



**Energy and Environmental
Building Alliance
October 10, 2017**

Agenda

- Company Overview
- State of the U.S. Housing Market
- Innovation: Opportunities and Challenges
- Making the Business Case
 - ✓ Smart Wall Technology – Chuck Chippero
 - ✓ Zero Net Energy – Brian Jamison

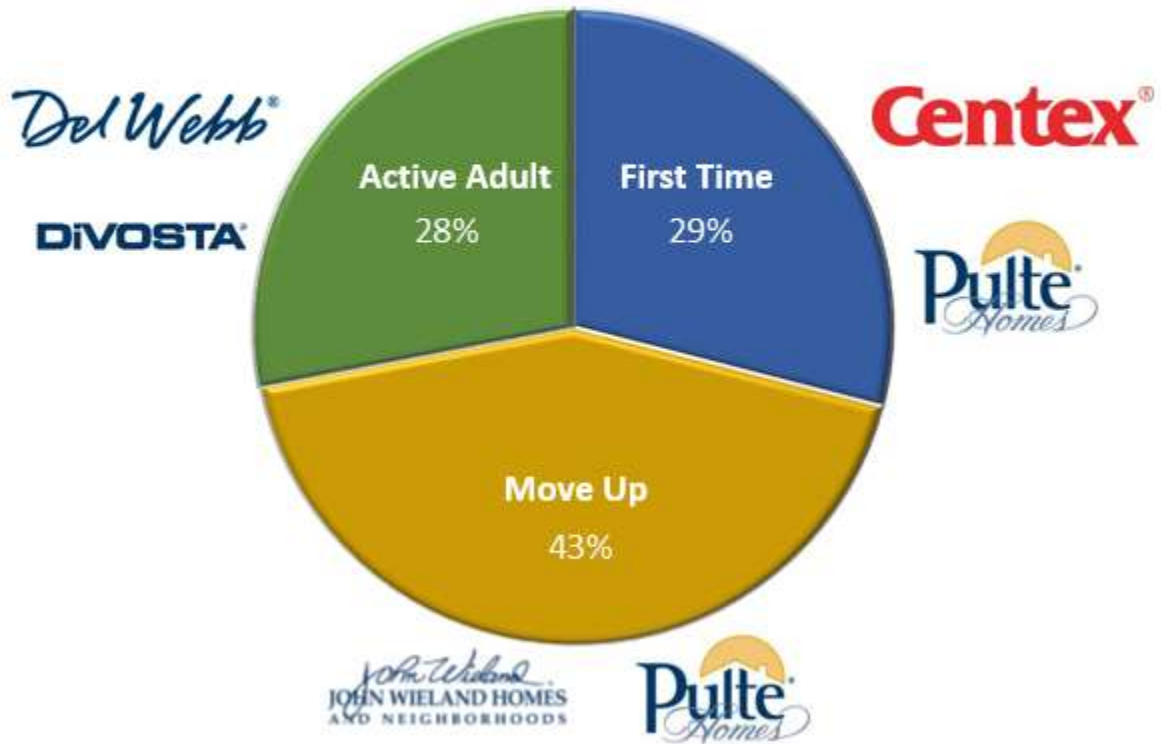


Company Overview

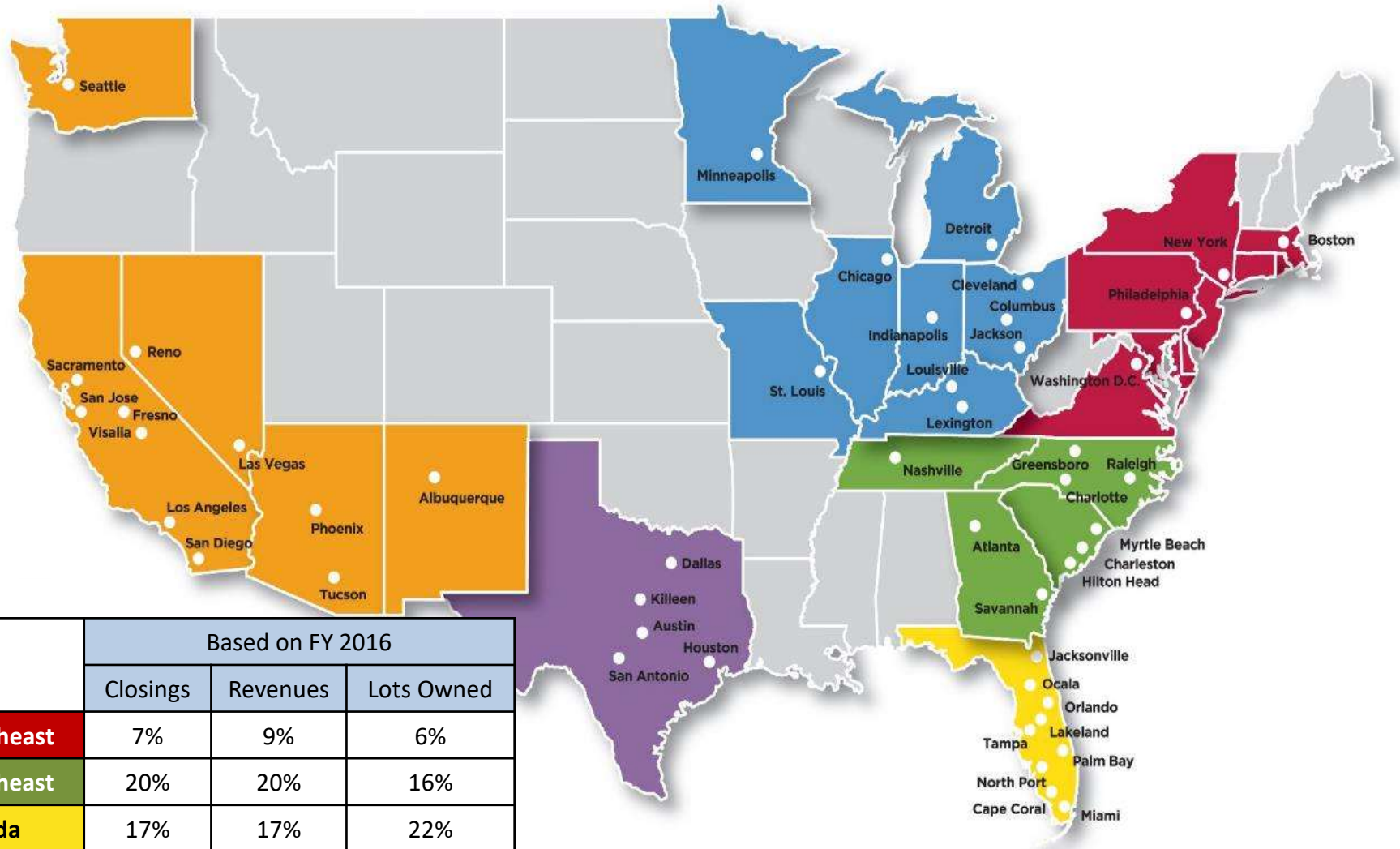
Building for All Major Buyer Groups

- Founded in 1950 in Detroit, and now among the nation's largest and most experienced homebuilders
- Brand-based approach to serving all primary buyer segments: first time, move up and active adult

Closings by Buyer Group



Diversified Platform Spans Leading U.S. Markets



	Based on FY 2016		
	Closings	Revenues	Lots Owned
Northeast	7%	9%	6%
Southeast	20%	20%	16%
Florida	17%	17%	22%
Midwest	17%	17%	12%
Texas	19%	14%	14%
West	20%	23%	30%

Recognized Commitment to Build Quality

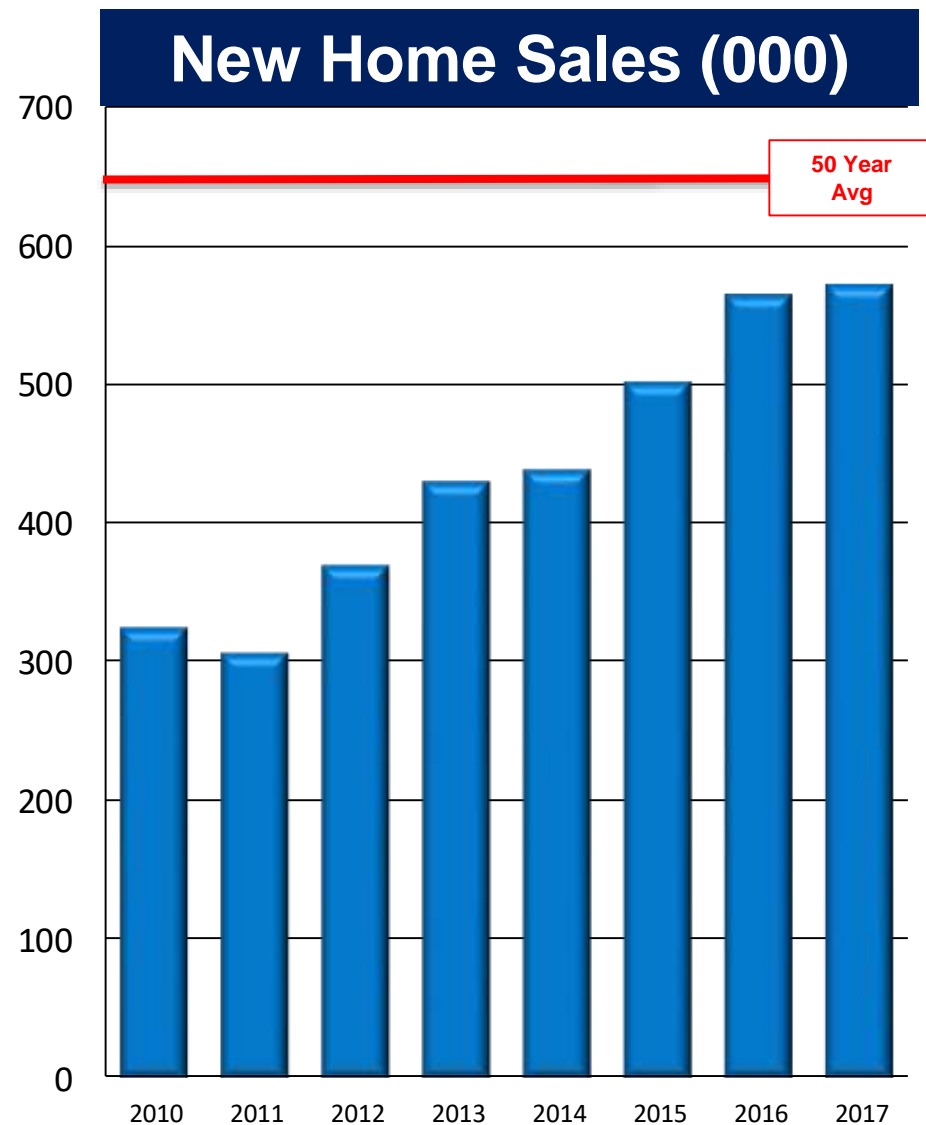
- Pulte Construction Standards and Pulte Quality Index
 - ✓ Clearly defined construction practices that are applied throughout the organization
 - Monthly score card highlights and ranks division performance
 - ✓ Internal and third-party construction audits to ensure compliance
 - ✓ Homeowner survey at time of home close and after one year to consistently monitor performance
 - ✓ Higher build costs can be offset with lower service and warranty expense
- Net Promoter Score
- Voice of the Consumer Dashboard



The State of the Housing Market

A Methodical Housing Recovery

- Slow rate of growth allowing for a longer housing cycle
- Favorable market dynamics support increasing demand
 - ✓ Positive demographics
 - ✓ Millennials moving from renters to owners
 - ✓ Gains in job formations and overall economy
 - ✓ Historically low interest rates



Source: U.S. Census

Limited Home Inventory

- Supply of homes well below 6 months in most markets
 - ✓ Low supply of homes supports price and creates a sense of urgency
- Constrained supply dynamic
 - ✓ Limited lot availability with slow entitlement process
 - ✓ Tight trade resources
 - Immigration policies
 - Millennials not entering the industry
 - ✓ Understaffed municipalities resulting in slow permit approvals



Product Innovation in Homebuilding

Opportunities and Challenges: Developing a Manufacturing Mindset

- Opportunity to increase use of manufactured components in production homebuilding
 - ✓ Greater precision
 - ✓ Less material waste
 - ✓ Easier integration of new building technologies
 - ✓ Improved energy efficiency of delivered home
- Slow pace of adoption
 - ✓ Higher delivered costs
 - ✓ Trade acceptance in the field
 - ✓ Limited availability of manufacturing plant labor
 - ✓ Difficult to scale up/down quickly in response to changes in the housing cycle

Opportunities and Challenges: Energy Efficiency

- Opportunity to build more energy efficient homes
 - ✓ Tighter, more energy efficient building envelope
 - Preassembled wall panels
 - Advanced insulation packages
 - Alternative building materials
 - ✓ Improving solar and battery technologies
 - ✓ More efficient appliances
 - ✓ Lower cost lighting
- Challenges remain
 - ✓ Cost to the consumer
 - ✓ Consumer acceptance
 - ✓ Consistency and quality of field installation

Opportunities and Challenges: Related Technologies

- Opportunities to make homes smarter
 - ✓ Actively manage/lower energy use
 - ✓ Enhance safety and security
- How will autonomous vehicles impact what and where homes are built
- Challenges remain
 - ✓ Guessing which technology survives
 - ✓ Bundling the right package for the right cost
 - ✓ Future maintenance
 - ✓ Liability – hacking





Assessing the Market Opportunity What Buyers Say vs. What Buyers Do

Market Realities: What Buyers Say

According to survey data: 9 out of 10 buyers would pay at least \$2,000 for a more energy efficient home

Energy Star 2010

15% More energy efficient than a typical new home. Saves 15% (approx. \$30) on utility bills each month

Energy Star 2011

32% More energy efficient than a typical new home. Saves 32% (approx. \$64) on utility bills each month

Energy Max

64% More energy efficient than a typical new home. Saves 64% (approx. \$128) on utility bills each month

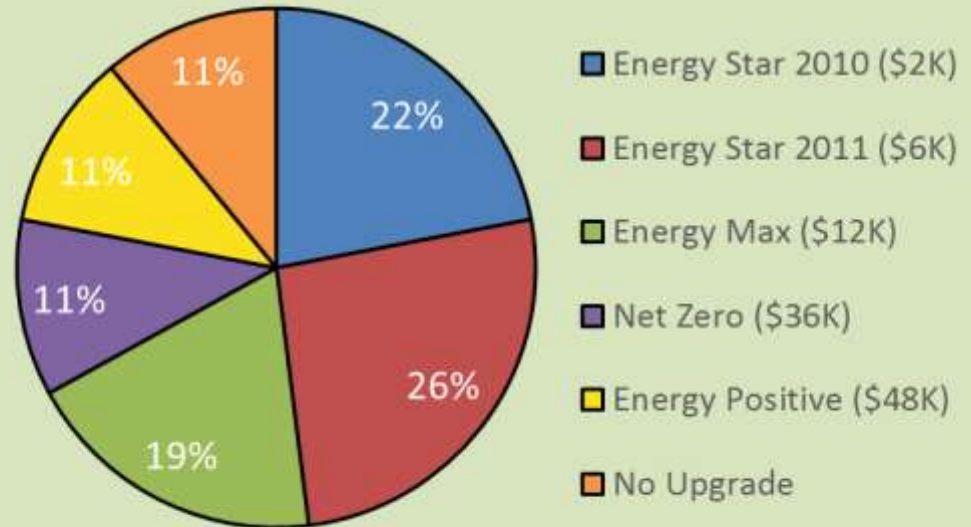
Zero Energy Home

100% More energy efficient than a typical new home-producing as much energy as it consumes. Saves 100%/month on utility bills

Energy Positive Home

115% More energy efficient than a typical new home-producing more energy than it consumes. Owner receives a credit from utility co.

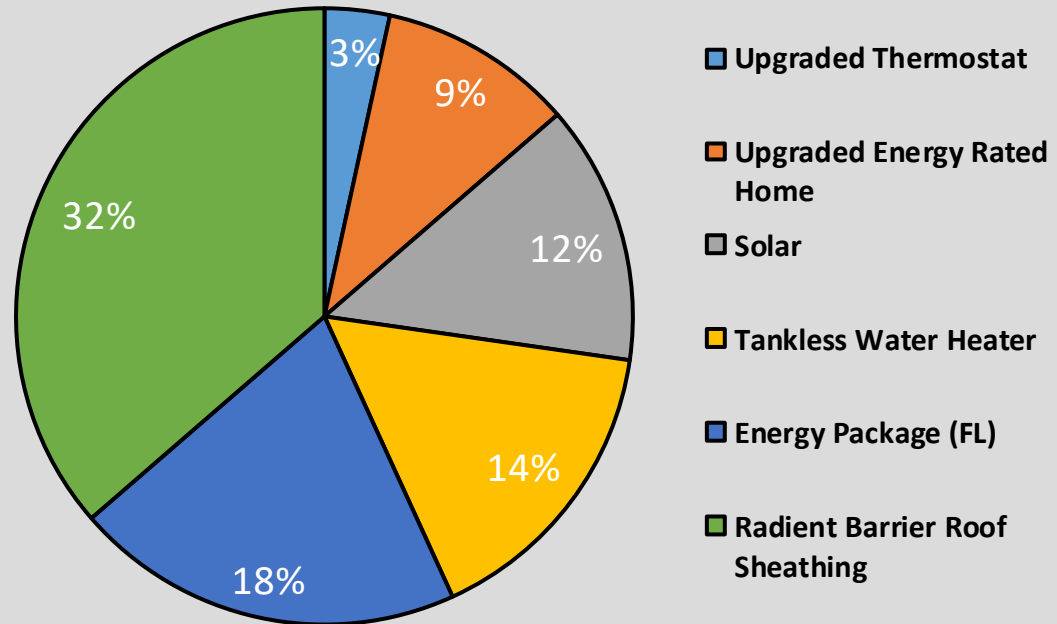
Focus Group Responses on What Buyers Would be Willing to Pay for a More Energy Efficient Home



Market Realities: What Buyers Do

- What people say they want vs. what they are willing to pay for
- Millennial buyers are the most tech savvy and eco-friendly, but most financially challenged
- Return on technology investment can extend over 10 years, while most people live in their home for 7 years

Customer Take Rate for Select Options



Final Thoughts

- Optimistic that market dynamics can support an ongoing recovery in housing demand
- There are numerous opportunities to improve construction and home efficiency
- Must demonstrate a clear value to the consumer wherein we balance opportunity to enhance home performance with buyer willingness to pay

Making the Business Case

- Chuck Chippero: National Director of Strategic Sourcing at PulteGroup with over 15 years of purchasing and supply chain experience in residential construction.
 - Assessing advanced wall systems i
- Brian Jamison: National Purchasing Director for Mechanical and Finish categories has over 26 years of experience in residential construction. As part of his responsibilities he leads Pulte's Zero Net Energy and Connected Home initiatives.
 - Prototyping a Zero Net Energy home

EEBA Presentation

Advanced Wall System Development

Oct 10, 2017
Chuck Chippero



What problem are we trying to solve?

- Current residential wall construction technology will not fully satisfy future energy code requirements

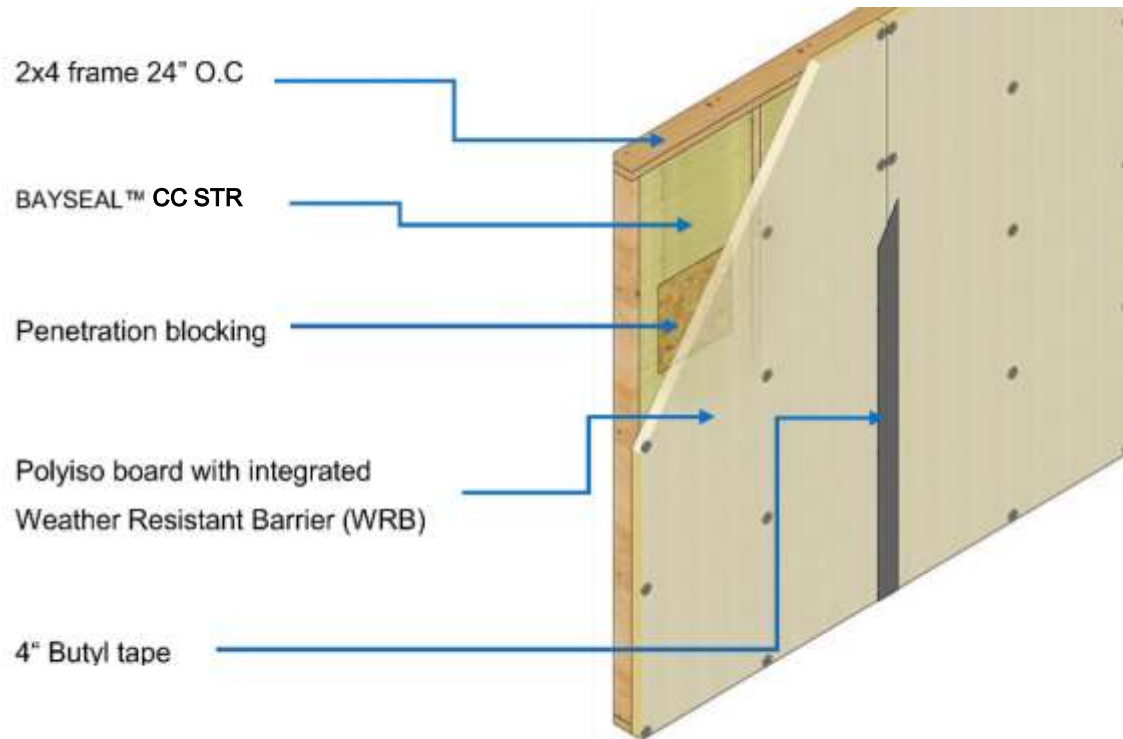
- Why? Challenges of today's commercially available solutions include, but are not limited to;
 - High material costs (price and excessive waste)
 - Dependency on additional and more skilled jobsite labor
 - Quality execution consistency - uncontrolled field environment
 - Longer build cycle times
 - Jobsite safety concerns

How did we innovate the solution?



Fabricator

What is the PUReWall™ system?



1" Exterior foam insulation

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



2" Exterior foam insulation

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



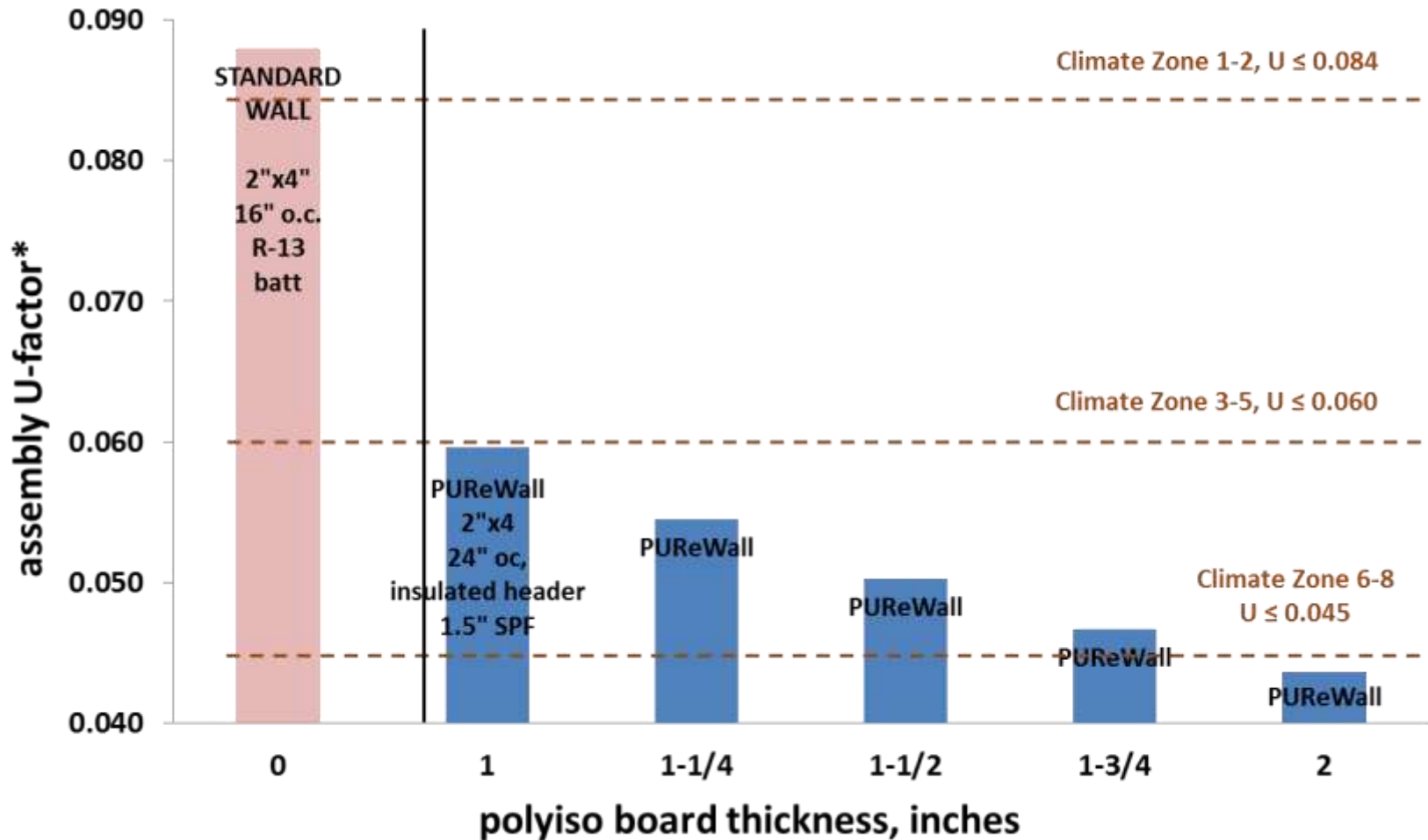
Why PReWall™?

Builder perspective

- **Performance standards for today and tomorrow**
 - By varying foam board thickness, PReWall can be adapted to meet all climate zone R value requirements.
- **Simplification & speed of assembly**
 - Panelization allows for high quality, reproducible panels built in a controlled environment.
- **Reduction in site labor and waste**
 - Walls can be erected quickly at the job site.
 - Insulation is already installed.
- **Cost competitive, high performance solution**
 - Equal or lower cost compared to common wall constructions.
 - Structural without wood sheathing.
 - Taped wall assembly is a WRB, no house wrap
- **Minimal potential for condensation**
 - Minimal potential for water vapor condensation in the wall assembly in any climate zone



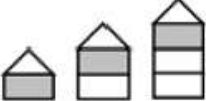
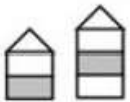

PURewall meets thermal performance requirements in all climate zones

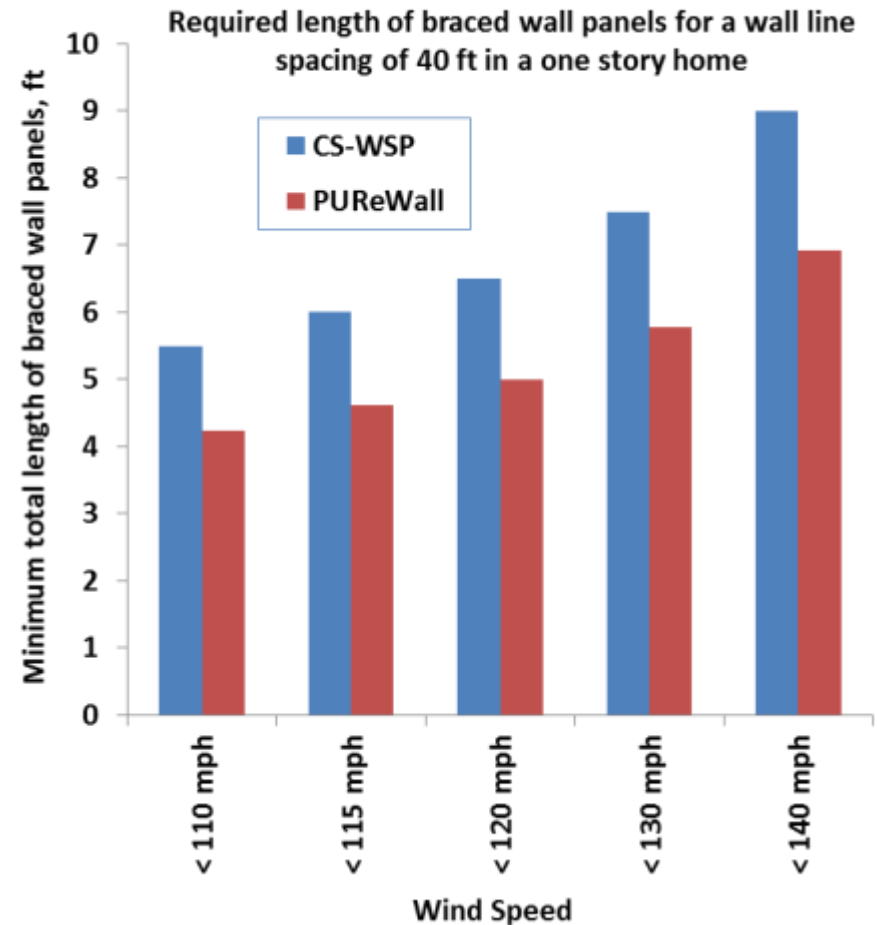


*assumed cladding for all walls is lapped fiber cement siding.

PURewall requires less bracing length than continuously sheathed wood structural panels (CS-WSP) in the IRC

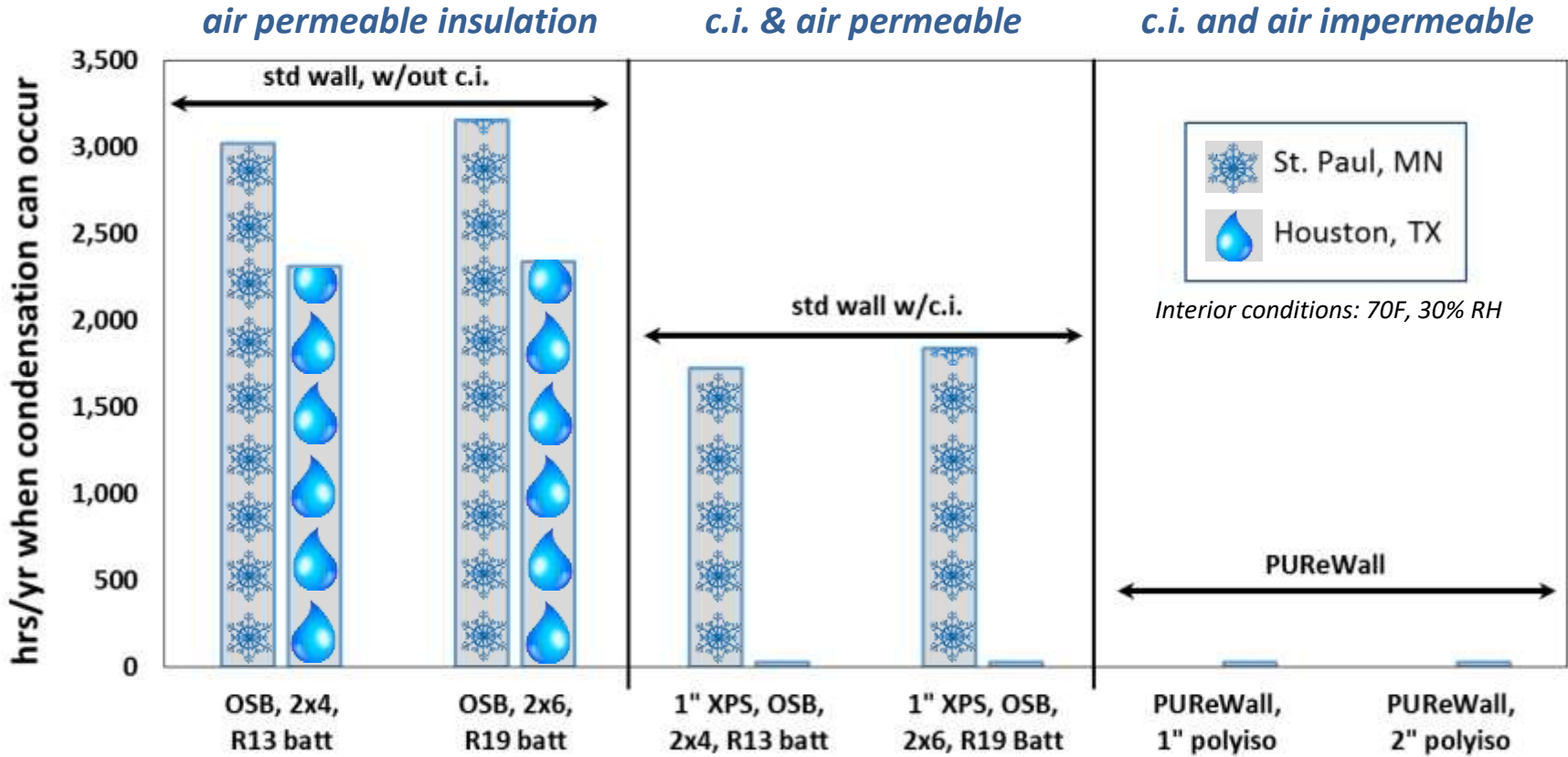
IRC 2015 Table R602.10.3(1) Bracing Requirements Based on Wind Speed (Method CS-WSP)

Story Location	Braced Wall Line Length (ft)	<110 mph	<115 mph	<120 mph	<130 mph	<140 mph
One Story or Top of Two or Three Stories 	10	1.5	2.0	2.0	2.5	2.5
	20	3.0	3.5	3.5	4.0	5.0
	30	4.5	4.5	5.0	6.0	7.0
	40	5.5	6.0	6.5	7.5	9.0
	50	7.0	7.5	8.0	9.5	11.0
	60	8.0	9.0	9.5	11.0	13.0
First Story of Two Stories or Second Story of Three Stories 	10	3.0	3.5	3.5	4.5	5.0
	20	5.5	6.5	7.0	8.0	9.0
	30	8.0	9.0	9.5	11.5	13.0
	40	10.5	11.5	12.5	15.0	17.0
	50	13.0	14.0	15.5	18.0	21.0
	60	15.5	17.0	18.5	21.5	25.0
First Story of Three Stories 	10	4.5	5.0	5.5	6.5	7.5
	20	8.5	9.0	10.0	11.5	13.5
	30	12.0	13.0	14.5	17.0	19.5
	40	15.5	17.0	18.5	22.0	25.0
	50	19.0	21.0	23.0	26.5	31.0
	60	23.0	25.0	27.0	31.5	36.5



PURewall has very low potential for condensation in any climate

Potential for summer and winter condensation occurrences in different types of wall assemblies



The modified panel process has been successfully demonstrated

Framing
(existing step)

Polyiso Attachment
(replaces OSB attachment)

Panel Rotation
NEW to Panel
manufacturer

SPF Application
NEW to Panel
manufacturer

Rotation and Stack
(modify existing step)



PUReWALL Interiors

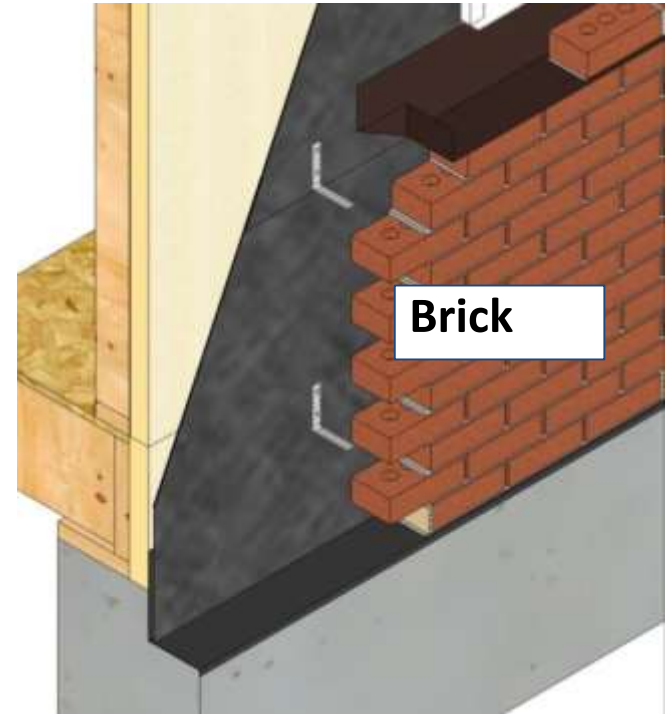
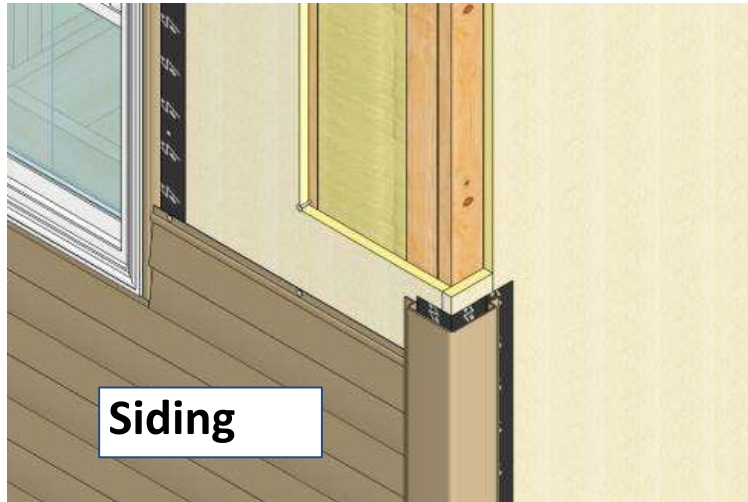
Plumbing

Benefit of PUReWALL is supply plumbing can be routed in exterior walls

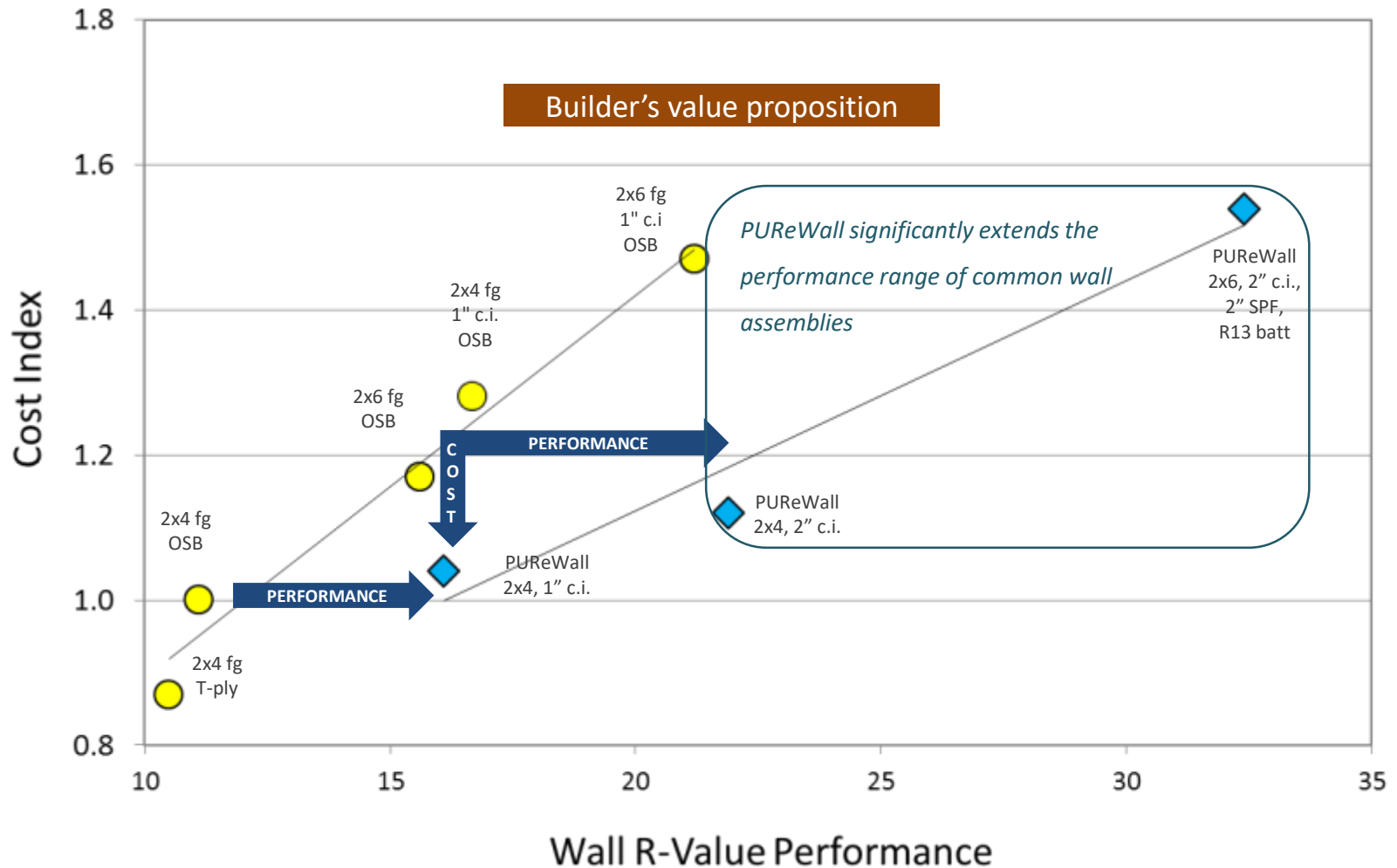
Always provide nail plates where piping passes through framing



PUReWALL Cladding



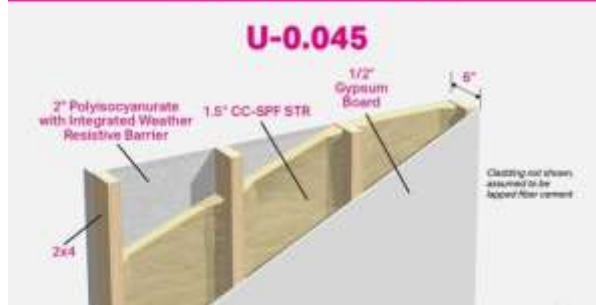
PURewall offers cost and performance benefits



PURewall™

<http://ecm.cm.covestro.com/en/purewall/purewall>

PURewall™ 45 for Climate Zones 6-8



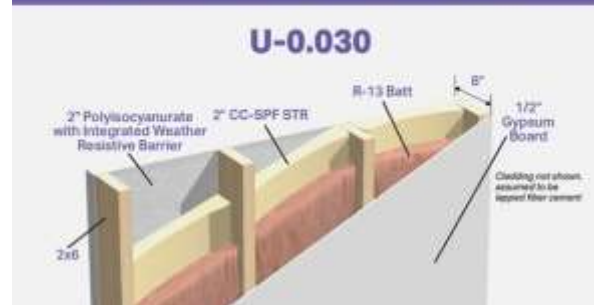
PURewall™ 60 for Climate Zones 1-5



PURewall™ T24 for California Title 24



PURewall™ 30 for Net Zero / Passive designs



PURewall™ is a panelized wall that is designed for use in residential construction. Its innovative design replaces traditional exterior sheathing and replaces it with a combination of polyisocyanurate (polyiso) continuous insulation on the exterior and spray polyurethane foam (SPF) in the wall cavity, both of which are installed at a panelization facility.

PURewall™ is not only a continuously insulated, highly energy efficient wall, it is also structural. It has a new SPF formulation that works in combination with the polyiso and framing lumber to create a structural wall panel. The SPF is applied in an environmentally controlled setting in the panel facility, which allows for repeatable, tight tolerance construction in a manufactured setting.

EEBA Presentation
Zero Net Energy
Northern California San Francisco Division

Oct 10, 2017

ZNE Defined

- **A home that consumer no more energy from the conventional power grid than it produces from onsite renewable resources.**
- http://newsroom.pultegroup.com/presskit_display.cfm?presskit_id=10006
- **There are many ways to build a ZNE home**
 - Add large solar array to compensate lower performing home
 - Mix of high performance home and solar
 - High performance home and small solar array
 - Onsite storage battery (s)
 - Any combination in between

HOW – Our Approach and Philosophy

- **Solve for how we could implement in 2020**
 - Created builder, manufacturer, and trade partner awareness to needed products
 - Create and test sales and relator acceptance of ZNE product
- **Started with the philosophy of simplicity**
- **Production environment keeping the build cycle time as close to the same as today –Effect as few trades as possible to minimize complexity**
- **Deliver quality sustainability results to the homebuyers**
 - Understand how to set homeowner expectations for how a ZNE home lives and how that may differ from previously owned homes
- **Philosophy: Few people know how a smart phone works they just know it works. Apply the same end results to the ZNE home.**

Guiding Principals

- **First we wanted our home to face south**
 - Show the solar array
 - Protecting our streetscapes
 - Blending in with the rest of the neighborhood
- **Second we wanted to follow the California code or as close as possible**
 - We took the California Energy Code 2016 and build in most of the projected code improvements from 2016 to 2020
 - 2020 California code wants all new construction to be ZNE
- **Third we wanted this home to look a typical the same inside and out**
- **Lastly we didn't want any additional homeowner maintenance**
 - We wanted it to live like a typical home

Our Path

- **Guided by the California Energy Code 2016 to 2020**
- **Owens Corning cathedral R38 attic insulation- Attic conditioned space**
- **All Energy Star Appliances including Refrigerator and Front Load W&D**
- **On Demand Tankless Water Heater**
- **Seer 19 Heat Pump**
- **Fresh Air Induction**
- **MERV 16 air filtration**
- **Smart Thermostat**
- **All LED lighting**
- **Then we added Solar**
- **Myopic energy monitoring**

- **With instructions for the homeowners to just live in it like their previous home –key for our learning on this project**

Energy Monitoring 8:30 AM



Energy Monitoring 12:00 PM



Energy Monitoring 4:30 PM



The Results

Goal: Simple, meaningful, reproducible, consumer friendly, sustainable,

- **Less than 7 trade partners affected so it is reproducible in production environment**
- **All consumer facing product positive impact to homeowner with no maintenance**
- **Known products with known track record supporting life of the home**
- **Still in the 12 month monitoring cycle**

Zero Net Energy Home

Thank you...