

# 2015 Washington State Energy Code Residential Sections

*Where did we come from, where are we at and  
where are we going?*

**Gary Nordeen**

Senior Building Science Specialist

**Luke Howard**

Building Science Specialist



WASHINGTON STATE UNIVERSITY



ENERGY PROGRAM

[www.energy.wsu.edu](http://www.energy.wsu.edu)

# Energy Code Support in WA State

## Residential

- Washington State University Energy Program
- 360-956-2042
- [energycode@energy.wsu.edu](mailto:energycode@energy.wsu.edu)
- [www.energy.wsu.edu/code](http://www.energy.wsu.edu/code)
- Gary Nordeen, Luke Howard, Tanya Beavers

## Non-residential

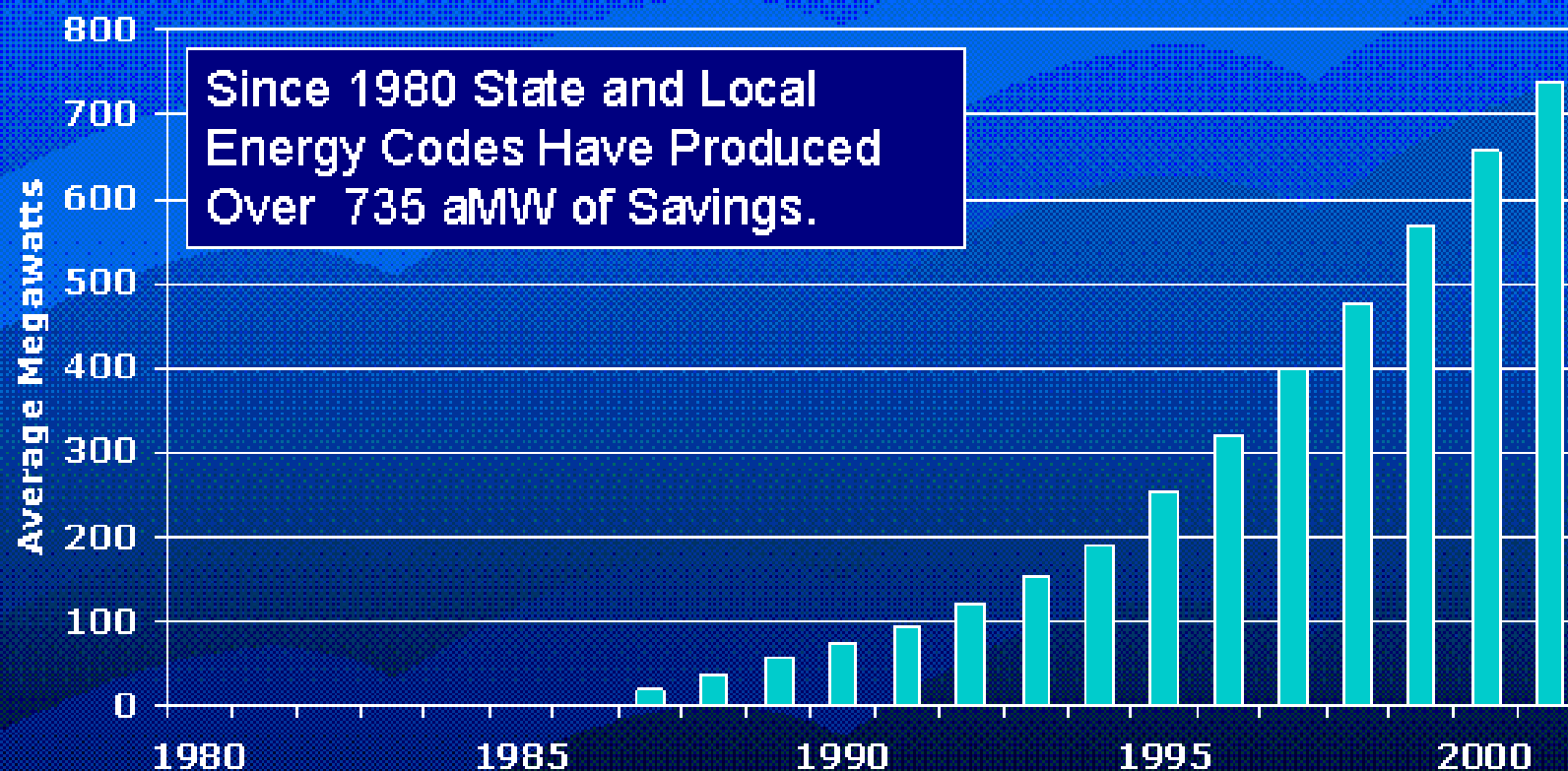
- Northwest Energy Efficiency Council
- Lisa Rosenow
- 206-624-0283
- [wsec@putnamprice.com](mailto:wsec@putnamprice.com)
- [www.neec.net](http://www.neec.net)

# Ancient History

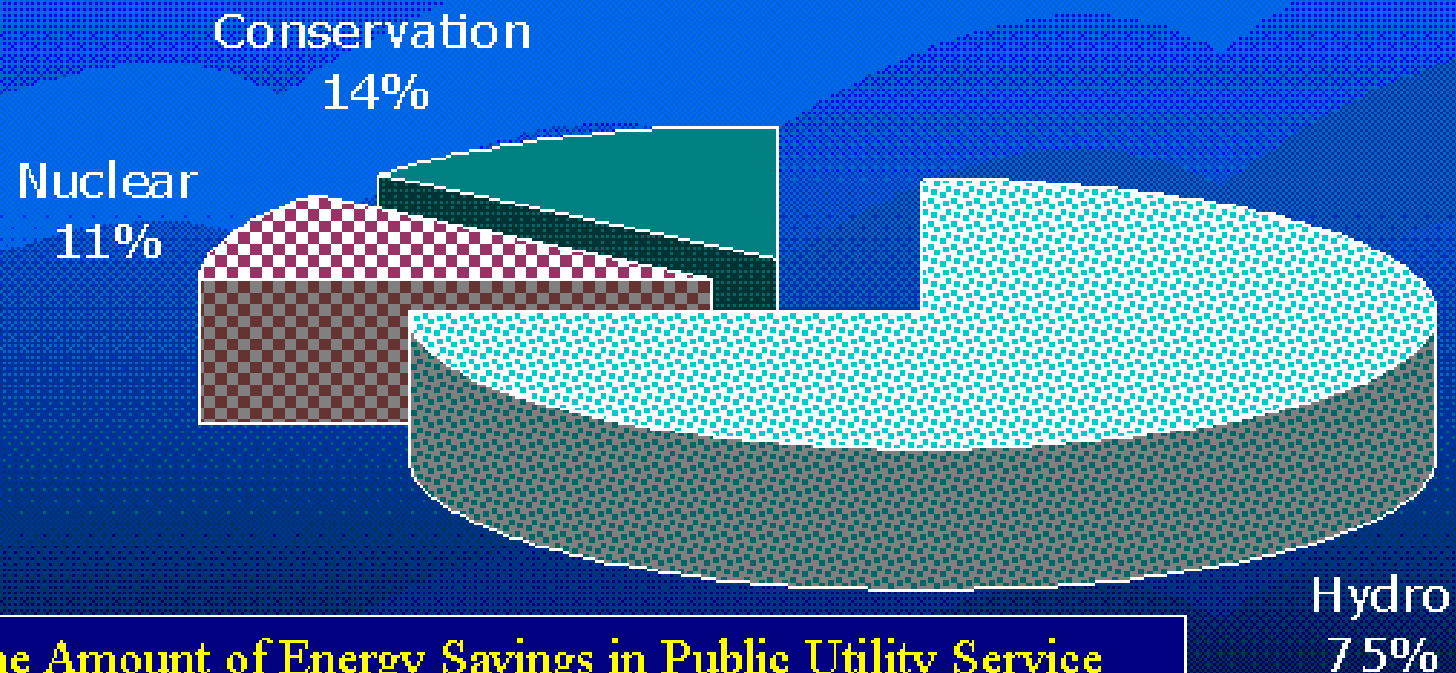


- 1978 – First Washington State Energy Code
- 1980 – Creation of Northwest Power Planning Council by Congress
- 1983 – First regional Power Plan by NWPPC
  - Plan included *Model Conservation Standards* (MCS)
- 1986 – Washington updates Energy Code
  - Halfway between 1980 and MCS standards
- 1991 – Washington State Legislature mandates Energy Code requirements be raised to full MCS levels

# 20 Years of Progress – State Energy Code Accomplishments

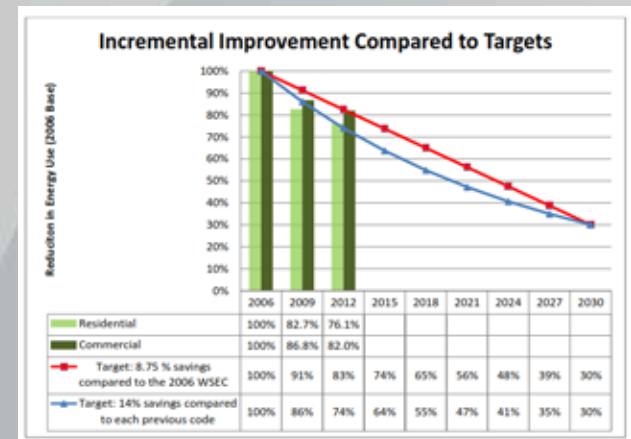


# Conservation Is Now The Second Largest Single Federal Power Firm Energy Resource



The Amount of Energy Savings in Public Utility Service Territories from Conservation Programs, Codes and Standards Is Equivalent to Three Times the Annual Firm Energy Output of Bonneville Dam

# Climate Action Team Recommendations Legislation (2009)



RCW 19.27A.160

**Residential and nonresidential construction—Energy consumption reduction—Council report.**

(1) Except as provided in subsection (2) of this section, residential and nonresidential construction permitted under the 2031 state energy code must achieve a seventy percent reduction in annual net energy consumption, using the adopted **2006** Washington state **energy code as a baseline**

# Model Codes (ICC) are adopted on a 3 year cycle

- Code change proposals received by SBCC from Jan 1 to March 1
- Tech Advisory Groups review proposals and forward them to SBCC
- SBCC puts together model codes integrated with proposed changes
- Public hearings in Sept and Oct.
- Council votes in November



# R101.2 Scope

## Residential buildings and their associated:

- Sites
- Systems
- Equipment
- Includes R-2, R-3 and R-4 Three stories or less above grade



*This code shall be the maximum and minimum energy code for residential construction in each town, city and county.*



## Compliance R401.2

- Prescriptive – WSU form
- Total UA Alternative – WSU form \*
- Performance Approach – as required in R405

*Check WSU's Energy Code webpage for compliance tool information as it becomes available:*

[www.energy.wsu.edu/code](http://www.energy.wsu.edu/code)

\*REScheck no longer available in WA State

# Where are we at?

**TABLE R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>**

<b>CLIMATE ZONE</b>	<b>5 AND MARINE 4</b>
<b>FENESTRATION U-FACTOR<sup>b</sup></b>	0.30
<b>SKYLIGHT<sup>b</sup> U-FACTOR</b>	0.50
<b>GLAZED FENESTRATION SHGC<sup>b, e</sup></b>	NR
<b>CEILING R-VALUE<sup>k</sup></b>	49
<b>WOOD FRAME WALL<sup>g, m, n</sup> R-VALUE</b>	21 int
<b>Mass Wall R-Value<sup>i</sup></b>	21/21 <sup>h</sup>
<b>FLOOR R-VALUE</b>	30 <sup>g</sup>
<b>BELOW-GRADE<sup>c, m</sup> WALL R-VALUE</b>	10/15/21 int + TB
<b>SLAB<sup>d</sup> R-VALUE &amp; DEPTH</b>	10, 2 ft

# Definition: NOMINAL R-VALUE:

The thermal resistance of insulation alone as determined in accordance with the U.S. Federal Trade Commission R-value rule.



The screenshot shows the Federal Trade Commission website header with the logo and the text "FEDERAL TRADE COMMISSION PROTECTING AMERICA'S CONSUMERS". Below the header is a navigation menu with "ABOUT THE FTC", "NEWS & EVENTS", "ENFORCEMENT", and "POLICY". The main content area shows a breadcrumb trail: "Home » News & Events » Press Releases » R-value Rule". The title "R-value Rule" is displayed in a large font, followed by a green box containing the text "FOR YOUR INFORMATION" and the date "April 6, 1995".



[www.ftc.gov/bcp/rulemaking/rvalue/index.shtml](http://www.ftc.gov/bcp/rulemaking/rvalue/index.shtml)

# Prescriptive Insulation Ceilings

**TABLE R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>**

CLIMATE ZONE	5 AND MARINE 4
FENESTRATION U-FACTOR <sup>b</sup>	0.30
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Mass Wall R-Value <sup>i</sup>	21/21 <sup>h</sup>
FLOOR R-VALUE	30 <sup>g</sup>
BELOW-GRADE <sup>c, m</sup> WALL R-VALUE	10/15/21 int + TB
SLAB <sup>d</sup> R-VALUE & DEPTH	10, 2 ft

# Footnotes

CEILING R-VALUE <sup>k</sup>	49
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<sup>k</sup> For single rafter- or joist-vaulted ceilings, the insulation may be reduced to R-38.

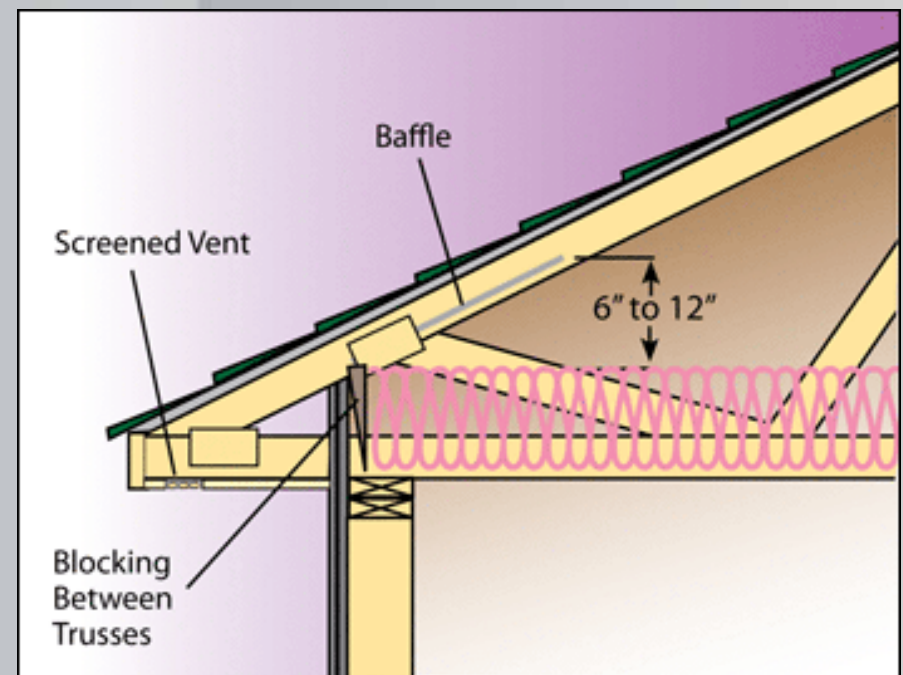
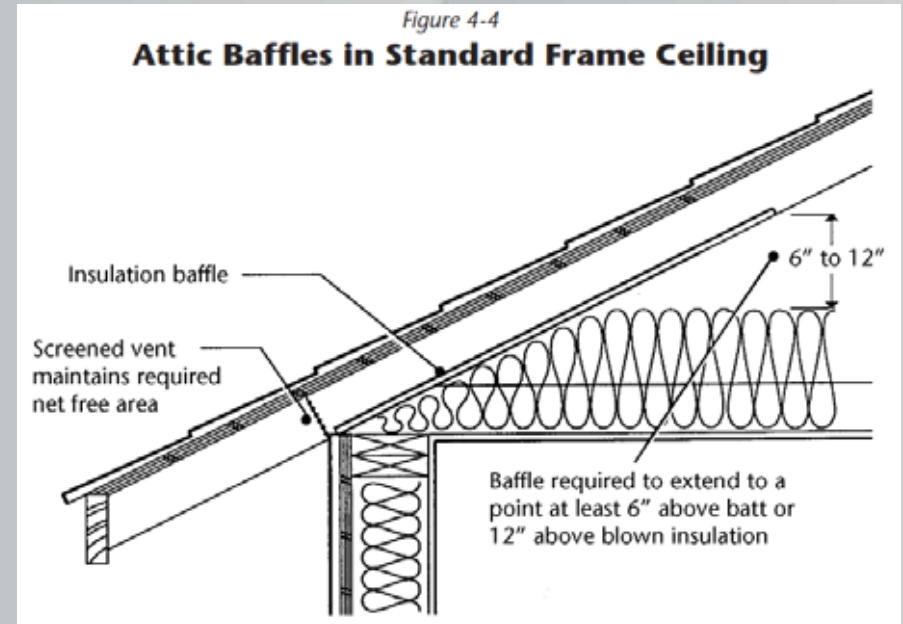
- **R402.2.1 Ceilings with attic spaces.** Where Section R402.1.1 would require R-49 in the ceiling, installing R-38 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the *U*-factor alternative approach in Section R402.1.3 and the total UA alternative in Section R402.1.4.

Standard framing assumes tapering of insulation depth around the perimeter with resultant decrease in thermal resistance.

- R-49 STD  
U-0.027

Advanced framing assumes full and even depth of insulation extending to the outside edge of exterior walls.

- R-38 ADV  
U-0.026



# Cellulose Depth & Bag Count

Application Coverage Chart			Product #INS551LD				
R-Value @ 75° F Mean Temperature	Minimum Thickness (inches)		Maximum Net Coverage (no adjustment for framing)			Gross Coverage (based on 2" x 6" framing on 16" centers)	
To Obtain a Thermal Resistance of:	Installed Insulation Should Not Be Less Than:	Thickness After Settling	Maximum Sq. Ft. Per Bag	Minimum Bags Per 1,000 Sq. Ft.	Minimum Weight (lbs) Per Sq. Ft.	Maximum Sq. Ft. Per Bag	Minimum Bags Per 1,000 Sq. Ft.
R-13	4.1	3.7	55.4	18.0	0.407	61.1	16.4
R-19	5.9	5.4	36.2	27.6	0.623	40.0	25.0
R-22	6.9	6.2	30.7	32.6	0.734	33.5	29.8
R-24	7.5	6.7	27.9	35.9	0.809	30.2	33.1
R-25	7.8	7.0	26.6	37.6	0.847	28.7	34.8
R-30	9.3	8.4	21.7	46.1	1.039	23.1	43.2
R-38	11.7	10.5	16.6	60.1	1.355	17.5	57.1
R-42	12.9	11.6	14.9	67.2	1.516	15.8	64.2
R-49	15.0	13.5	12.5	79.9	1.802	13.0	76.8
R-60	18.3	16.5	10.0	100.3	2.261	10.3	97.1

## SIDEWALLS

R-value	Wall Thickness	Thickness (inches)	Maximum Square Feet per Bag Coverage		Weight per Square Foot
			16" oc	24" oc	
R-13	(2 x 4)	3.5	32.8	31.7	0.758
R-20	(2 x 6)	5.5	20.9	20.2	1.192

R-value/inch: 3.7      Attic Density Range: 1.32-1.65 lbs/cu. ft.  
 Bag Weight : 22.55 lbs.      Wall Density: 2.6 lbs/cu.ft.

# Exception for Ventilated Attics

- Unvented, conditioned attics are allowed under certain conditions



*See website for detailed requirements*



# Unvented Attic Criteria

- Unvented attic contained completely within the building thermal envelope.
- NO vapor retarders installed at ceiling level.



*See website for detailed requirements*

# Prescriptive Insulation Walls

**TABLE R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>**

<b>CLIMATE ZONE</b>	<b>5 AND MARINE 4</b>
<b>FENESTRATION U-FACTOR<sup>b</sup></b>	0.30
<b>SKYLIGHT<sup>b</sup> U-FACTOR</b>	0.50
<b>GLAZED FENESTRATION SHGC<sup>b, e</sup></b>	NR
<b>CEILING R-VALUE<sup>k</sup></b>	49
<b>WOOD FRAME WALL<sup>g, m, n</sup> R-VALUE</b>	21 int
<b>Mass Wall R-Value<sup>i</sup></b>	21/21 <sup>h</sup>
<b>FLOOR R-VALUE</b>	30 <sup>g</sup>
<b>BELOW-GRADE<sup>c, m</sup> WALL R-VALUE</b>	10/15/21 int + TB
<b>SLAB<sup>d</sup> R-VALUE &amp; DEPTH</b>	10, 2 ft

# R104.2.1. Wall Insulation Inspection



Wall insulation inspection after all wall insulation is in place and prior to cover.

*WSEC language added because it is required by RCW 19.27A*





Table R402.1.1  
Insulation that readily conforms to the available space shall be installed filling the entire cavity and within the manufacturers' density recommendation.

*BIBs System  
A better practice*

# Prescriptive Insulation Below-Grade Walls

**TABLE R402.1.1**  
**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>**

<b>CLIMATE ZONE</b>	<b>5 AND MARINE 4</b>
<b>FENESTRATION U-FACTOR<sup>b</sup></b>	0.30
<b>SKYLIGHT<sup>b</sup> U-FACTOR</b>	0.50
<b>GLAZED FENESTRATION SHGC<sup>b, e</sup></b>	NR
<b>CEILING R-VALUE<sup>k</sup></b>	49
<b>WOOD FRAME WALL<sup>g, m, n</sup> R-VALUE</b>	21 int
<b>Mass Wall R-Value<sup>i</sup></b>	21/21 <sup>h</sup>
<b>FLOOR R-VALUE</b>	30 <sup>g</sup>
<b>BELOW-GRADE<sup>c, m</sup> WALL R-VALUE</b>	10/15/21 int + TB
<b>SLAB<sup>d</sup> R-VALUE &amp; DEPTH</b>	10, 2 ft

## Below Grade Wall Insulation

- Exterior Insulation
  - R-10 Continuous
- or*
- Interior Insulation
  - R-15 Continuous



*or*  
R-21 Cavity  
(allowed but not recommended)







Wall vapor retarders below grade are not recommended



**R702.7 Vapor retarders.** Class I or II vapor retarders are required on the interior side of frame walls in Climate Zones 5, 6, 7, 8 and Marine 4.

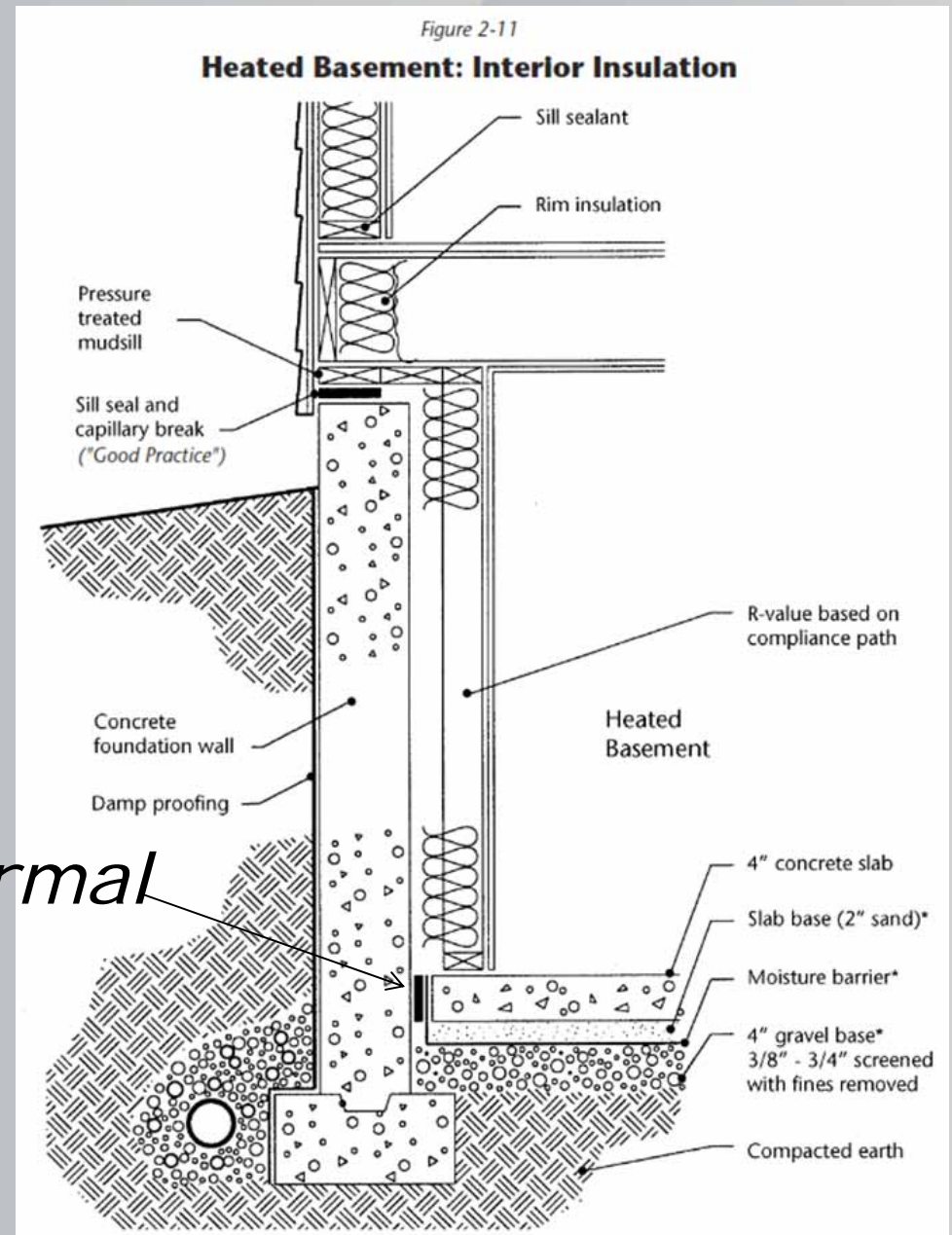
**Exceptions:**

1. Basement walls.
2. Below grade portion of any wall.
3. Construction where moisture or its freezing will not damage the materials.

**2012 INTERNATIONAL RESIDENTIAL CODE®**

- R-21 + TB at foundation wall to slab joint

*TB = R-5 thermal break*





# Prescriptive Insulation Floors

**TABLE R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>**

<b>CLIMATE ZONE</b>	<b>5 AND MARINE 4</b>
<b>FENESTRATION U-FACTOR<sup>b</sup></b>	0.30
<b>SKYLIGHT<sup>b</sup> U-FACTOR</b>	0.50
<b>GLAZED FENESTRATION SHGC<sup>b, e</sup></b>	NR
<b>CEILING R-VALUE<sup>k</sup></b>	49
<b>WOOD FRAME WALL<sup>g, m, n</sup> R-VALUE</b>	21 int
<b>Mass Wall R-Value<sup>i</sup></b>	21/21 <sup>h</sup>
<b>FLOOR R-VALUE</b>	30 <sup>g</sup>
<b>BELOW-GRADE<sup>c, m</sup> WALL R-VALUE</b>	10/15/21 int + TB
<b>SLAB<sup>d</sup> R-VALUE &amp; DEPTH</b>	10, 2 ft

## R402.2.7 Floors

**R402.2.7 Floors.** Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.



# Crawl space walls (R402.2.10)

This section deleted in its entirety.

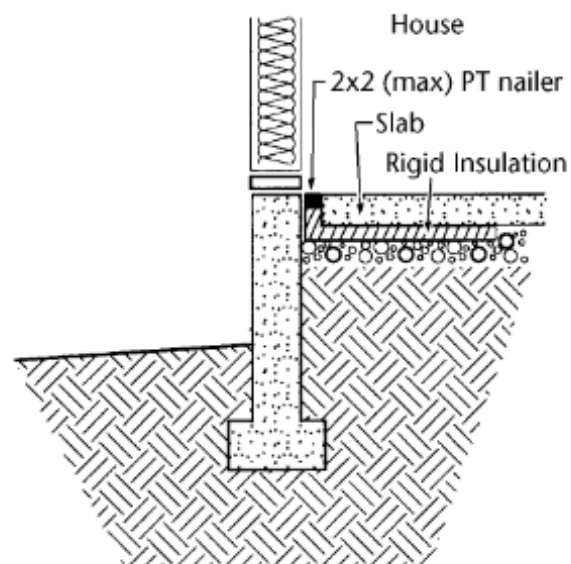
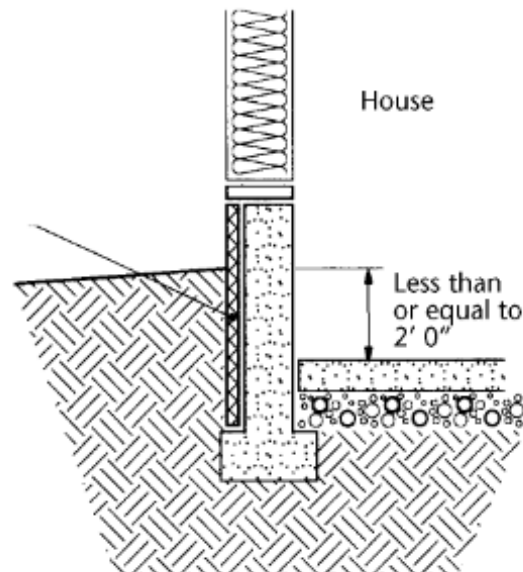
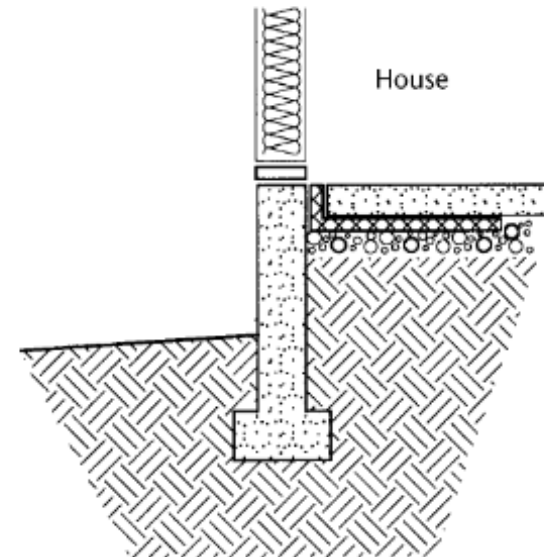
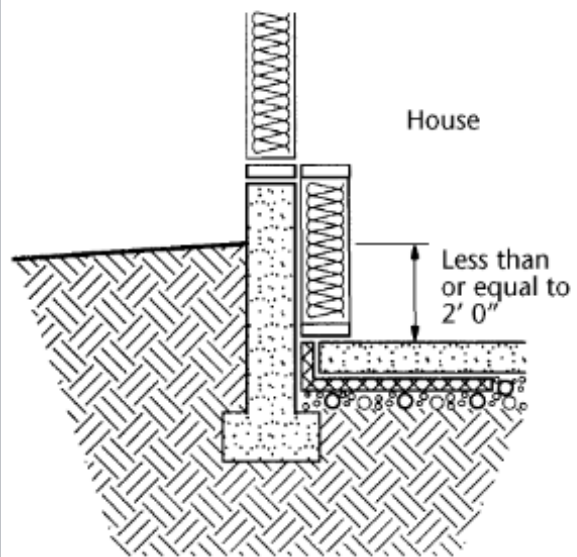


*Unvented crawl spaces are not prescriptively allowed.*

# Prescriptive Insulation Slab-On-Grade

**TABLE R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>**

<b>CLIMATE ZONE</b>	<b>5 AND MARINE 4</b>
<b>FENESTRATION U-FACTOR<sup>b</sup></b>	0.30
<b>SKYLIGHT<sup>b</sup> U-FACTOR</b>	0.50
<b>GLAZED FENESTRATION SHGC<sup>b, e</sup></b>	NR
<b>CEILING R-VALUE<sup>k</sup></b>	49
<b>WOOD FRAME WALL<sup>g, m, n</sup> R-VALUE</b>	21 int
<b>Mass Wall R-Value<sup>i</sup></b>	21/21 <sup>h</sup>
<b>FLOOR R-VALUE</b>	30 <sup>g</sup>
<b>BELOW-GRADE<sup>c, m</sup> WALL R-VALUE</b>	10/15/21 int + TB
<b>SLAB<sup>d</sup> R-VALUE &amp; DEPTH</b>	10, 2 ft





<sup>d</sup> R-10 continuous insulation is required under heated slab on grade floors. See R402.2.9.1.

The entire area of a radiant slab shall be thermally isolated from the soil with a minimum of R-10 insulation.



## R402.1.4 Total UA Alternative

*Not as easy as a commercial building*

- The U-factors for typical construction assemblies are included in Appendix A.
- Language was added with a 15% maximum glazing area for the target house when using the “Total UA Alternative” (Component Performance). 15% is the glazing percentage in RCW 19.27A.

# UA Alternative

## Building Envelope Trade-Off

0																					
1	Conditioned Floor Area																				1,947
2																					
3																					
4																					
5	<b>Component Performance, R occupancies</b>																				
6																					
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1,947

**Code Target Values**

	Area	UA
Doors U = 0.300	122	37
Overhead Glazing U = 0.500	0	0
Vertical Glazing U = 0.300	143	43
Flat/Vaulted Ceilings U = 0.026	1,441	37
Wall (above grade) U = 0.056	2,015	113
Floors U = 0.029	341	10
Slab on Grade F = 0.540	90	49
Below Grade Wall U = 0.042	0	0
Below Grade Slab F = 0.570	0	0

**Proposed Design**

	Area	UA
Doors U = 0.300	122	33
Overhead Glazing U = 0.500	0	0
Vertical Glazing U = 0.300	143	42
Flat/Vaulted Ceilings U = 0.026	1,441	45
Wall (above grade) U = 0.056	2,015	97
Floors U = 0.029	341	11
Slab on Grade F = 0.540	90	49
Below Grade Wall U = 0.042	0	0
Below Grade Slab F = 0.570	0	0

Target UA Total 288

Target Credits from Table 406.2 3.5

Proposed UA Total 275

Proposed Credits from Table 406.2 3.5



# Air Leakage Testing

- Air leakage testing is required for:
  - R-3 Occupancies (Single family, duplexes, townhomes up to three stories)
  - R-2 Occupancies (Multifamily buildings up to three stories)

Maximum leakage rate is 5.0 ACH@50 Pa

# Multi-Family Air Leakage Testing

- Whole building testing
- Single door individual dwelling unit testing
- Guarded individual dwelling unit testing using multiple fans



## 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 plane 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.\*



\*1.0 credits allowed from options package 3d

# Additional Energy Credits

## Table 406.2

Each dwelling unit in a residential building shall comply with sufficient options from Table R406.2 as to achieve the following minimum number of credits.

- This includes multifamily 3-stories or less

SECTION R406 ADDITIONAL ENERGY EFFICIENCY REQUIREMENTS		
<p><b>R406.1 Scope.</b> This section establishes options for additional criteria to be met for one- and two-family dwellings and townhouses, as defined in Section 101.2 of the <i>International Residential Code</i> to demonstrate compliance with this code.</p> <p><b>R406.2 Additional energy efficiency requirements (Mandatory).</b> Each dwelling unit in a residential building shall comply with sufficient options from Table R406.2 so as to achieve the following minimum number of credits:</p>		
1. Small Dwelling Unit: .....	1.5 credits	
<p>Dwelling units less than 1500 square feet in conditioned floor area with less than 300 square feet of fenestration area. Additions to existing building greater than 500 square feet of heated floor area but less than 1500 square feet.</p>		
2. Medium Dwelling Unit: .....	3.5 credits	
<p>All dwelling units that are not included in #1 or #3.</p> <p><b>Exception:</b> Dwelling units serving R-2 occupancies shall require 2.5 credits.</p>		
3. Large Dwelling Unit: .....	4.5 credits	
<p>Dwelling units exceeding 5000 square feet of conditioned floor area.</p> <p><b>Exception:</b> Dwelling units serving R-2 occupancies shall require 2.5 credits.</p>		
4. Additions less than 500 square feet: .....	0.5 credits	
<p>The drawings included with the building permit application shall identify which options have been selected and the point value of each option, regardless of whether separate mechanical, plumbing, electrical, or other permits are utilized for the project.</p>		
TABLE 406.2 ENERGY CREDITS		
OPTION	DESCRIPTION	CREDIT(\$)
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 <b>or</b> 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 <del>int</del> plus R-5 <del>ci</del> Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab <b>or</b> Compliance based on Section R402.1.4: Reduce the Total UA by 15%.</p>	1.0
1c	EFFICIENT BUILDING ENVELOPE 1c: .....	2.0

# Additional Energy Credits

## Small Dwelling Unit

Dwelling units less than 1500 square feet in conditioned floor area with less than 300 square feet of fenestration area. Additions to existing building greater than 500 square feet of heated floor area but less than 1500 square feet.

- *This includes multifamily 3-stories or less*

**1.5 Credits**

# Additional Energy Credits

## Medium Dwelling Units

- All dwelling units between 1,500 and 5,000 square feet.
  - **Exception:** Dwelling units serving R-2 occupancies shall require 2.5 credits.

**3.5 Credits**

# Additional Energy Credits

## Large Dwelling Units

- Dwelling units exceeding 5000 square feet of conditioned floor area.
  - **Exception:** Dwelling units serving R-2 occupancies shall require 2.5 credits.

**4.5 Credits**

# Additional Energy Credits

## Additions



Additions less than 500 square feet

**0.5 Credit**



# Summary of Credit Options

**Table R406.2 Summary**

Opt.	Description	Credit(s)
1a	Efficient Building Envelope 1a	0.5
1b	Efficient Building Envelope 1b	1.0
1c	Efficient Building Envelope 1c	2.0
1d	Efficient Building Envelope 1d	0.5
2a	Air Leakage Control and Efficient Ventilation 2a	0.5
2b	Air Leakage Control and Efficient Ventilation 2b	1.0
2c	Air Leakage Control and Efficient Ventilation 2c	1.5
3a	High Efficiency HVAC 3a	1.0
3b	High Efficiency HVAC 3b	1.0
3c	High Efficiency HVAC 3c	1.5
3d	High Efficiency HVAC 3d	1.0
4	High Efficiency HVAC Distribution System	1.0
5a	Efficient Water Heating 5a	0.5
5b	Efficient Water Heating 5b	1.0
5c	Efficient Water Heating 5c	1.5
5d	Efficient Water heating 5d	0.5
6	Renewable Electric Energy	0.5

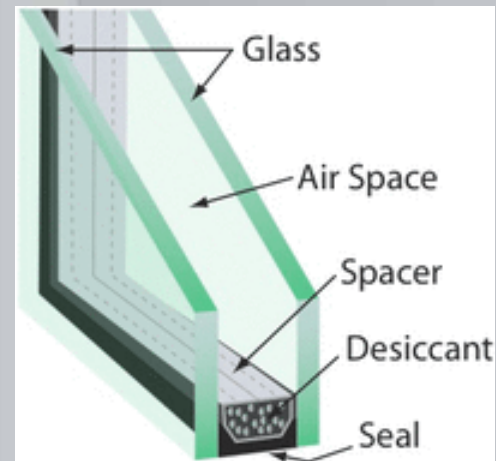
# Envelope Option 1a

R-38 floor insulation

U-.28 windows

**.5 Credits**

Credit may also be gained by reducing building UA by 5% relative to the code target UA



# Envelope Option 1b

R-38 floor insulation

U-.25 windows

R-21 + R-4 foam sheathing\*

\* Thermal Break Shear Wall:

A Case Study of Rigid Foam Insulation between Frame and Sheathing

**1.0 Credits**

Credit may also be gained by reducing building UA by 15% relative to the code target UA



# Envelope Option 1c

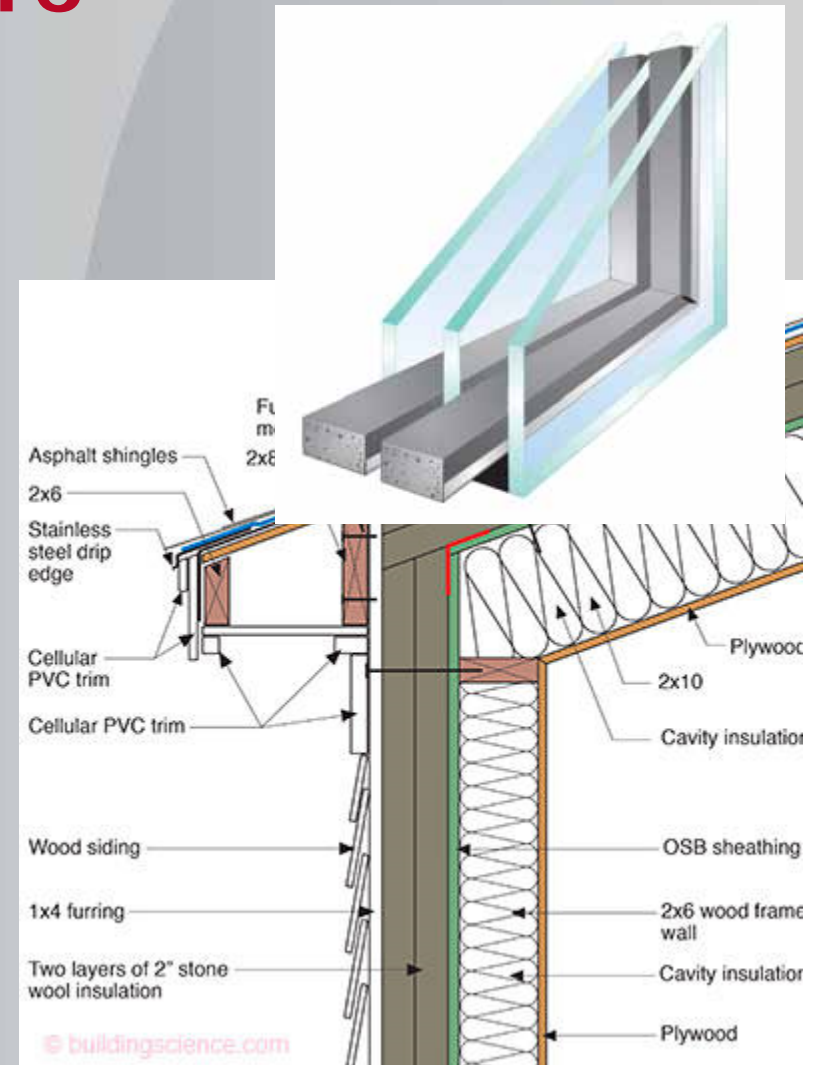
R-38 floor insulation

U-.22 windows

R-21 + R-12 foam sheathing

**2.0 Credits**

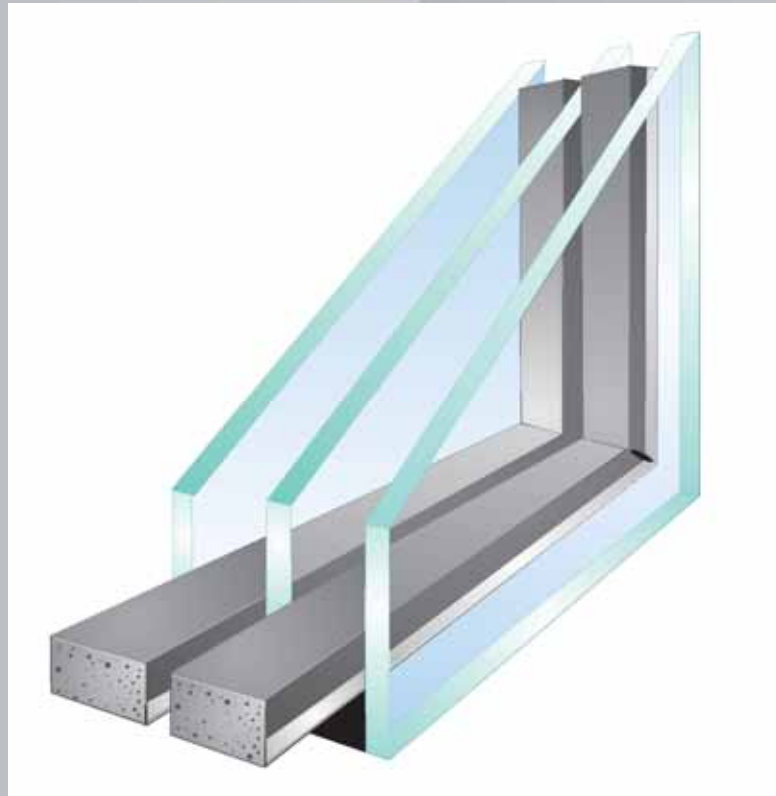
Credit may also be gained by reducing building UA by 30% relative to the code target UA



# Envelope Option 1d

U-.24 windows

**.5 Credits**



# Envelope Option 2a

Reduce air leakage to 3.0  
ACH50

Install good ventilation fan

**.5 Credits**



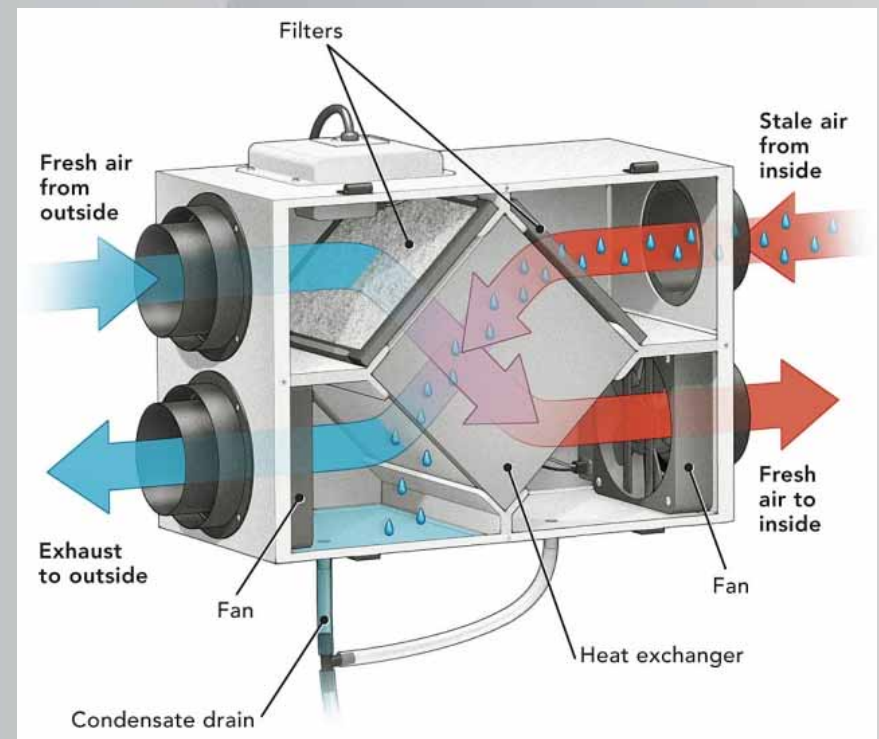


# Envelope Option 2b

Reduce air leakage to 2.0 ACH50

Install HRV with efficiency of .70

**1.0 Credits**

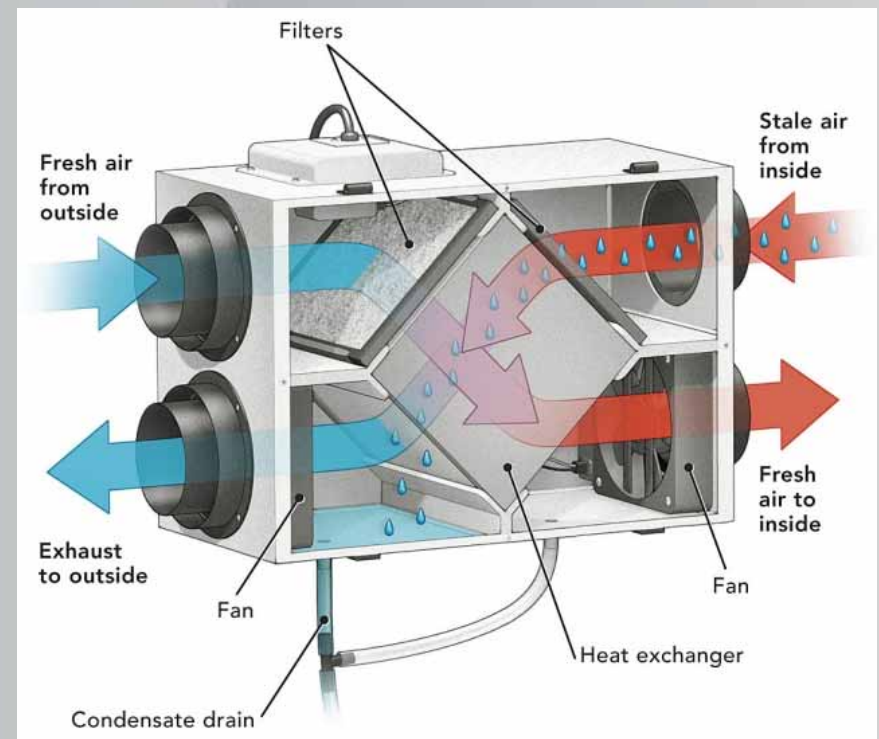


# Envelope Option 2c

Reduce air leakage to 1.5 ACH50

Install HRV with efficiency of .85

**1.5 Credits**





# Table 406.2

## How to meet the mark

### 1,501-5,000 sf homes (3.5 credits)



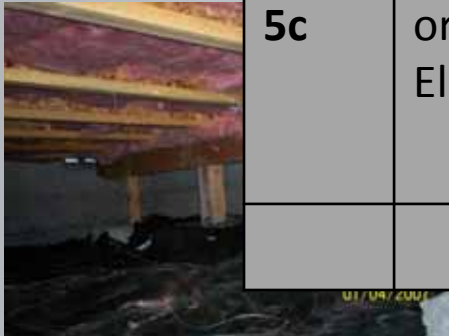
Opt	Description	Pts
<b>3a</b> or <b>3b</b>	94 AFUE Gas Furnace or 9.0 HSPF heat pump	1.0
<b>4</b>	All ducts and furnace located inside the conditioned space	1.0
<b>5a</b>	Kitchen sink and showerheads $\leq$ 1.75 GPM, lavatory faucets $\leq$ 1.0 GPM	0.5
<b>5b</b>	Gas water heater $\geq$ 0.74 EF	1.0
	<b>Total</b>	<b>3.5</b>



# Table 406.2

## How to meet the mark

### 1,501-5,000 sf homes (3.5 credits)



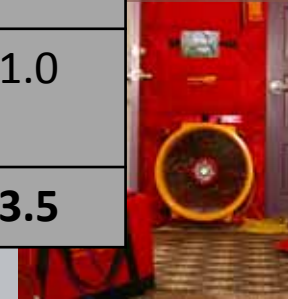
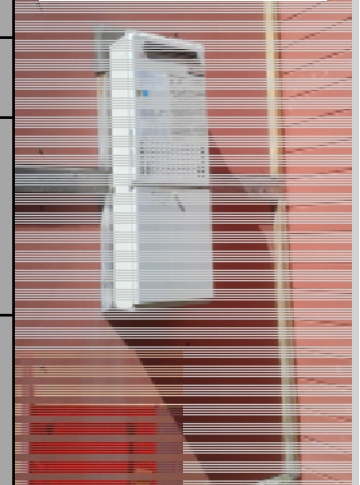
Opt	Description	Pts
<b>1a</b>	R-38 Floors and U-0.28 Windows	0.5
<b>3a</b> or <b>3b</b>	94 AFUE Gas Furnace or 9.0 HSPF heat pump	1.0
<b>5a</b>	Kitchen sink and showerheads $\leq$ 1.75 GPM, lavatory faucets $\leq$ 1.0 GPM	0.5
<b>5c</b>	Gas water heater $\geq$ 0.91 EF or Electric water heater $\geq$ 2.0 EF	1.5
	<b>Total</b>	<b>3.5</b>



# Table 406.2

## How to meet the mark

### 1,501-5,000 sf homes (3.5 credits)

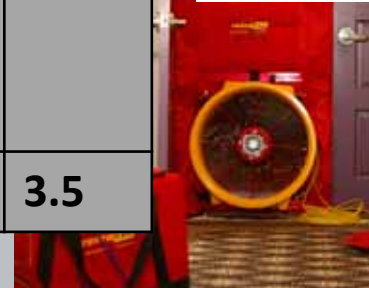
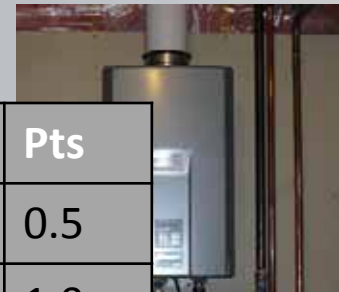


Opt	Description	Pts
<b>1a</b>	R-38 Floors and U-0.28 Windows	0.5
<b>2a</b>	Air leakage $\leq 3.0$ ACH @ 50pa	0.5
<b>3a</b> or <b>3b</b>	94 AFUE Gas Furnace or 9.0 HSPF heat pump	1.0
<b>5a</b>	Kitchen sink and showerheads $\leq 1.75$ GPM, lavatory faucets $\leq 1.0$ GPM	0.5
<b>5b</b>	Gas water heater $\geq 0.74$ EF	1.0
	<b>Total</b>	<b>3.5</b>

# Table 406.2

## How to meet the mark

### 1,501-5,000 sf homes (3.5 credits)



Opt	Description	Pts
<b>2a</b>	Air leakage $\leq 3.0$ ACH @ 50pa	0.5
<b>3a</b> or <b>3b</b>	94 AFUE Gas Furnace or 9.0 HSPF heat pump	1.0
<b>5a</b>	Kitchen sink and showerheads $\leq 1.75$ GPM, lavatory faucets $\leq 1.0$ GPM	0.5
<b>5c</b>	Gas water heater $\geq 0.91$ EF or Electric water heater $\geq 2.0$ EF	1.5
<b>Total</b>		<b>3.5</b>

# Table 406.2

## How to meet the mark

### 1,501-5,000 sf homes (3.5 credits)



Opt	Description	Pts
1a	R-38 Floors and U-0.28 Windows	0.5
3d	Ductless Heat Pump	1.0
5a	Kitchen sink and showerheads $\leq$ 1.75 GPM, lavatory faucets $\leq$ 1.0 GPM	0.5
5c	Electric water heater $\geq$ 2.0 EF	1.5
	<b>Total</b>	<b>3.5</b>





# Table 406.2

## How to meet the mark

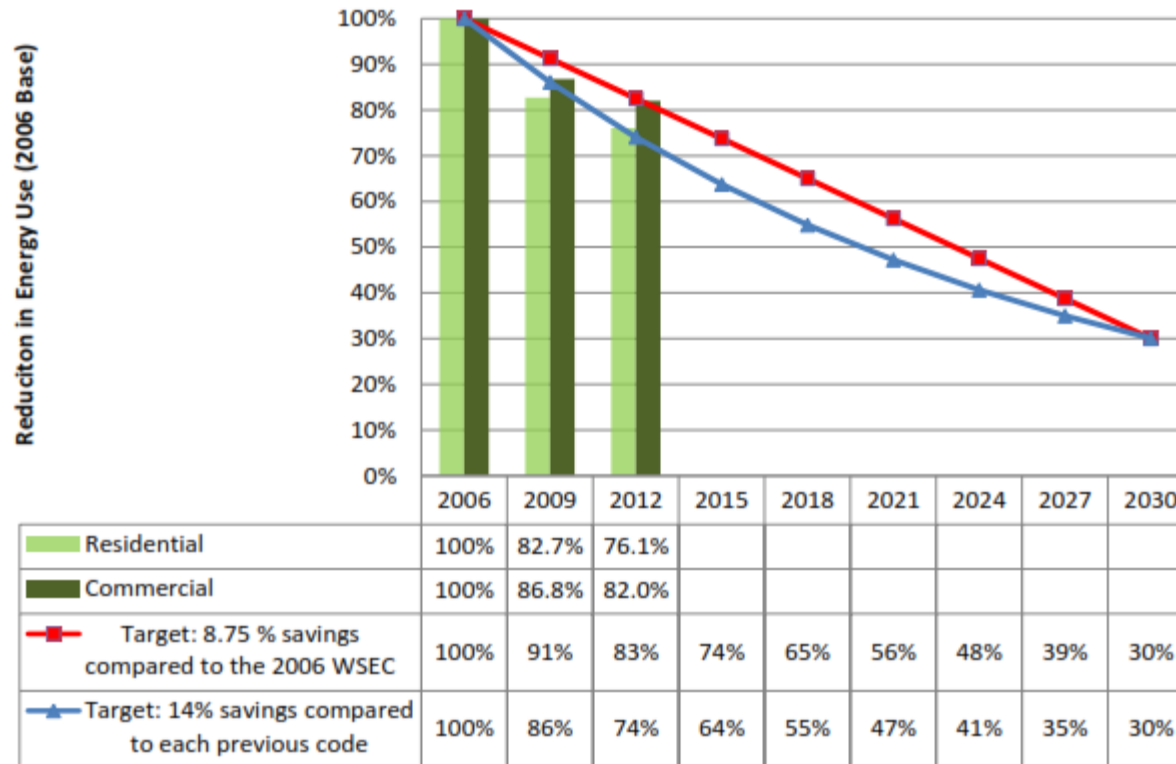
1,501-5,000 sf homes (3.5 credits)

Opt	Description	Pts
3a	92 AFUE Gas Boiler	1.0
4	All heating and cooling system components installed within the conditioned space. Electric resistance and ductless heat pumps not permitted under this option.	1.0
5c	Gas water heater $\geq 0.91$ EF	1.5
	<b>Total</b>	<b>3.5</b>



# Where are we going?

## Incremental Improvement Compared to Targets

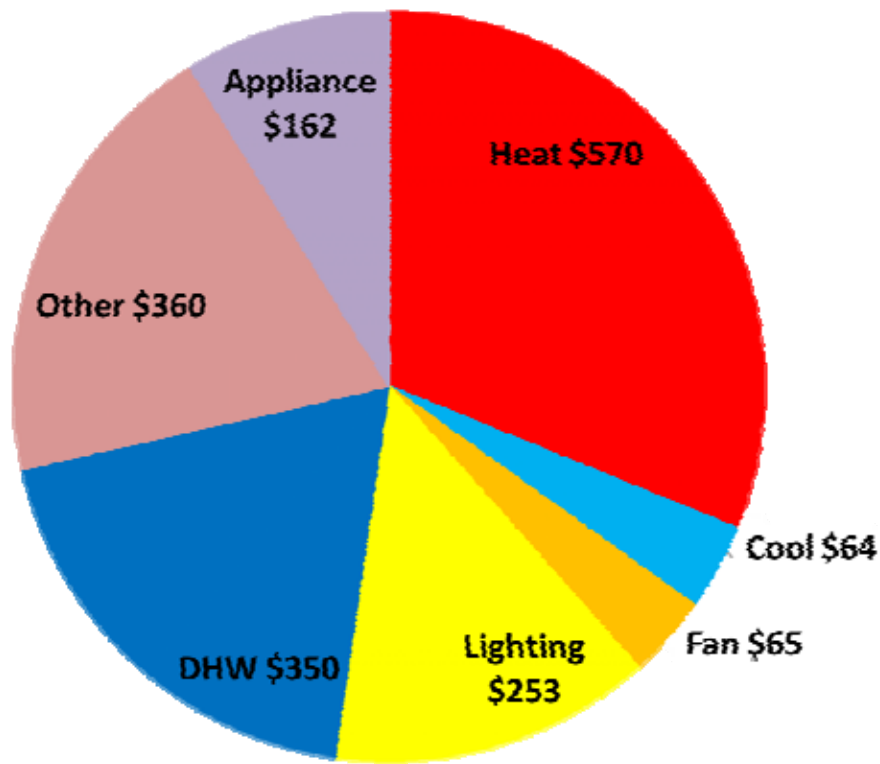


# How will we get there?

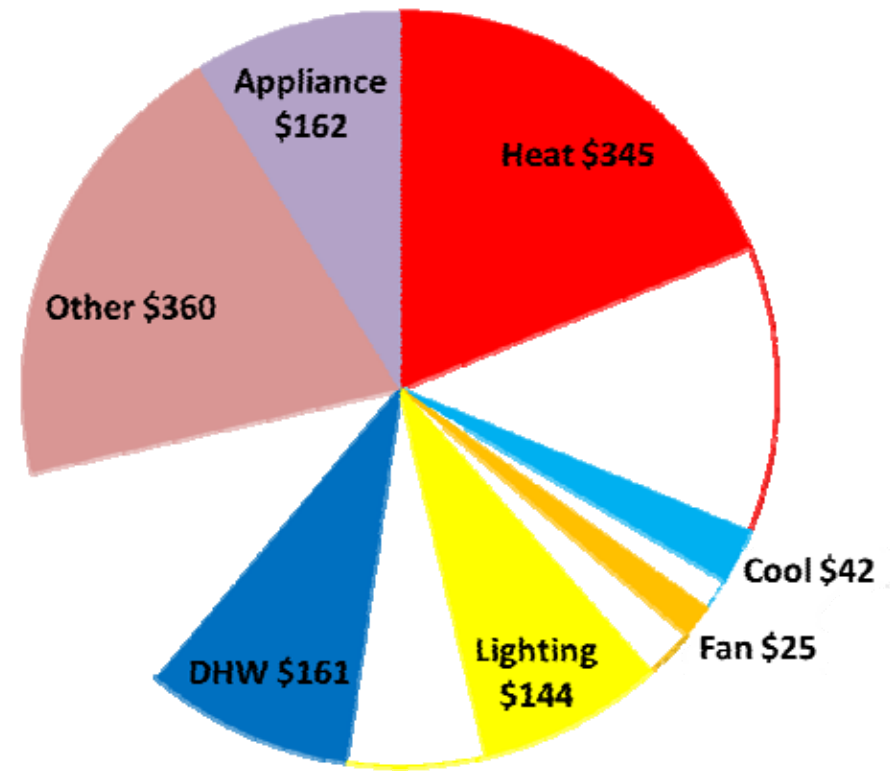
A deeper understanding of where we are at

Code Home with Heat Pump

2006



2015





# Envelope Improvements

## – Air Sealing

- Quality Control

- R402.4.1.1 The *building thermal envelope* shall meet the requirements of Table R402.4.1.1

- Who's in charge

- What's the process

» Find or develop quality control tools



Northwest ENERGY STAR® Homes, Version 3 (Rev. 01)  
Thermal Enclosure System Verifier Checklist<sup>1</sup>

Home Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_

Inspection Guidelines	Must Comply	Builder Verified	Verifier Verified	N/A
<b>1. High-Performance Fenestration</b>				
1.1 Fenestration shall meet or exceed Northwest ENERGY STAR Homes BOP or TGD <sup>2</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>2. Quality-Installed Insulation</b>				
2.1 Ceiling, wall, floor, and slab insulation levels shall meet or exceed Northwest ENERGY STAR Homes BOP prescriptive path or TGD requirements <sup>3,4,5</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.2 All ceiling, wall, floor, and slab insulation shall achieve R-VALUE defined Goals 1 installation or, alternatively, Grade II for surfaces with insulated sheathing (see checklist item 4.4.1 for required insulation levels)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>3. Fully-Aligned Air Barriers</b>				
All walls, insulation, and air barriers shall be installed in a manner that is fully aligned with the insulation as follows:				
• All interior surfaces of ceilings. Also, include barrier at interior edge of attic gable using a wind baffle that extends to the full height of the insulation. Include a baffle in every bay or a lapped baffle in each bay with a gully vent that will prevent wind washing of insulation in adjacent bays.				
• All exterior surface and interior surface of walls <sup>6</sup>				
• All interior surface of floors, including supports to ensure permanent contact and blocking of exposed edges <sup>6,8</sup>				
<b>3.1 Walls<sup>6</sup></b>				
3.1.1 Walls behind showers and tubs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.2 Walls behind fireplaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.3 Attic knee walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.4 Straight shaft walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.5 Wall entering porch roof	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.6 Basement walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.7 Double walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.8 Garage rim / band joint adjoining conditioned space	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.9 All other exterior walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>3.2 Floors</b>				
3.2.1 Floor above garage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2.2 Carport/porch floor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2.3 Floor above unconditioned basement or vented crawlspace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>3.3 Ceilings<sup>6</sup></b>				
3.3.1 Chopped ceiling/soffit below unconditioned attic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3.2 All other ceilings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>4. Reduced Thermal Bridging</b>				
4.1 For insulated ceilings with attic space above (i.e., non-catheterized ceilings), uncompressed insulation ≥ R-14 extends to the inside face of the exterior wall below.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.2 For walls on grade, insulation under slab meets or exceeds Northwest ENERGY STAR BOP or TGD, and 100% of wall edge required by a R-6 at depth specified by BOP or TGD and aligned with thermal boundary of the walls. <sup>7</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3 R-Value and other attic platforms constructed to allow for full-depth insulation below.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>4.4 Reduced Thermal Bridging at above-grade walls separating conditioned from unconditioned space (rim / band joints exempt):</b> using one of the following options: <sup>9,10</sup>				
4.4.1 Continuous rigid insulation sheathing, insulated siding, or combination of the two; <b>OR</b> R-2 in Climate Zones 4 & 5; R-3 in Climate Zones 1 & 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4.2 Structural Insulated Panels (SIPs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4.3 Insulated Concrete Forms (ICFs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4.4 Double-wall/massaged stud framing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



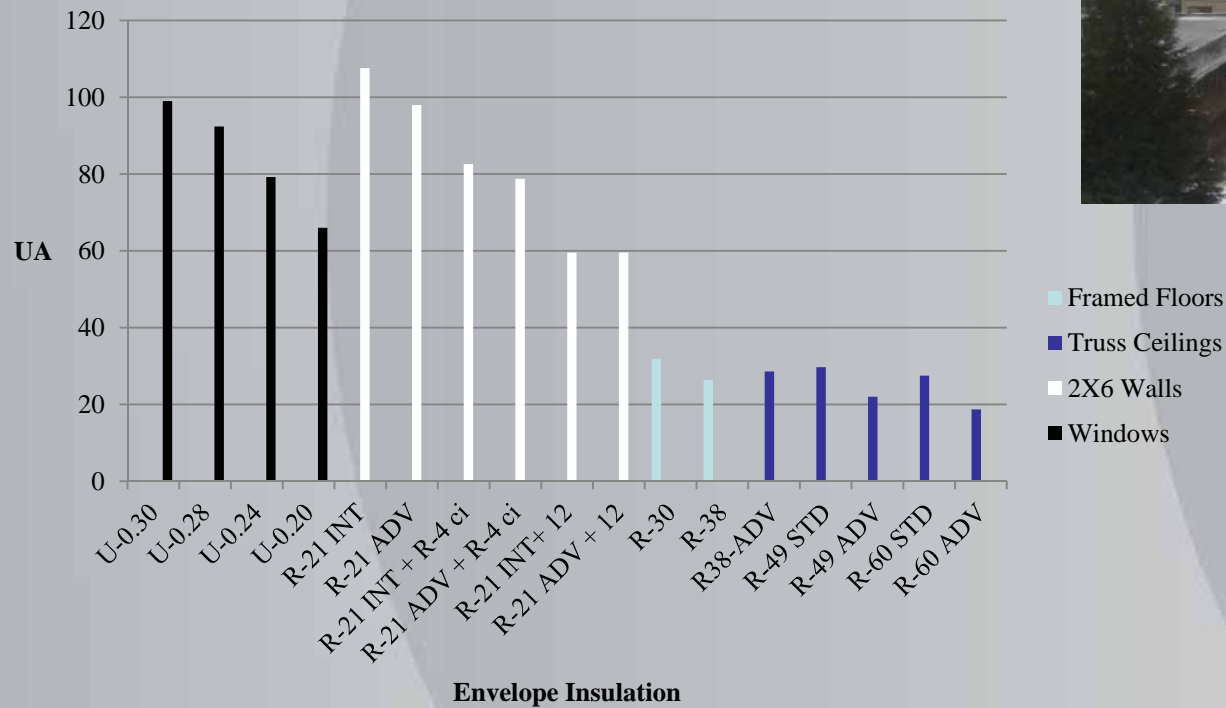
# Maximum Air Leakage Rates

## Air Leakage Standards



# Insulation Improvements

2200 Two-Story Home

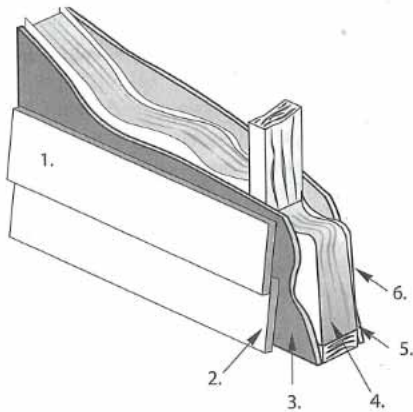




# UA

UA=U-Value X Area of a Building Assembly

## R-Value and U-factor Calculation



Numbered Wall Segment	R w/o Ins.	R w/Ins.
1. Outside Air Film	0.17	0.17
2. Lapped Wood Siding	0.81	0.81
3. OSB Sheathing (1/2")	0.80	0.80
4. Stud or Insulation	*4.67	13.0
5. Gypsum Wall Board (1/2")	0.45	0.45
6. Inside Air Film	0.68	0.68
<b>Total R</b>	<b>7.58</b>	<b>15.91</b>
<b>U-factor</b>	<b>0.132</b>	<b>0.063</b>
Fraction of the wall A <sub>1</sub> & A <sub>2</sub>	0.25	0.75

\* R-value of the area through the wall stud

Calculation: Area-Weighted Average U-Factor

$$U = (A_1 \times U_1) + (A_2 \times U_2)$$

$$U = (0.25 \times 0.132) + (0.75 \times 0.063)$$

$$U = 0.080$$

Calculation of R-value from Average U-factor

$$R = 1/U = 1/0.080 = R-12.5$$

R-values for the un-insulated and insulated wall are blended by way of an area-weighted average. The inverse of this average R-value is the U-factor.

**TABLE A103.3.1(4)**  
**2 x 6 Single Wood Stud: R-19 Batt**

R-value of Foam Board	Siding Material/Framing Type					
	Lapped Wood			T1-11		
	STD	INT	ADV	STD	INT	ADV
0	0.062	0.058	0.055	0.065	0.061	0.058
1	0.058	0.055	0.052	0.060	0.057	0.055
2	0.054	0.052	0.050	0.056	0.054	0.051
3	0.051	0.049	0.047	0.053	0.051	0.049
4	0.048	0.046	0.045	0.050	0.048	0.046
5	0.046	0.044	0.043	0.048	0.046	0.044
6	0.044	0.042	0.041	0.045	0.044	0.042
7	0.042	0.040	0.039	0.043	0.042	0.040
8	0.040	0.039	0.038	0.041	0.040	0.039
9	0.038	0.037	0.035	0.039	0.038	0.037
10	0.037	0.036	0.035	0.038	0.037	0.036
11	0.036	0.035	0.034	0.036	0.035	0.035
12	0.034	0.033	0.033	0.035	0.034	0.033

**NOTE:**

Nominal Batt R-value:  
R-19 at 6 inch thickness

Installed Batt R-value:  
R-18 in 5.5 inch cavity

# Continuous Insulation

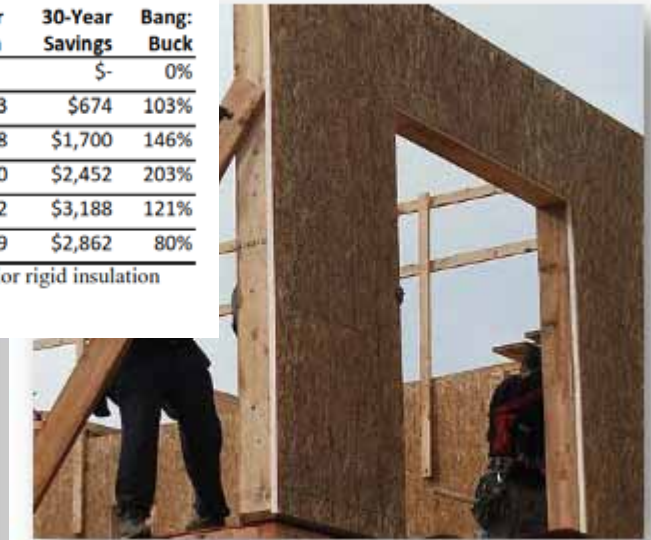


TABLE 1. COST COMPARISONS<sup>6</sup>

Wall	Stud Cavity	Batt Type	Insulation (\$/ft <sup>2</sup> )	Materials (\$/ft <sup>2</sup> )	Labor (\$/ft <sup>2</sup> )	Wall Total Cost	Incremental Cost	Floor Area	30-Year Savings	Bang-Buck
Code Minimum	2x6	HD	\$0.62	\$1.55	\$1.85	\$7,477	\$-	\$-	\$-	0%
2x6 Standard	2x6	BIB	\$0.92	\$1.85	\$1.85	\$8,132	\$655	\$0.33	\$674	103%
2x8 Standard	2x8	HD	\$0.82	\$1.78	\$2.15	\$8,638	\$1,162	\$0.58	\$1,700	146%
2x6 TBS	2x6	HD	\$1.15	\$2.00	\$1.95	\$8,684	\$1,207	\$0.60	\$2,452	203%
2x8 TBS	2x8	HD	\$1.35	\$2.35	\$2.25	\$10,109	\$2,633	\$1.32	\$3,188	121%
2x6 Xrigid	2x6	HD	\$1.42	\$2.47	\$2.55	\$11,054	\$3,577	\$1.79	\$2,862	80%

Notes: For Batt Type, HD = high density; BIB = blown-in blanket, XPS rigid refers to an exterior rigid insulation system.

Thermal Break Shear Wall:  
A Case Study of Rigid Foam Insulation between Frame and Sheathing



# Changes and Improvements to Solar Permitting Process

- Elimination of engineering calculations if solar PV systems meet certain requirements-IRC M2302
- Inclusion of Appendix U for “solar ready zone”
- Credits for energy code compliance using solar PV systems





# Elimination of Engineering Requirements

- Solar PV systems may be installed on existing houses that meet the weight and height limits and meet the fire access requirements.
  - Saves the homeowner up to \$2500 in additional costs
  - Can reduce project time by up to 8 weeks
  - “Over the counter” or online permits expedite the process



# A New “Solar Ready” Appendix in the IRC\*

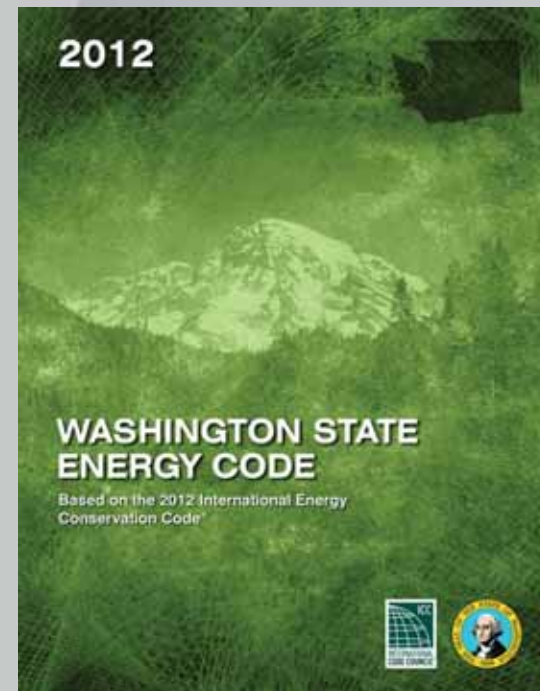
- IRC Appendix “U” has been approved by the SBCC
  - Not mandatory but can be adopted by progressive jurisdictions
  - Reserves a zone on the house with solar access for future installation
  - Saves the homeowner money
    - No rerouting plumbing vents, chimneys or other obstructions at a later date
    - Location for production meter is reserved
    - A capped conduit is located in the solar ready zone for future wiring runs



\*Effective July 1, 2016 if  
adopted by local  
jurisdictions

# Credits for Compliance with the Energy Code for Solar PV

- Installing a PV system qualifies for energy credits required by code.
- Expedited solar permitting process will reduce work load for building department staff
- Reduces wait time for permit issuance



# Where are we going?



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Tanya Beavers

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ENERGY PROGRAM

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