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2017 Oregon Residential Specialty Code Energy Efficiency: Impact Assessment

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Glossary of Acronyms

AFUE	Annual Fuel Utilization Efficiency
AHRI	American Heating and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
CFL	Compact fluorescent lamp
Council	Northwest Power and Conservation Council
DHP	Ductless heat pump
ft	Foot
HVAC	Heating, Ventilation and Air Conditioning
ISO	International Organization for Standards
kWh	Kilowatt-hour
NEEA	Northwest Energy Efficiency Alliance
ORSC	Oregon Residential Specialty Code
PTDS	Performance tested duct system
RBSA	Residential Building Stock Assessment
RTF	Regional Technical Forum
SEEM	Simplified Energy and Enthalpy Model
SqFt	Square feet
TMY	Typical Meteorological Year
UA	Building heat loss expressed as U-value times area

Executive Summary

For more than 30 years, the Pacific Northwest has successfully pursued state residential energy codes and building programs to create ever more efficient housing. Since its inception, the Northwest Energy Efficiency Alliance (NEEA) has played a pivotal role in aiding states to deliver more effective and efficient energy codes. NEEA contracted Ecotope to quantify the energy use, energy savings, and incremental costs for residential codes in Oregon. Ecotope compared the 2017 and 2014 residential energy code for single-family (including townhomes) and low-rise multifamily units; low-rise multifamily units are defined as 3-stories or less.

The study objectives included:

- Calculate average expected energy use per home under the new Oregon Residential Specialty Code (ORSC), specifically Chapter 11 of the ORSC relating to Energy Efficiency.
- Calculate the incremental savings due to code improvements for each heating type and climate for single-family and low-rise multifamily scenarios.
- Estimate new construction incremental costs of the ORSC for both single-family and low-rise multifamily.

Comparison of 2014 and 2017 Code Provisions

The structure of the 2014 and 2017 ORSC are the same, including both a prescriptive table and an options table where the builder is free to select one option from each of two sections in the options table. However, both the prescriptive table and the options table have been updated to be more energy efficient and some of the options have been removed for the 2017 code, specifically the solar PV and solar water heating options. In the prescriptive table, ceiling R-value, Window U-value, and high efficacy lighting percentage have been increased over the 2014 prescriptive table, and a requirement for low-flow showerheads has been added. Details about the options are included in Table 6 in the Appendix.

Energy Impacts

The analysis estimated incremental energy savings and costs for the most recent round of the ORSC change from 2014 to 2017. Table ES1 gives the estimated savings of the new code on a per unit basis. The estimates are a weighted average of all construction types, heating system types, and climates in a given category. Further, the estimates consider both the electric and gas savings separately. Overall this represents 6.1% of the estimated energy use of the homes built to the 2014 ORSC.

Table ES1: Unit Savings by Unit Type

Unit Type	Electric (kWh/yr)	Natural Gas (therm/yr)	Combined (kBtu/yr)	Combined Savings (%)
Single-Family	914	21	5,205	6.5%
Low-Rise Multifamily	515	2	1,922	3.6%
Combined SF & LRMF	843	17	4,618	6.1%

Cost Impacts

Table ES2 provides estimates of weighted average incremental cost per unit. The costs in 2012 dollars include envelope measures, duct sealing, HVAC equipment upgrades, water heating and use upgrades, house sealing, and lighting upgrades. The numbers are the minimum first cost necessary to achieve the code changes pertaining to energy consumption in the building.

Table ES2: Average Incremental Costs (per Unit)

Unit Type	Incremental Cost (2012 $s)
Single-Family	$808
Low-Rise Multifamily	$559
Combined SF & LRMF	$764

1. Introduction

Ecotope estimated the site energy use and savings for units built under the 2017 Oregon Residential Specialty Code (ORSC) for residential buildings, specifically using the Chapter 11 Energy Efficiency specifications of the ORSC. The energy use is compared against the 2014 ORSC. This residential code applies to single-family homes (including townhomes) and low-rise multifamily buildings (multifamily buildings three stories or less).

The structure of the 2014 and 2017 ORSC are the same, including both a prescriptive table and an options table where the builder is free to select one option from each of two sections in the options table. However, both the prescriptive table and the options table have been updated to be more energy efficient and some of the options have been removed for the 2017 code, specifically the solar PV and solar water heating options. In the prescriptive table, ceiling R-value, Window U-value, and high efficacy lighting percentage have been increased over the 2014 prescriptive table, and a requirement for low-flow showerheads has been added. Details about the options are included in Table 6 in the Appendix.

For this analysis Ecotope developed a picture of the new construction markets in Oregon using the ORSC specifications and housing characteristics surveys. The analysis produces energy use and savings using four different space conditioning systems in each heating and cooling climate across 10 different prototype homes (six single-family and four low-rise multifamily). The energy end-uses considered in the homes are space heating, space cooling, ventilation, domestic water heating, and lighting. The analysis applies to site-built single-family houses and multifamily dwellings three stories or less constructed under the residential energy code.

For more than 30 years, the Pacific Northwest has successfully pursued state residential energy codes and building programs to create ever more efficient housing. Since its inception, the Northwest Energy Efficiency Alliance (NEEA) has played a pivotal role in aiding states to deliver more effective and efficient energy codes. NEEA contracted Ecotope to quantify the energy use, energy savings, and incremental costs for residential codes in Oregon. Ecotope compared the 2017 and 2014 residential energy code for single-family (including townhomes) and low-rise multifamily units; low-rise multifamily units are defined as 3-stories or less.

The study objectives included:

- Calculate average expected energy use per home under the new Oregon Residential Specialty Code (ORSC), specifically Chapter 11 of the ORSC relating to Energy Efficiency.
- Calculate the incremental savings due to code improvements for each heating type and climate for single-family and low-rise multifamily scenarios.
- Estimate incremental new construction incremental costs of the ORSC for both single-family and low-rise multifamily.

The modeling software used for this project is SEEM (Simplified Energy and Enthalpy Model), which is used by the Regional Technical Forum and other regional stakeholders for modeling prototype homes in the Northwest. The Oregon code analysis includes about 2,000 SEEM simulations.

Ecotope evaluated the two codes and relevant equipment standards within the same analytical context, running SEEM models for both the 2017 and 2014 code instead of just using past modeling efforts for the 2014 results. This ensures the results are internally consistent using the same version of SEEM and the same inputs for costs and assumptions. The analysis of the 2017 code impact is based on the 2017 code versus what would have happened had the 2017 code not been implemented, which would be the 2014 code as it would be applied in 2017; this has implications on the equipment efficiencies based on federal minimum equipment changes between 2014 and 2017, and for the main impact analysis in this report the federal minimums as of 2017 are used for both the 2014 and 2017 code. Alternative analyses are provided in the final workbook allowing, for instance, 2014 code with 2014 equipment to be the baseline, if desired. The analysis includes only regulated loads: space heating and cooling, water heating, lighting and ventilation. Loads not regulated by the code, including appliances and plug loads, are held constant in the analysis.

All of the work in the report is based on paper-to-paper comparisons of building specifications. The energy use and savings estimates are based on simulations and engineering models that have been calibrated in previous field studies; no field work was conducted nor measurements made in this current study. In this way, the compliance rates with the building codes were assumed to be 100%, so this analysis will produce an upper bound of energy savings.

2. Methodology

The methodology for this code analysis follows previous code analyses with some updates in data sources and processes. Improvements in SEEM allows a full treatment of the options table, and RBSA datasets and previous field studies provide a source for updating some of the weights. The full details of the methodology are given in the following sections, including a discussion about the code changes, the modeling approach, baseline assumptions, weather and prototype weighting schemes, and the treatment of the options table.

2.1. Comparison of 2014 and 2017 Code Provisions

The structure of the 2014 and 2017 ORSC are the same, including both a prescriptive table and an options table where the builder is free to select one option from each of two sections in the options table. However, both the prescriptive table and the options table have been updated to be more energy efficient and some of the options have been removed for the 2017 code, specifically the solar PV and solar water heating options. In the prescriptive table, ceiling R-value, Window U-value, and high efficacy lighting percentage have been increased over the 2014 prescriptive table, and a requirement for low-flow showerheads has been added. Details about the options are included in Table 6 in the Appendix.

2.2. Savings Analysis

2.2.1. Modeling Approach

The analysis methodology develops a representative set of prototypical houses whose energy use can be estimated through the SEEM simulation tool. These representative characteristics include climate, occupancy, house size, foundation type, and heating system type.

The building energy use is predicted by a combination of numerical simulations and engineering calculations. SEEM is used to simulate heating, cooling, and ventilation energy use with inputs about the building shell characteristics, thermostat settings, occupant behavior inputs, heating and cooling system details, and duct distribution efficiency. Additionally, engineering calculations calibrated by field studies are employed to determine the energy use for lighting and water heating. All other energy use (plug loads, etc.) are assumed to be a fixed value across all models (see the Appendix for input details).

SEEM consists of an hourly thermal, moisture (humidity), and infiltration simulation that interact with ducts, equipment, building shell, and weather parameters to calculate the space conditioning requirements of the building. It is based on algorithms consistent with current American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), American Heating and Refrigeration Institute (AHRI), and International Organization for Standards (ISO) calculation standards. The simulation generates outputs used in this analysis; they include building heat loss (UA), heating equipment input energy, cooling equipment input energy, and ventilation equipment input energy.

2.2.2. Baseline and Measure Assumptions

Equipment efficiency baselines are set by the National Appliance Energy Conservation Act (NAECA). The ORSC includes options that allow added measures that exceed the NAECA standard; the use of these options is discussed in Section 2.2.5. The baseline equipment efficiencies used in this analysis are listed in Table 5 of the Appendix and improved equipment efficiencies are listed in Table 6 of the Appendix. When working with the federal minimum efficiencies, the 2014 and 2017 ORSC use the same minimum standard; this allows a summary of just the code impact without including federal equipment efficiency impacts in the analysis.

High efficacy lamps are CFLs in this analysis and lighting energy calculations use a lighting power density method corresponding to the level of regular and high efficacy lights required by the codes. This method assumes all lamps in the house operate an average of 1.85 hours per day throughout the year for calculating lighting energy consumption.

Water heating energy is calibrated to the equivalent of $[23 + 11(\#occ - 1)]$ gallons per day per occupant (Larson et al. 2015). Single-family occupancy varies based on prototype (see Table 8) and is based on the RBSA Single-Family Report (Baylon et al. 2012). Multifamily occupancy is 1.7 people/house, taken from the RBSA Multifamily Report (Baylon et al. 2013). The loads not regulated by the code, including appliances and plug loads, are assumed to be 4,000 kWh per year, and the SEEM model uses estimates of the heating impact of these uses in estimating the heating and cooling requirements of the dwelling.

2.2.3. Weather and Climate Zones

The weather files used in all savings simulations are composite typical meteorological year (TMY) weather files corresponding to the heating and cooling climate zones used by the Council. As the future distribution of new construction housing in the Northwest is not known, the geographic distribution of housing permit records reported by the U.S. Census in 2013 is used to represent future construction locations. Table 10 in the Appendix lists the climate zone weights and the breakdown of single-family and multifamily by climate zone.

2.2.4. Building Prototypes

Ten building prototypes are used in the SEEM simulations and all but one of these are standard analytical prototypes used by the Council to develop and evaluate energy forecasts and conservation plans for the region's utilities; the 5000b prototype is an extension of the 2688b prototype and is used to represent large buildings. The prototypes and some selected prototype characteristics are listed in Table 8 of the Appendix.

Each prototype is run with four base heating systems based on the standard methodology used for the Council analysis. The four base heating systems are: gas furnace with no central air conditioning, gas furnace with central air conditioning, central heat pump, and electric zonal. Heating system weights and details about the mechanics of developing the weights can be found in the Appendix starting on page 16.

2.2.5. ORSC Energy Efficiency Options Table

The 2017 ORSC uses the same format as the 2014 ORSC and 2011 ORSC, with a prescriptive table and an options table. To meet the code requirements, homes must meet or exceed each item in the prescriptive table and then choose an item from each of two sections of the Additional Measures table (referred to as the options table in this memo). The options table is split into a section relating to envelope enhancement and a section relating to conservation measures (HVAC, hot water, and solar measures). Details about the prescriptive table and options table are listed in Table 5 and Table 6, respectively.

2.3. Cost Inputs

Ecotope assembled cost estimates for the individual analysis inputs, including envelope measures, duct sealing, HVAC equipment upgrades, water heating and use upgrades, house sealing, and lighting upgrades. These individual costs are then aggregated for each model to estimate the total increased cost for that home. For example, the individual measures can include items like ceiling and wall insulation. The cost of upgrading the envelope then is calculated by multiplying the prototypical roof area by the insulation upgrade cost per unit area and so on for each construction component. The component costs are summed to create a full cost for the prototype. The individual measure cost estimates are based on a number of sources which primarily include the Council's 7th Northwest Power Plan workbooks and various measure analyses from the RTF (Council 2016; RTF 2011-2016). The cost analysis uses the same weights as the energy analysis.

2.4. Model Selection

With the options table as part of the code, there are many combinations of options available for builders to meet the code; the 2014 has 47 possible combinations and the 2017 code has 30 possible options. Many of these combinations are likely not selected by builders and some of the combinations are popular with builders. The impact analysis looked at two methods to calculate the savings: engineering judgment and least first cost. These two methods select the most likely scenario builders will choose and estimate the savings using just these paths. In the case of the engineering judgment, past information about builder opinions and evidence of path selection is used to select the most likely path. In the case of least first cost, the cost for each of the combinations is compared for each of the unique prototypes and the least cost path for each prototype is chosen. For this report, the engineering judgment path is used for all analyses; the workbook contains both approaches.

3. Savings Estimates

Table 1 presents the estimated savings of the new code on a per unit basis. Single-family units in Oregon have more incidence of gas heating compared to low-rise multifamily, which explains the difference in savings by fuel. The estimates are weighted averages of all construction types, heating system types, and climates in a given category.

Table 1: Average per Unit Savings by Unit Type

Unit Type	Electric (kWh/yr)	Natural Gas (therm/yr)	Combined (kBtu/yr)	Combined Savings (%)
Single-Family	914	21	5,205	6.5%
Low-Rise Multifamily	515	2	1,922	3.6%
Combined SF & LRMF	843	17	4,618	6.1%

Table 2 presents the single-family and multifamily estimates broken out by the four heating systems most prevalent in Northwest building stock. The tables were constructed using a weighted average of the prototypes used in the simulation analysis. These tables provide more granularity on the range of savings potential depending on heating system type. Table 1 is then a weighted average of Table 2 using the weights from Table 9 in the Appendix. Overall this 2017 ORSC is estimated to save 6.1% of the energy use over homes built to the 2014 ORSC.

Table 2: Savings by Building Type and Base Heating System

Unit Type	Base Heating System	Electric (kWh/yr)	Natural Gas (therm/yr)	Combined (kBtu/yr)	Combined Savings (%)
Single-Family	Gas Furnace with Central AC	938	26	5,781	6.5%
	Gas Furnace without Central AC	838	24	5,295	6.2%
	Central Heat Pump	939	0	3,203	6.9%
	Electric Zonal	1,023	0	3,491	7.2%
Low-Rise Multifamily	Gas Furnace with Central AC	477	18	3,458	4.1%
	Gas Furnace without Central AC	370	18	3,069	3.8%
	Central Heat Pump	455	0	1,552	3.3%
	Electric Zonal	531	0	1,812	3.6%

4. Costs Estimates

Table 3 provides estimates of weighted average incremental cost per unit. The costs, in 2012 dollars, include envelope measures, duct sealing, HVAC equipment upgrades, water heating and use upgrades, house air sealing, and lighting upgrades.

Table 3: Average Incremental Costs per Unit

Unit Type	Incremental Cost (2012 $s)
Single-Family	$808
Low-Rise Multifamily	$559
Combined SF & LRMF	$764

Table 4 breaks out the incremental costs by base heating system type. Multifamily buildings have a much higher prevalence of electric heat compared to single-family homes.

Table 4: Average Incremental Costs per Unit by Heating System Type

Building Type	Base Heating System	Incremental Cost
Single-Family	Gas Furnace with Central AC	$823
	Gas Furnace without Central AC	$823
	Central Heat Pump	$739
	Electric Zonal	$739
Multifamily	Gas Furnace with Central AC	$753
	Gas Furnace without Central AC	$753
	Central Heat Pump	$539
	Electric Zonal	$539

5. References

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Appendix

Detailed Modeling Assumptions

This appendix provides more detail on the modeling assumptions used in the analysis. Assumptions related to the code are presented first, followed by a discussion and presentation of the weights used in the analysis.

2014 vs 2017 ORSC Energy Efficiency Specifications

The following tables describe the ORSE for 2014 and 2017, along with assumptions related to the code specifications. Table 5 shows the prescriptive table comparison between the two codes, with the final column indicating whether the specification changed. Table 6 is a comparison of the options table between 2014 and 2017. Table 7 shows the incremental cost assumptions for individual inputs. These are the costs that are used to build up the 2014 and 2017 total costs, which are then subtracted to get the 2017 upgrade cost over the 2014 code. Table 5 and Table 6 are simplified summaries of the requirements and not intended to be a complete reference of all the required provisions of the code.

Table 5. Comparison of the Prescriptive Requirements

Prescriptive Requirement	2014	2017	Δ
Wall insulation above grade	R-21	R-21 int	+
Wall insulation below grade	R-15	R-21	+
Flat ceiling insulation	R-38	R-49	+
Floor insulation	R-30	R-30	
Slab edge perimeter	R-15	R-15	
Window U-value	U-0.35	U-0.30	+
Door U-value	U-0.20	U-0.20	
Duct insulation	R-8	R-8	
High efficacy lighting	50%	95%	+
Low-flow fixtures	—	Showerheads ≤ 2gpm	+

Table 6. Comparison of the Option Tables

Option	2014 ORSC	2017 ORSC
1	Wall R-19+5 Window U-0.30	Wall R-21+5
2	Wall R-21 Flat ceiling R-49 Floor R-38 Window U-0.30 Door U-0.20 or 65% lights or D+E	Wall R-21 advanced Floor R-38 Window 0.28
3	Flat ceiling R-49 Window U-0.30 Performance tested duct systems (PTDS) *(Don't combine with E)*	Wall R-21 advanced Ceiling R-60 Floor R-38
4	UA 15% lower than Table 5	Window U-0.22 Ceiling R-60 Floor R-38
5	ASHRAE 62.2 ventilation 6.0 ACH50 or PTDS *(Don't combine with E)*	ASHRAE 62.2 ventilation Air sealing checklist Ducts inside Ducts sealed with mastic
6	Ducts inside *(Don't combine with B or C)*	UA 8% lower than Table 5
A	Gas furnace 90% Air source heat pump 8.5 HSPF Ground source heat pump 3.0 COP	Gas furnace 94% Air source heat pump 9.5 HSPF 15 SEER Ground source heat pump 3.5 COP
B	Ducts inside	Ducts inside *(Don't combine with 5)*
C	Ductless heat pump 8.5 HSPF	Ductless heat pump 10.0 HSPF
D	Gas water heater 0.80 EF Heat pump water heater 1.8 EF 75% high efficacy lights	Gas water heater 0.85 UEF Heat pump water heater Tier 1 Northern Climate Specification
E	Energy management device Performance tested duct systems 75% high efficacy lights	—
F	Solar photovoltaic 1 W/sqft	—
G	Solar water heating	—

Table 7. Cost Assumptions for Individual Technologies

Category	Base	Upgrade	Cost	Cost Unit
HVAC	Zonal Electric	DHP	$3,887.85	per unit
	Gas Furnace 80%	Gas Furnace 90%	$515.00	per unit
	Gas Furnace 80%	Gas Furnace 94%	$545.03	per unit
	Heat Pump 8.2 HSPF 14 SEER	Heat Pump 8.5 HSPF 14 SEER	$653.60	per unit
	Heat Pump 8.2 HSPF 14 SEER	Heat Pump 9.5 HSPF 15 SEER	$766.40	per unit
	Heat Pump 8.2 HSPF 14 SEER	Ground Source Heat Pump	$3,267.00	per ton
	Baseline ducts	Ducts inside envelope	$350.00	per unit
	Baseline ducts	PTDS	$0.32	per sqft duct
Insulation	Floor R-30	Floor R-38	$0.45	per sqft floor
	Wall R-21	Wall R-19+5	$0.96	per sqft wall
	Wall R-21	Wall R-21+5	$1.03	per sqft wall
	Bsmt Wall R-15	Bsmt Wall R21	$0.50	per sqft wall
	Ceiling R-38	Ceiling R-49	$0.23	per sqft ceiling
	Ceiling R-38	Ceiling R-60	$0.46	per sqft ceiling
	Window 0.35	Window 0.30	$0.80	per sqft window
	Window 0.35	Window 0.28	$0.80	per sqft window
	Window 0.35	Window 0.22	$6.60	per sqft window
	7 ACH50	6 ACH50	$0.10	per sqft home
Ventilation	Standard	ASHRAE 62.2	$80.64	per unit
DHW	0.94 EF Electric	Heat Pump WH	$704.00	per unit
	0.59 EF Gas	0.80 EF Gas	$586.00	MF
	0.59 EF Gas	0.85 UEF Gas	$923.00	per unit
	Standard	Solar WH	$7,000.00	per unit
	Standard	Low flow fixtures	$47.31	per unit
Solar PV	None	~1kW–6kW	$7–$3.40	per Watt
Baseload	None	Energy Mgmt Device	$150.00	per unit
	None	50% high efficacy	$0.026	per sqft floor
	None	65% high efficacy	$0.030	per sqft floor
	None	75% high efficacy	$0.033	per sqft floor
	None	95% high efficacy	$0.038	per sqft floor

Prototype, Heating System, Climate Zone, and Option Path Weights

The weights were developed from a combination of the RLW reports (RLW 2007a, RLW 2007b), the RBSA phone survey, and the RBSA field study (Baylon 2012, Baylon 2013). Final prototype weights along with some general characteristics about the prototypes can be found in Table 8.

Table 8. A Selection of Prototype Characteristics

Characteristics	Prototypes									
	1344c	1344s	2200c	2200s	2688b	5000b	1904c	1904s	2856c	2856s
Building Type	SF	SF	SF	SF	SF	SF	MF	MF	MF	MF
Foundation	Crawl	Slab	Crawl	Slab	Bsmt	Bsmt	Crawl	Slab	Crawl	Slab
Units	1	1	1	1	1	1	2	2	3	3
Floors	1	1	1.5	1.5	1	2	2	2	3	3
Occupants per Unit	2.00	2.00	2.75	2.75	3.50	4.00	1.69	1.69	1.69	1.69
Prototype Weight	0.035	0.173	0.182	0.491	0.084	0.035	0.330	0.104	0.430	0.136

Each prototype was run with four base heating systems based on the standard methodology used for the Council analysis. The four base heating systems are gas furnace with no central air conditioning, gas furnace with central air conditioning, central heat pump, and electric zonal. Weights for the base heating systems in the single-family prototypes were developed using the RLW single-family report (RLW 2007a). The multifamily heating system weights were developed from the RBSA phone survey.[1]

The final base heating system weights by building type are shown in Table 9. Each row adds to one; to renormalize across the whole population (so the whole table adds to one), multiply the single-family row by 0.825 and the multifamily row by 0.175.

Table 9. Base Heating System Weights by Building Type

Building Type	Base Heating System			
	gfac	gfnc	hp	zonal
Single-Family	0.535	0.290	0.119	0.056
Multifamily	0.019	0.072	0.042	0.867

The weather files used in all savings simulations are composite typical meteorological year (TMY) weather files corresponding to the heating and cooling climate zones used by the Council. As the future distribution of new construction housing in the Northwest is not known, the geographic distribution of housing permit records reported by the US Census in 2013 has been used to represent future construction locations. Table 10 lists the climate zone weights and the breakdown of single-family and multifamily by climate zone.

[1] Note the RBSA phone survey was also summarized for single-family as well, but the RLW field survey was chosen as the better single-family dataset because of the difficulty in properly identifying heating equipment types in phone surveys.

Table 10. Climate Zone Weights

Heating Zone	Cooling Zone	Climate Weight	Percent SF	Percent MF
1	1	0.469	82.7%	17.3%
1	2	0.320	77.1%	22.9%
1	3	0.109	90.0%	10.0%
2	1	0.068	92.2%	7.8%
2	2	0.030	91.7%	8.3%
2	3	—	—	—
3	1	0.005	92.5%	7.5%
3	2	—	—	—
3	3	—	—	—

Federal Minimum Equipment Assumptions

The following table lists the federal minimum equipment assumptions used in the analysis. Both the 2014 and 2017 code analysis use the same federal minimum equipment specifications in place on January 1, 2018. This allows the analysis to focus just on the code impact effects and not include federal standard changes. The workbook allows for a more flexible analysis with or without the federal equipment, but this report just focuses on the changes without federal equipment changes.

Table 11. List of Equipment Federal Minimum Efficiency Assumptions

Equipment	Federal Minimum Efficiency
Air Conditioner	13 SEER
Heat Pump	8.2 HSPF 14 SEER
Gas Furnace	80% AFUE
Electric Water Heater	0.94 EF
Natural Gas Water Heater	0.59 EF