Better Buildings Residential Network Peer Exchange Call Series:

Modular Housing, Tiny Homes and What the Future of Homeownership Means for Energy Efficiency

June 13, 2019

Agenda and Ground Rules

- Agenda Review and Ground Rules
- Opening Poll
- Residential Network Overview and Upcoming Call Schedule
- Featured Speakers:
  - **Mark Wyman,** Energy Trust of Oregon
  - **Jordan Dentz,** Systems Building Research Alliance
  - **John Weldy,** Clayton Homes
- Open Discussion
- Closing Poll and Announcements

Ground Rules:

1. **Sales of services and commercial messages are not appropriate** during Peer Exchange Calls.
2. Calls are a safe place for discussion; **please do not attribute information to individuals** on the call.

The views expressed by speakers are their own, and do not reflect those of the Dept. of Energy.

Better Buildings Residential Network

Join the Network

Member Benefits:

- Recognition in media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- One-on-One brainstorming conversations

Commitment:

- Members only need to provide *one number*: their organization's number of residential energy upgrades per year, or equivalent.

Upcoming Calls (2nd & 4th Thursdays):

- Jun 27th: Making the Most of Home Performance Data
- Jul 11th: Getting Net Zero Upgrades to Scale – The Future is Now
- Jul 17th: Bonus Episode! Meet the Winners of the 2019 Home Performance with ENERGY STAR Awards

Peer Exchange Call summaries are posted on the Better Buildings website a few weeks after the call

For more information or to join, for no cost, email bbresidentialnetwork@ee.doe.gov, or go to energy.gov/eere/bbrn & click Join

Jordan Dentz
Systems Building Research Alliance

U.S. DEPARTMENT OF ENERGY

Manufactured Homes: Innovations in Energy Efficiency

June 13, 2019

Jordan Dentz
Systems Building Research Alliance

Systems SBRA Building Research Alliance

SBRA'S MISSION

"SBRA's mission is to develop new technologies that enhance the value, quality, and performance of the nation's factory built homes, both manufactured and modular."

Activities include research, new product development, training and educational programs, testing programs and demonstrations, commercialization efforts, workshops, conferences and other events.

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AGENDA

- Types of factory built homes
- The manufactured home industry
- Manufactured home efficiency programs
- Retrofitting manufactured homes
- Innovations in new manufactured home construction
- Potential future innovations

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TYPES OF FACTORY BUILT HOMES

Manufactured

Modular

Park Model

Tiny House

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DEFINITIONS

A manufactured home is:

- Built entirely in a factory to preemptive, federal building standards known as the HUD-Code which went into effect on June 15, 1976.
- Federal standards regulate design and construction, strength and durability, transportability, fire resistance, energy efficiency, and quality. Performance standards for heating, plumbing, air conditioning, thermal and electric systems.

A modular home is:

- Built in a factory but built to the regional, state or local code where the home will be located.
- Sections – or "modules" – are transported to the home site and installed.

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MANUFACTURED HOMES BY THE NUMBERS

General Profile

22 million people live in manufactured homes

10% of new single-family home starts

$71,900 average new home sales price

$30,000 median household income

77% of new manufactured homes titled as personal property (chattel)

Sources: U.S. Census Bureau and MHI, 2018

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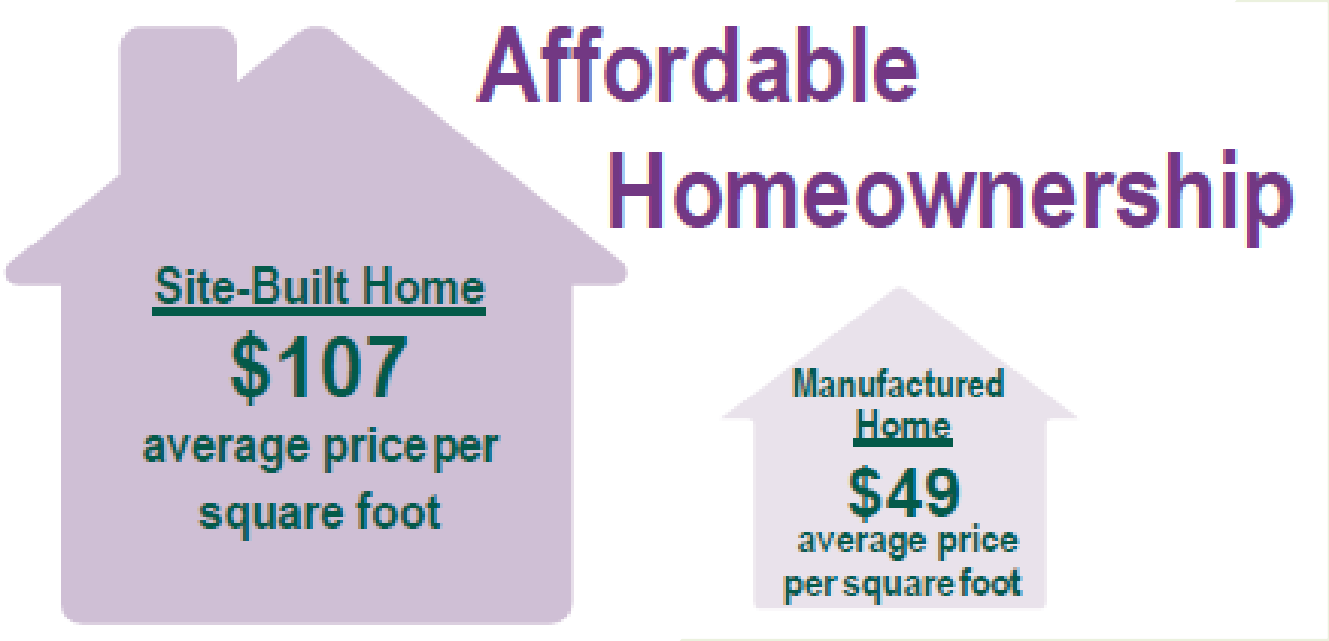
THE AFFORDABLE OPTION



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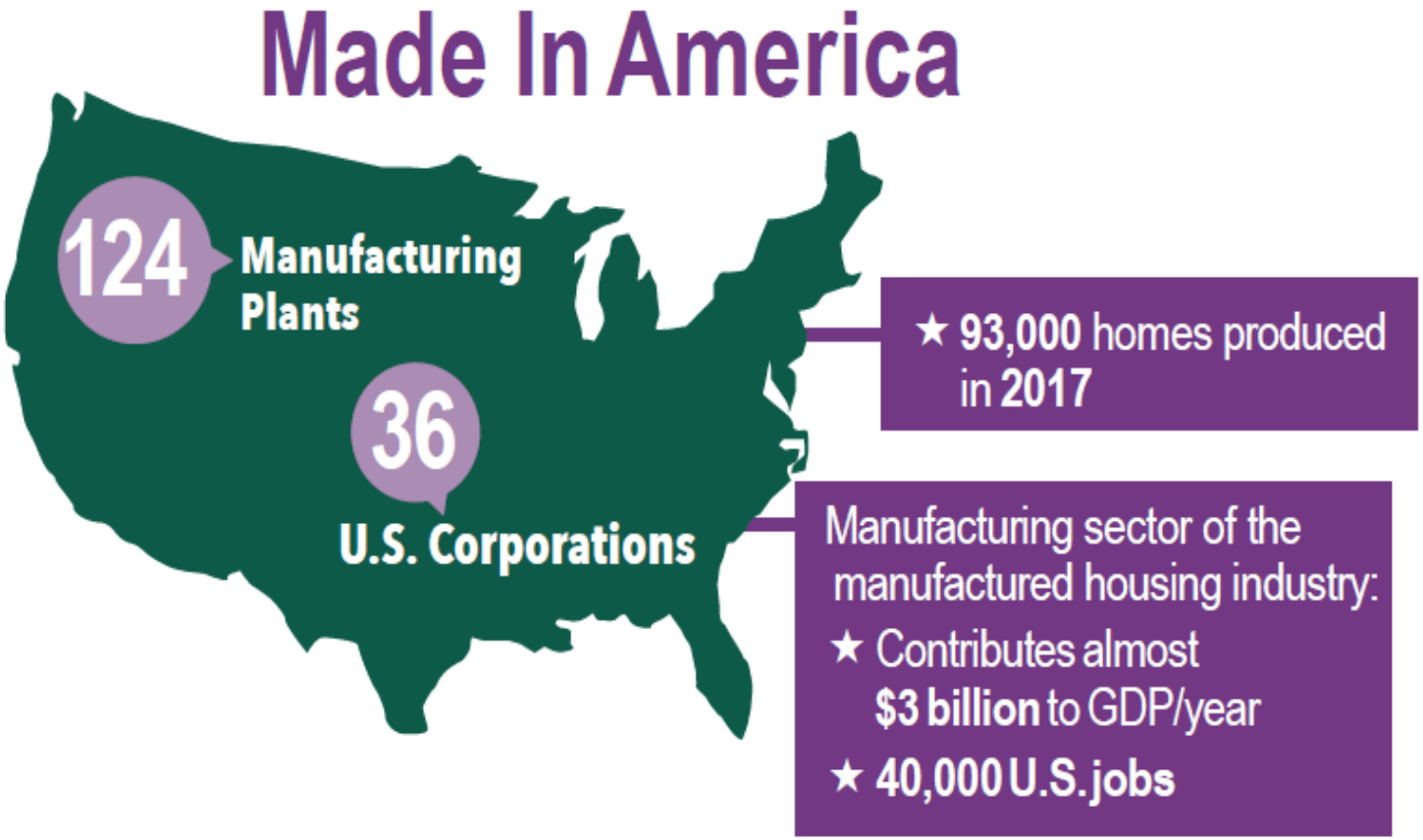
MANUFACTURED HOMES BY THE NUMBERS



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NEW MANUFACTURED HOME EFFICIENCY PROGRAMS

- ENERGY STAR QUALIFIED MANUFACTURED HOMES
  80 Certified plants completed 5,000 certified homes in 2018

- UTILITY PROGRAMS
  Offer about $1,500 per home for improved efficiency standards and heat pumps
  - **East Kentucky Power Cooperative (KY)**
  - **American Electric Power (OH)**
  - **Appalachian Power Company (WV)**
  - **First Energy (PA)**
  - **Northwest Energy-Efficient Manufactured Housing Program**

- Details at www.research-alliance./org and https://www.neemhomes.com/

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MANUFACTURED HOME RETROFIT

- DOE and DOA Weatherization Assistance Programs largest source of energy retrofits for manufactured homes
- Utility programs sometimes encourage replacement of ACs with heat pumps, among other measures
- Replacement home programs in a few states
- Studies and pilots to install ductless heat pumps to offset resistance furnace heating




NEW MANUFACTURED HOME INNOVATION

- TECHNOLOGY DEVELOPMENT

  Next generation design—advanced envelope and HVAC design

  Co-sponsors:

  - US Dept. of Energy
  - Tennessee Valley Authority
  - New York State Energy Research and Development Authority
  - California Energy Commission

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ADVANCED ROOF PROTOTYPING

Prototyping hosted by
SE Homes, Double Springs, AL

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ADVANCED WALLS PROTOTYPING

Prototyping hosted by
Karsten Homes, Sacramento, CA

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MINI-SPLIT HEAT PUMPS

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SIDE-BY-SIDE TESTS

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COLD CLIMATE TESTS

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Building America Top Innovation Award 2014

ENERGY | Energy Efficiency & Renewable Energy

BUILDING AMERICA TOP INNOVATIONS 2014 PROFILE

INNOVATIONS CATEGORY:
Advanced Technologies and Practices
Building Science Solutions
Thermal Enclosure

INNOVATOR:
ARIES Collaborative

Cost-Optimized Attic Insulation Solution for Factory-Built Homes

This low-cost, low-tech attic insulation technique is immediately applicable to the nearly 125,000 new manufactured homes built each year. With widespread adoption, this one measure could save home owners over 6 trillion Btus by 2030, equal to $100 million in savings that would go into the pockets of families with modest incomes.

BUILDING AMERICA TOP INNOVATIONS

Energizing 30 innovations in building science – the U.S. Department of Energy's Building America program was started in 1994 to provide research and development to the residential new construction and remodeling industry. As a national center for world-class research, Building America funds integrated research in market-ready technology solutions through collaborative partnerships between building and remodeling industry leaders, nationally recognized building scientists, and the national laboratories. Building America Top Innovation Awards recognize those projects that have had a profound or transforming impact on the new and retrofit housing marketplace on the road to high-performance homes.

Increasing attic insulation in manufactured housing has been a significant challenge due to cost, production and transportation constraints. The simplicity of this dense-pack solution to increasing attic insulation R-value promises real hope for widespread industry adoption.

The U.S. Department of Energy's ARIES research team, led by The Levy Partnership Inc., partnered with Clayton Home's Southern Energy Homes division and Johns Manville Corporation to develop and test a new attic insulation method that involves dense packing the shallow attic space in manufactured homes with blown fiberglass insulation.

With this new method of applying dense-pack insulation, installers are able to achieve a much higher attic insulation R-value than is typically installed in manufactured homes.

Specifically, Southern Energy Homes has achieved an overall average attic R-value of R-44.6 and an R-value of R-54.6 at the center or peak of the attic using this innovative new dense-packing method. For comparison, a home certified to the ENERGY STAR Qualified Manufactured Homes program typically has an average R-value of between R-30 and R-38 in the ceiling. The typical ceiling insulation level in a manufactured home in HUD Code zone 1 is around R-22 at the peak.

The method was tested in a home built by Southern Energy to the performance criteria of the DOE's Zero Energy Ready Home program, which seeks to achieve whole house energy performance that exceeds the requirements of the 2012 International Energy Conservation Code.

The home is being monitored for 12 months at Clayton's Russellville, Alabama, plant in side-by-side testing with homes built to ENERGY STAR and to the U.S. Department of Housing and Urban Development's Manufactured Home Construction and Safety Standards (commonly known as the HUD code).

Building America – U.S. Department of Energy

(top left) The dense-pack roof insulation technique is being tested in a side-by-side comparison with two other manufactured homes—one built to ENERGY STAR and one built to the HUD code. The homes are undergoing 12 months of performance testing by the DOE's ARIES research team and National Renewable Energy Laboratory.

ZERH Housing Innovation Award 2014

ENERGY | Energy Efficiency & Renewable Energy

DOE ZERO ENERGY READY HOME™

ZERO 2014 WINNER Housing Innovation Award

Southern Energy Homes

First DOE Zero Energy Ready Manufactured Home
Russellville, AL

BUILDER PROFILE

Southern Energy Homes, Inc.
(a division of Clayton Homes)
Russellville, AL
David Brewer
davidbrewer@claytonhomes.com
205-469-5405
www.claytonhomes.com
Rater: The Levy Partnership, Inc., Jordan Dentz, jdentz@levy-partnership.com

FEATURED HOME/DEVELOPMENT

Project Data:
- Name: First DOE Zero Energy Ready Manufactured Home
- Location: Russellville, AL
- Layout: 3 bedrooms, 2 baths, 1 floor
- Conditioned Space: 1,232 ft²
- Climate Zone: IECC 3A, mixed-humid
- Completion: May 2014
- Category: Affordable

Performance Data:
- HERS Index without PV: 57
- Projected Annual Utility Costs: without PV $799
- Projected Annual Energy Cost Savings (compared to a home built to the HUD Code): without PV $372
- Builder's Added Cost Over HUD Code (HHCSS): $1,87
- Annual Energy Savings: without PV 4,658 kWh

The country's first U.S Department of Energy-certified Zero Energy Ready manufactured home is up and running in Russellville, Alabama. The manufactured home is being put through its paces along side of a standard to-code manufactured home and an ENERGY STAR manufactured home. The manufactured home, built by Clayton Home's Southern Energy Homes subsidiary, has an impressive suite of energy-saving, water-saving, high-tech features that any home would be proud of. "The DOE Zero Energy Ready home is a potential game changer for the factory building industry," said Jordan Dentz, a building scientist for The Levy Partnership, a research partner in the DOE Building America program, who is collaborating with Clayton Homes and the National Renewable Energy Laboratory to do 18 months of side-by-side performance testing on the three homes.

Testing began May 2014 and preliminary cooling-season results are already showing the DOE Zero Energy Ready Home as a strong leader in this energy savings race, using half the space conditioning energy of a manufactured home built to the U.S. Department of Housing and Urban Development's Manufactured Home Construction and Safety Standards (commonly known as the HUD code), which is the building standard for all U.S. manufactured housing. The other manufactured home, which was built to the ENERGY STAR criteria for manufactured homes has about a 15% savings over the HUD Code home.

The DOE Zero Energy Ready Home meets all of the requirements that site-built homes must meet to qualify for this high-performance home labeling program. The home is built to meet all of the air sealing and construction quality requirements of ENERGY STAR Certified Homes Version 3.0. It also meets the indoor air quality and water-saving requirements of the U.S. Environmental Protection Agency's Indoor airPLUS and WaterSense programs. The DOE

ZERO ENERGY READY HOME

The U.S. Department of Energy invites home builders across the country to meet the extraordinary levels of excellence and quality specified in DOE's Zero Energy Ready Home program (formerly known as Challenge Home). Every DOE Zero Energy Ready Home starts with ENERGY STAR Certified Homes Version 3.0 for an energy-efficient home built on a solid foundation of building science research. Advanced technologies are designed in to give you superior construction, durability, and comfort; healthy indoor air; high-performance HVAC, lighting, and appliances; and solar-ready components for low or no utility bills in a quality home that will last for generations to come.

POTENTIAL FUTURE INNOVATIONS

- Endorsed by Industry Meeting March 28, 2019
- Hosted by TVA
- Attended by Utilities and Home Manufacturers
- Coordinated by SBRA
- Identified research and program priorities

Contact SBRA to get involved

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Fixing HVAC Faults

Measure by what means and to what extent flaws in HVAC installation practices degrade system performance and plan actions that can be taken to ameliorate these problems.

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Plant-integrated HVAC Installation

Develop and test designs and processes to fully install all components of the HVAC in the factory under the plants' QA process rather than coils and condensers being installed in the field by independent contractors.

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Manufactured Home Replacement Program

Design and demonstrate (pilot) a manufactured home replacement program that encourages and incentivizes the replacement of older, dilapidated manufactured homes with new, ENERGY STAR models.

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Software for Energy Design and Compliance

Develop software that facilitates code compliance while providing feedback on expected energy use and other design feedback (example: ResCheck for manufactured homes (“HUDCheck”)

Generated by REScheck-Web Software

Compliance Certificate

Project A Sample Project

Energy Code: 2015 IECC
Location: Richland, Washington
Construction Type: Single-family
Project Type: New Construction
Orientation: Bldg. faces 180 deg. from North
Conditioned Floor Area: 3,000 ft2
Glazing Area: 25%
Climate Zone: 5 (4882 HDD)
Permit Date:
Permit Number:

Construction Site:
123 Main St.
Dayton, WA 99352

Owner/Agent:
R. Franklin
123 M. Tenth
Dayton, WA 99352
509.888.7777

Designer/Contractor:
Anne Mahrt
Anne Mahrt Designers
355 Pine Ridge
Dayton, WA 99352

Compliance: Passes using UA trade-off

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	U-Factor	UA
Ceiling: Flat Ceiling w/ Vaulted Trusses	3,000	41.0	0.0	0.029	86
Skylight: Metal Frame	70			0.550	39
Wall 1: Wood Frame, 24" o.c. Orientation: Front	1,200	21.0	5.0	0.057	69
Door 1: Solid Door (under 50% glazing) Orientation: Front	37			0.350	13
Wall 2: Wood Frame, 24" o.c. Orientation: Front	1,200	21.0	5.0	0.057	69
Window 1: Metal Frame Orientation: Front	35			0.550	19
Window 2: Metal Frame Orientation: Front	35			0.550	19
Window 3: Metal Frame Orientation: Front	35			0.550	19
Wall 3: Wood Frame, 24" o.c. Orientation: Front	1,200	21.0	5.0	0.057	69
Window 4: Metal Frame Orientation: Front	35			0.550	19
Wall 4: Wood Frame, 24" o.c. Orientation: Front	1,200	21.0	5.0	0.057	69
Window 5: Metal Frame Orientation: Front	35			0.550	19

Project Title: A Sample Project
Data Filename:
Report date: 02/25/19
Page 1 of 10

Systems SBRA Building Research Alliance

Thank You

Jordan Dentz
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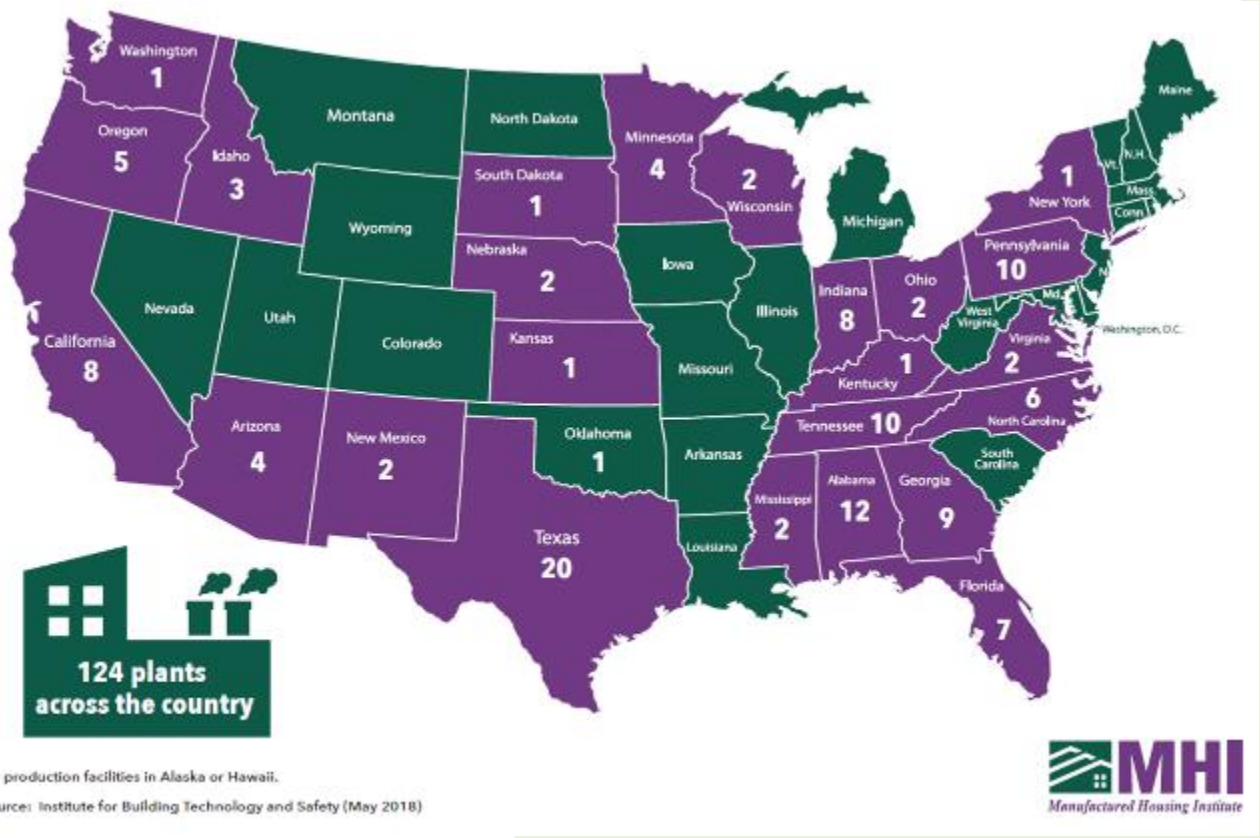
Systems SBRA Building Research Alliance

Reference Slides

NEW HOMES: PRODUCTION

While manufactured housing has a presence in all 48 contiguous states, production is concentrated in certain markets



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NEW HOMES: BY STATE

Major market is the Southeast (indicated by *), totaling 10 of the top 12 states for shipments

State	Home Shipments
Texas*	17,676
Alabama*	6,046
Florida*	5,855
Louisiana*	5,776
Michigan	4,791
North Carolina*	3,835
South Carolina*	3,797
California	3,681
Mississippi*	3,665
Georgia*	2,852
Kentucky*	2,807
Tennessee*	2,664

Source: MHI

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EXISTING HOMES: INVENTORY BY STATE

In eight states, manufactured homes represent more than 15% of the total occupied housing units

	No. of Manufactured Homes (MH)	Total Occupied Housing Units in State	MH as a % of all occupied housing
South Carolina	364,076	1,839,041	19.8%
New Mexico	150,613	762,551	19.8%
West Virginia	133,588	739,397	18.1%
Mississippi	193,308	1,098,803	17.6%
Alabama	295,722	1,851,061	16.0%
Wyoming	36,381	226,985	16.0%
North Carolina	590,302	3,815,392	15.5%
Louisiana	265,977	1,731,398	15.4%
USA Total	8,454,133	117,716,237	7.2%

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Manufactured Housing: Nexus Of Clean Energy & Affordable Housing Finance

Energy Trust of Oregon

Key Points

- High-efficiency mini-split HVAC systems are particularly well suited to mobile homes.
- Fault detection systems represent a promising area of research, offering great potential to reduce energy consumption in manufactured homes.
- Given great advances in manufactured housing efficiency, replacing older stock with newer can deliver significant savings.

John Weldy
Clayton Homes

U.S. DEPARTMENT OF ENERGY

Modular Housing, Tiny Homes and What the Future of Homeownership Means for Energy Efficiency

John Weldy, PE
Director of Engineering

Clayton home building group

Modular Housing, Tiny Homes and What the Future of Homeownership Means for Energy Efficiency

Let's look at:

- Progress of modular & Tiny housing in pictures.
- United States Housing Crisis and what it means for homeownership and energy use.
- Balancing homeownership cost and home energy consumption cost.
- Impact of home size on environmental footprint and what role does Modular and Tiny Homes play.

Pre-1976 Mobile Homes

Source: https://clickamericana.com/topics/home-garden/mobile-homes-hot-housing-trend-50s-60s

Source: http://www.whitehouse51.com/vintage-kropf-mobile-homes/17/1960-kropf-121802/

Source: 2019 HUD report to Congress on the On-site Completion of Construction for Manufactured Homes

Manufactured Homes of Today

The Captain Jack by Clayton Homes
Source: Clayton Homes

Catalina Model by Cavco Durango
Source: Cavco Durango

Source: 2019 HUD report to Congress on the On-site Completion of Construction for Manufactured Homes

Tiny Homes

Source: Forbes.com

Tiny Homes

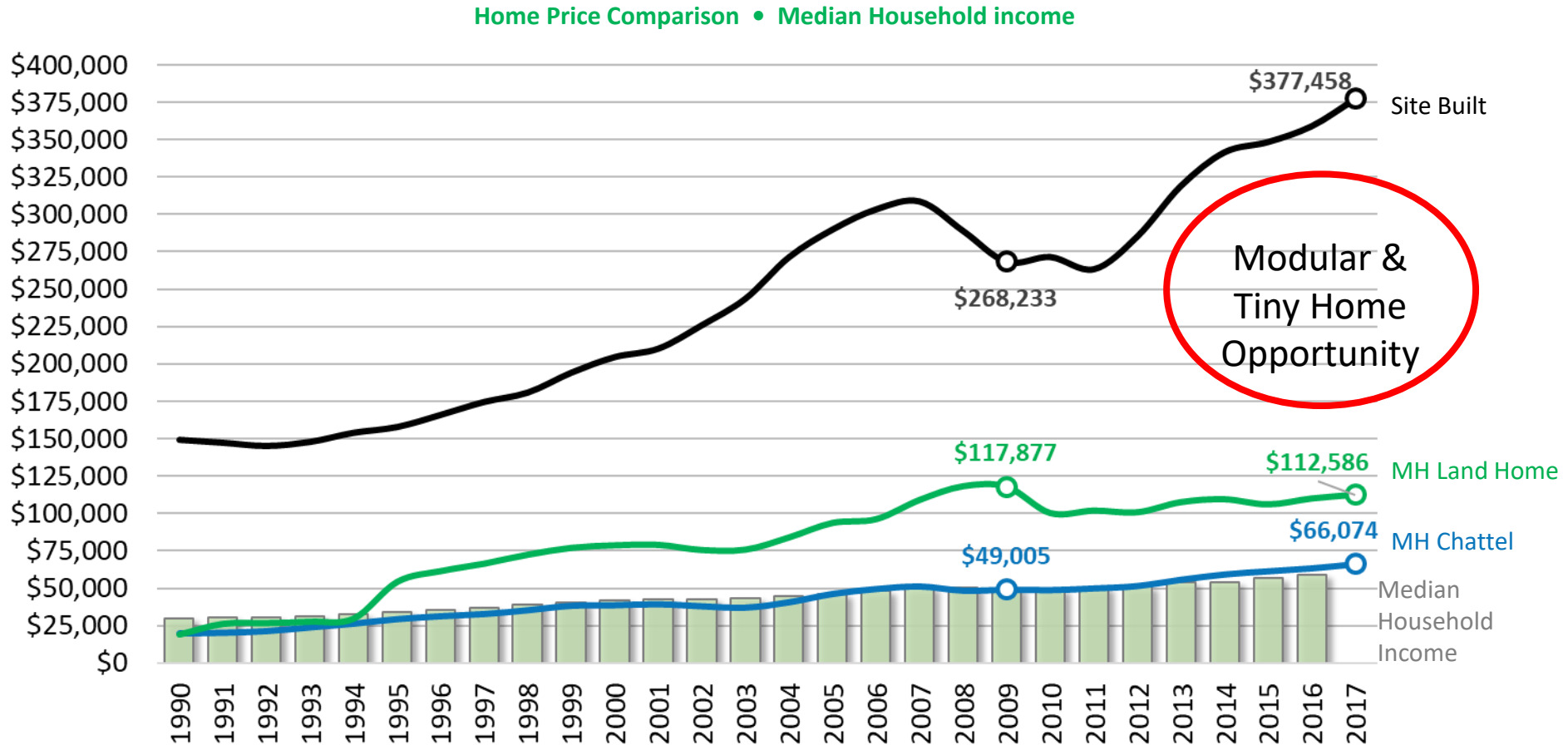
Source: Clayton Dungan

United States Housing Crisis and what it means for homeownership and energy use

While the average new on-site built home with land costs nearly $400,000, the increase in homeownership cost has out passed income in the United States which has contributed to a National Housing Crisis.

More families need smaller, more affordable housing alternatives and will continue to turn to Modular and Tiny Homes which can be sold in most markets for under $200,000 before land costs.

Modular Housing & Tiny Homes will continue to fill the gap in affordable Homeownership



Source: 2018 US. Census Bureau Oct. 2018

The New York Times

The Affordable Housing Crisis Is About to Get Worse

By The Editorial Board

Feb. 2, 2018

Tenants protesting rent increases in Redwood City, Calif., where private equity firms have been buying buildings and raising rents on apartments housing lower-income workers.
Andrew Burton for The New York Times

For example, a 2017 report from Harvard's Joint Center for Housing Studies shows that about 11 million families — or about a quarter of all renters in the United States — spend more than half of their incomes on housing. These families often have to choose between making rent and paying for essentials like food, child care and health care, and many are just one financial emergency away from eviction.

What makes housing unaffordable in Boston isn't just the high price of land — though that's a very large part of it — it's also the cost of local labor and construction. And that's where the waste-reducing, assembly-line efficiency of manufactured housing yields big savings. The median site-built home in the Northeast cost $135.10 per square foot to build in 2017; a manufactured home averages just $50.42 per square foot, or less than half the price. McCarthy said a 1,600-square-foot single-family home can be produced in the $80,000 range, even with high-quality materials and Energy Star-rated efficiency. "There's no way you could touch that with on-site construction," said George "Mac" McCarthy, president and CEO of the Lincoln Institute of Land Policy in Cambridge.

Source: RealEstate by Boston.com & Globe.com Oct. 3,2018 article "Are we ignoring or outright banning an easy affordable-housing fix?"

United States Housing Crisis and what it means for homeownership and energy use

shared video comments

Source: RealEstate by Boston.com & Globe.com Oct. 3,2018 article "Are we ignoring or outright banning an easy affordable-housing fix?"

United States Housing Crisis and what it means for homeownership and energy use.

Appendix IV: Who Lives in Manufactured Housing?

Characteristic	Manufactured Housing	Site-Built Multi-family	Site-Built Single-Family
Median Size of Unit (sq. ft)	1000-1499	750-999	1500-1999
Number of Rooms	5	4	6
Median Number of Bedrooms	3	2	3
Median Number of Bathrooms	3	1	3
Head of Households: Female (%)	50	54	46
Median Age, Head of Household	54	45	54
Head Households Married (%)	40	23	58
Head Households Never Married	17	42	14
% of Head of Households: White	85	66	82
% of Head of Households: Black	9	22	11
Median Year of Last Move	2009	2015	2007
Median Ratio Income to Poverty Level (%)	192	222	367
Median Household Size	2	2	2
Median Number of Adults in Household	2	1	2
Households with Elderly Member (%)	31	21	31
Monthly Median Total Housing Cost ($)	600-699	800-999	1000-1249
Households receiving food stamps (%)	17	16	6
Median HH income, past 12 months ($)	33,600	35,720	66,400
Median Family income, past 12 months ($)	30,550	31,000	62,500

Source: 2017 American Community Survey and 2017 American Housing Survey

Source: 2019 HUD report to Congress on the On-site Completion of Construction for Manufactured Homes

Affordability Crisis

‹ BACK TO ALL 2015 RECS TABLES

Table HC9.9 Household demographics of U.S. homes by home size, 2015[1]

Release date: October 2017
Revised date: May 2018

Lower income families live in smaller homes.

	Number of housing units (million)						
		Size of home in square feet[3]					
	Total U.S.[2]	Fewer than 1,000	1,000 to 1,499	1,500 to 1,999	2,000 to 2,499	2,500 to 2,999	3,000 or greater
All homes	118.2	26.6	25.9	17.5	14.3	10.9	23.0
Number of household members							
1 member	28.5	11.4	6.7	3.7	2.2	2.0	2.6
2 members	42.8	8.3	8.8	6.9	5.9	4.2	8.7
3 members	19.7	3.7	4.4	2.9	2.5	2.0	4.2
4 members	15.4	1.9	3.3	2.3	2.0	1.6	4.2
5 members	7.1	0.8	1.6	1.1	0.9	0.7	1.9
6 or more members	4.8	0.5	1.1	0.6	0.8	0.4	1.5
Children under 18 in household							
Yes	37.8	6.0	8.8	5.5	5.2	3.5	8.8
No	80.4	20.7	17.1	12.0	9.1	7.4	14.2
2015 annual household income							
Less than $20,000	22.5	10.0	6.3	2.6	1.5	0.9	1.3
$20,000 to $39,999	27.2	7.4	7.1	4.5	3.0	2.3	2.9
$40,000 to $59,999	18.6	3.7	4.7	3.1	2.6	1.6	3.0
$60,000 to $79,999	15.4	2.5	3.1	2.4	2.4	1.8	3.2
$80,000 to $99,999	9.7	0.9	1.9	1.8	1.6	1.2	2.3
$100,000 to $119,999	8.1	0.6	1.1	1.3	1.4	1.1	2.7
$120,000 to $139,999	5.4	0.4	0.6	0.7	0.8	0.9	2.1
$140,000 or more	11.2	1.1	1.1	1.1	1.1	1.2	5.5
Ownership of housing unit[4]							
Owned	74.5	5.1	13.4	13.2	11.9	9.6	21.3
Rented	43.7	21.6	12.5	4.3	2.4	1.3	1.7
Payment method for energy bills							

Source: 2015 US. Residential Energy Consumption Survey

Affordability Crisis

Lower income families use less housing energy.

	Number of housing units (million)	Site energy consumption[1]				Energy expenditures[1]			
	Total U.S.[2]	Total (trillion Btu)	Per household (million Btu)	Per household member (million Btu)	Per square foot (thousand Btu)	Total (billion dollars)	Per household (dollars)	Per household member (dollars)	Per square foot (dollars)
All homes	118.2	9,114	77.1	30.3	38.4	219.34	1,856	728	0.92
2015 annual household income									
Less than $20,000	22.9	1,303	57.0	25.9	43.1	32.47	1,421	645	1.08
$20,000 to $39,999	27.3	1,882	68.9	29.3	40.7	44.49	1,629	692	0.96
$40,000 to $59,999	18.4	1,354	73.6	29.9	38.7	32.73	1,778	723	0.93
$60,000 to $79,999	15.2	1,218	80.0	29.9	37.0	29.55	1,940	725	0.90
$80,000 to $99,999	9.7	827	85.4	31.5	37.4	19.50	2,014	741	0.88
$100,000 to $119,999	8.1	733	90.4	30.6	34.2	17.74	2,187	739	0.83
$120,000 to $139,999	5.4	552	101.7	33.7	37.1	13.00	2,396	794	0.87
$140,000 or more	11.2	1,244	111.2	36.8	36.0	29.87	2,669	884	0.86

Source: 2015 US. Residential Energy Consumption Survey

The data from the Residential Energy Consumption Survey indicates lower income families live in smaller homes which consume more energy per square foot than higher income families living in bigger homes

Is this a valid metric for how people consume energy or good method to measure the environmental footprint of a home?

Regarding energy consumption and environmental footprint, family income and home size does matter and per household, per housing unit or per dwelling unit should be used for comparison.

[12] U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics, Forms EIA-457A and EIA-457C of the 2015 Residential Energy Consumption Survey.

Source: MHI Manufactured Housing Institute Sept. 17, 2018 letter to US Department of Energy

Balancing cost of homeownership with Environmental Impact/ Energy Consumption/ Environmental footprint

Smaller homes, smaller environmental footprint

Smaller homes:

- Require less material resources
- Use less electricity and fuel
- Have less construction waste
- Require less transportation of materials to construct
- Use less fuel and electricity to operate during life of home.

Source: Ecotrope 10/26,2010 "Report:smaller homes, smaller carbon footprint" by Cassandra Profita

Smaller homes, smaller environmental footprint

Additionally **factory built Modular homes**:

Greatly reduce construction waste.

Reduce cost by eliminating weather delays by being built in a climate controlled indoor facility.

Reduce material transportation cost by using bulk transportation and assembly line assembly efficiency.

Are often built in ISO 14001 registered facilities which promote sustainable building practices, set environmental, safety and green building practices. We diverted 16,544 tons of landfill waste in one year after having our building facilities ISO 14001 certified.

Summary:

Regarding energy consumption and environmental footprint, family income and home size does matter and families living in small homes consume much less energy.

Policy makers and building authorities should carefully consider the impact of energy regulations as they balance increase cost of housing with environmental impact to ensure new policies do not contribute to a growing housing crisis.

Tier energy requirements based on cost of home and energy credits for smaller homes may be justified due to their lower energy consumption and may help reduce the nations housing crisis.

Summary:

The future of Modular Housing and Tiny homes is bright as millions of Americans seek safe affordable housing.

Modular and Tiny home Homeowners pay less for energy due to the smaller size of living space and new modern construction energy saving materials and technics.

Factory constructed Modular and Tiny homes can lower environmental footprint of a new home while playing a significant roll solving the current housing crisis.

& A

Key Points

- Manufactured housing has made tremendous strides in quality, efficiency and aesthetics over the last several decades.

- Affordability crisis may indicate greater adoption of manufactured housing in the future – something for the efficiency industry to consider.

- Modular and tiny homes can lower environmental footprints while playing a significant role in solving the current housing crisis.

Mark Wyman
Energy Trust of Oregon

U.S. DEPARTMENT OF ENERGY

Agenda

- Introduction To Energy Trust
- Manufactured Housing: Energy & Housing Perspectives
- Chattel Market Characteristics
- Oregon Manufactured Home Replacement Pilot

About us

Independent nonprofit

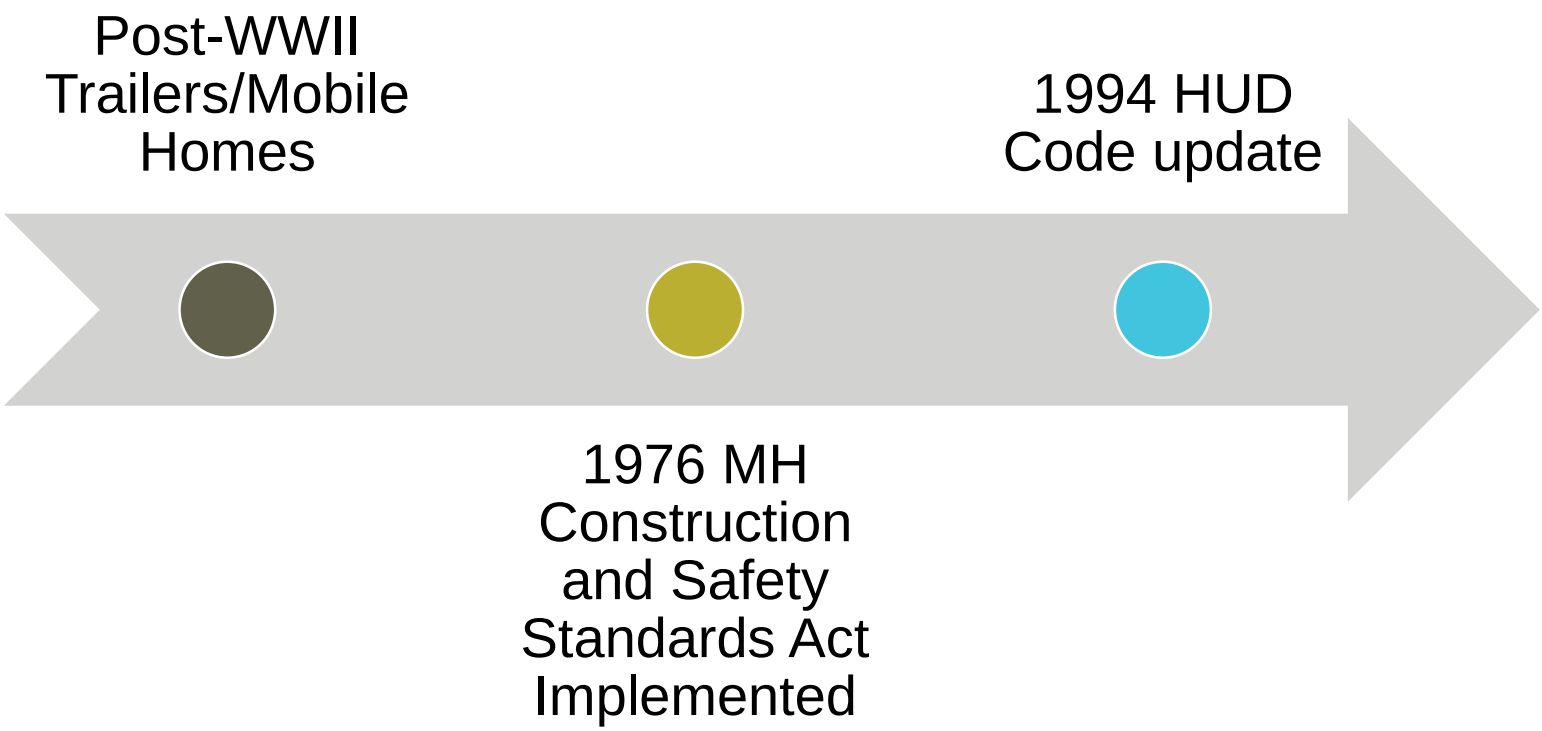
Serving 1.6 million customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista

Providing access to affordable energy

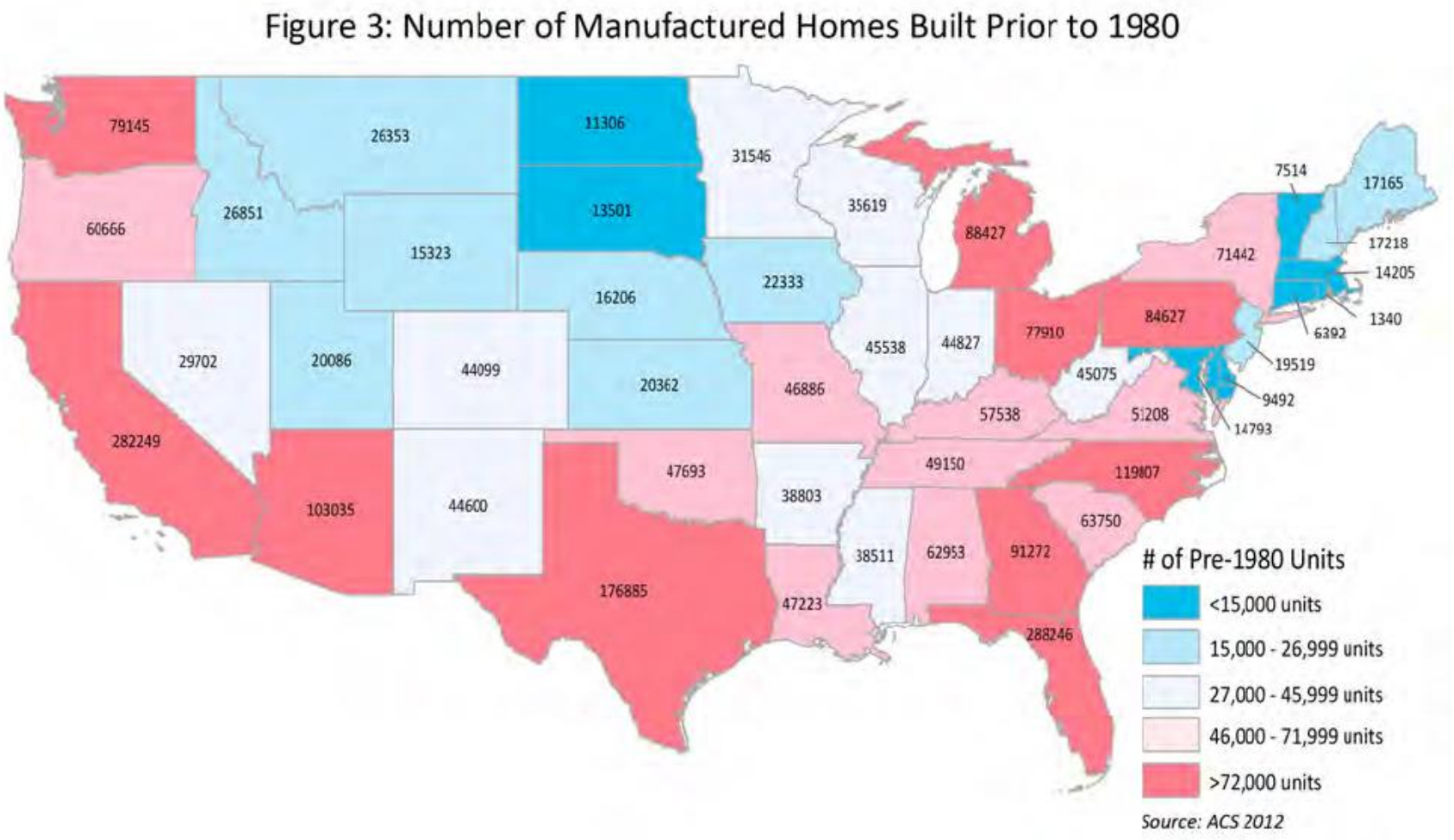
Generating homegrown, renewable power

Building a stronger Oregon and SW Washington

Trailer vs Manufactured Home? Timeline and Definitions



Distribution Of Older Vintage Homes



Source: “Eradicating Older Manufactured Homes: Replacement Programs As A Strategy” retrieved from http://www.jchs.harvard.edu/research/publications/eradicating-substandard-manufactured-homes-replacement-programs-strategy

Ownership Models

- Parks = land-lease community
- Occupant may own the home, but the land underneath is leased from a park operator
- 43% of MHs are sited in leased land communities
- 60,000 leased land communities nationally
- Titling varies by state, typically default to personal property with provisions to be titled as real property

Older Manufactured Homes: The Energy Perspective

- High energy burden
- Structurally cannot accommodate increased insulation
- Frequently in distressed condition, diminishing energy benefit of individual repairs and improvements
- Repair costs can exceed value of the home
- In place well beyond useful life with a natural rate of retirement at 1.4% of existing stock per year (Oregon)

Manufactured Homes as Affordable Housing

- $28,400 median annual income in manufactured homes
- $51,939 median annual income in single family, site-built homes
- Largest source of “naturally occurring” affordable housing
- Avg cost of single-wide home: $42,000

Image retrieved from https://www.collectorsweekly.com/articles/home-in-a-can (From *Don’t Call Them Trailer Trash,* Schiffer Publishing) March 9, 1946 edition of “Saturday Evening Post”

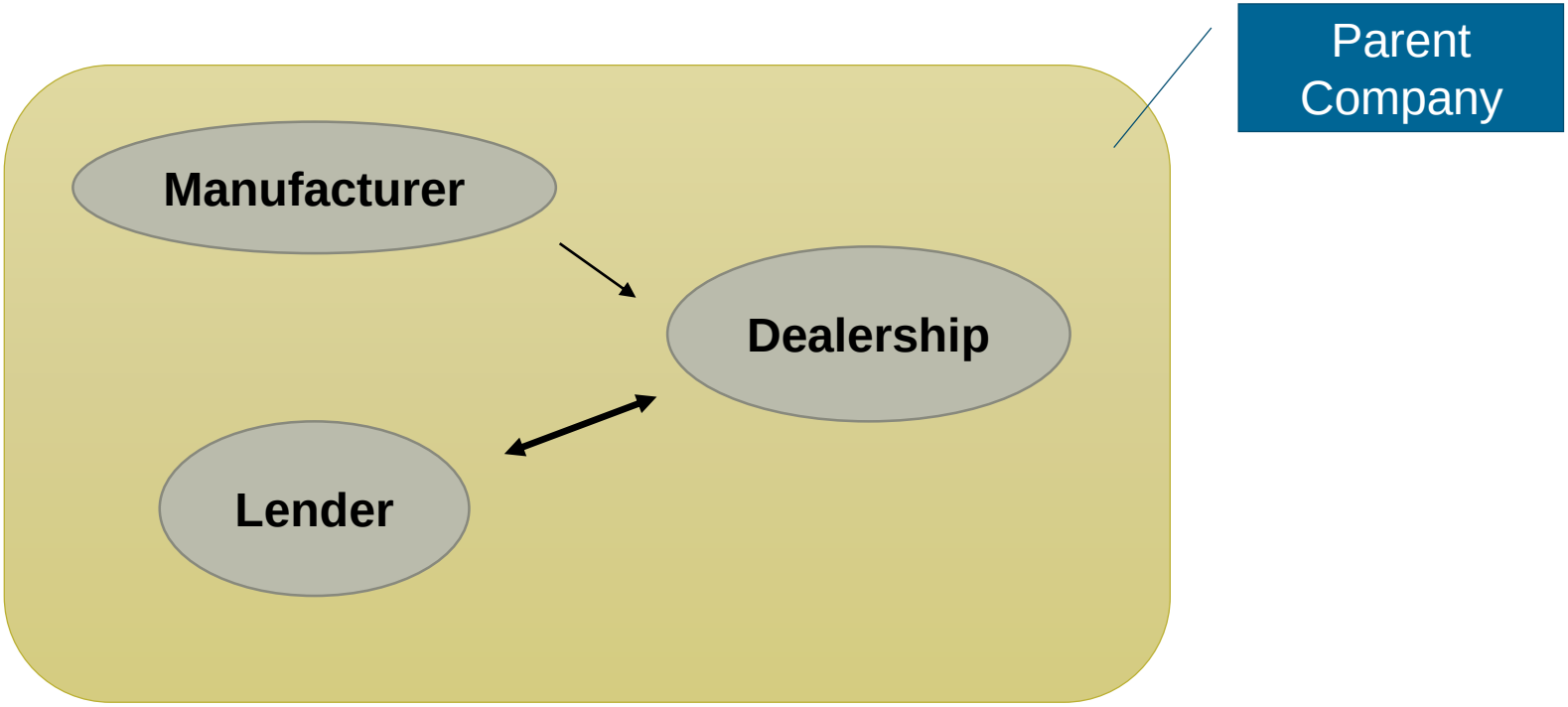
Manufactured Home Financing

Manufactured Homes as Personal Property

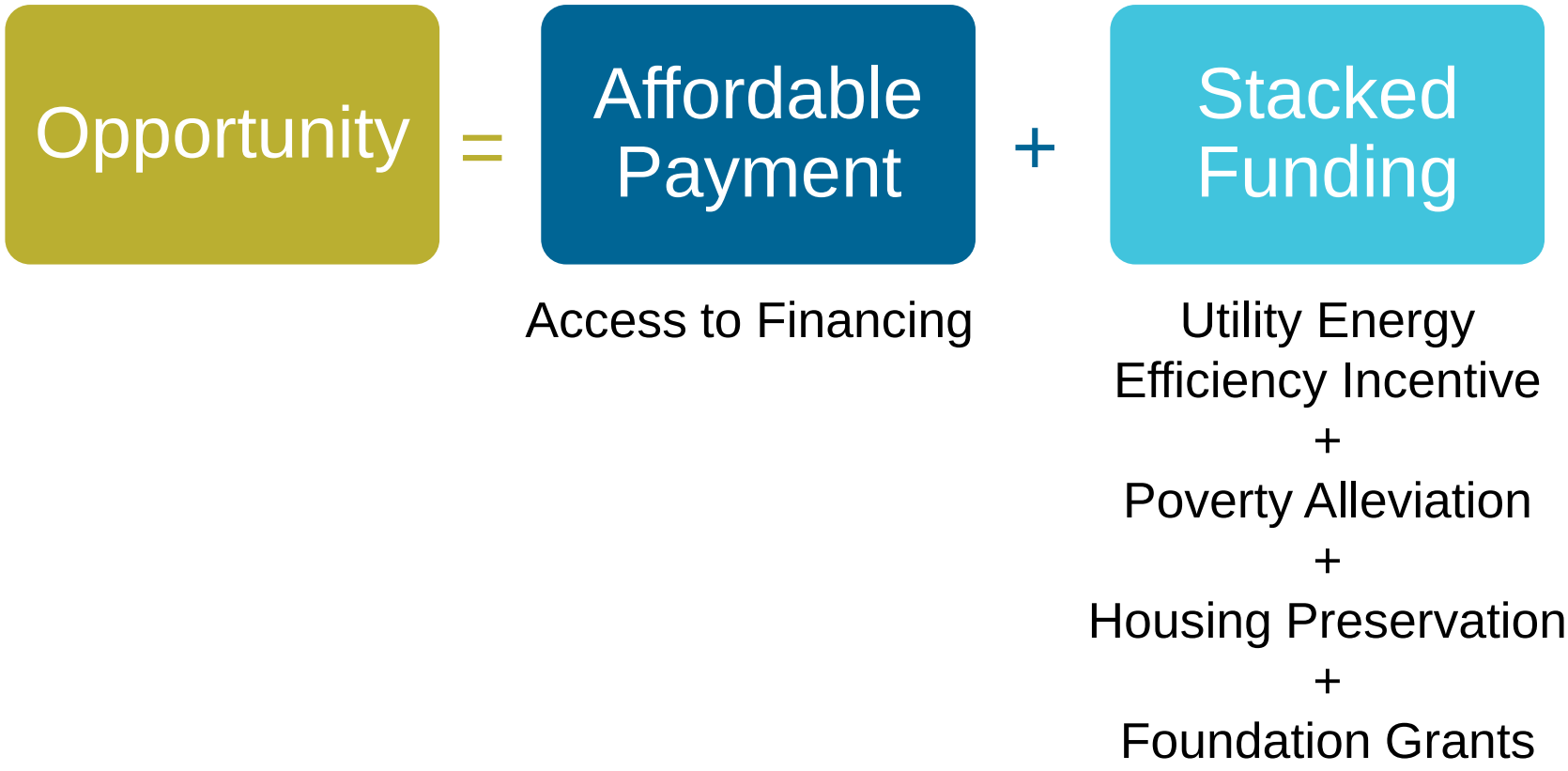
- Chattel loans have higher rates and shorter terms as compared with conventional mortgage products
- 68% of MH loans are classified as “Higher Priced Mortgage Loan” (as compared to 3% of site built)*
- MH finance experienced a wave of defaults during late 90’s early 2000’s
- Chattel lending has since consolidated to a handful of privately held firms, secondary market never recovered.

*Manufactured Housing Consumer Finance In The United States. (2014, September). Retrieved from http://files.consumerfinance.gov/f/201409_cfpb_report_manufactured-housing.pdf

Chattel Market Structure: Sample Scenario



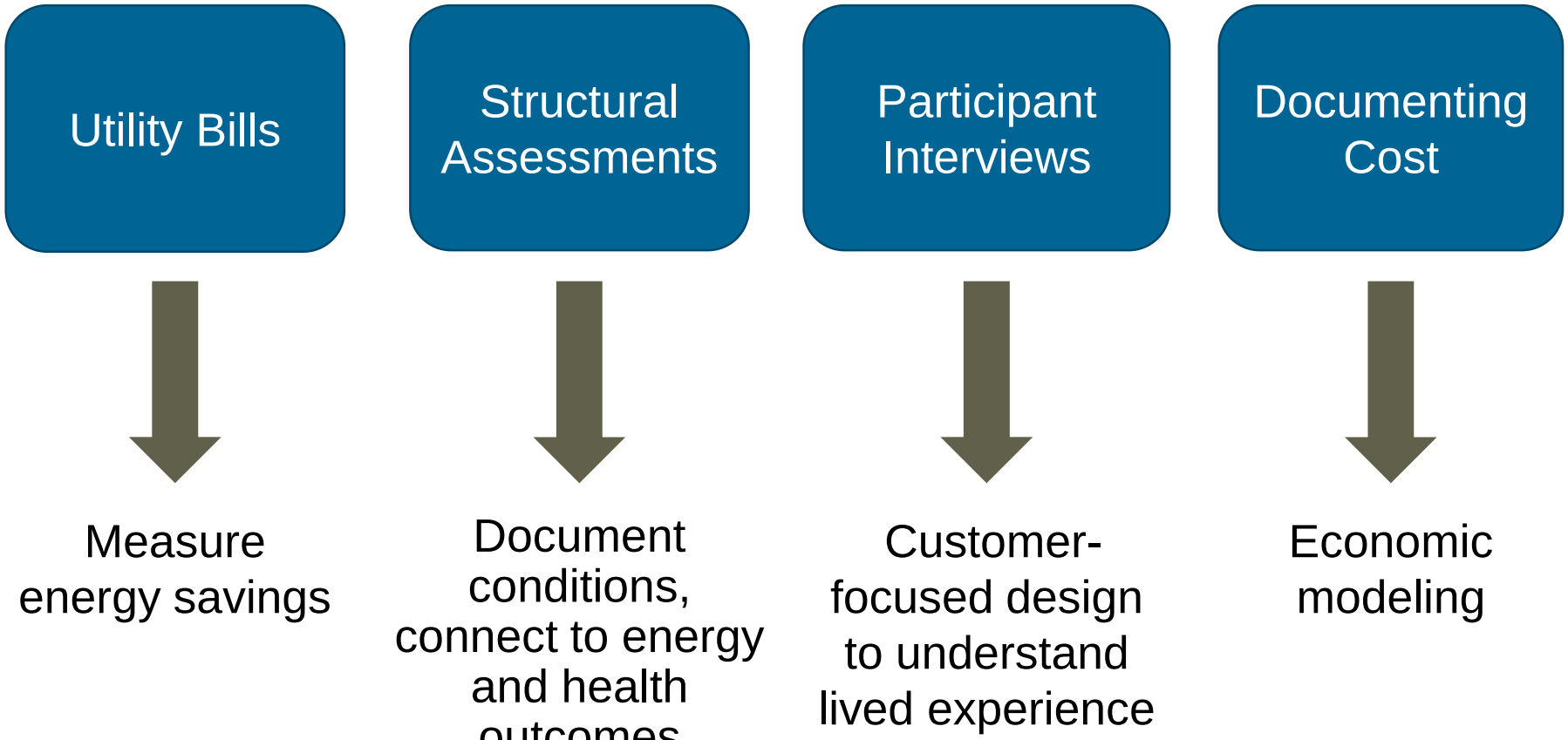
Energy Trust of Oregon
Manufactured Home Replacement Pilot


Opportunity
=
Affordable Payment
+
Stacked Funding
Access to Financing
Utility Energy Efficiency Incentive
+
Poverty Alleviation
+
Housing Preservation
+
Foundation Grants

Manufactured Home Replacement Pilot

- Partnership between housing, energy and community development organizations
- Goal is to better understand energy impact, quality of life improvements, project costs, barriers to participation and key elements of a successful program design
- Create a scalable financial model for leased land communities

Research Objectives



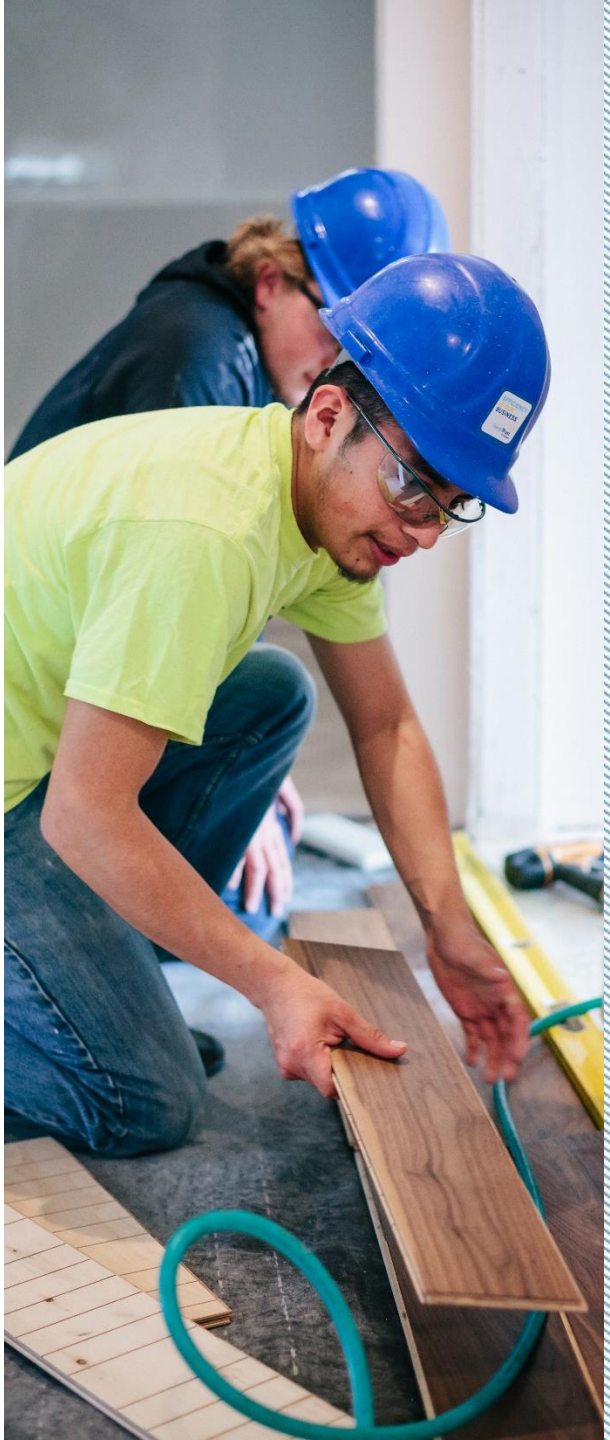
Energy Trust MH Replacement Savings and Incentives

Climate Zone: West of the Cascades			
Home configuration	**Year built**	**Energy savings**	**Maximum Energy Trust Incentive**
Single-Wide	Pre-1976	7,937 kWh	$10,000
	1976-1994	4,723 kWh	$7,500
Double-Wide	Pre-1976	15,148 kWh	$15,000
	1976-1994	9,653 kWh	$12,500

Climate Zone: East of the Cascades			
Home configuration	**Year built**	**Energy savings**	**Maximum Energy Trust Incentive**
Single-Wide	Pre-1976	14,935 kWh	$15,000
	1976-1994	9,695 kWh	$9,000
Double-Wide	Pre-1976	27,656 kWh	$17,500
	1976-1994	18,696 kWh	$15,000

Recommended Reading

1) “Manufactured Housing Consumer Finance In The United States” Consumer Finance Protection Bureau, Sept 2014
2) “Eradicating Substandard Manufactured Homes: Replacement Programs as a Strategy” Mathew Furman, Harvard Joint Center For Housing Studies, Nov 2014
3) “The Mobile Home Trap” Investigative series from Seattle Times and Center For Public Integrity, 2015-2016



Mark Wyman

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Residential Portfolio

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EnergyTrust of Oregon

	Consumer 1: Loan at APOR	Consumer 2: Loan at HPML APR	Consumer 3: Loan at the HOEPA high-cost APR
Manufactured home price	$80,000	$80,000	$80,000
20-year fixed-rate loan at 80% loan-to-value	$64,000	$64,000	$64,000
Rate	3.36%	4.87%	9.87%
Percentage points above APOR	0%	1.50%	6.50%
Monthly payment	$367	$418	$618

"Manufactured Housing Consumer Finance In The United States. (2014, September). Retrieved from http://files.consumerfinance.gov/f/201409_cfpb_report_manufactured-housing.pdf

Key Points

- High industry adoption of ENERGY STAR with respect to manufactured housing in the Pacific NW.
- Energy Trust of Oregon launched a Manufactured Home Replacement Pilot as a partnership between housing, energy and community development organizations.
- Incentives were generous (up to $17,500) and response promising.

Explore the Residential Program Solution Center

Resources to help improve your program and reach energy efficiency targets:

- Handbooks - explain *why* and *how* to implement specific stages of a program.
- Quick Answers - provide answers and resources for common questions.
- Proven Practices posts - include lessons learned, examples, and helpful tips from successful programs.
- Technology Solutions NEW! - present resources on advanced technologies, **HVAC** & **Heat Pump Water Heaters**, including installation guidance, marketing strategies, & potential savings.

https://rpsc.energy.gov

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Please send any follow-up questions or future call topic ideas to:
bbresidentialnetwork@ee.doe.gov