized for productivity** – scope changes and extensions increase profits.
- **Insufficient skilled labor exists today** - little is being done to fill the pipeline.

# Construction productivity has been on the decline for decades, while other industries experience continual improvement



# A combination of market forces are in play that could enable a transformation in construction productivity

*Source - McKinsey Global Institute - REINVENTING CONSTRUCTION – Feb 2017*

- **Rising demand and requirements**
- **Labor shortages or rising wages**
- **Entrants with new, disruptive business models**
- **Emerging technologies, materials, and processes**

# Transformation enablers

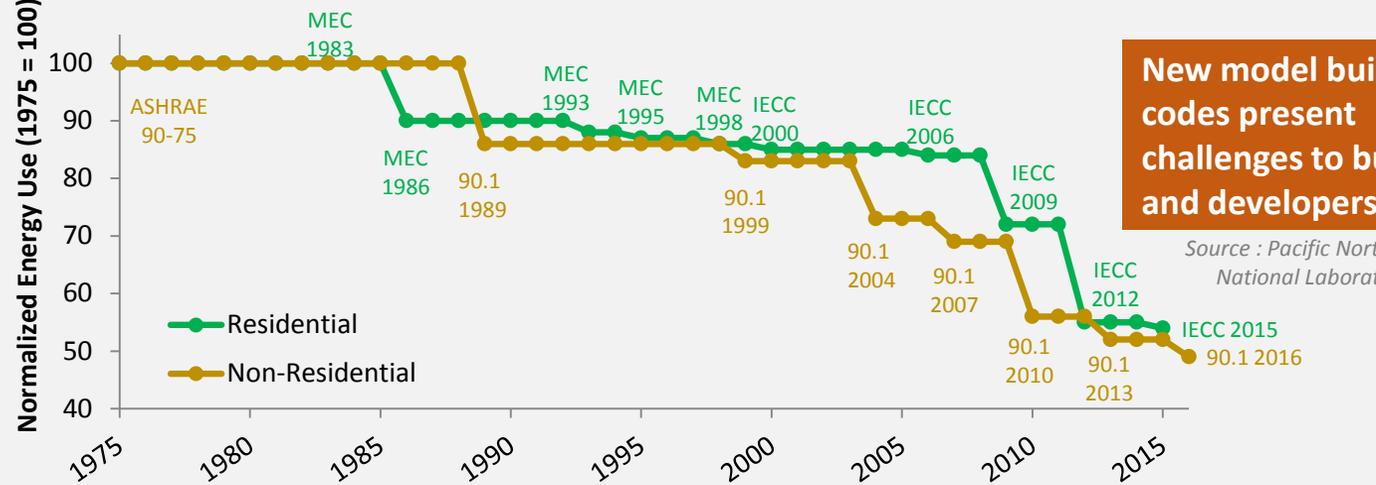
## ⇒ Rising demand, demanding requirements

Residential construction still in recovery from the great housing recession



Source : US Census Bureau

Historical Efficiency Improvements in Residential and Non-Residential Model Energy Codes (1975-2016)



New model building codes present challenges to builders and developers

Source : Pacific Northwest National Laboratory



Ongoing progression of code adoption

- Adopted ASHRAE 90.1- 2013 or equivalent
- Adopted ASHRAE 90.1- 2010 or equivalent
- Adopted ASHRAE 90.1- 2007 or equivalent

Source : Covestro

# Transformation enablers

## ⇒ Skilled labor shortages

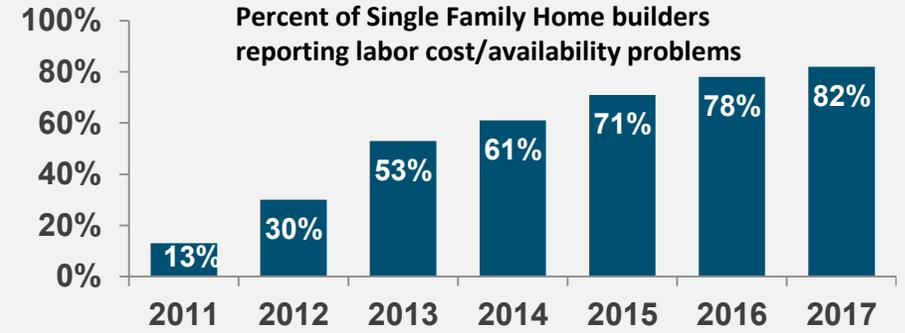
The average age of construction workers is increasing. Where are the new entrants?

Sources: U.S. Bureau of Labor Statistics, World Economic Forum, Boston Consulting Group



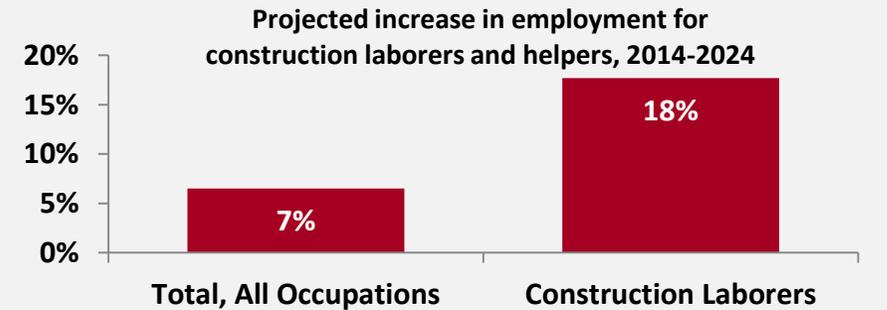
More than 80% of Single-Family Builders are reporting labor cost/availability problems.

Sources: HMI Survey, NAHB EchP



The shortfall in construction labor availability is forecast to be a long term issue.

Sources: Bureau of Labor Statistics, Employment Projections program.



# ⇒ Entrants with new business models

### Entekra - replicating a successful offsite model from Ireland

- FIOSS™ – Fully Integrated Offsite Solution
- Design, engineering, and fully integrated for offsite manufacturing.
- Successful business model previously employed in Ireland.

### Acquisitions by Japanese home builders who have advanced experience with offsite manufacturing

- Sumitomo ⇒ Mainvue, Gehan, Bloomfield, Dan Ryan, Edge
- Sekisui ⇒ Woodside
- Diawa ⇒ Stanley Martin

### Katerra – Silicone Valley startup

- Technology and manufacturing company seeking to reduce time and cost inefficiencies inherent to construction.
- Offsite manufacturing; repeatable units, global SC, mass timber
- Jobsite JIT: supplying structural components, mass timber, kitchen and bath, finish accessories

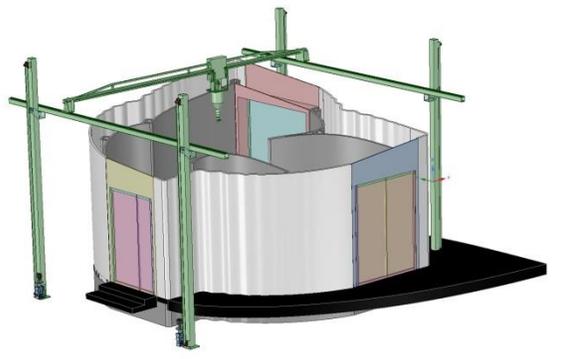
# Transformation enablers

## ⇒ New technologies, materials, and processes

Smart homes offer wireless sensor network connectivity from the home to the internet



By iSys.PL (<http://www.isys.pl/wiki/>) [Attribution], via Wikimedia Commons



3D printing offers fast onsite building with the precision of robotic automation

By 3DPrinthuset (Denmark) [CC BY-SA 4.0 (<https://creativecommons.org/licenses/by-sa/4.0/>)], via Wikimedia Commons

5-D Building Information Modeling (BIM) adds scheduling and cost to the spatial design capabilities of 3D BIM.



By Christophe Krief [CC BY-SA 4.0 (<https://creativecommons.org/licenses/by-sa/4.0/>)], from Wikimedia Commons



[www.covestro.com/en/purewall](http://www.covestro.com/en/purewall)

PURewall™ incorporates insulation and weather barrier into a structural wall panel that is built offsite

- ✓ Reveal underlying issues in building and construction that create the **need for innovative new technology and manufacturing processes.**

- ❖ **Following the great recession of 2008/2009 demand for new housing continues to grow, and energy codes are increasingly stringent.**
- ❖ **Most builders have problems finding skilled labor, with no obvious near-term solution.**
- ❖ **Builders need to do more with less, but construction productivity has been stagnant for decades.**
- ❖ **New offsite manufacturing processes and technologies are emerging that can enhance productivity and shorten cycle time.**

# Course / Learning Objectives

- Reveal underlying issues in building and construction that create the **need for innovative new technology and manufacturing processes.**
- **Compare offsite construction to site-built in a side-by-side demonstration.**
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# What is offsite construction?

Source: [www.housinginnovationalliance.com](http://www.housinginnovationalliance.com)



More content installed offsite, greater efficiency at the jobsite

- Roof and floor trusses,
- precut door frames, stairs
- drop-shipped to jobsite
- Panelized (prefab) wall assemblies, floor systems, and roof systems
- Wall assemblies may also contain insulation, windows, claddings, housewrap, and utilities
- Entire buildings, or block sections of buildings
- Assembled at the jobsite
- Must satisfy state and local building code
- Crane required

# The Structural Building Components Association conducted a side-by-side comparison of stick-built versus component-built

Source: The "Framing the American Dream" project, a study conducted by the Structural Building Components Association.

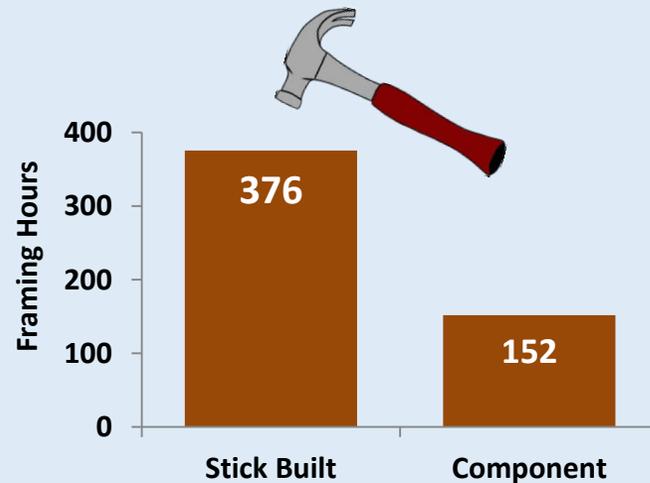


- Framing the American Dream project set up a controlled experiment in a neighborhood in Jackson, Wisconsin in 2015.
- Two identical 2,900 sq ft ranch homes were framed in adjacent lots, providing an apples-to-apples comparison of stick and component framing methods.

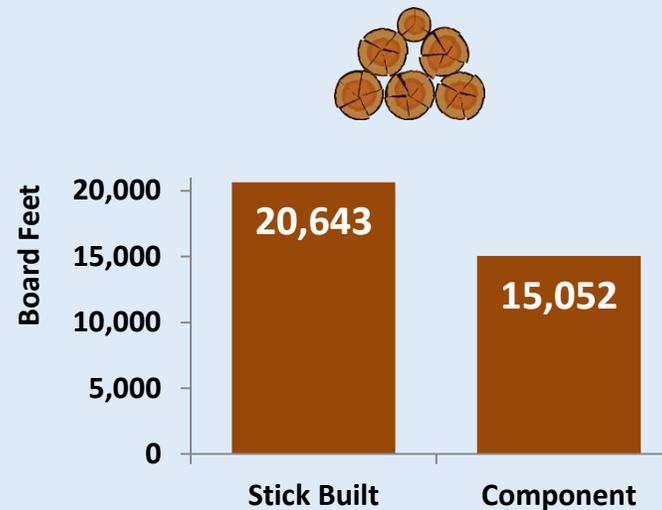
# ✓ Compare offsite construction to site-built in a side-by-side demonstration.

❖ Components offer more efficient use of labor and materials ... and a more sustainable process.

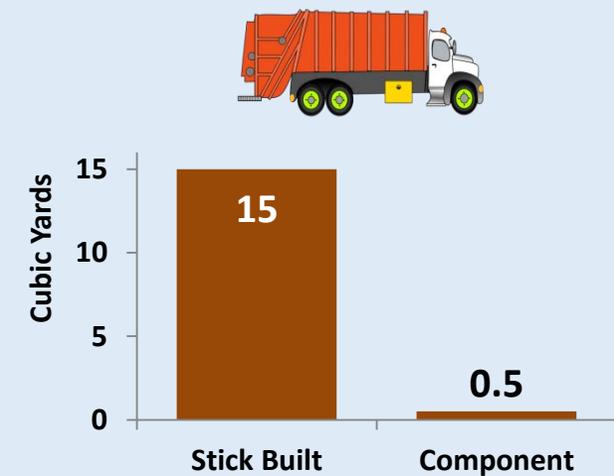
Framing hours reduced by 59%



Lumber usage reduced by 27%



Jobsite waste reduced by 97%



Source: The "Framing the American Dream" project, a study conducted by the Structural Building Components Association.

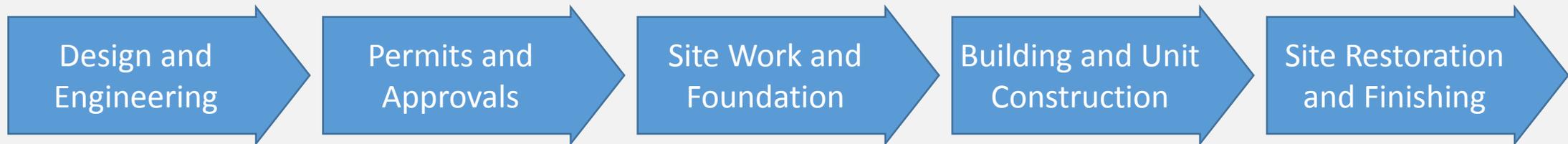
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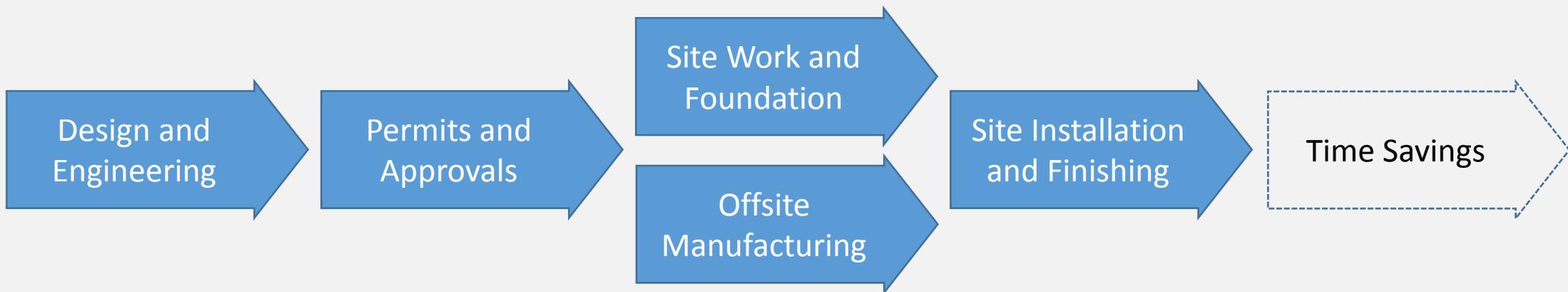
# Site work can occur in parallel with offsite module / assembly / component manufacturing

Source: Turner Center for Housing and Innovation, UC Berkeley, *Housing Affordability by Housing Affordably*

## Onsite construction timeline



## Offsite construction timeline



✓ Understand how **offsite production can boost construction productivity, quality, and sustainability.**

❖ Offsite construction offers many advantages with a few challenges to overcome.

### Advantages

- Productivity - faster cycle time
- Lower demand for skilled labor, reduced cost
- Sustainability - efficient material usage
- Reduced cost-of-carry
- Elimination of jobsite theft
- Minimal jobsite waste and removal
- Enhanced jobsite safety
- QC manufacturing standards

### Challenges

- Transportation, delivery without damage
- Site placement of components or modules
- Modifications at the jobsite

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# How prevalent is offsite construction?

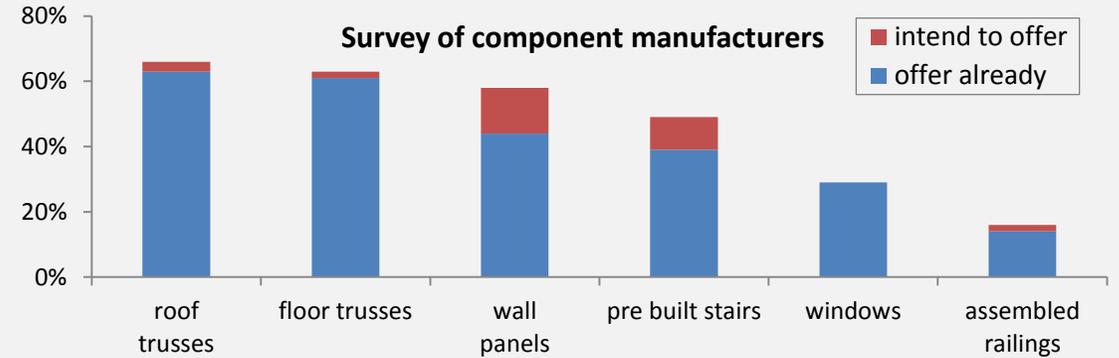
Modular represents about 3% of total homes built in the U.S. Two types: permanent and relocatable

Source: U.S. Census Bureau



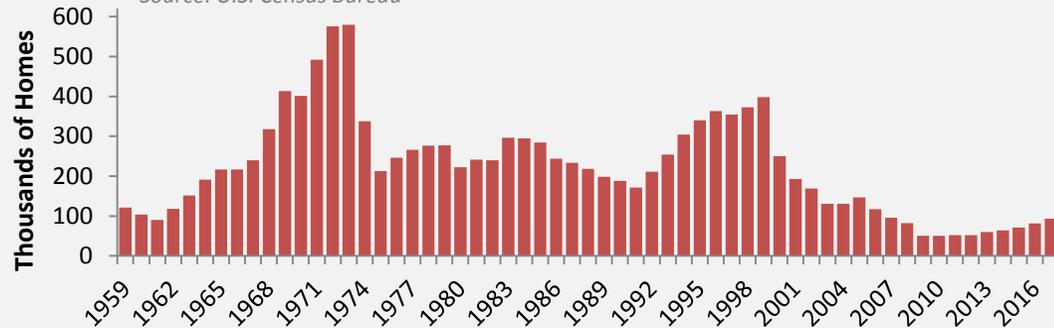
Roof trusses are the most prevalent structural component, with more than 80% market share. The prevalence of other structural components is growing

Source: [www.prosalesmagazine.com/benchmarks/prosales-100-survey/2014-prosales-100-steady-as-she-goes-May-2014](http://www.prosalesmagazine.com/benchmarks/prosales-100-survey/2014-prosales-100-steady-as-she-goes-May-2014)



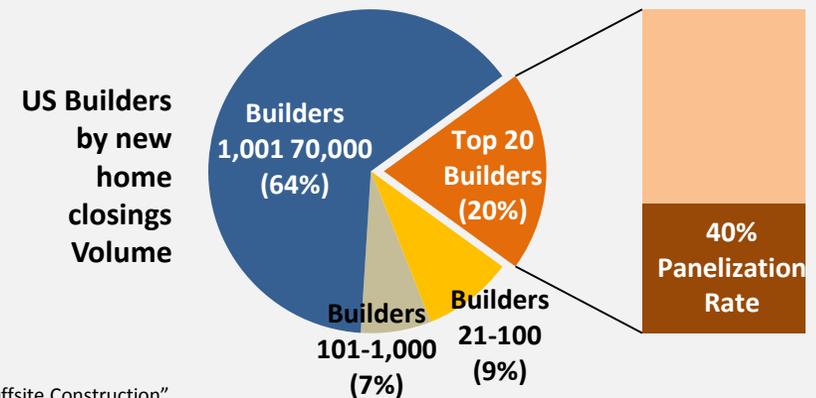
Manufactured (mobile) homes are built at a rate of ~100,000 units/yr today. Production has been much higher in the past.

Source: U.S. Census Bureau



Top 20 Builders already panelize at a high rate.

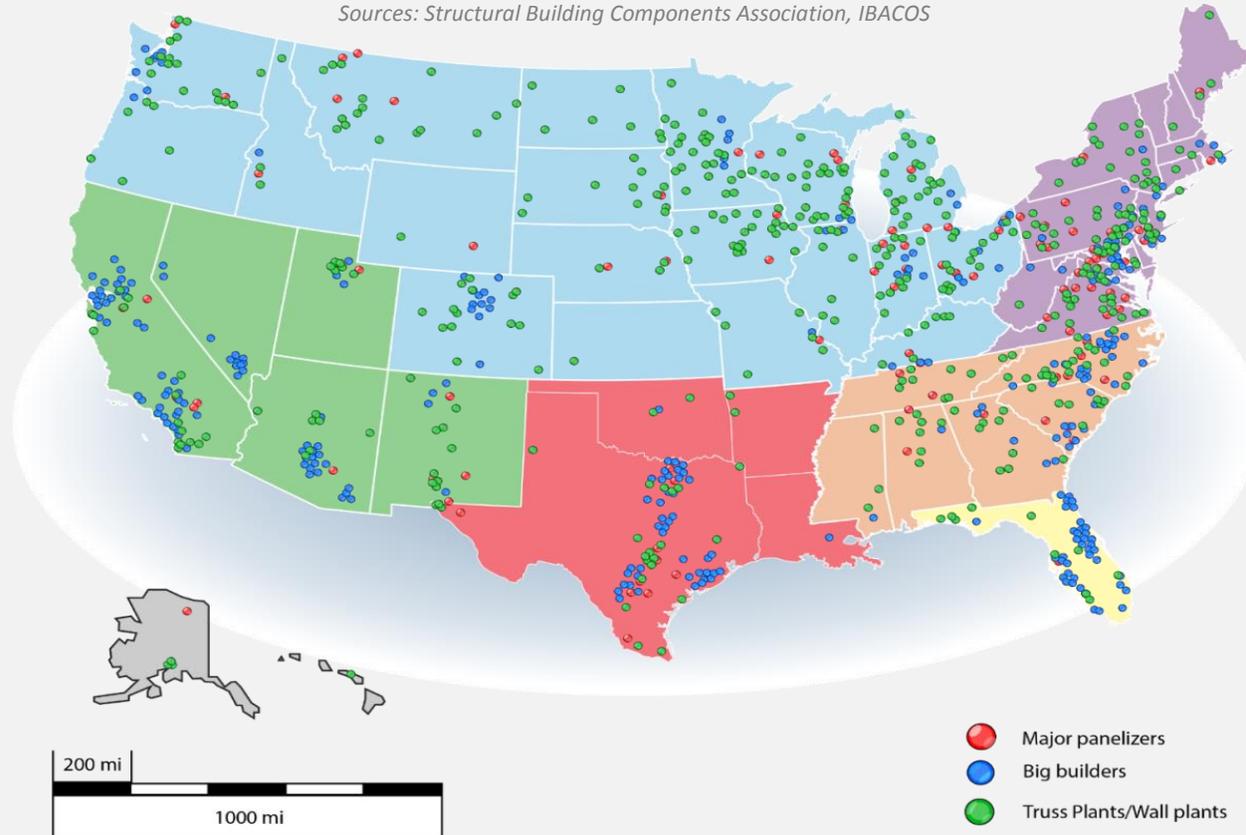
Source: Prosales, NAHB, IBACOS survey



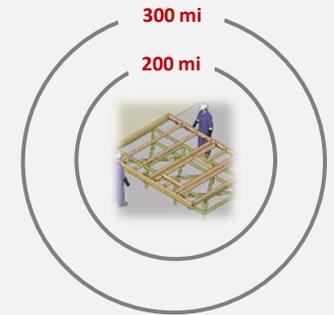
# Significant infrastructure for component manufacturing already exists

Sources: Structural Building Components Association, IBACOS

More than 300 component plants operate in regions of the country where significant homebuilding occurs today.

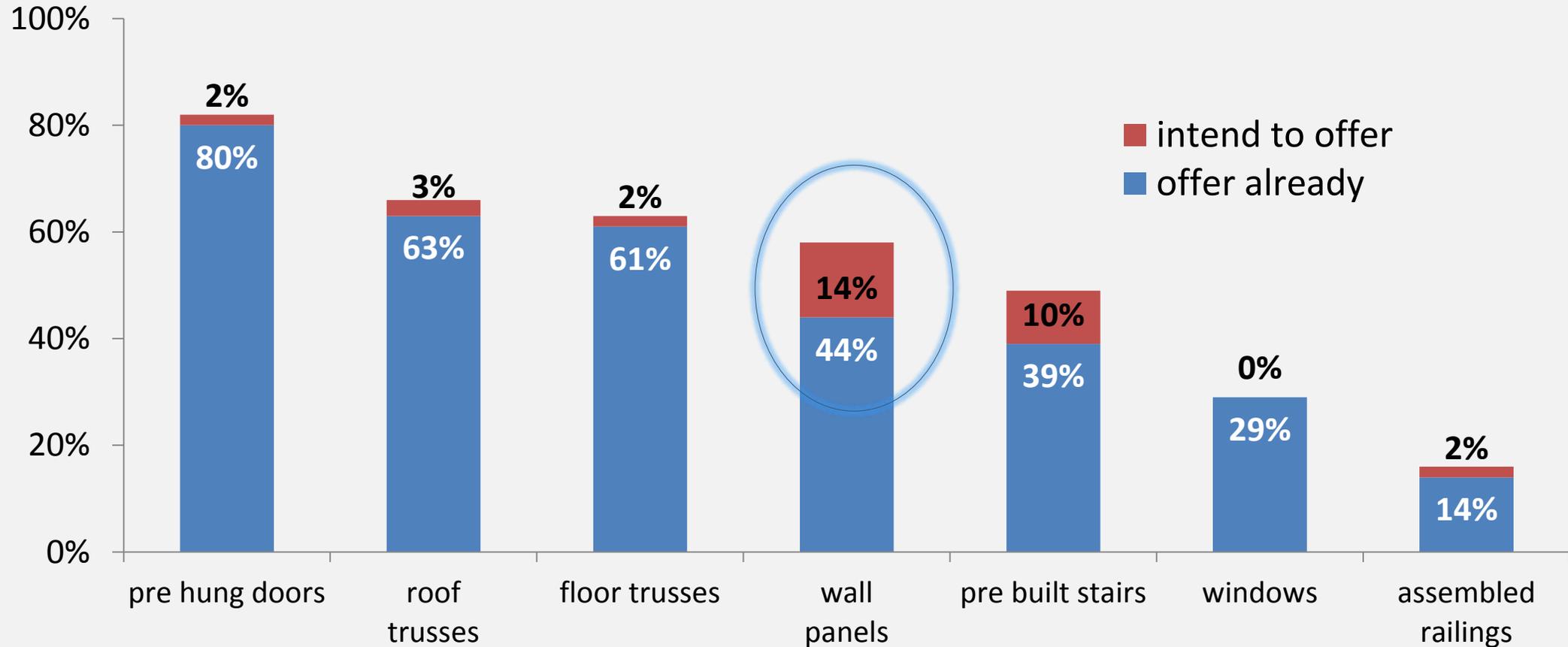


200-300 mile radius from the plant is a practical transport limit



# Many component manufacturers plan to expand their product offerings in the future

Source: [www.prosalesmagazine.com/benchmarks/prosales-100-survey/2014-prosales-100-steady-as-she-goes-May-2014](http://www.prosalesmagazine.com/benchmarks/prosales-100-survey/2014-prosales-100-steady-as-she-goes-May-2014)

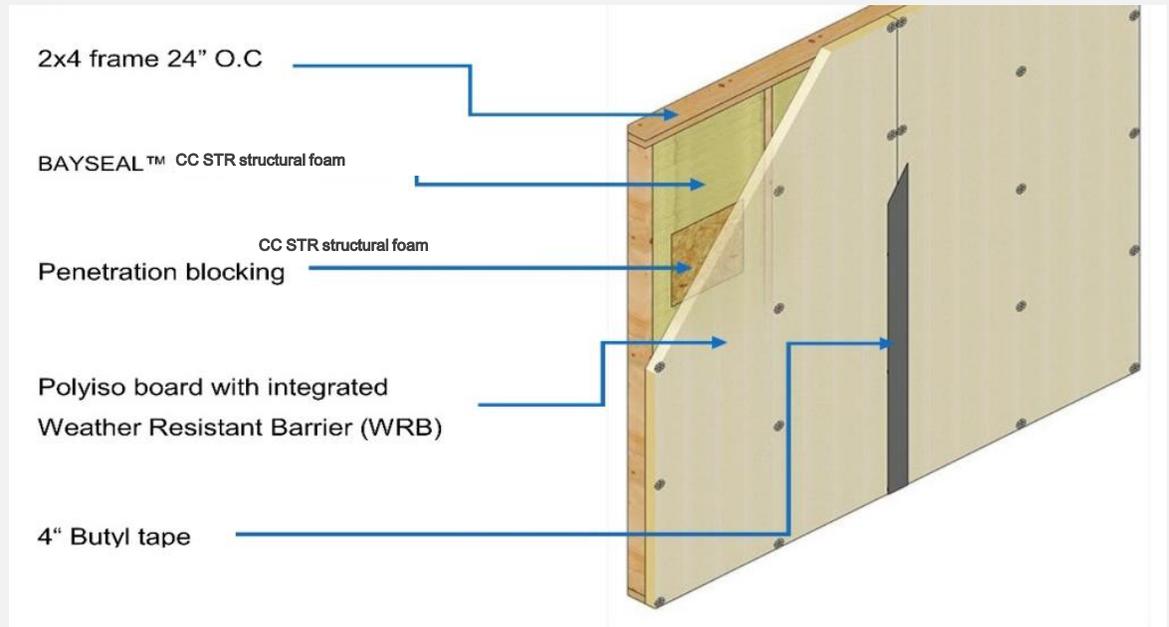


# PURewall™ is an example of an innovative solution enabled by the offsite channel

Panelized wall assembly for residential construction with insulation and weather barrier installed at the factory

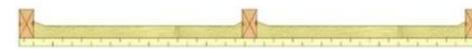
## SIMPLICITY

- Insulation and weather barrier are integral to the wall panel, installed at the factory.
- Fewer components
  - minimal wood structural panels (e.g. OSB)
  - no housewrap needed (e.g. Tyvek)
  - 2x6 framing lumber unnecessary
- PURewall panels are structural
- Less labor at the jobsite
- Polyiso continuous insulation meets energy code requirements throughout the U.S.



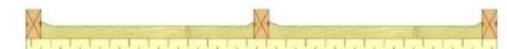
## 1" Exterior foam insulation

2x4 framed wall 24" O.C  
1½ BAYSEAL™ CC STR structural foam  
1" Polyiso board

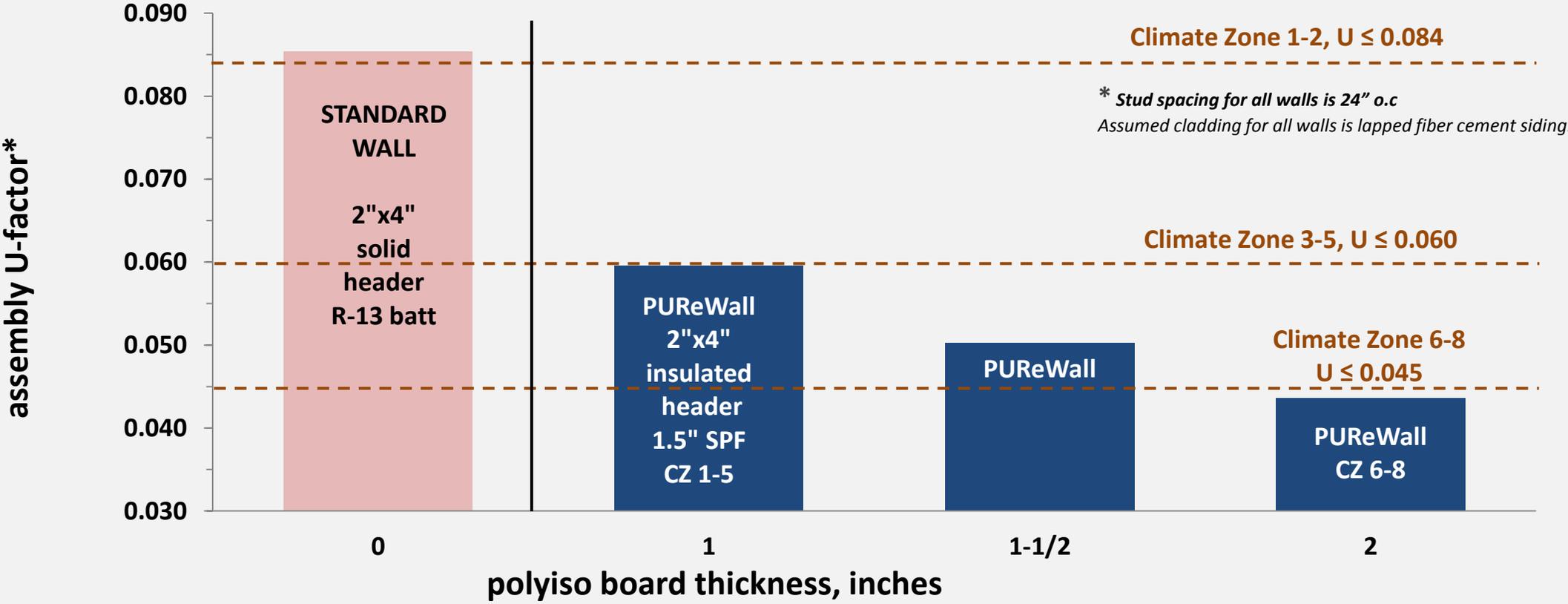


## 2" Exterior foam insulation

2x4 framed wall 24" O.C  
1½ BAYSEAL CC STR structural foam  
2" Polyiso board



# Meets thermal performance requirements in all climate zones



# The completion of several demonstration homes demonstrates feasibility



- ✓ Discover that **offsite construction** can be an entry point for innovation that **simplifies onsite assembly**, provides **cost savings**, and offers **superior performance**.

❖ **Offsite manufacturing is transformational to the construction industry, offering a platform to higher productivity and further innovation.**

- **Quality monitoring and verification, ISO manufacturing standards**
- **Just-In-Time job site production**
- **Evolve to:**
  - 1) **increasingly integrated assemblies to further reduce site labor**
  - 2) **advanced automation**
- **Reduced cycle time and inventory**
- **Vendor-managed process**
- **Innovation partnerships**

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For more information visit Covestro at Booth 4861

OR contact the PReWall team at [purewall@covestro.com](mailto:purewall@covestro.com)



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# Thank you!