STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development

Standard Energy Code Proposal Form

May 2018

Log No. WSEC-R35
TAG Revisions 5/17

Code being amended: ☐ Commercial Provisions ☒ Residential Provisions

Code Section # **New Appendix X, New Appendix Y**

Brief Description: **This proposal creates two optional appendix chapters, Appendix X which increases energy efficiency by approximately 8 percent and Appendix Y which increases energy efficiency by approximately 16 percent.**

Proposed code change text: (Copy the existing text from the Integrated Draft, linked above, and then use underline for new text and ~~strikeout~~ for text to be deleted.)

New Appendix Chapter X

Building owners who choose, may use this appendix to achieve an additional 6% savings in building energy use. The number of additional energy efficiency credits in Section R406.2, option tables, would be increased by the following amounts:

1.0 credit for each new single-family, two-family, and townhouse dwelling unit
0.5 credit for each new dwelling unit within an R-2 occupancy building.
0.5 credit for each addition smaller than 500 square feet to a single-family, two-family, or townhouse dwelling unit
1.0 credit for each addition of 500 square feet or larger to a single-family, two-family, or townhouse dwelling unit

Where the R405 simulated performance alternative is used, the maximum allowable annual energy consumption shall be 92 percent of the value calculated according to Section R405.3.

New Appendix Chapter Y

Building owners who choose, may use this appendix to achieve an additional 12% savings in building energy use. The number of additional energy efficiency credits in Section R406.2, option tables, would be increased by the following amounts:

2.0 credits for each new single-family, two-family, and townhouse dwelling unit
1.0 credit for each new dwelling unit within an R-2 occupancy building.
1.0 credit for each addition smaller than 500 square feet to a single-family, two-family, or townhouse dwelling unit
1.5 credits for each addition of 500 square feet or larger to a single-family, two-family, or townhouse dwelling unit

Where the R405 simulated performance alternative is used, the maximum allowable annual energy consumption shall be 84 percent of the value calculated according to Section R405.3.

Purpose of code change:

This code change helps comply with the Governor's Executive Order 14-04 in a manner that is cost-effective.
There are existing precedents for additional residential code stringency in fire sprinkler and solar readiness appendices. The proposal also provides flexibility in the implementation of the residential energy code by jurisdictions wishing to improve their residential building stock. Finally, the extra points would provide some experience with the code as it would be changed to meet the requirements of RCW1927A-160 in future code cycles.

Your amendment must meet one of the following criteria. Select at least one:

- ☐ Addresses a critical life/safety need.
- ☐ The amendment clarifies the intent or application of the code.
- ☒ Addresses a specific state policy or statute. (Note that energy conservation is a state policy)
- ☐ Consistency with state or federal regulations.
- ☐ Addresses a unique character of the state.
- ☐ Corrects errors and omissions.

Check the building types that would be impacted by your code change:

☒ Single family/duplex/townhome	☐ Multi-family 4 + stories	☐ Institutional
☒ Multi-family 1 – 3 stories	☐ Commercial / Retail	☐ Industrial

Your name	David Baylon
Your organization	Ecotope
Other contact name	Click here to enter text.
Email address	david@ecotope.com
Phone number	206.596.4706

Economic Impact Data Sheet

Briefly summarize your proposal's primary economic impacts and benefits to building owners, tenants and businesses.

First cost and energy savings

First cost and energy savings estimates have been developed using an estimating procedure used by the Northwest Power and Conservation Council (NPCC). This method uses 6 prototype single family homes and one multi-family building to assess regional energy impacts. This includes: a 1344 sf rambler (crawl space and slab), a 2200 square foot rambler (crawl space and slab), a 2866 sf home with half basement, a 5000 sf home with a full basement, and a 820 sf multifamily dwelling unit (modeled a 3 story, exterior entry, low-rise building). For each building both cost and energy savings are estimated for each prototype and each measure.

First Cost: The first cost included in Tables 1 and 2 were developed using multiple sources of information:

- NPCC, the Regional Technical Forum (RTF), http://rtf.nwcouncil.org/ This is a federally mandated multi-state compact that develops the efficiency resources for the region's electric utilities
- Navigant is a business consulting firm which provides resource planning for both gas and electric utilities, including gas utilities in Washington State. http://www.navigant.com/industries/energy/
- CEE is the Consortium for Energy Efficiency. CEE is the US and Canadian consortium of gas and electric efficiency program administrators. http://www.cee1.org/
- This study also uses cost information provided to the SBCC by Ecotope

The cost of each option is included in Table 1 and 2. Cost are considered for 6 single family and 1 multi-family prototype. For single family prototypes, the crawlspace and slab variations have already been incorporated in the '1344sf' and 2200sf' prototypes – which is why only 4 cost numbers are shown.

Table 1: Total Measure Costs by Single Family Prototypes

			Prototypes Weight % by Floor Area			
			1344	2200	2688	5000
Option-Description	Credit Value	**Weighted Measure Cost**	15%	72%	11%	2%
1a - 5% UA reduc	0.5	**$ 1,102**	$ 767	$ 1,097	$ 1,667	$ 676
1b - 15% UA reduc	1	**$ 4,311**	$ 2,649	$ 4,565	$ 4,582	$ 6,127
1c - 30% UA reduc	2	**$ 7,947**	$ 4,869	$ 8,537	$ 7,609	$ 11,659
1d - U-.24 Glaze	0.5	**$ 1,583**	$ 907	$ 1,638	$ 1,818	$ 3,375
1e - 40% UA reduc	3	**$ 11,889**	$ 7,641	$ 12,925	$ 10,191	$ 15,828
1f - U-.20 Glaze	1	**$ 3,166**	$ 1,814	$ 3,276	$ 3,636	$ 6,750
2a - 3ACH , fan eff	0.5	**$ 517**	$ 349	$ 521	$ 618	$ 1,081
2b - 2 ACH, HRV	1	**$ 2,727**	$ 1,680	$ 2,750	$ 3,360	$ 6,250
2c - 1.5 ACH, HRV	1.5	**$ 6,108**	$ 3,763	$ 6,160	$ 7,526	$ 14,000
2d - 0.6 ACH, HRV	2	**$ 8,725**	$ 5,376	$ 8,800	$ 10,752	$ 20,000
3a - Furnace	1	**$ 230**	$ 230	$ 230	$ 230	$ 230
3b - 9.5 HSPF HP	0.5	**$ 1,270**	$ 1,270	$ 1,270	$ 1,270	$ 1,270
3c - GSHP	1.5	**$ 11,034**	$ 10,900	$ 10,900	$ 10,900	$ 17,600
3d - DHP	1	**$ 1,400**	$ 1,400	$ 1,400	$ 1,400	$ 1,400
3e - 11.0 HSPF HP	1	**$ 5,400**	$ 5,400	$ 5,400	$ 5,400	$ 5,400
3f - DHP (15% elec)	1.5	**$ 5,400**	$ 5,400	$ 5,400	$ 5,400	$ 5,400
4 - HVAC inside	1	**$ 300**	$ 300	$ 300	---	---
5a - DWR	0.5	**$ 400**	$ 400	$ 400	$ 400	$ 400
5b - 0.80 gas DHW	0.5	**$ 586**	$ 586	$ 586	$ 586	$ 586
5c - 0.91 gas DHW, GSHP	1	**$ 923**	$ 923	$ 923	$ 923	$ 923
5d - Tier I HPWH	1.5	**$ 874**	$ 874	$ 874	$ 874	$ 874
5e - Tier III HPWH	2	**$ 874**	$ 874	$ 874	$ 874	$ 874
5f - Tier III HPWH Split	2.5	**$ 3,500**	$ 3,500	$ 3,500	$ 3,500	$ 3,500
6 - Solar pV	0.5	**$ 5,040**	$ 5,040	$ 5,040	$ 5,040	$ 5,040
7 - ES Appl+ventless Dryer	0.5	**$ 462**	$ 462	$ 462	$ 462	$ 462

All questions must be answered to be considered complete. Incomplete proposals will not be accepted.

Table 2: Total Measure Costs for Multifamily prototype

Option-Description	Credit Value	Measure Cost
1a - 5% UA reduc	---	---
1b - 15% UA reduc	1	**$ 1,359**
1c - 30% UA reduc	1.5	**$ 2,615**
1d - U-.24 Glaze	0.5	**$ 554**
1e - 40% UA reduc	2	**$ 3,773**
1f - U-.20 Glaze	1	**$ 1,107**
2a - 3ACH , fan eff	1	**$ 245**
2b - 2 ACH, HRV	1.5	**$ 1,025**
2c - 1.5 ACH, HRV	2	**$ 2,296**
2d - 0.6 ACH, HRV	2.5	**$ 3,280**
3a - Furnace	1	---
3b - 9.5 HSPF HP	---	---
3c - GSHP	1	---
3d - DHP	2	**$ 2,800**
3e - 11.0 HSPF HP	0.5	---
3f - DHP (15% elec)	2.5	**$ 4,800**
4 - HVAC inside	---	---
5a - DWR	0.5	**$ 133**
5b - 0.80 gas DHW	0.5	---
5c - 0.91 gas DHW, GSHP	1	---
5d - Tier I HPWH	2	**$ 291**
5e - Tier III HPWH	2.5	**$ 291**
5f - Tier III HPWH Split	3	**$ 1,167**
6 - Solar pV	0.5	**$ 5,040**
7 - HP dryers, ES Appl	1	**$ 462**

Energy Savings Estimates

The energy savings estimates below have been developed using 6 single family and one multi-family prototype. For each building prototype, each predominant HVAC system (gas furnace, gas furnace with AC, central heat pump and Ductless heat pumps with zonal electric) was modeled and located in various weather climates within the state. The energy savings attributed to each option listed in Table 406.2 were then weighted to consolidate energy savings estimates for the 4 primary categories of homes in Section R406.2 (small, medium, large, and R-2 dwelling units). As shown in Table 1, large homes (greater than 5000sf) only compromise 2% of the total building stock – therefore energy savings estimates used for the Life Cycle Cost Analysis have been omitted from this economic analysis.

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Table 3: Savings All Climates, All Systems

Savings are positive	Small Single Family (less than 1500sf)				Medium Single Family				Multifamily (R-2 occ)
	Gas Home		Central HP	Zonal Elec	Gas Home		Central HP	Zonal Elec	Zonal Elec
Option-Description	kWh	Therm	kWh	kWh	kWh	Therm	kWh	kWh	kWh
1a - 5% UA reduc	-5	25	212	477	-5	41	355	810	135
1b - 15% UA reduc	-6	57	516	1034	-5	100	908	1884	517
1c - 30% UA reduc	-11	99	891	1787	-12	169	1519	3194	898
1d - U-.24 Glaze	-2	17	150	315	-1	36	325	689	228
1e - 40% UA reduc	-27	135	1193	2419	-30	229	2024	4316	1172
1f - U-.20 Glaze	-6	29	253	541	-7	62	546	1185	391
2a - 3ACH , fan eff	52	14	177	313	52	43	440	905	475
2b - 2 ACH, HRV	-313	20	-92	-4	-313	56	231	767	939
2c - 1.5 ACH, HRV	-203	33	137	331	-204	75	520	1239	1284
2d - 0.6 ACH, HRV	-205	46	253	560	-205	100	737	1708	1533
3a - Furnace	0	41	---	---	0	77	---	---	---
3b - 9.5 HSPF HP	---	---	180	---	---	---	343	---	---
3c - GSHP	---	---	729	---	---	---	1301	---	---
3d - DHP	---	---	---	1835	---	---	---	3526	1132
3e - 11.0 HSPF HP	---	---	407	---	---	---	784	---	---
3f - DHP (15% elec)	---	---	---	1928	---	---	---	3700	1193
4 - HVAC inside	11	46	517	---	13	60	638	---	---
5a (5g) - DWR	0	17	322	322	0	19	368	368	265
5b - 0.74 gas DHW	0	22	---	---	0	24	---	---	---
5c - 0.91 gas DHW, GSHP	0	32	---	---	0	36	---	---	---
5d - Tier I HPWH	---	---	1236	1236	---	---	1393	1393	1038
5e - Tier III HPWH	---	---	1623	1623	---	---	1823	1823	1369
5f - Tier III HPWH Split	---	---	1836	1836	---	---	2064	2064	1547
6 - Solar pV	1262	---	1262	1262	1262	---	1262	1262	1262
7 - Appliances	840	---	840	840	840	---	840	840	612

Provide your best estimate of the annual energy savings (or additional energy use) for your code change proposal?

See Table 3 for kWh/dwelling unit or therm/dwelling unit savings (savings values are positive)

List any code enforcement time for additional plan review or inspections that your proposal will require, in hours per permit application:

This process is consistent with the current code. We do not anticipate additional enforcement cost.

Provide your best estimate of the construction cost (or cost savings) of your code change proposal?

See Table 4 for square foot cost of various measures. Also, see Table 1 and 2 for per dwelling unit cost of each measure, by prototype.

All questions must be answered to be considered complete. Incomplete proposals will not be accepted.

Table 4: Measure cost estimates ($/component area, SF or housing unit)

Component	Base Level	Measures Beyond Base Level	Cost $/ft2 or $/unit	Source
Envelope				
Ceiling	R-49	R-49 RH Ceiling Insulation	$ 0.20	ResSFEStarBuiltGreenHomesWA2014_v2_5.xlsm
Ceiling	R-49	R-60 RH Ceiling Insulation	$ 0.23	CERF
Wall	R-21 Std	R-21 int Wall + R4 Foam Sheathing	$ 0.96	RTF RESnew.xls 6th plan
Wall	R-21 Std	R-21 int Wall + R12 Foam Sheathing	$ 2.25	RTF RESnew.xls passiveHouse Consultant
Wall	R-21 Std	R-21 int Wall + R16 Foam Sheathing	$ 3.00	passiveHouse Consultant
Floor	R-30	R-38 Floor	$ 0.38	RTF-ResNCMTHouseID_v_3_0 .xlsm April 4, 2018; ShellCosts tab
Floor	R-30	R-48 Floor	$ 1.50	Assuming high density foam (R-6.inch) installed in std 12" joists
Slab	R-10 2' perim	Slab R-10 Full	$ 0.91	6th Plan Appendix G
Slab	R-10 2' perim	Slab R-20 Full	$ 1.22	NextStepHomes data
Window	U-0.30	Window U-0.28	$ 0.80	NPCC Standard workbook
Window	U-0.30	Window U-0.25	$ 4.50	NPCC Standard workbook
Window	U-0.30	Window U-0.24	$ 4.50	NPCC Standard workbook
Window	U-0.30	Window U-0.22	$ 6.60	NPCC Standard workbook
Window	U-0.30	Window U-0.18	$ 9.00	MF bids (tripleglaze-BidPrices.xl)
Air Sealing & Ventilation				
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 3 ACH50	$ 0.20	RTF Workbook. ResWXSF_FY10v2_1.xls passiveHouse consultant
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 2 ACH50	$ 0.50	
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 1.5 ACH50	$ 0.80	
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 0.6 ACH50	$ 1.50	
Exhaust Fan	Pt Source Exhaust Fan =0.75W/cfm	Pt Source Exhaust Fan <0.35W/cfm	$ 80.64	navigant 2013
ERV	No ERV	ERV with SHR>= 0.65	$ 0.75	Whispercomfort and minimal ducting
ERV	No ERV	ERV with SHR>= 0.75	$ 2.00	renewaire or lifebreath
ERV	No ERV	ERV with SHR>= 0.80	$ 2.50	high efficiency HRV with ducting (venmar, zhender)

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Component	Base Level	Measures Beyond Base Level	Cost $/ft2 or $/unit	Source
HVAC System				
Ducts	Code level is sealed	Ducts Inside	$ 300.00	NPCC Sixth Power Plan, Support documentation
Furnace	0.8	Furnace Upgrade to 94AFUE	$ 230.25	Navigant Sept 2011 Report for NEEP
Heat Pump	8.2 HSPF	9.5 HSPF	$ 1,270.00	NPCC Standard workbook, with linear regression
DHP	Zonal Resistance (MF)	1-ton single zone DHP	$ 2,800.00	Ecotope analysis of NEEA DHP pilot program database
11.0 DHP	8.2 DHP (SF)	1-ton single zone DHP	$1,400.00	Ecotope analysis of NEEA DHP pilot program database
Heat Pump	8.2 HSPF	11 HSPF	$ 5,400.00	3 ton unit. ResSFExistingHVAC
multizone 11.0 DHP	8.2 HSPF	10 HSPF efficiency with no electric resistance. Reduction in elec heat but higher tonnage	$5,400	Ecotope analysis of NEEA DHP pilot program database
Domestic Hot Water				
Water Htr	0.59 EF	Gas Water Heater >=0.80 EF	$ 586.00	NREL, 2013
Water Htr	0.59 EF	Gas Water Heater >=0.91 EF	$ 923.00	NREL, 2013
Water Htr	0.95 EF	Heat Pump Water Heater 2 EF	$ 874.00	RTF ResHPWH.xls
DWHR	none	Drain water heat recovery pipe	$ 400.00	RTF RESDHWDrainWaste.xls
Water Htr	0.95 EF	Tier 3 Water Heater 3 EF	$ 874.00	RTF ResHPWH.xls
Water Htr	0.95 EF	CO2 Water Heater 4 EF	$ 3,500.00	RTF ResHPWH.xls
Appliances				
Dryers, refr, dishwasher	Fed pre-empted	ventless dryers, ES appliances	$ 462.000	RTF-ResClothesDryers, ResRef, HD.com $420 for HP dryer, +$40 for Cloth washer, +$90 for refr

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