

Energy Efficient Manufactured Homes

Presenting a New High Performance Home Specification

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Agenda



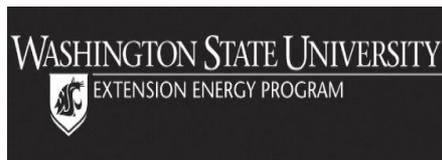
- Introductions
- History of Utility Involvement
- NEEM Program Overview
- State of the Manufactured Housing Industry
- The High Performance Manufactured Home
- Discussion of Potential Program Mechanisms

25 Years of Utility Involvement

- Model Conservation Standards/RCDP, 1987 - 1991
 - Research Phase, utilities began industry engagement
- MAP – Super Good Cents, 1992 - 1995
 - 50,000 homes built under MAP
 - Utility support led to HUD standard change in 1994
- NEEM /Super Good Cents, later became Energy Star and Eco-rated, 1996 to present
 - Industry funded
 - Utility incentives promoted program uptake

Major Partners in this Journey

- Bonneville Power Administration
- Northwest Energy Works
- Oregon and Washington Manufactured Housing Associations
- Washington State University
- Ecotope
- Building America Partnership for Improved Residential Construction
- NW Ductless Heat Pump Project (NEEA)
- EPA Energy Star New Homes Program



Manufactured Home Builders in the Pacific Northwest

OREGON

- Cavco Homes (Fleetwood, Palm Harbor)
- Clayton Homes (Golden West/Karsten, Marlette)
- Skyline Homes

IDAHO

- Cavco Homes (Fleetwood)
- Champion Homebuilders
- Kit Homebuilders West

WASHINGTON

- Valley Quality Homes



Background: NEEM Program

(Northwest Energy Efficient Manufactured Home)

- Promotes energy efficient manufactured homes
- Regional effort (utilities, manufactured home industry)
 - 9 regional HUD/Manufactured home factories participate in NEEM
 - 87+ participating utilities in the PNW and California
 - Includes ongoing quality management procedures and inspections
 - Administered by Northwest Energy Works (NEW)



NEEM Functions and Services

- ENERGY STAR Home QA Provider and plant certifier
- Quarterly construction process inspections at each plant
- Home certification and tracking database
- Training and certification for plant and retailer personnel
- Problem home assistance by phone and field inspection
- Research – NEW and WSU are Building America partners
- New technology deployment and approvals assistance
- Sales and marketing materials

Utility Benefits

- NEEM certification is a recognized UES by the RTF
- Multiple in-depth field studies demonstrate a history of consistently meeting the NEEM specifications
- NEEM program is simple to administer, even in hard to reach rural markets—at minimum cost to utilities
- Marketwide applicability—all manufactured homebuilders in the region participate in NEEM

NEEM Electrically-heated Homes

In-region siting, 2006 – 2011

Total Homes in NEEM database	9,937
Homes with Utility in NEEM system	4,079

	Count	Estimated
IOU activity	2,095	3,780
Public activity	1,933	6,130
PTR count	2,454	
“Slippage”		60%
Rural Homes		71%

NEEM siting in IOU Territories

Electrically-heated homes 2006 - 2011

	Count	Estimated
Avista Utilities, WA	154	480
Idaho Power Company, ID	280	880
Northwestern Energy, MT	61	190
PacifiCorp, OR (Energy Trust of Oregon)	1,031	1,100
Portland General Electric, OR (Energy Trust of Oregon)	284	300
Puget Sound Energy, WA	310	980

NEEM siting in Public Utility Territories

Electrically-heated homes 2006 - 2011

	Count	Estimated
Kootenai Electric Cooperative, ID	79	251
Flathead Electric Cooperative, MT	43	136
Oregon Trail Electric Cooperative, OR	51	162
Umatilla Electric Cooperative, OR	46	146
Grant County PUD, WA	160	507
Inland Power and Light Co., WA	187	593
Okanogan County PUD, WA	78	247
Snohomish County PUD, WA	89	282

Production Mix by Manufacturer, 2011 Estimates

Plant Code	Basic Energy Pkg., %	HUD % "Sorta Good Cents"	ESTAR HUD %	Basic Pkg. R-values (Ceiling, wall, floor, window)	"Sorta Good Cents" R-Values (Ceiling, wall, floor, window)
1	0	60	40		40, 19,22 U-0.34
2	27	0	73	22,11,22, U-0.30	
3	0	22	78		30,21,33 U-0.30
4	78	0	22	25,11,22, U-0.34	
5	0	79	21		40,19,33 U-0.34
6	0	73	27		33,19,22 U-0.34
7	78	10	12	33,11,22, U-0.78 or U-0.34	33,19,22 U-0.34
8	0	0	100	Does Not Apply	Does Not Apply
9	0	0	100	Does Not Apply	Does Not Apply

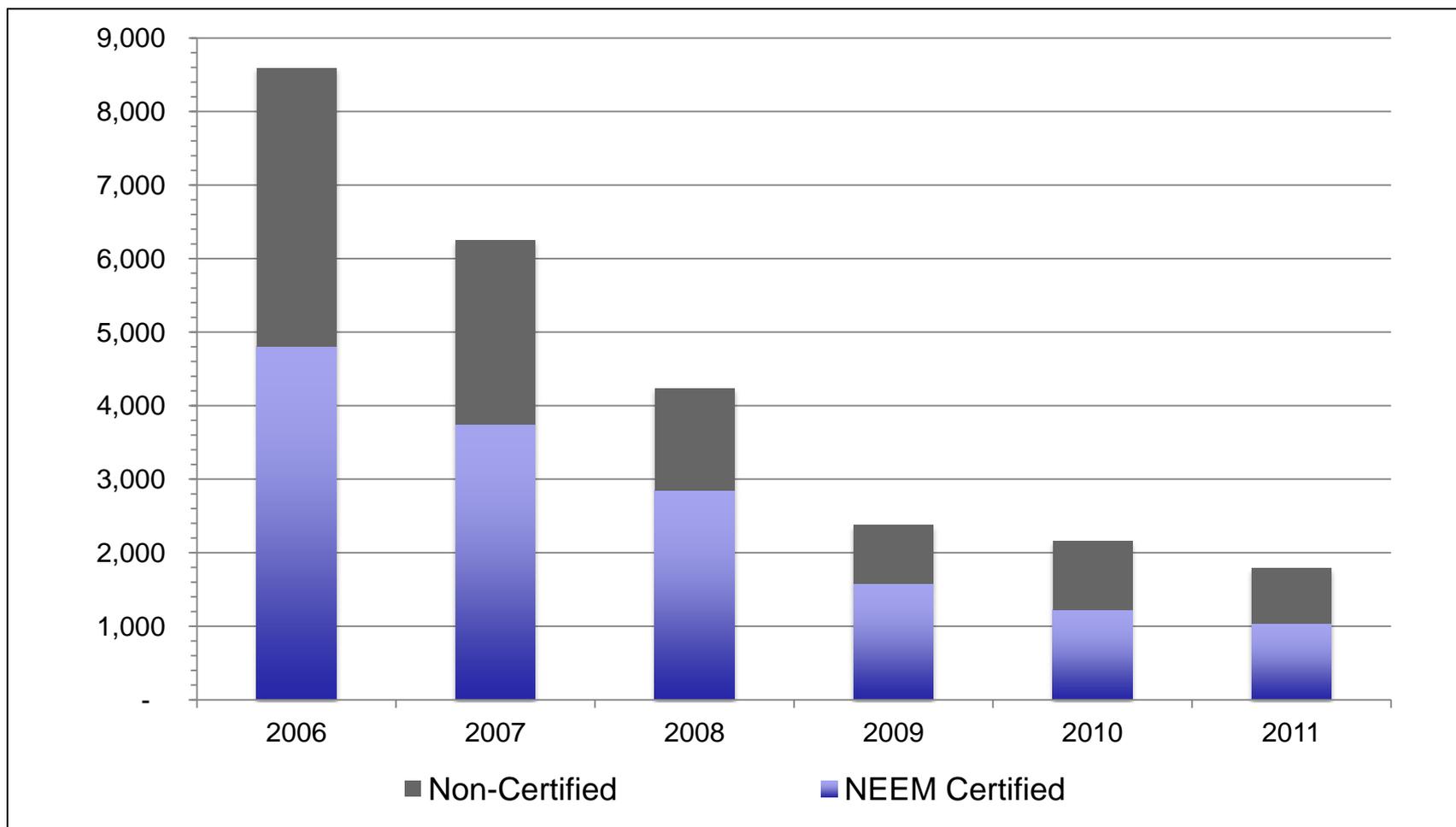
Mfd. Home Specifications Overview

Component	Units	Baseline "HUD+"	NEEM
Envelope			
Ceiling	R-Value	R22	R40
Wall	R-Value	R11 – R19	R21
Window U-Value	U-Value	0.4	0.34 (.30 Eco-rated)
Glazing %	% of CFA	12%	12%
Door	U-Value	0.2	0.2
Floor	R-Value	R19	R33
Infiltration	ACH 50	4.8	3.9
Ventilation	Exhaust Fan	Market Base	Energy Star
Uo	Btu/hr-ft ² -°F	0.065	0.054

Mfd. Home Specifications Overview, (continued)

Component	Units	Baseline "HUD+"	NEEM
HVAC			
Heating System		Electric FAF	Electric FAF
Cooling System		none	none
Supply Duct Leakage	% system flow	12.5%	5%
Return Duct Leakage	% system flow	None - Interior	None - Interior
DHW			
Water Heater	EF	0.9 EF	0.93 EF
Shower Head	gpm	2.5	2.5
Lighting			
LPD	W/ft ²	1.4	1.4 (1.0 Eco-rated)
Appliances			
Dishwasher		Market Base	Energy Star
Refrigerator		Market Base	Market Base

Northwest Manufactured Home Production and NEEM Certification (all fuels)

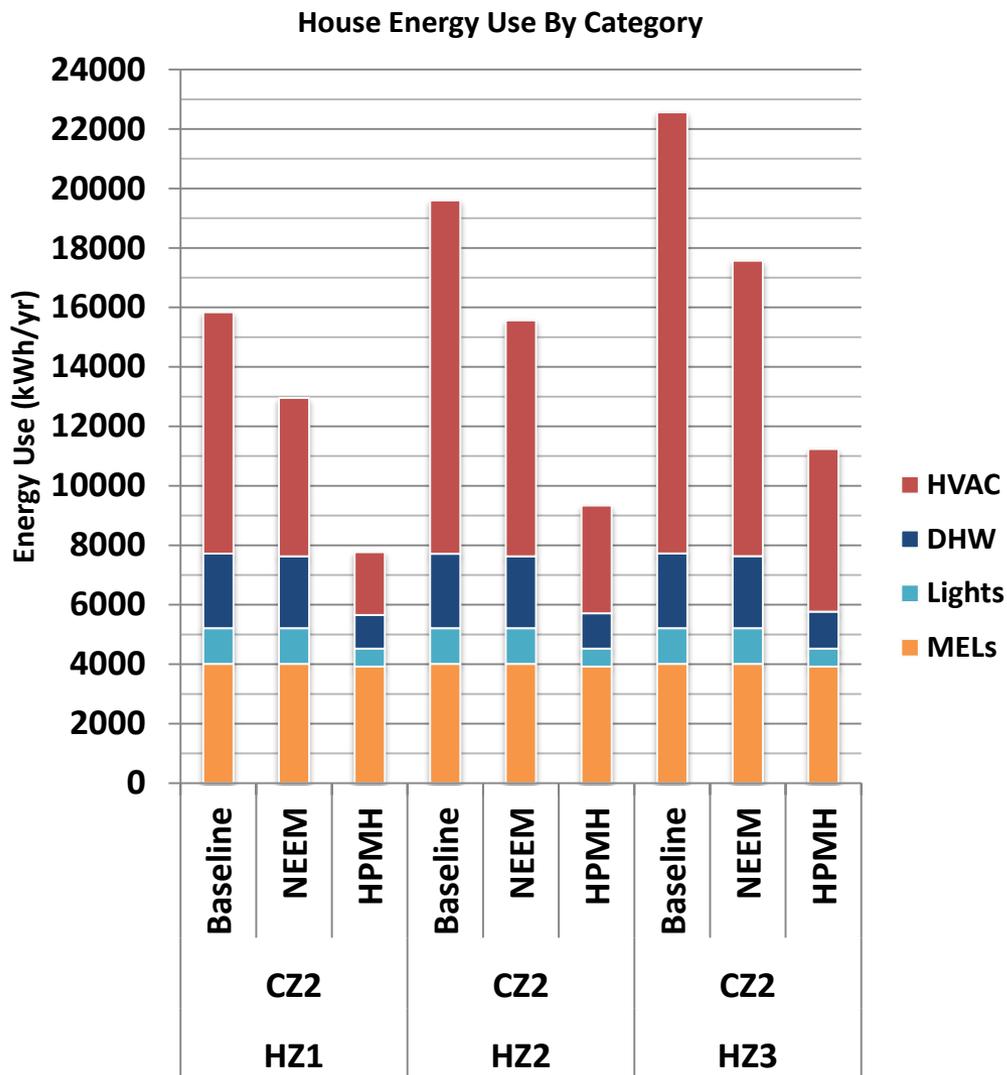


High Performance Manufactured Home Development Effort

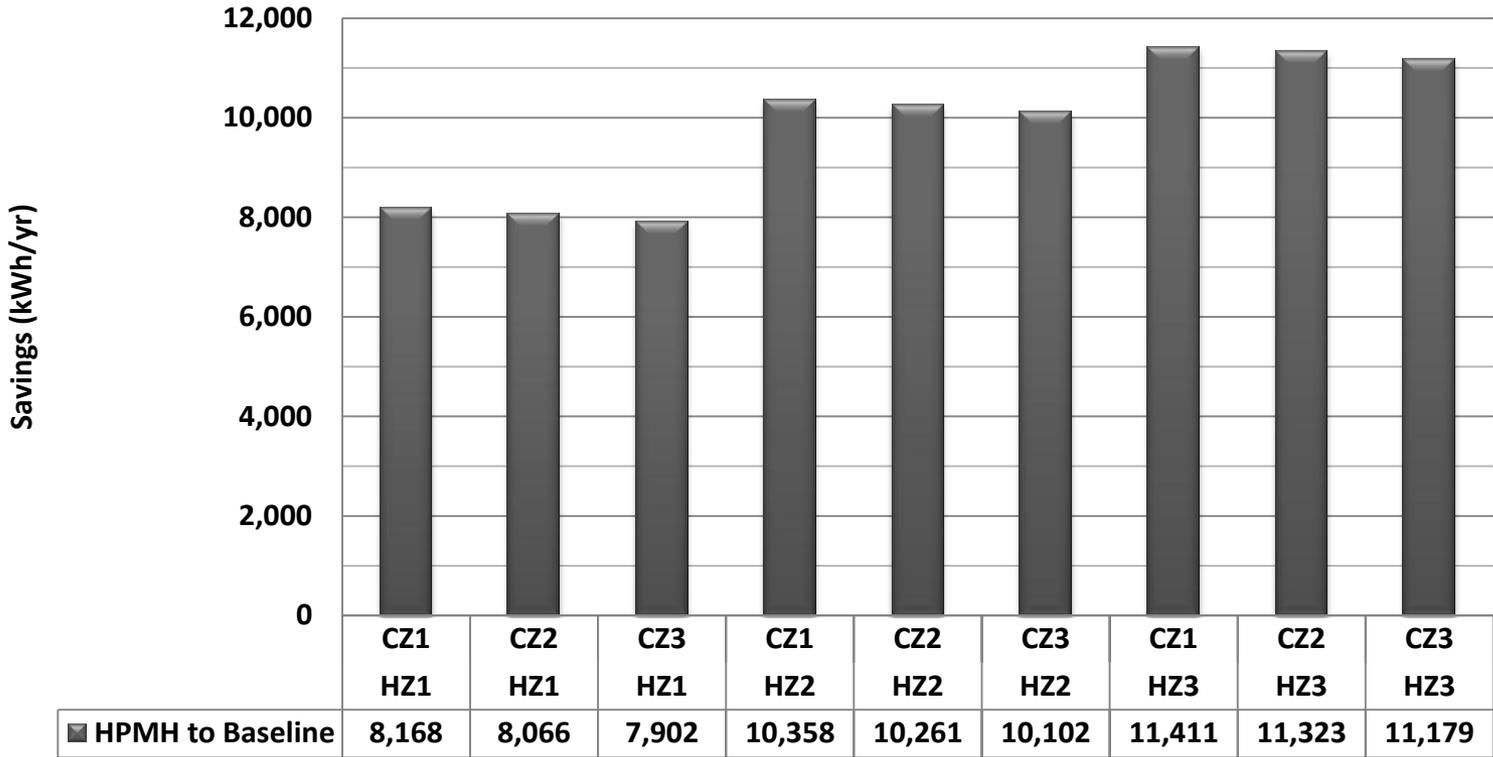
- BPA sponsors NEEM development of a new integrated measure package
 - Reduces total energy use by nearly 50 percent over today's baseline home
- HPMH approved by RTF as Provisional UES
- Early prototyping efforts under way to develop guidance for manufacturers
 - NEEA's DHP Project has provided strong leverage

HPMH Impact on Energy Use

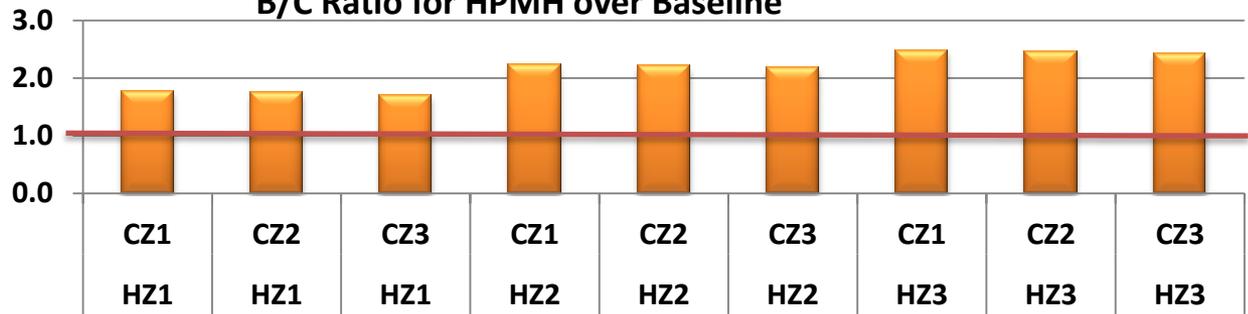
- Reductions to space heating, water heating, and lighting
- Big savings from
 - wall sheathing,
 - triple-glazed windows,
 - DHP with zonal backup,
 - HPWH (NEEA Tier II),
 - lighting improvements



Manufactured Home Annual Energy Savings (Prototype Weighted)



B/C Ratio for HPMH over Baseline



Mfd. Home Specifications Overview

Component	Units	Baseline "HUD+"	NEEM	HPMH "Super NEEM"
Envelope				
Ceiling	R-Value	R22	R40	R45
Wall	R-Value	R11 – R19	R21	R21 + R5 Foam Sheathing
Window U-Value	U-Value	0.4	0.34 (.30 Eco-rated)	0.22
Door	U-Value	0.2	0.2	0.2
Floor	R-Value	R19	R33	R38
Infiltration	ACH 50	4.8	3.9	3.0
Ventilation	Exhaust Fan	Market Base	EnergyStar	EnergyStar
Uo	Btu/hr-ft ² -°F	0.065	0.054	0.040

Mfd. Home Specifications Overview, Continued

Component	Units	Baseline "HUD+"	NEEM	HPMH "Super NEEM"
HVAC				
Heating System		Electric FAF	Electric FAF	DHP HSPF 10 & Wall Heaters
Cooling System		none	none	DHP SEER 20
Supply Duct Leakage	% system flow	12.5%	5%	No Ducts
Return Duct Leakage	% system flow	None - Interior	None - Interior	No Ducts
DHW				
Water Heater	EF	0.9 EF	0.93 EF	HPWH (COP 2.0)
Shower Head	gpm	2.5	2.5	1.75
Lighting				
LPD	W/ft ²	1.4	1.4 (1.0 Eco-rated)	0.6
Appliances				
Dishwasher		Market Base	Energy Star	Energy Star
Refrigerator		Market Base	Market Base	Energy Star

Measure Cost by Category

Category	Notes	2011 \$s	Measure Life (yrs)
Envelope	Majority from Walls and Windows	\$ 4,277	45
Air Sealing & Ventilation	Whole House Exhaust Fan	\$ 50	20
HVAC System	DHP & Resistance Wall Heaters (less cost of furnace and duct system)	\$ 4,701	20
Domestic Hot Water	Heat Pump Water Heater	\$ 1,110	15
Lighting	Compact and Linear Fluorescents	\$ 117	8
Appliances	Dishwasher & Refrigerator	\$ 62	16
Total		\$ 10,318	

Prototyping Work, DHP Example

- NEEM support with design approvals and system sizing
- Factory staff trained by NW DHP project to perform installation
- System charged and commissioned in-plant



- DHP traveled to its destination as a retail display home – ready to go
- NW DHP project trained retailer on DHP operation, features and benefits

Next Steps

- NEEM software upgrades to facilitate integration of HPMH into system
- Prototyping – begin familiarizing plants with the HPMH package
- Determine utility interest in engaging the industry at the manufacturer level
- Consideration of potential utility program mechanisms

Potential Program Designs

- Create a new higher tier for HPMH under NEEM with utility incentives
- Offer incentives for individual measures
 - Shell improvements, DHP, HPWH
- Coordinated regional approach like Energy Star Homes NW
 - Opportunity to target efforts at home manufacturers, leveraging regional funds upstream

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