



Energy Code Update

October 6, 2017



Housekeeping

Welcome

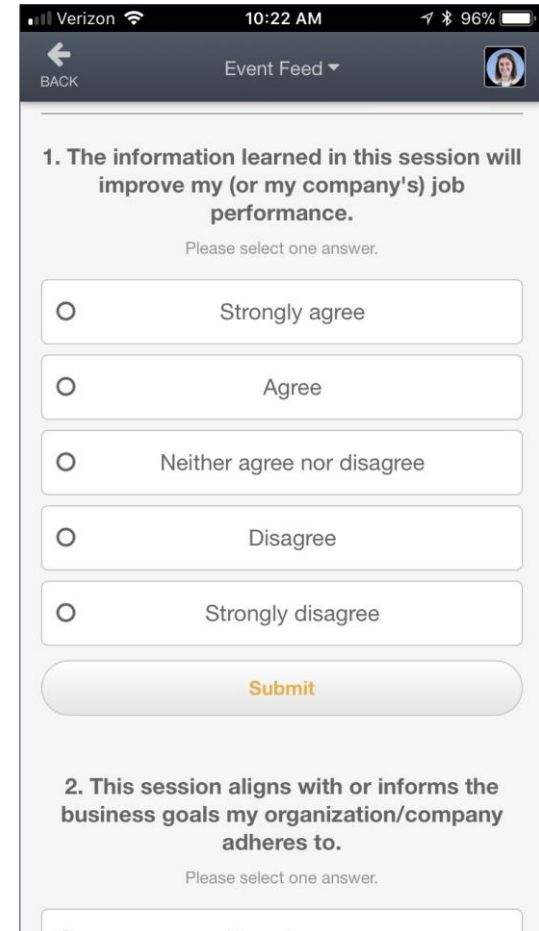
- Safety
- Bathrooms
- Cell phones



Session Survey Instructions

At the end of each session, you will be given 5 minutes to complete the session survey.

1. Open the “HEF2017” app
2. Navigate to “Agenda” and select the session
3. Scroll down to “Session Feedback”
4. For each question, select answer and hit “Submit”
5. Show completed survey to BetterBuiltNW rep to earn points
6. Prizes awarded Friday to the top point earners
 - See “Challenge” section in the app for activities
7. Assistance available at the BetterBuiltNW table

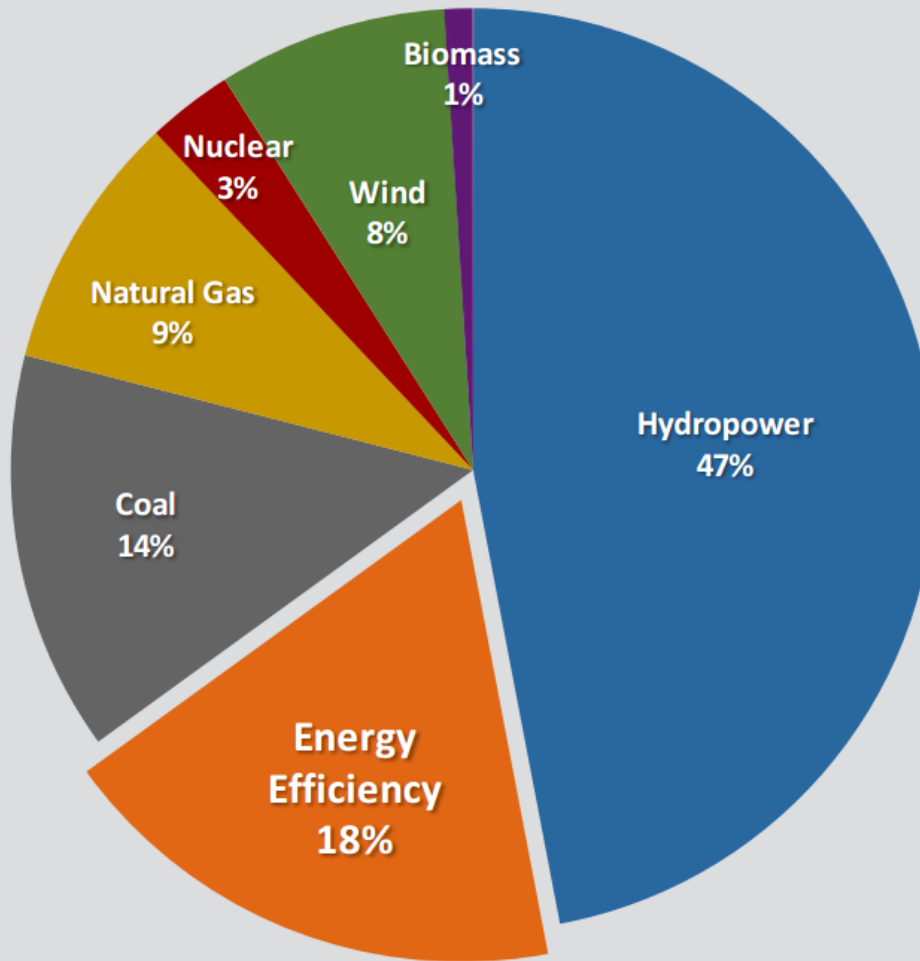


The screenshot shows the HEF2017 app interface on a mobile device. At the top, the status bar shows Verizon, 10:22 AM, and 96% battery. The app header includes a 'BACK' button, 'Event Feed' with a dropdown arrow, and a user profile icon. The main content area displays a survey question: '1. The information learned in this session will improve my (or my company's) job performance.' Below the question, it says 'Please select one answer.' and provides five radio button options: 'Strongly agree', 'Agree', 'Neither agree nor disagree', 'Disagree', and 'Strongly disagree'. A 'Submit' button is located below the options. The second question is partially visible: '2. This session aligns with or informs the business goals my organization/company adheres to.' with the instruction 'Please select one answer.'



The Basics

The Basics



Since 1978, the region has met over half of its load growth through efficiency resources

\$4 billion saved in energy bills

6,000 aMw – enough to power 5 cities the size of Seattle

Image and data courtesy of NW Power & Conservation Council

The Basics

Cumulative Regional Savings from All Mechanisms

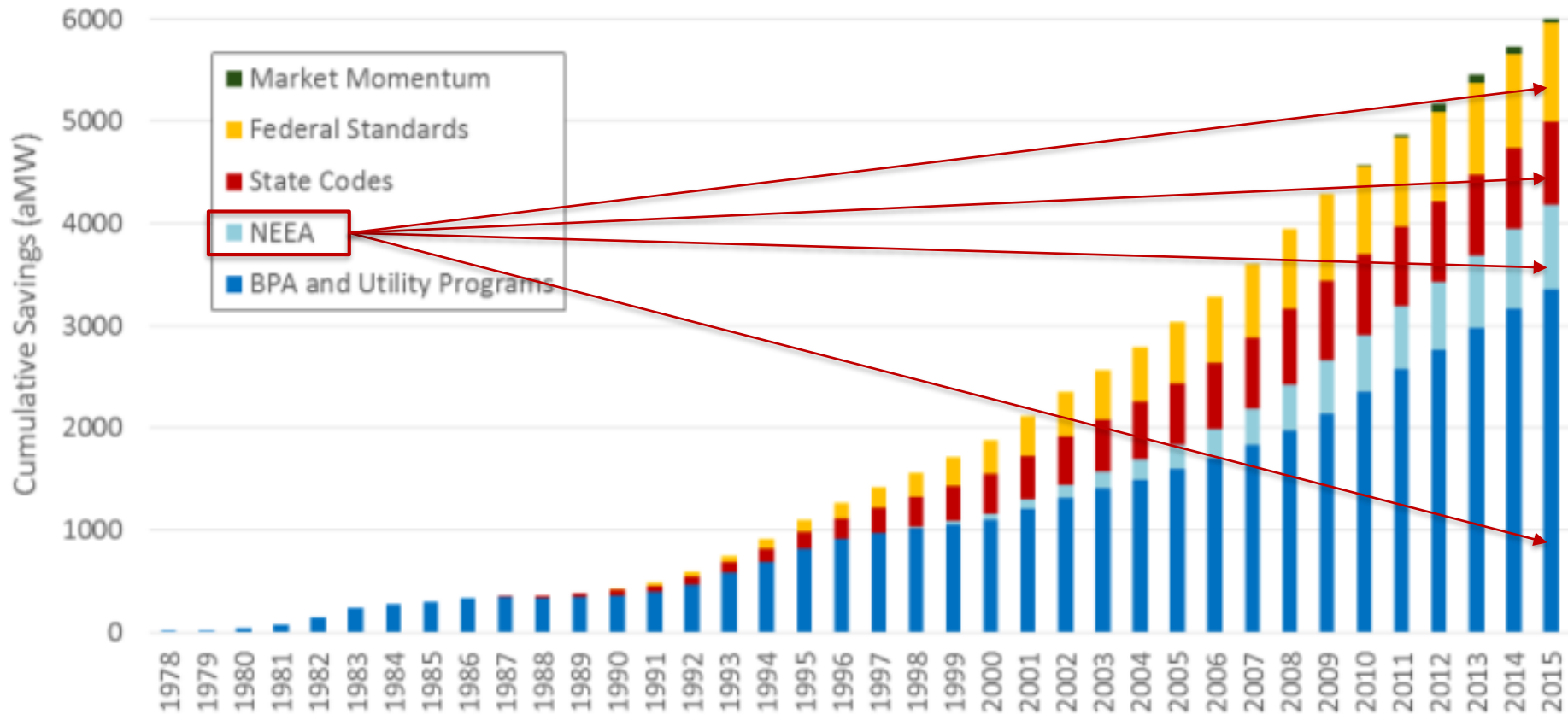


Image and data courtesy of NW Power & Conservation Council

The Basics – Reducing Energy Use

- Reduce Heating/Cooling loads
 - UA reductions, air sealing
 - Duct sealing/Ducts inside
 - Heat recovery
 - Shading, siting, passive design
- Use High-efficiency HAC systems to serve loads
- Reduce DHW load
 - Low flow fixtures
 - Pipe insulation
 - Plumbing design
 - DWHR
- Use High-efficiency DHW equipment

Reducing Energy Use

Table 1. Design steps and technology options for ULEBs

Design step	Sample technology options
1. Reduce building energy loads with improved envelopes and the use of passive systems.	Superinsulation, daylighting, exterior shading, natural ventilation
2. Install high-efficiency systems to address primary building energy loads.	Heating, ventilation, and air-conditioning systems (including distribution), water heating, appliances/equipment
3. Install systems to manage building energy loads with effective control strategies and other mechanisms.	Energy management systems, plug-load control strategies, feedback to users and occupants
4. Incorporate energy recovery mechanisms to minimize energy losses.	Energy recovery ventilation, heat-pump water heaters
5. Use renewables to meet remaining building loads.	Rooftop and other photovoltaic energy systems
6. Monitor and manage post-occupancy building energy use.	Monitoring-based commissioning, occupant engagement

Sources: PG&E 2012; NBI 2014.

<http://aceee.org/sites/default/files/ultra-low-energy-0717.pdf>

Reducing Energy Use

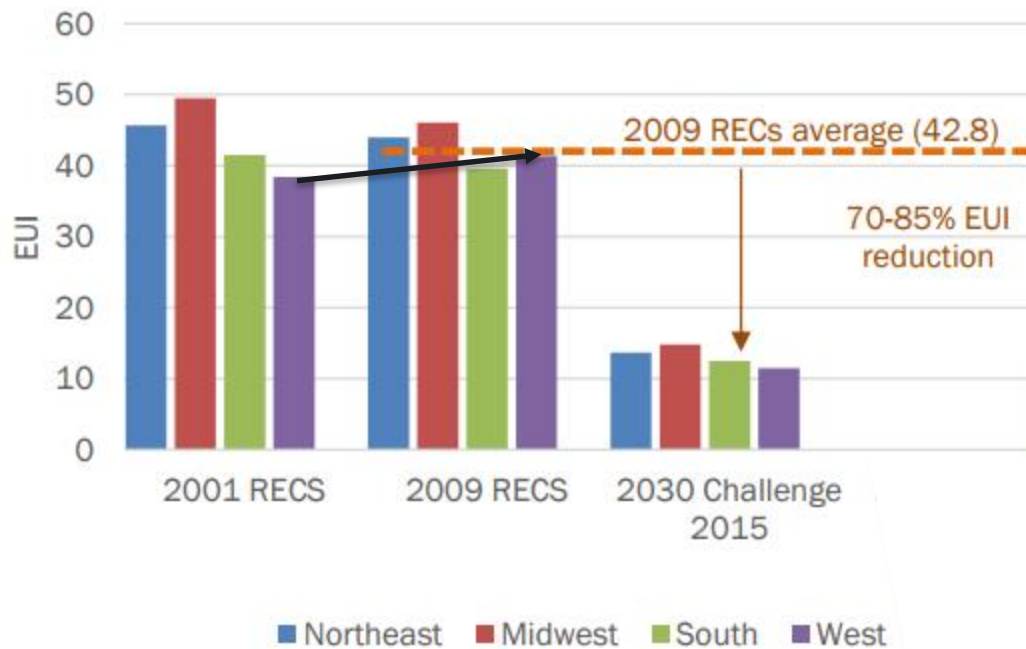


Figure 2. Average EUI for existing single-family homes and selected ULE retrofit initiatives

<http://aceee.org/sites/default/files/ultra-low-energy-0717.pdf>



Prescriptive Codes

Prescriptive Approaches

- Reduce Heating/Cooling loads
 - UA reductions, air sealing
 - Duct sealing/Ducts inside
 - Heat recovery
 - Shading, siting, passive design
- Use High-efficiency HAC systems to serve loads
- Reduce DHW load
 - Low flow fixtures
 - Pipe insulation
 - Plumbing design
 - DWHR
- Use High-efficiency DHW equipment

Prescriptive Approaches

TABLE 6-1
PRESCRIPTIVE REQUIREMENTS^{0,1} FOR SINGLE-FAMILY RESIDENTIAL
CLIMATE ZONE 1

Option	Glazing Area ¹⁰ : % of Floor	Glazing U-Factor		Door ⁹ U-Factor	Ceiling ²	Vaulted Ceiling ³	Wall ¹² Above Grade	Wall• int ⁴ Below Grade	Wall• ext ⁴ Below Grade	Floor ⁵	Slab ⁶ on Grade
		Vertical	Overhead ¹¹								
I.	13%	0.34	0.50	0.20	R-49 or R-38 adv	R-38	R-21 int ⁷	R-21 TB	R-10	R-30	R-10 2'
II.*	25%	0.32	0.50	0.20	R-49 or R-38 adv	R-38	R-21 int ⁷	R-21 TB	R-10	R-30	R-10 2'
III.	Unlimited	0.30	0.50	0.20	R-49 or R-38 adv	R-38	R-21 int ⁷	R-21 TB	R-10	R-30 / U=0.029	R-10 2'

* Reference Case

Heating & Cooling Equipment		
Gas Furnace	90 AFUE	Installed according to ENERGY STAR Homes Northwest specifications for sizing, controls, airflow and refrigerant charge. Performance testing is required. * As of July 1, 2006 any home initiated in the ENERGY STAR Homes Northwest database utilizing a heat pump must be an 8.5 HSPF. Homes initiated prior to July 1, 2006 will qualify with an 8.0 HSPF/SEER 13 heat pump.
Heat Pump	8.5 HSPF* / SEER 13	
Air Conditioner	SEER 13	

Prescriptive Approaches

The Beauty

- Straightforward, easy to understand
- Buildable
- Enforceable

The Pain

- Challenging for emerging methods/tech
- Legal limitations for mandating equipment efficiencies
- Not flexible – Need Trade-offs



Trade-offs

Trade-offs



Northwest ENERGY STAR[®] Homes Program Requirements¹ Oregon Single-Family Homes

Effective Date: January 1, 2012

NWBOP 1
Natural Gas Fired
Furnaces & Electric
Heat Pumps

Prescriptive Pathway Options (MUST choose one or an alternate approved Technical Compliance Option):

Prescriptive Path Option	Mandatory Requirements
1. Ducts in Conditioned Space	<ul style="list-style-type: none"> All ducts and equipment located within thermal and pressure boundary of the home
2. Equipment Upgrade	<ul style="list-style-type: none"> Electric water heater ≥ 2.0 EF² OR gas water heater ≥ 0.82 EF ≥ 94 AFUE gas furnace
3. Envelope Pathway	<ul style="list-style-type: none"> Wall U-value must be ≤ 0.043 (i.e., R-21 wall insulation AND R-5 continuous foam) Windows: ≤ 0.25 U-Value

Northwest ENERGY STAR BOP 1; Additional requirements, unless otherwise specified in Prescriptive Pathway:

Heating and Cooling Equipment

- Heating equipment shall meet the following applicable efficiency levels:
 - ≥ 92 AFUE gas furnace
 - 8.5 HSPF / 14.5 SEER / 12 EER air-source heat pump, ENERGY STAR qualified with electric backup (Climate Zone 4)³
 - 9.0 HSPF / 14.5 SEER / 12 EER air-source heat pump, ENERGY STAR qualified with electric backup (Climate Zone 5)³
 - Ground-source heat pump, any product type, ENERGY STAR qualified
- Cooling equipment shall meet the following applicable efficiency levels:
 - ≥ 13 SEER AC **OR** Heat pump (see above)

Trade-offs

2017 **TABLE N1101.1(2)**
ADDITIONAL MEASURES

Envelope Enhancement Measures (Select One)	1	High efficiency walls Exterior walls – U-0.045 / R-21 cavity insulation+R-5 continuous
	2	Upgraded features Exterior walls – U-0.057 / R-23 intermediate or R-21 advanced, Framed floors – U-0.026 / R-38, and Windows – U-0.28 (average UA)
	3	Upgraded features Exterior walls – U-0.055 / R-23 intermediate or R-21 advanced, Flat ceiling ^e – U-0.020-017 / R-60, and Framed floors – U-0.026 / R-38
	4	Super Insulated Windows and Attic OR Framed Floors Windows – U-0.22 (Triple Pane Low-e), and Flat ceiling ^e – U-0.017 / R-60 or Framed floors – U-0.026 / R-38
	5	Air sealing home and ducts Mandatory air sealing of all wall coverings at top plate and air sealing checklist ^f , and <u>Mechanical whole-building ventilation system with rates meeting N1101.1(3) or ASHRAE 62.2, and</u> All ducts and air handlers contained within building envelope ^d or All ducts sealed with mastic ^b
	6	High efficiency thermal envelope UA^g Proposed UA is 8% lower than the code UA
Systems (Select One)	A	High efficiency HVAC system^a Gas-fired furnace or boiler AFUE 94%, or Air source heat pump HSPF 9.5/15.0 SEER cooling, or Ground source heat pump COP 3.5 or Energy Star rated
	R	Ducted HVAC systems within conditioned space

Trade-offs

Enhanced Flexibility, Increased Complexity

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
10																						
11		Conditioned Floor Area	2,200																			
12																						
13																						
14																						
15		Component Performance, R occupancies		Code Target Values														Proposed Design				
16				Area	UA													Area	UA			
17		Doors U = 0.300		0	0													0	0			
18		Overhead Glazing U = 0.500		0	0													0	0			
19		Vertical Glazing U = 0.300		0	0													0	0			
20		Flat/Vaulted Ceilings U = 0.026		0	0													0	0			
21		Wall (above grade) U = 0.056		0	0													0	0			
22		Floors U = 0.029		0	0													0	0			
23		Slab on Grade F = 0.540		0	0													0	0			
24		Below Grade Wall U = 0.042		0	0													0	0			
25		Below Grade Slab F = 0.570		0	0													0	0			
26																						
27				Target UA Total	0													Proposed UA Total	0			
28				Target Credits from Table 406.2	3.5													Proposed Credits from Table 406.2	0.0			

Copyright 2013 | Instructions | **Group R** | Table 406.2 | Vertical Glazing | Overhead Glazing | Doors | Flat-Vaulted Ceilings | ...

Trade-offs

Enhanced Flexibility, Increased Complexity

- Who does the work?
 - Analyze options
 - Select optimal options
 - Document selected options
- Who checks the work?
 - Do selected options comply?
- Who field-verifies the work?
- How are builder choices tracked?

Trade-offs

**TABLE 406.2
ENERGY CREDITS**

OPTION	DESCRIPTION	CREDIT(S)
1a	<p>EFFICIENT BUILDING ENVELOPE 1a: Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration $U = 0.28$ Floor R-38 Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab</p> <p>or</p> <p>Compliance based on Section R402.1.4: Reduce the Total UA by 5%.</p>	0.5
1b	<p>EFFICIENT BUILDING ENVELOPE 1b: Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration $U = 0.25$ Wall R-21 plus R-4 Floor R-38 Basement wall R-21 int plus R-5 ci Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab</p> <p>or</p> <p>Compliance based on Section R402.1.4: Reduce the Total UA by 15%.</p>	1.0
1c	<p>EFFICIENT BUILDING ENVELOPE 1c: Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration $U = 0.22$ Ceiling and single-rafter or joist-vaulted R-49 advanced Wood frame wall R-21 int plus R-12 ci Floor R-38 Basement wall R-21 int plus R-12 ci Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab</p> <p>or</p> <p>Compliance based on Section R402.1.4: Reduce the Total UA by 30%.</p>	2.0
1d ^a	<p>EFFICIENT BUILDING ENVELOPE 1d: Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration $U = 0.24$</p>	0.5

3a ^b	<p>HIGH EFFICIENCY HVAC EQUIPMENT 3a: Gas, propane or oil-fired furnace with minimum AFUE of 94%, or Gas, propane or oil-fired boiler with minimum AFUE of 92%</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	1.0
3b ^b	<p>HIGH EFFICIENCY HVAC EQUIPMENT 3b: Air-source heat pump</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	1.0
3c ^b	<p>HIGH EFFICIENCY HVAC EQUIPMENT 3c: Closed-loop geothermal heat pump or Open loop well water heat pump</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	1.5
3d ^b	<p>HIGH EFFICIENCY HVAC EQUIPMENT 3d: Ductless Split System Heat Pumps, Zonal Control: In homes where the primary space heating system is zonal electric heating, a ductless heat pump system shall be installed and provide heating to the largest zone of the housing unit.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	1.0

R403.7.1 Electric resistance zone heated units.

All detached one- and two-family dwellings and multiple single-family dwellings (townhouses) up to three stories in height above grade plan using electric zonal heating as the primary heat source shall install an inverter-driven ductless mini-split heat pump in the largest zone in the dwelling. Building permit drawings shall specify the heating equipment type and location of the heating system.

Exception: Total installed heating capacity of 2Kw per dwelling or less.

Trade-offs

Additional challenge for programs:

- Determine what was done to meet code vs exceed code
- In states with options-based codes, this is a question for both whole-home programs and individual measures:
 - Shell measures
 - DHPs
 - HPWHs
 - HRVs
 - Air Sealing



Code Changes

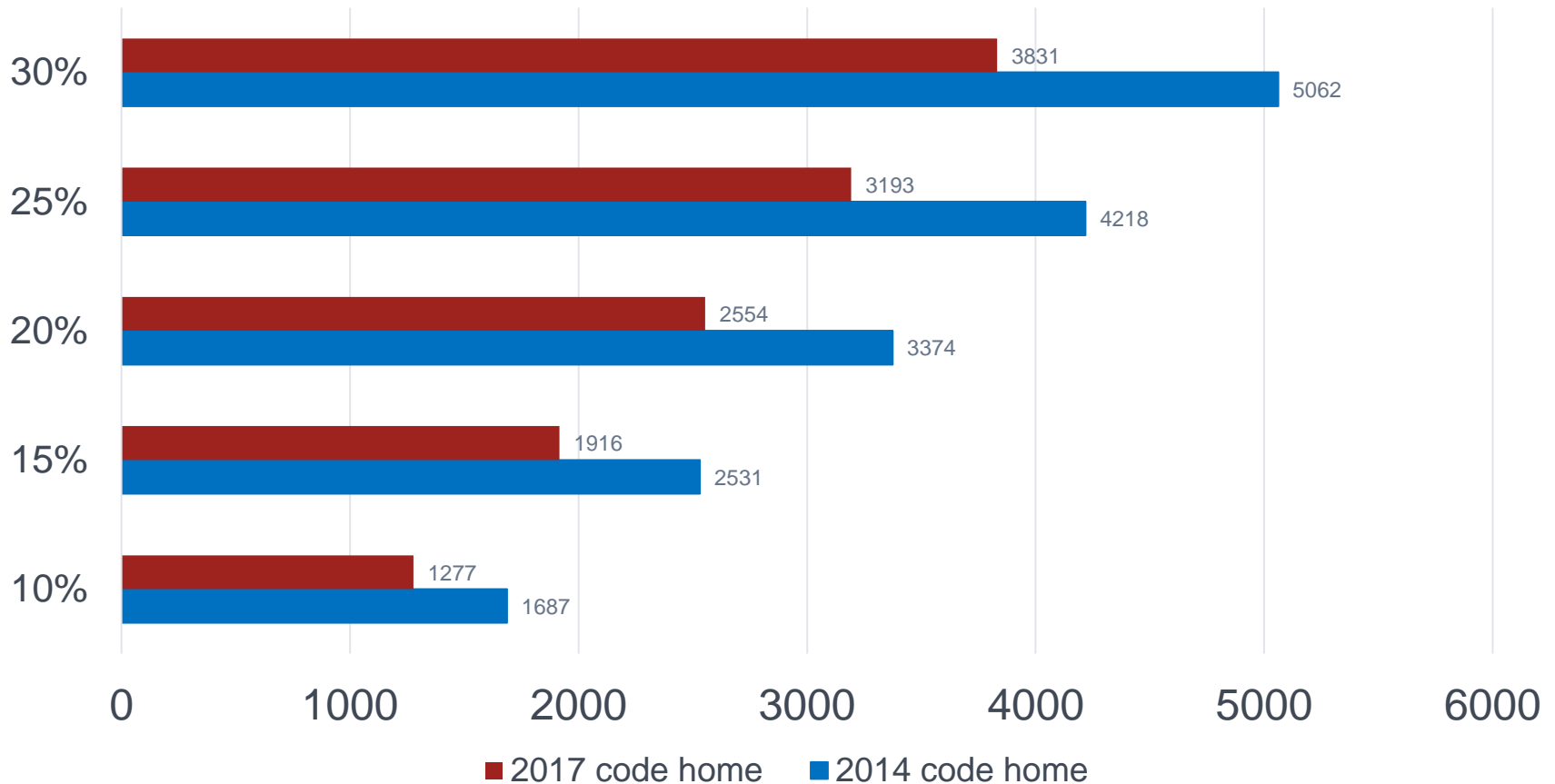
Code Changes

Highlights from 2016 WSEC:

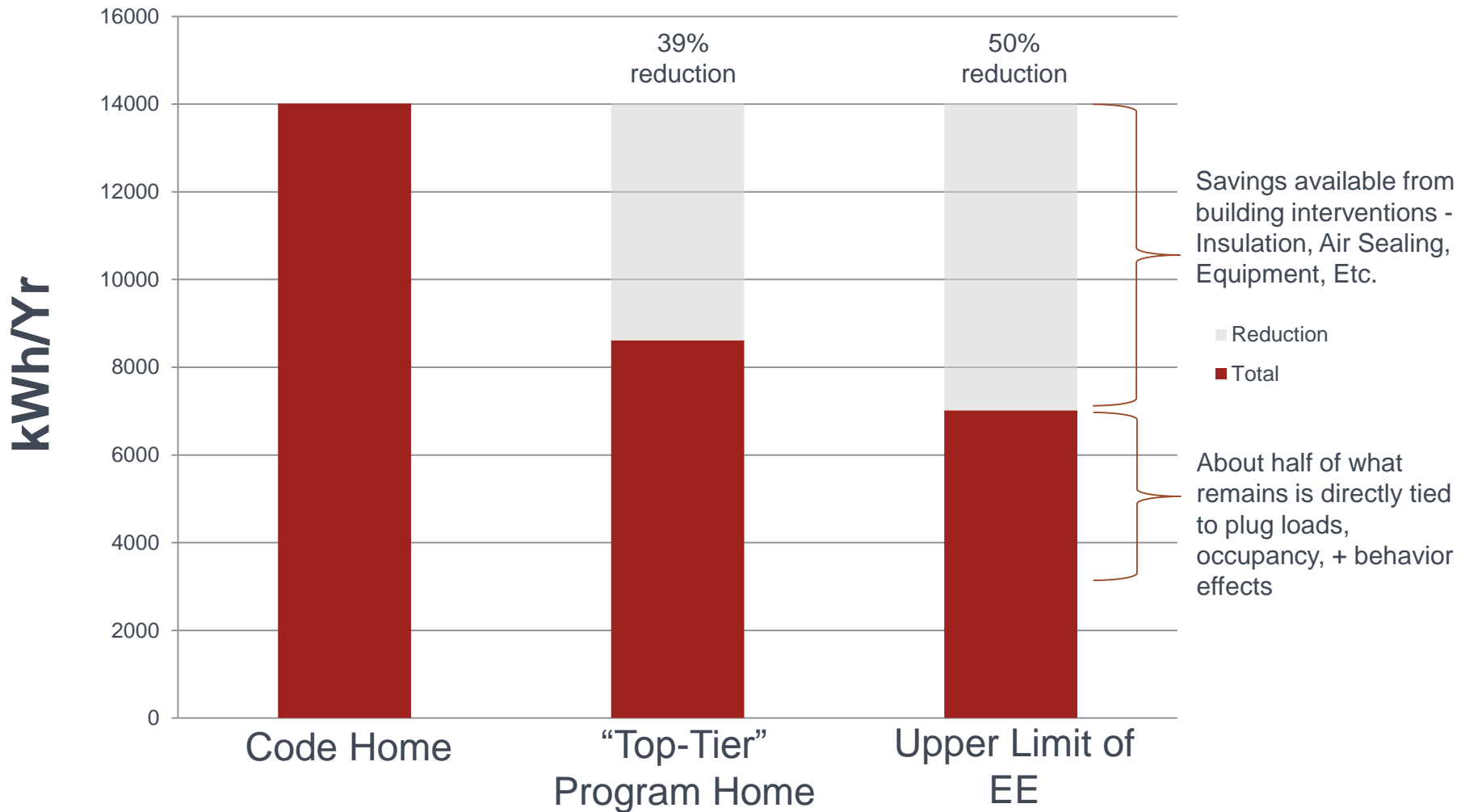
- Increase to select prescriptive minimums
 - Zonal heated homes must have a DHP
- Increase to Table 406 credits
 - Small homes need 1.5 credits
 - Medium homes need 3.5 credits
 - Large homes need 4.5 credits

Code Changes

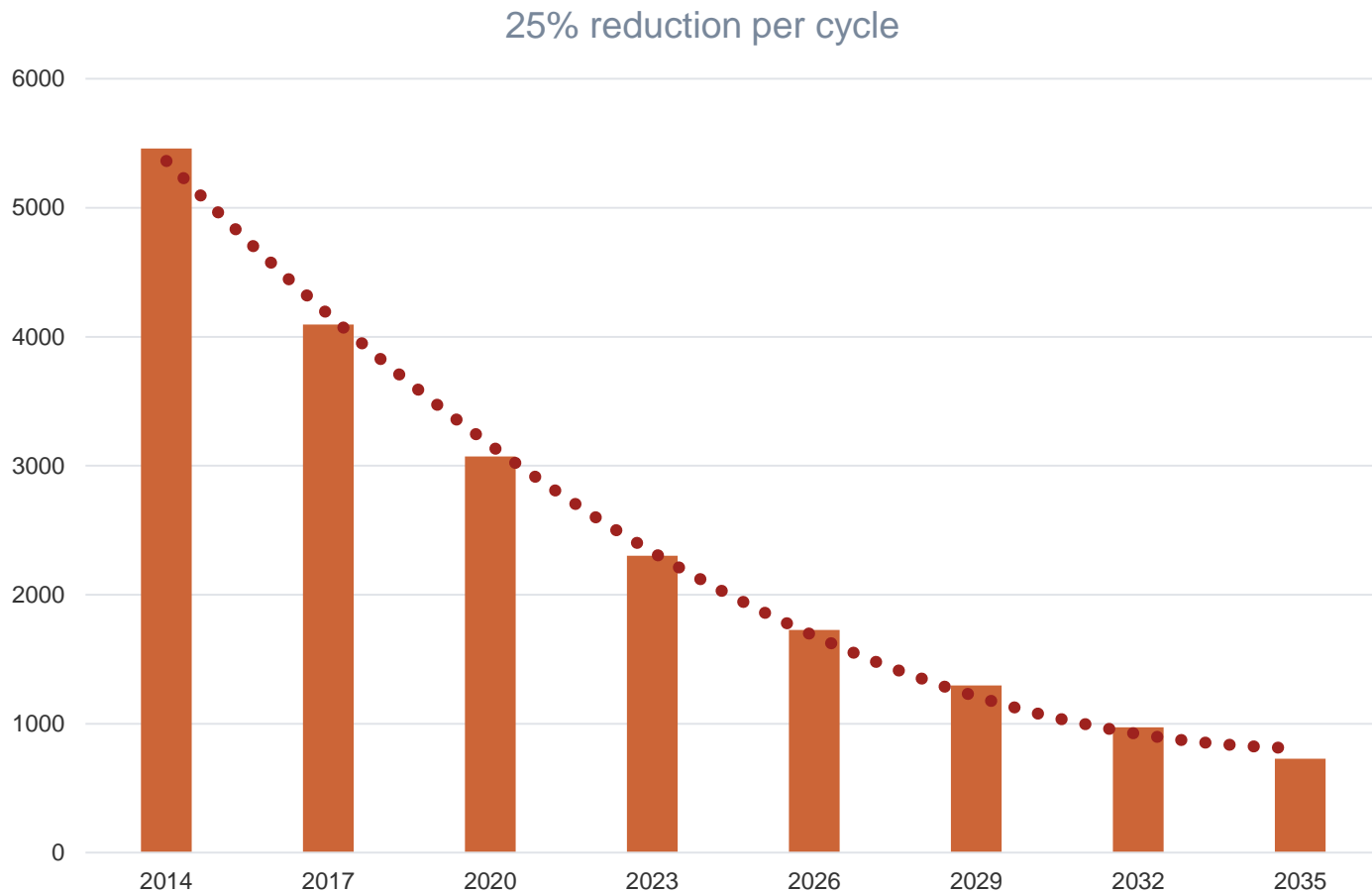
Change in Savings 2014-2017 (WA)



Reducing Energy Use



Code Changes



Code Changes

Highlights from 2016 WSEC:

- Increases to select prescriptive minimums
 - Zonal heated homes must have a DHP
- Increases to Table 406 credits
 - Small homes need 1.5 credits
 - Medium homes need 3.5 credits
 - Large homes need 4.5 credits
- Increase minimum thresholds for performance-based compliance (Section R405) – More on this later

Code Changes

Highlights from 2017 ORSC:

- Updates to prescriptive minimums
 - Intermediate framing, below-grade walls, ceiling insulation, windows
- Additional measure option tables have changed
 - Shell upgrades, equipment upgrades, air sealing details and removal of solar for energy compliance
- Lighting, showerheads and other changes

<http://www.oregon.gov/bcd/codes-stand/Documents/17res-comm/17orsc-ch11-ohba-nea-comp-proposal.pdf>

Code Changes

Highlights from 2017 ORSC:

- Lighting required to be 100% high-efficacy
 - Exception to allow two standard fixtures
 - Applies to interior and exterior
- 100% low flow showerheads and toilets
- Solar and electric vehicle ready electric panel
 - Panel space and capacity for PV inverter and electric vehicle charger. Does not specify other infrastructure.

<http://www.oregon.gov/bcd/codes-stand/Documents/17res-comm/17orsc-ch11-ohba-nea-comp-proposal.pdf>

Code Changes

BUILDING COMPONENT	STANDARD BASE CASE
	Equiv. Value ^b
Wall insulation-above grade	R-21 <u>Intermediate</u> ^c
Wall insulation-below grade ^c	R-15 / <u>R-21</u>
Flat ceilings ^f	R-38 <u>R-49</u>
Vaulted ceilings ^g	<u>R-38 R-30 Rafter or</u> <u>R-30A^{g,h} Scissor Truss</u>
Under floors	R-30
Slab edge perimeter	R-15
Heated slab interior ⁱ	R-10
Windows ^j	U-0.35 <u>U-0.30</u>
Window area limitation ^{j,k}	n/a
Skylights ^l	U-0.60 <u>U-0.50</u>
Exterior doors ^m	U-0.20
Exterior doors w/>2.5 ft ² glazing ⁿ	U-0.40
Forced air duct insulation	R-8

Ceiling

- R-49 flat ceilings
- Minimum 6" depth at exterior top plates
- R-30 vault if <50%
- R-38 vault if ≥ 50 %

Windows

- U-0.30

Code Changes

Envelope Enhancements

- Some moved to requirements
- Ducts inside is no longer an envelope option*
- Air sealing option has changed

2017 **TABLE N1101.1(2)**
ADDITIONAL MEASURES

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	3	Upgraded features Exterior walls – U-0.055 / R-23 intermediate or R-21 advanced, Flat ceiling ^e – U-0.020-0.017 / R-60, and Framed floors – U-0.026 / R-38
	4	Super Insulated Windows and Attic OR Framed Floors Windows – U-0.22 (Triple Pane Low-e), and Flat ceiling ^e – U-0.017 / R-60 or Framed floors – U-0.026 / R-38
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	6	High efficiency thermal envelope UA^g Proposed UA is 8% lower than the code UA
HVAC Measures (Select One)	A	High efficiency HVAC system^h Gas-fired furnace or boiler AFUE 94%, or Air source heat pump HSPF 9.5/15.0 SEER cooling, or Ground source heat pump COP 3.5 or Energy Star rated
	B	Ducted HVAC systems within conditioned space

Code Changes

Envelope Enhancements: Measure 5 Before and After

B	Ducted HVAC systems within conditioned space
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	All ducts and air handlers contained within building envelope ^d <i>Cannot be combined with Measure 5</i>
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5	Air sealing home and ducts
	Mandatory air sealing of all wall coverings at top plate and air sealing checklist ^f , and <u>Mechanical whole-building ventilation system with rates meeting N1101.1(3) or ASHRAE 62.2, and</u> All ducts and air handlers contained within building envelope ^d or All ducts sealed with mastic ^b

Code Changes

Conservation Measures

- HVAC efficiencies increased – DHPs added
- Ducts inside moved to conservation
- Water heating efficiency increased
- Solar PV no longer an option

2017 **TABLE N1101.1(2)**
ADDITIONAL MEASURES

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HVAC Measures (Select One)	A	High efficiency HVAC system^h Gas-fired furnace or boiler AFUE 94%, or Air source heat pump HSPF 9.5/15.0 SEER cooling, or Ground source heat pump COP 3.5 or Energy Star rated
	B	Ducted HVAC systems within conditioned space

Code Changes

Conservation Measure A: Before and After

A	High efficiency HVAC system:
	Gas-fired furnace or boiler with minimum AFUE of 90% a, or Air-source heat pump with minimum HSPF of 8.5 or Closed-loop ground source heat pump with minimum COP of 3.0

A	High efficiency HVAC system ^a
	Gas-fired furnace or boiler AFUE 94%, or Air source heat pump HSPF 9.5/15.0 SEER cooling, or Ground source heat pump COP 3.5 or Energy Star rated

Code Changes

Conservation Measure C: Before and After

C	Ductless heat pump:
	Replace electric resistance heating in at least the primary zone of dwelling with at least one ductless mini-split heat pump having a minimum HSPF of 8.5. Unit shall not have integrated backup resistance heat, and the unit (or units, if more than one is installed in the dwelling) shall be sized to have capacity to meet the entire dwelling design heat loss rate at outdoor design temperature condition. Conventional electric resistance heating may be provided for any secondary zones in the dwelling. A packaged terminal heat pump (PTHP) with comparable efficiency ratings may be used when no supplemental zonal heaters are installed in the building and integrated backup resistant heat is allowed in a PTHP

Conservation Measure C	C	Ductless heat pump
		Ductless heat pump HSPF 10.0 in primary zone of dwelling

The background of the slide is a photograph of a workshop or lumber yard. In the foreground, there are several stacks of cut lumber. On the left, a stack of thick, square-sectioned wooden beams is visible, showing their natural wood grain and some knots. To the right, there are stacks of thinner, rectangular wooden planks. The background is slightly out of focus, showing more stacks of wood and the structure of a building, possibly a warehouse or a construction site. The overall lighting is warm and natural, suggesting an indoor or sheltered outdoor environment.

Performance-Based Codes

Performance Based Codes

Oregon Section 408

SECTION 408 ALTERNATIVE SYSTEMS ANALYSIS

This section provides an alternate method of demonstrating code compliance with this chapter by demonstrating that such deviation will result in an annual energy consumption equal to or less than a building that is in compliance with this chapter.

408.1 Equivalent annual energy consumption. The baseline design, conforming to requirements specified in this chapter and the proposed design shall be analyzed using the same procedures. The analyses shall use equal floor area and equal environmental requirements. The comparison shall be expressed in Btu input per gross building square foot of conditioned space per year (MJ/m² per year).

Performance Based Codes

Oregon Section 408

- Exceed performance of the base home
- Hourly Simulation
- Completed/documentated by registered engineer

Performance Based Codes

Washington Section R405

SECTION R405 SIMULATED PERFORMANCE ALTERNATIVE (PERFORMANCE)

R405.1 Scope. This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, and service water heating energy only.

R405.2 Mandatory requirements. Compliance with this section requires that the mandatory provisions identified in Section R401.2 be met. All supply and return ducts not completely inside the *building thermal envelope* shall be insulated to a minimum of R-8.

Performance Based Codes

Washington Section R405

- Software must be capable of simulating equipment under part-load conditions
- Exceed performance of the base home by:
 - Small homes – 20%
 - Medium homes – 28%
 - Large homes – 34%
 - R-2 dwellings – 15%
- Sampling prohibited

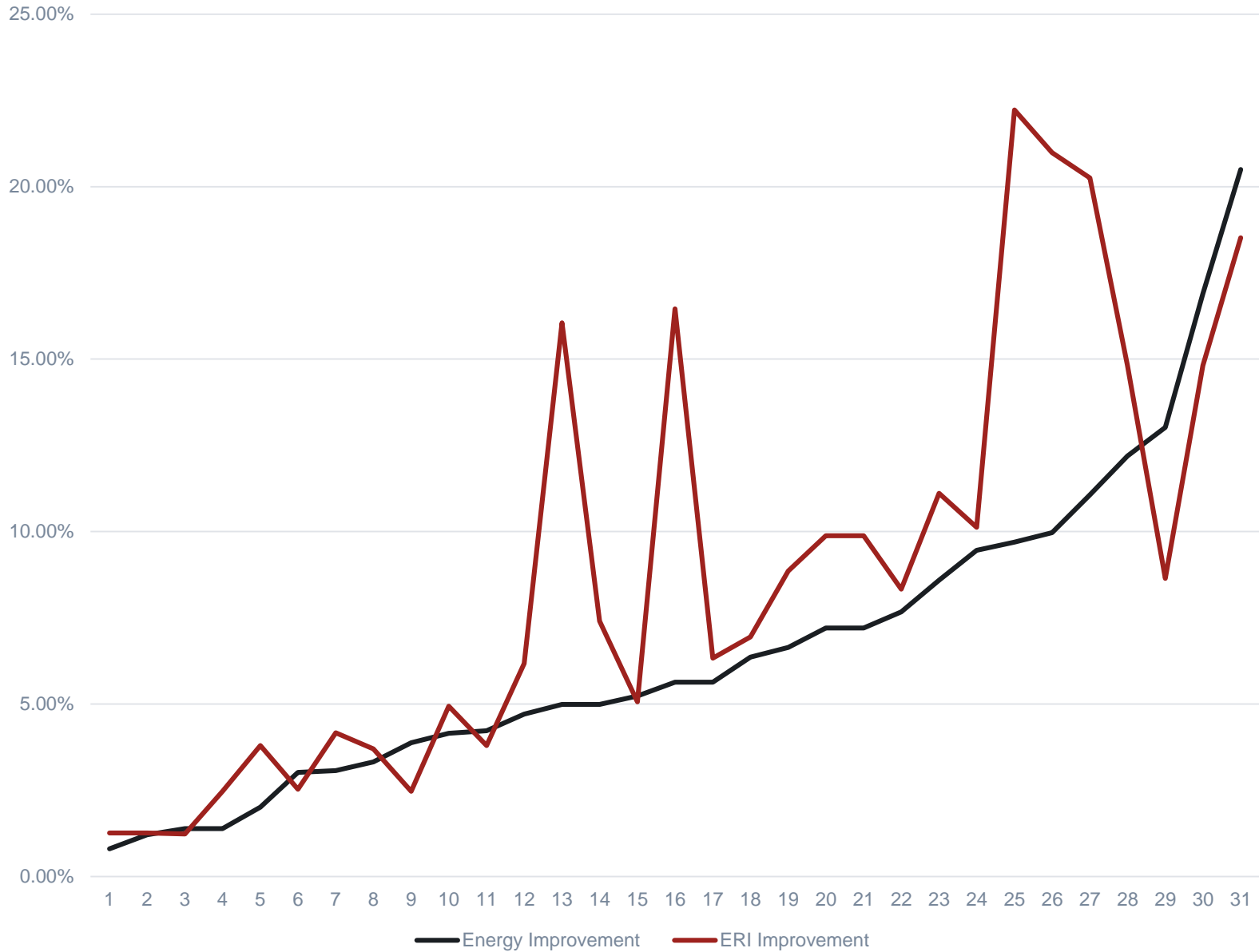
Performance Based Codes

2015 IECC Section R406

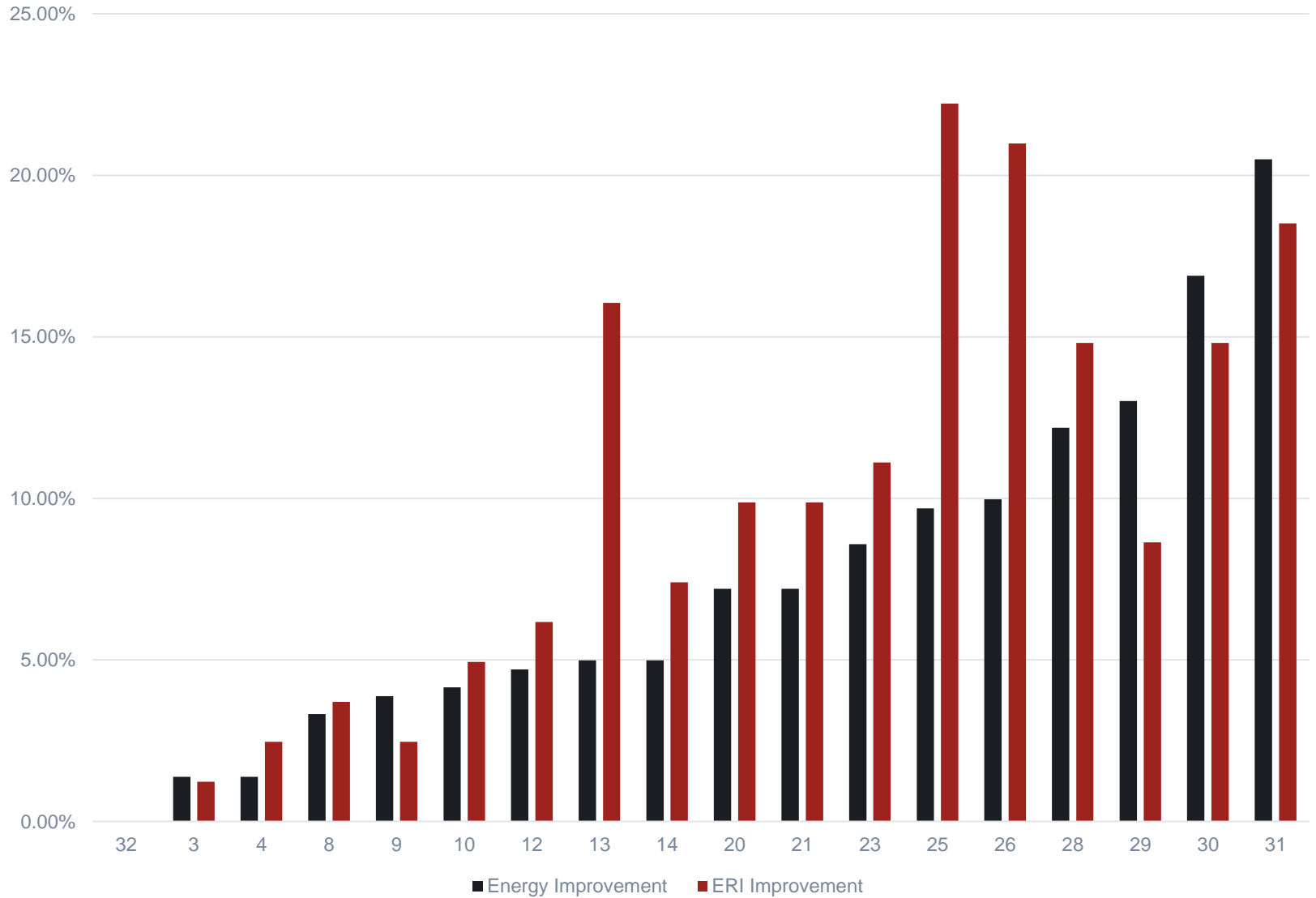
TABLE R406.4
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX
1	52
2	52
3	51
4	54
5	55
6	54
7	53
8	53

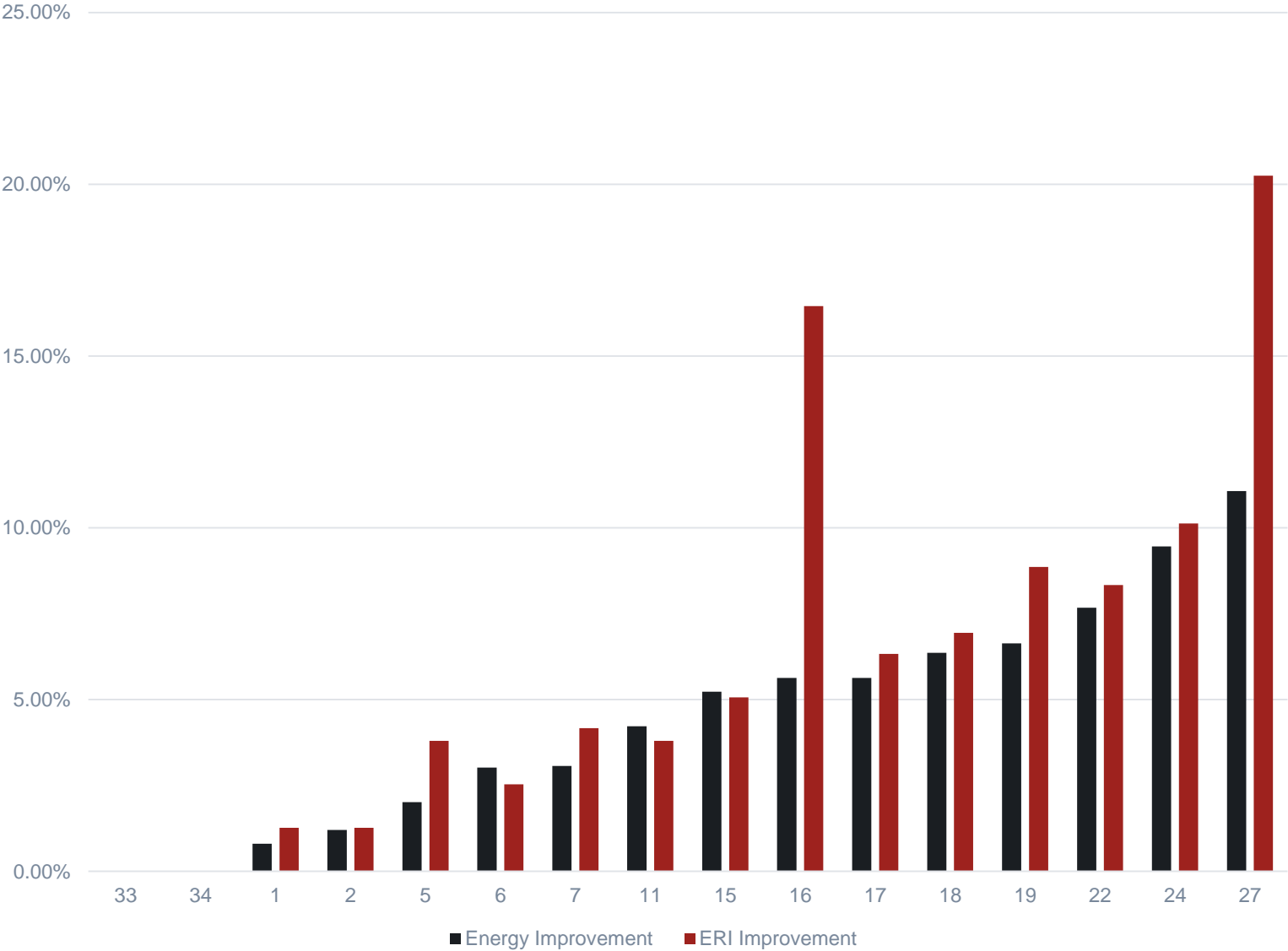
ERI vs Energy Improvement (Mmbtu)



ERI vs Energy Improvement (Elec)



ERI vs Energy Improvement (Gas)



Other



HOME PROFILE

LOCATION:
123 Main St
Portland, OR 97201

YEAR BUILT:
2017

HEATED FLOOR AREA:
1,500 sq. ft.

NUMBER OF BEDROOMS:
3

ASSESSMENT

ASSESSMENT DATE:
12/22/2016

EXPIRATION DATE:
12/22/2018

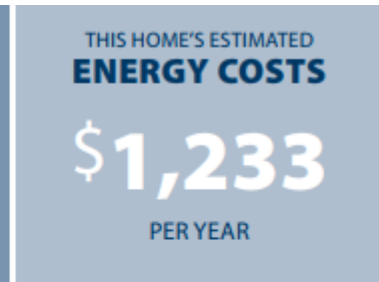
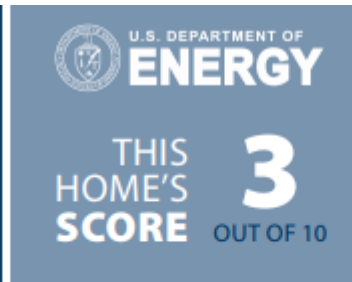
ASSESSOR:
Maria Gomez
Gomez Energy Partners

PHONE:
503-555-1211

EMAIL:
maria@gomezenergy.com

CCB LICENSE #:
1234567890

MAKE THE MOST OUT



Home Energy Score



Pre-construction Assessment | ID#1234567

The Home Energy Score is a national rating system developed by the U.S. Department of Energy. The Score reflects the energy efficiency of a home based on the home's structure and heating, cooling, and hot water systems. The average score is a 5. Learn more at HomeEnergyScore.gov.

HOW MUCH ENERGY IS THIS HOME LIKELY TO USE?

Electric: 10,000 kWh/yr.\$600
Natural Gas: 700 therms/yr.\$633
Other: _____ gal/yr.\$0

TOTAL ENERGY COSTS PER YEAR \$1,233

How much **renewable energy** does this home generate?

3,000 kWh/yr

THIS HOME'S CARBON FOOTPRINT:



Estimated average carbon footprint for a similar sized home: 3.8 tons of CO₂ equivalent emissions per year.

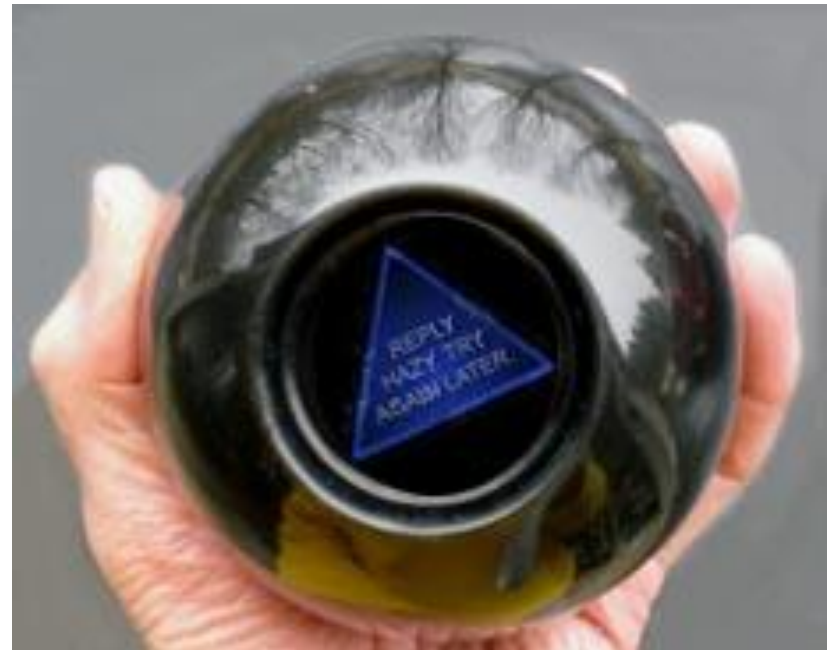
Looking Ahead*


- IECC-based states begin to adopt ERI with modified targets
- Or – IECC-based states begin to roll Commercial upgrade options into Res code
- DOE HES and other rating tools migrate to better/common engines
- Raters leveraged as 3rd party code inspectors
- Programs “squeezed” up against ZNE codes



Looking Ahead*

- DOE HES and other rating tools migrate to hourly simulation engines
- Greater alignment between tools/resources used for policy, code, programs, MLS
- Enhanced QA on performance-based code approaches
- Migration to EUI code metrics
- Integration of EE, Renewables, Storage, DR, Smart devices





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