

STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development Standard Energy Code Proposal Form

May 2018

Log No. 19-WSEC-R35

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 <u>underline</u> for new text and strikeout for text to be deleted.)

New Appendix Chapter X

Where this Appendix is adopted by the local jurisdiction, the number of additional energy efficiency credits required by Section R406.2 shall 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

Where this Appendix is adopted by the local jurisdiction, the number of additional energy efficiency credits required by Section R406.2 shall 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 m	ust meet one of the fo	ollowing criteria. Selec	t at least one:		
Addresses a critic	cal life/safety need.	Consistency with state or federal regulations.			
 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) 			 Addresses a unique character of the state. Corrects errors and omissions. 		
Check the building ty	ypes that would be in	npacted by your code o	change:		
Single family/dup	olex/townhome	Multi-family 4 + s	stories	Institutional	
⊠ Multi-family 1 – 3 stories		Commercial / Retail		Industrial	
Your name	David Baylon		Email address	david@ecotope.com	
Your organization	Ecotope		Phone number	206.596.4706	
Other contact name	Click here to enter	text.			

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. <u>http://www.navigant.com/industries/energy/</u>
- CEE is the Consortium for Energy Efficiency. CEE is the US and Canadian consortium of gas and electric efficiency program administrators. <u>http://www.cee1.org/</u>
- 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.

				Prototypes Weight % by Floor Area					
					1344		2200	2688	5000
	Credit	w	eighted						
Option-Description	Value	Mea	sure 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 - U24 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 - U20 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

Table 1: Total Measure Costs by Single Family Prototypes

		м	easure
Option-Description	Credit Value		Cost
1a - 5% UA reduc			
1b - 15% UA reduc	1	\$	1,359
1c - 30% UA reduc	1.5	\$	2,615
1d - U24 Glaze	0.5	\$	554
1e - 40% UA reduc	2	\$	3,773
1f - U20 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

Table 2: Total Measure Costs for Multifamily prototype

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.

Savings are positive	Sm	all Single F 15	amily (less 00sf)	s than	Medium Single Family			mily	Multifamily (R-2 occ)
	Gas	Home	Central HP	Zonal Elec	Gas I	lome	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 - U24 Glaze	-2	17	150	315	-1	36	325	689	228
1e - 40% UA reduc	-27	135	1193	2419	-30	229	2024	4316	1172
1f - U20 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

Table 3: Savings All Climates, All Systems

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.

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

Component	Base Level	Measures Beyond Base Level	C \$/ f \$/	ost t2 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 & Ventila	ation		1		
АСН	Tested Infiltration at 5 ACH 50	Tested Infiltration to 3 ACH50	\$	0.20	
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 2 ACH50	\$	0.50	RTF Workbook. ResWXSF_FY10v2_1.xls
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 1.5 ACH50	\$	0.80	passiveHouse consultant
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 0.6 ACH50	\$	1.50	
Exhaust Fan	Pt Source Exhaust Fan =0.75W/cf m	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)

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

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	r			
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



STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development Standard Energy Code Proposal Form

May 2018

_____ 19-WSEC-R36

Log No. —

Code being amended:

Commercial Provisions

Residential Provisions

R406, Carbon Accounting

Code Section # R402.4.1.2, R403.3.7, R405.3, R406,

Brief Description: This proposal updates Section R406 based on carbon emissions drawn from the carbon accounting included in the final proposed commercial energy code approved by the SBCC in 2018 (Table C403.3(1)). This proposal requires additional energy efficiency credits which have been renormalized using carbon accounting in Table C403.3(1) to allocate credit based on the impact on carbon emissions of each option. It amends portions of the prescriptive code, as required, to support proposed revisions to Section R406. Finally, it alters the performance path in Section 405.3 to include carbon emissions as the basis for performance compliance with the residential energy code. This section now includes the carbon emissions table transferred from the approved commercial energy code.

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

R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope. Once visual inspection has confirmed sealing (see Table R402.4.1.1), operable windows and doors manufactured by small business shall be permitted to be sealed off at the frame prior to the test.

Exception. For dwelling units that are accessed directly from the outdoors, other than detached one-family dwellings and townhouses, an air leakage rate not exceeding 0.4 cfm per ft2 of the dwelling unit enclosure area shall be an allowable alternative. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals) in accordance with RESNET/ICC 380, ASTM E779 or ASTM E1827. Doors and windows of adjacent dwelling units (including top and bottom units) shall be open to the outside during the test. This exception is not permitted for dwelling units that are accessed from corridors or other enclosed common areas.

R403.3.7 Ducts located in conditioned space. For ducts to be considered as being located inside a conditioned space, such ducts shall comply with one of the following:

- 1. <u>The duct system shall be located completely within the continuous air barrier and within the building thermal envelope.</u>
- All heating, cooling and ventilation system components shall be installed inside the conditioned space, including but not limited to forced air ducts, hydronic piping, hydronic floor heating loops, convectors and radiators. Combustion equipment shall be direct vent or sealed combustion.
- 3. For forced air ducts: A maximum of 10 linear feet of return ducts and 5 linear feet of supply ducts is permitted to be located outside the conditioned space, provided they are insulated to a minimum of R-8.
- 4. <u>Metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic.</u>
- 5. If flex ducts are used, they cannot contain splices. Flex duct connections must be made with nylon straps and installed using a plastic strapping tensioning tool

R405.3 Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (*proposed design*) be shown to have an annual energy consumption based on site energy carbon emissions of the fuels and energy use in the proposed building. Carbon emissions for both the *standard reference design* and the *proposed design* shall be calculated using Table R405.3.1. Energy use derived from simulation analysis shall be expressed in Btu pounds of carbon and pounds of carbon and Btu per square foot of *conditioned floor area* as follows:

- For single family structures (including townhouses) less than 1,500 square feet of conditioned floor area, the annual <u>carbon emissions</u> energy consumption shall be less than or equal to 80 70 percent of the annual <u>carbon</u> emissions energy consumption of the standard reference design.
- 2. For <u>single family</u> structures (including townhouses) 1,500 to 5,000 square feet of conditioned floor area, the annual <u>carbon emissions energy consumption</u> shall be no more than 72 62 percent of the *standard reference design*.
- 3. For <u>single family</u> structures <u>(including townhouses)</u> over 5,000 square feet of conditioned floor area, the annual <u>carbon emissions</u> energy consumption shall be no more than 66 56 percent of the *standard reference design*.
- Exception: For structures serving Group R-2 occupancies, the annual <u>carbon emissions</u> energy consumption shall be less than or equal to 85 <u>70</u> percent of the annual <u>carbon emissions</u> energy consumption of the *standard* reference design.

TABLE R405.3 CARBON EMISSIONS FACTORS						
Type	CO2e (lb/unit)	Unit				
Electricity	0.70	kWh				
Natural Gas	<u>11.7</u>	Therm				
Oil	19.2	<u>Gallon</u>				
Propane	10.5	Gallon				
Other ^a	<u>195.00</u>	<u>mm<mark>Btu</mark></u>				
On-site renewable energy	<u>0.00</u>					

^aDistrict energy systems may use alternative emission factors

supported by calculations approved by the code official.

SECTION R406 ADDITIONAL ENERGY EFFICIENCY REQUIREMENTS

R406.1 Scope. 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 *International Residential Code*, and dwelling units in *residential buildings*, to demonstrate compliance with this code. <u>The credits from both Table R406.2(1) and Table R406.2(2) are required</u>.

R406.2 Additional energy efficiency requirements (Mandatory). Each dwelling unit in a residential building shall comply with sufficient options from Table R406.2(1) and Table R406.2(2) so as to achieve the following minimum number of credits:

1. Small Dwelling Unit: 1.5 4.0 credits

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.

Exception:-Dwelling units serving R-2 occupancies shall require 2.5 credits.

3. Large Dwelling Unit: 4.5 6.0 credits

Dwelling units exceeding 5000 square feet of conditioned floor area.

Exception: Dwelling units serving R-2 occupancies shall require 2.5 credits.

- 4. Additions less than 500 square feet: 0.5 credits
- 4. Dwelling units serving R-2 occupancies: 4.5 credits (from Group R-2 Credit column in Table R406.2)
- 5. Additions less than or equal to 500 square feet: ... 1.5 credits

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.

Table R406.2(1) establishes fuel emissions credits for a base equalization between fuels used in the dwelling units. Table R406.2(2) establishes energy credits. The fuel emissions credits in Table R406.2(1) shall be selected based on the initial heating system for each dwelling unit. These credits shall be added to the energy credits selected in Table 406.2(2). The sum of credits from Table R406.2(1) and Table R406.2(2) shall be equal to or greater than the points required in section R406.2. The permit shall define the base heating fuel selection to be used and the points specified for both tables.

<u>Option</u>	Description	<u>Credits</u> (<u>Single</u> <u>Family)</u>	<u>Credits</u> (Group R- <u>2, R-3, R-</u> <u>4)</u>
<u>a</u>	For initial heating system using Gas furnace with minimum efficiency in accords with federal standards (AFUE 80)	<u>0</u>	<u>N/A</u>
<u>b</u>	For an initial heating system using a heat pump that meets federal standards	<u>1.0</u>	<u>1.0</u>
<u>c</u>	For an initial heating system based on electric resistance only (either forced air or Zonal)	<u>-1.0</u>	<u>5</u>
<u>d</u>	For an initial heating system based on electric resistance with a DHP per section R403.7.1 (either forced air or Zonal)	<u>0</u>	<u>N/A</u>

Table R406.2(1) Fuel Emissions Credits

TABLE R406.2(2) ENERGY CREDITS

OPTION	DESCRIPTION	CREDIT(S)	CREDIT(S)
		<u>Single</u>	(Group R-2)
		Family and	
		<u>townhouse</u>	
1a	EFFICIENT BUILDING ENVELOPE 1a:	0.5	<u>N/A</u> e
	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		
	or		
16	Compliance based on Section R402.1.4: Reduce the Total <u>conductive</u> ^a UA by 5%.	1.0	1.0
10	EFFICIENT BUILDING ENVELOPE 10. Procerintive compliance is based on Table P402-1-1 with the following modifications:	1.0	1.0
	Vertical fenestration II = 0.25		
	Wall R-21 int plus R-4 ci		
	Eloor 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		
	or		
	Compliance based on Section R402.1.4: Reduce the Total <u>conductive</u> ^a UA by 15%.		
1c	EFFICIENT BUILDING ENVELOPE 1c:	2.0	<u>1.5</u>
	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 K-10 perimeter and under entire slab		
	or		
	Compliance based on Section R402.1.4: Reduce the Total conductive ^a UA by 30%.		

1d a b	EFFICIENT BUILDING ENVELOPE 1d:	0.5	0.5
	Prescriptive compliance is based on Table R402.1.1 with the following modifications:		
	Vertical fenestration $U = 0.24$		
1e		3.0	2.0
<u></u>	Prescriptive compliance is based on Table R402 1 1 with the following modifications:	<u>5.0</u>	2.0
	Vertical fenestration $II = 0.18$		
	Ceiling and single-rafter or joist-vaulted R-60 advanced		
	Wood frame wall P 21 int plus P 16 ci		
	Eloor P 49		
	Pasamant wall P 21 int plus P 16 ci		
	Slab on grade P. 20 perimeter and under entire slab		
	Below grade slab B 20 perimeter and under entire slab		
	or		
	<u>01</u> Compliance based on Section P402.1.4: Reduce the Total conductive? UA by 40%		
		1.0	1.0
<u>1fc</u>	EFFICIENT BUILDING ENVELOPE II. Drosprintive compliance is based on Table D402.1.1 with the following modifications:	<u>1.0</u>	<u>1.0</u>
	Vertical forestration U = 0.20		
2-		0.5	1.0
Za	AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION 2a:	0.5	1.0
	Compliance based on R402.4.1.2: Reduce the tested air leakage to 3.0 air changes		
	per hour maximum <u>at 50 pascais</u>		
	<u>Or</u>		
	For R-2 construction, optional compliance based on Section R402.4.1.2: Reduce the		
	tested air leakage to 0.3 cfm/ft ² maximum at 50 pascals		
	and		
	All whole house ventilation requirements as determined by Section M1507.3 of the		
	International Residential Code or Section 403.8 of the International Mechanical Code shall be		
	met with a high efficiency fan (maximum 0.35 watts/cfm), not interlocked with the		
	furnace fan (if present). Ventilation systems using a furnace including an ECM motor		
	are allowed, provided that they are controlled to operate at low speed in		
	ventilation only mode.		
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall specify the maximum tested building air leakage and shall		
	show the qualifying ventilation system.		
2b	AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION 2b:	1.0	<u>1.5</u>
	Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 2.0 air		
	changes per hour maximum <u>at 50 pascals</u>		
	<u>Or</u>		
	For R-2 construction, optional compliance based on Section R402.4.1.2: Reduce the		
	tested air leakage to 0.25 cfm/ft ² maximum at 50 pascals		
	and		
	All whole house ventilation requirements as determined by Section M1507.3 of the		
	International Pacidential Code or Socion A02.9 of the International Mechanical Code shall		
	he met with a best recovery wentilation system with minimum sensible best		
	be thet with a heat recovery ventilation system with minimum sensible heat		
	recovery enciency of 0.70 <u>0.05</u> .		
	I o qualify to claim this credit, the building permit drawings shall specify the option being sologied and shall energify the maximum tested building air loakage and shall		
	show the heat recovery ventilation system		
20	AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION 2c:	15	2.0
20	Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 1.5 air	1.5	2.0
	changes per hour maximum at 50 pascals		
	Or		
	For R-2 construction, optional compliance based on Section R402.4.1.2; Reduce the		
	tested air leakage to 0.20 cfm/ft2 maximum at 50 pascals		
	and		
	All whole house ventiletion requirements or determined by Constant M4507.0. Cul		
	All whole house ventilation requirements as determined by Section M1507.3 of the		
	international Residential Code or Section 403.8 of the International Mechanical Code shall		
	be met with a heat recovery ventilation system with minimum sensible heat		
	recovery efficiency of 0.85 <u>0.75</u> .		
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall specify the maximum tested building air leakage and shall		
	show the heat recovery ventilation system.		

2d	AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION 2d:	2.0	2.5
	Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.6 air		
	changes per hour maximum at 50 pascals		
	Or		
	For R-2 occupancies, optional compliance based on Section R402.4.1.2; Reduce the		
	tested air leakage to 0.15 cfm/ft2 maximum at 50 nascals		
	All whole house ventilation requirements as determined by Section M1507.3 of the		
	International Residential Code or Section 403.8 of the International Mechanical Code		
	shall be met with a heat recovery ventilation system with minimum sensible heat		
	recovery efficiency of 0.80. Duct installation shall comply with Section R403.3.7.		
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall specify the maximum tested building air leakage and shall		
le al		1005	1005
3a ⁰⁰	Energy Star Pated (U.S. North) Gas or propage or oil fired furgace with	1.0 0.5	<u>+.0-</u> 0.5
	<u>Ellergy Star Rated (0.5. North)</u> Gas <u>or</u> propane or on-med runnace with		
	minimum AFOE of 94% 95%, or <u>Energy Star Rated</u> Gas <u>or</u> propane or		
	oiled-fired boiler with minimum AFUE of <u>92%90%</u>		
	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.		
зь ^b d	HIGH EFFICIENCY HVAC EQUIPMENT 3b:	1.0	N/A ^e
35 -	Air-source heat pump with minimum HSPF of 9.0 <u>9.5</u>		
	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.		
3cbd	HIGH EFFICIENCY HVAC EQUIPMENT 3c:	1.5	1.0
50 -	Closed-loop ground source heat pump; with a minimum COP of 3.3		
	or		
	Open loop water source heat nump with a maximum numping hydraulic head of 150		
	feet and minimum COP of 3.6		
	To gualify to claim this gradit, the building normit drawings shall enosify the option		
	hoing colocted and chall choosify the besting equipment type and the minimum		
	onvinment officiency		
la al		1.0	4.5
3d ¤ d	HIGH EFFICIENCY HVAC EQUIPMENT 3d:	1.0	1.5
	Ductless Split System Heat Pumps, Zonal Control: In homes where the primary space		
	heating system is zonal electric heating, a ductless heat pump system with a minimum		
	HSPF of 10.0 shall be installed and provide heating to the largest zone of the housing		
	unit.		
	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.		
3 od	HIGH EFFICIENCY HVAC EQUIPMENT 3e:	1.0	NA
<u></u>	Air-source heat pump with minimum HSPF of 11.0		
	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.		
	HIGH EFFICIENCY HVAC EQUIPMENT 3f:		
	Ductless Split System Heat Pumps with no electric resistance heating in the primary		
	living areas. A ductless heat pump system with a minimum HSPE of 10 shall be sized		
	and installed to provide heat to entire housing unit at the design outdoor air		
əfd	temperature. Up to 15% of the rated heating canacity of the ductless heat nump	15	2.5
51	system is permitted to be an alternative heating source	<u></u>	<u></u>
	To qualify to claim this credit, the building nermit drawings shall specify the option		
	heing selected the heating equinment type the minimum equinment efficiency and		
	total installed heat capacity (divided out by equipment type)		
1	total motalica ficat capacity famaca out by equipment type		1

4	HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM:	1.0	<u>N/A</u>
	All heating and cooling system components installed inside the conditioned space.		
	This includes all equipment and distribution system components such as forced air		
	ducts, hydronic piping, hydronic floor heating loop, convectors and radiators. All		
	combustion equipment shall be direct vent or sealed combustion.		
	For forced air ducts: A maximum of 10 linear feet of return ducts and 5 linear feet of		
	supply ducts may be located outside the conditioned space. All metallic ducts located		
	outside the conditioned space must have both transverse and longitudinal joints		
	sealed with mastic. If flex ducts are used, they cannot contain splices. Flex duct		
	connections must be made with hylon straps and installed using a plastic strapping		
	tensioning tool. Ducts located outside the conditioned space must be insulated to a		
	minimum of R-8.		
	HVAC and duct system installation shall comply with requirements of Section		
	R403 3 7		
	l agating system companyonts in conditioned aroud spaces is not normitted under this		
	Locating system components in conditioned crawl spaces is not permitted under this		
	Electric resistance heat and ductless heat pumps are not permitted under this		
	option.		
	Direct combustion heating equipment with AFUE less than 80% is not permitted		
	under this option.		
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall specify the heating equipment type and shall show the		
	location of the heating and cooling equipment and all the ductwork.		
5a	EFFICIENT WATER HEATING 5a:	0.5	<u>0.5</u>
	All showerhead and kitchen sink faucets installed in the house shall be rated at 1.75		
	GPM or less. All other lavatory faucets shall be rated at 1.0 GPM or less. ^C		
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall specify the maximum flow rates for all showerheads, kitchen		
	sink faucets, and other lavatory faucets.		
	EFFICIENT WATER HEATING 5a:		
	A drain water heat recovery unit(s) shall be installed, which captures waste water		
	heat from all the showers and has a minimum efficiency of 40% if installed for equal		
	flow or a minimum efficiency of 52% if installed for unequal flow. Such units shall be		
	rated in accordance with CSA B55.1 and be so labeled.		
	To qualify to claim this credit, the building permit drawings shall include a plumbing		
	diagram that specifies the drain water heat recovery units and the plumbing layout		
	needed to install it. Labels or other documentation shall be provided that		
	demonstrates that the unit complies with the standard.		
5b	EFFICIENT WATER HEATING 5b:	1.0 0.5	0.5
	Water heating system shall include one of the following: Gas		
	<u>or</u> propane or oil water heater with a minimum EF of 0.80.		
	or		
	Water heater heated by ground source heat nump meeting the requirements of		
	Ontion 3c		
	For R-2 occupancy, a central heat pump water heater with an EF greater than 2.0 that		
	would supply DHW to all the units through a central water loop insulated with R-8		
	minimum pipe insulation.		
	I o quality to claim this credit, the building permit drawings shall specify the option		
	peing selected and shall specify the water heater equipment type and the minimum		
	equipment efficiency.	1	

5c	EFFICIENT WATER HEATING 5c:	1.5 1.0	1.0
	Water heating system shall include one of the following: Gas		
	or propane or oil water heater with a minimum EF of 0.91		
	or		
	Colar water beating supplementing a minimum standard water beater. Solar water		
	point water meating supprementing a minimum standard water meater. Soldr Water		
	neating will provide a rated minimum savings of 85 therms of 2000 kwn based on the		
	Solar Rating and Certification Corporation (SRCC) Annual Performance of OG-300		
	Certified Solar Water Heating Systems.		
	<u>or</u>		
	Water heater heated by ground source heat nump meeting the requirements of		
	Ontion 3c		
	or		
	Electric heat pump water heater with a minimum EF of 2.0 and meeting the		
	standards of NEEA's Northern Climate Specifications for Heat Pump Water Heaters.		
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall specify the water beater equinment type and the minimum		
	onuinment officiency and for color water heating systems, the calculation of the		
	equipment enciency and, for solar water heating systems, the calculation of the		
	minimum energy savings.		
5d	EFFICIENT WATER HEATING 50:	0.5<u>1.5</u>	<u>2.0</u>
	A drain water heat recovery unit(s) shall be installed, which captures waste water		
	heat from all the showers, and has a minimum efficiency of 40% if installed for equal		
	flow or a minimum efficiency of 52% if installed for unequal flow. Such units shall be		
	rated in accordance with CSA B55.1 and be so labeled.		
	To qualify to claim this credit, the building permit drawings shall include a plumbing		
	diagram that specifies the drain water heat recovery units and the plumbing layout		
	needed to install it and labels or other documentation shall be provided that		
	include to instant and labers of other documentation sharpe provided that		
	demonstrates that the unit complies with the standard.		
	Water heating system shall include one of the following:		
	For R-2 occupancy, an electric heat pump water heater with a minimum UEF of 2.0.		
	Water heater shall supply DHW to one or more units. If supplying more than one		
	unit, water loop shall be insulated with R-8 minimum pipe insulation.		
	<u>or</u>		
	Electric heat pump water heater with a minimum UEF of 2.0 and meeting the		
	standards of NEEA's Northern Climate Specifications for Heat Pump Water Heaters.		
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall specify the water heater equipment type and the minimum		
	equipment efficiency.		
	Water heating system shall include one of the following:		
	For P. 2 accurately an electric best numericater bester with a minimum UEF of 2.6		
	ror R-2 occupancy, an electric near pump water nearer with a minimum OEF of 2.6.		
	water neater shall supply DHW to all units. It supplying more than one unit, water		
50	loop shall be insulated with R-8 minimum pipe insulation.	2.0	25
<u> </u>	<u>or</u>	2.0	2.5
	Electric heat pump water heater with a minimum UEF of 2.6 and meeting the		
	standards of NEEA's Northern Climate Specifications for Heat Pump Water Heaters.		
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall specify the water heater equipment type and the minimum		
	EFFICIENT WATER HEATING ST.		
	water neating system shall include one of the following:		
	For R-2 occupancy, an electric heat pump water heater with a minimum UEF of 2.9		
	and utilizing a split system configuration with the air-to-refrigerant heat exchanger		
	located outdoors. Water heater shall supply DHW to one or more units. If supplying		
	more than one unit, water loop shall be insulated with R-8 minimum pipe insulation.		
5f	<u>or</u>	2.0 -2.5	2.5 3.0
	Electric heat pump water heater with a minimum UEF of 2.9 and utilizing a split		
	system configuration with the air-to-refrigerant heat exchanger located outdoors.		
	Equipment shall meet the standards of NEEA's Northern Climate Specifications for		
	Heat Pump Water Heaters.		
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall specify the water heater equipment type and the minimum		
	equipment efficiency.		

6	RENEWABLE ELECTRIC ENERGY:	0.5	0.5
	For each 1200 kWh of electrical generation per housing unit provided annually by on-		
	site wind or solar equipment a 0.5 credit shall be allowed, up to 3 credits. Generation		
	shall be calculated as follows:		
	For solar electric systems, the design shall be demonstrated to meet this requirement		
	using the National Renewable Energy Laboratory calculator PVWATTs.		
	Documentation noting solar access shall be included on the plans.		
	For wind generation projects designs shall document annual power generation based		
	on the following factors:		
	The wind turbine power curve; average annual wind speed at the site;		
	frequency distribution of the wind speed at the site and height of the tower.		
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall show the photovoltaic or wind turbine equipment type,		
	provide documentation of solar and wind access, and include a calculation of the		
	minimum annual energy power production.		
	APPLIANCE PACKAGE:		
	All of the following appliances shall be provided with the dwelling unit and shall		
	meet the following standards:		
	<u> Dishwasher – Energy Star Rated</u>		
	<u> Refrigerator – Energy Star Rated</u>		
7	<u> Washing Machine – Energy Star Rated</u>	0.5	15
<u>7</u>	Dryer – Energy Star Rated and utilizing full Heat Pump Technology	0.5	<u>1.5</u>
	To qualify to claim this credit, the building permit drawings shall specify the option		
	being selected and shall show the appliance type and provide documentation of		
	Energy Star Compliance. At the time of inspection, all appliances shall be installed		
	and connected to utilities. Dryer ducts and exterior dryer vent caps shall not be		
	installed in the unit.		

a. <u>Conductive UA as defined by Equation 1 and 2 in Section R402.1.4.</u>

<u>b.</u> Projects using this option may not use Option 1a, 1b, or 1c, 1e or 1f.

c. <u>Projects using this option may not use Option 1a, 1b, 1c, 1d or 1e.</u>

<u>d.</u> Projects may only include credit from one space heating option, 3a, 3b, 3c, or 3d, <u>3e</u> or <u>3f</u>. When a housing unit has two pieces of equipment (i.e., two furnaces) both must meet the standard to receive the credit.

e. Plumbing Fixtures Flow Ratings. Low flow plumbing fixtures (water closets and urinals) and fittings (faucets and showerheads) shall comply with the following requirements:

1. Residential bathroom lavatory sink faucets: Maximum flow rate – 3.8 L/min (1.0 gal/min) when tested in accordance with ASME A112.18.1/CSA B125.1.

2. Residential kitchen faucets: Maximum flow rate 6.6 L/min (1.75 gal/min) when tested in accordance with ASME A112.18.1/CSA B125.1.

3. Residential showerheads: Maximum flow rate 6.6 L/min (1.75 gal/min) when tested in accordance with ASME A112.18.1/CSA B125.1.

Purpose of code change:

The Washington State Legislature crafted the energy code enabling legislation (RCW 1927a) to show its intention to develop a carbon neutral building requirement by 2030. To date the SBCC and the various code changes have focused on the energy use and the metric to track progress toward that goal. In the 2018 code edits to the commercial energy code the SBCC approved a "carbon emissions" accounting to be used to assess buildings built under the performance path and HVAC systems built under the prescriptive path. Since these approaches are based on energy simulations, they are only partly applicable to the residential energy code. This code change revises the option table to include a more accurate accounting of the carbon emissions base on the table passed for the commercial code (C403.3(1)).

This code change parallels another code change proposal that modifies and extends the R406 option table based purely on energy efficiency and site energy. The content of that option table is substantially the same. The added change here is to reset the some of the option points based on the impact of the options on carbon emissions of the particular option. The revisions in the prescriptive code and in the descriptions and specifications in the option table are unchanged.

The carbon accounting is drawn from the carbon emissions table developed and passed for the commercial energy code. This table has been reproduced in the residential code in section R405 and is directly applicable to the results of any performance runs used to show compliance. The table was then used to assess the option table and correct for the changes that the carbon accounting would make in the option points. The change proposal incorporates a "fuel emissions credits" table, R406.2(1), to equalize the carbon emissions between chosen fuel types. The option points are altered where direct fuel consumption is credited specifically efficient gas furnaces and heat pumps.

This proposal modifies another proposal, the goals of that proposal are similar but have been modified here:

Incremental Improvements in Energy Efficiency consistent with RCW 19.27a.160: Specifically, these changes add additional option points necessary to meet the requirements of the Washington residential energy code. The additional points in this proposal and in the parallel proposal are designed to equalize the requirement across the residential sector. The additional points are required to bring the standards for smaller dwelling units to the same level as the present requirements for the single family homes.

- **Change in Scope**: Because this code covers multi-family construction and additions as well as single family homes, these applications have been added explicitly to Section R406. This step was necessary to facilitate an equalization between the multi-family occupancies and the other residential occupancies. To facilitate the options for tighter envelopes in the multifamily sector changes have been proposed to the section R402.4.2.1 testing standard to allow building officials and proposers more flexibility is establishing compliance with the air tightness requirements.
- **Other changes in the prescriptive code:** A few prescriptive code changes have been added to strengthen and clarify the requirements set out in Section R406. These include a detailed description of the requirements for interior ducts (R403.3.7) and revisions to the testing specification in R402.4.2.1.
- **Changes to R-406 Options:** There are several changes to the option table. Some of these changes have been modified to be consistent with the carbon emissions table. To provide clear enforceable code language, several editorial changes have been included. Low flow fixtures have been mandated through the legislature, therefore cannot be awarded as an energy credit under R406 this has been eliminated from the table
- Fuel Emissions Credits [Table R406.2(1)]. This table is designed to adjust the emissions factors so that the initial fuel selection can be equalized. The table has been designed to normalize all fuels with respect to a gas furnace system that uses federal minimum efficiency standards. In general, homes with heat pump systems are given extra points and homes with electric resistance systems are penalized. The results of this table partially offset the point requirements necessary for compliance with the energy credits table in Section R406.2 option table.
- Add New Efficiency Options and changes in points to reflect carbon emissions: To continue to provide a diverse set of options for implementation, several new options have been added.
 - Option 1e provides credit for 40% UA reduction
 - Option 1f provides credit for higher performing triple pane glazing
 - Option 2d allows credit for tighter envelope construction and top-tier ERVs

- Option 3a reduces credit for high efficiency gas reflecting lower carbon emissions.
- Option 3e provides credit for variable speed split system heat pumps and increases the points to reflect the reduced carbon impact of these options.
- Option 3f allows credit for homes with primarily heat pump heating. Eliminating much of electric resistance heating leads to increased energy savings. The impact on multifamily allows an increase in points for DHPs in that sector
- Option 5d, f is expanded to more thoroughly cover heat pump water heating options
- 5e increases the points available for central heat pump water heaters int eh multi-family sector
- Option 7 gives credit for appliances (primarily heat pump dryers). An energy end-use that has been neglected in the code. The electric savings from heat pump dryers allow an extra half point for the package in the multi-family sector.

Calculate Building Energy Use for the base code and section 406 options: The base code changes made in 2015 and by the 2018 IECC additions, along with WA state law, are first assessed to determine the base energy use of the prototype buildings. This ultimately impacts the credit provided by Section R406 options. For example, WA state law mandating low-flow fixtures reduces the savings potential from water heating equipment efficiencies – thus lowering their effective value. The savings attributed to low-flow fixtures are not 'lost' in the analysis however, as the energy savings is now reflected in the 2018 baseline (prescriptive) energy use of the residential sector. Based on this, the value of each credit is reassessed and if needed, reassigned.

Adjust the targets for systems analysis approach, section 405.3. This step is to places a parallel carbon accounting in the performance path and include a reduced energy target consistent with previous code changes. The targets for single family homes have been reduced by an additional 10 percent.

Your amendment m	nust meet one of the f	ollowing criteria. Sele	ect at least one:				
Addresses a crit	ical life/safety need.		Consistency with state or federal regulations.				
The amendmen the code.	t clarifies the intent o	r application of	Addresses a unique character of the state.				
Addresses a spe (Note that energed)	cific state policy or sta gy conservation is a sta	atute. ate policy)					
Check the building t	types that would be in	npacted by your code	change:				
Single family/du	plex/townhome	Multi-family 4 +	stories	Institutional			
🛛 Multi-family 1 –	3 stories	Commercial / R	etail	Industrial			
Co-proposers							
Your name	Chuck Murray,		Email address	chuck.murray@commerce.wa.gov			
Your organization	Department of Com	merce	Phone number	360 725-3113			
Your Name	David Baylon		Email address	david@ecotope.com			
Your Organization	Consultant		Phone Number	206 719-5772			
Your Name	Poppy Storm		Email address po	ppy.storm@2050-institute.org			
Your Organization	Shift Zero		Phone Number	206 650-7240			

<u>Instructions</u>: Send this form as an email attachment, along with any other documentation available, to: <u>sbcc@des.wa.gov</u>. For further information, call the State Building Code Council at 360-407-9278.

Economic Impact Data Sheet

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

The proposal delivers similar total energy savings to the alternative proposal for R406. This proposal recasts these savings to maximize the carbon emission savings from the energy savings. The result is a series of cost-effective approaches to reducing the energy impact of new homes by about 9% (of the 2006 energy code baseline, RCW1927a) while taking the impact of carbon emissions into account. The savings remain the same for this proposal. While these savings sustain progress toward the overall goal of 70% energy reduction the added feature is that the revised option table encourages the use of more efficient envelope measures or more efficient heat pump measures that offset the gas consumption of typical homes.

The results of the lifecycle cost analysis are attached in separate files for each example evaluated:

- 1. Medium Gas home: Baseline 2015 code, Alt 1: 2018 Proposed Options, Alt 2: 2018, Proposed Carbon Accounting, Alt 3 Proposed Carbon Accounting (with DHW change to electric HPWH);
- 2. Small Gas home: Baseline 2015 code, Alt 1: 2018 Proposed Options, Alt 2: 2018, Proposed Carbon Accounting;
- 3. Medium HP home: Baseline 2015 code, Alt 1: 2018 Proposed Options, Alt 2: 2018, Proposed Carbon Accounting;
- 4. Small Elect. Home: Baseline 2015 code, Alt 1: 2018 Proposed Options, Alt 2: 2018, Proposed Carbon Accounting;
- 5. MF Zonal: Baseline 2015 code, Alt 1: 2018 Proposed Options, Alt 2 2018, Proposed Carbon Accounting.

The results of these runs are summarized in tables 1 and 2. In all cases the NPV results show a positive value for all options analyzed (see Executive Report in attached LCCA summaries for all prototypes). The attached tables show the LCCA results and the cost assumed for the measures evaluated in these options. The Tables also include first cost (construction cost) for each alternative and cost per sq.ft.. The weights shown are used to derive the costs summarized for the entire proposal below. The multifamily costs are substantially increased due to the combination of extra points needed to equalize this sector with the remaining residential sector. Unlike the single-family dwellings, the majority of these costs are the result of a upgrade to DHPs which is not now part of the prescriptive

	Table 1 Base case (2015)													
Prototype	Size	Fuel	Weight	Credits	kWh	Th		First Cost (\$)	First Cost (\$/SF)	carbon (#/yr)				
Medium	2200	Gas	0.62	3.5	5338		503	1737	0.79	9621.7				
Small	1500	Gas	0.14	1.5	4895		362	255	0.17	7661.9				
Medium	2200	Elect (HP)	0.1	3.5	11226			2494	1.13	7858.2				
Small	1500	Elect (DHP)	0.14	1.5	9684			1425	0.95	6778.8				
MF (unit)	800	Elect.		1.5	7346			553	0.69	5142.2				

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

	Table 2 Carbon Accounting, Proposed (2018)												
Drototypo	5170	Fuel	Woight	Cradita	LAN/b	ть	First	First Cost	carbon				
Prototype	3120	ruei	weight	Credits	KVVII	111	COSL (S)	(3/36)	(#/yr)				
Medium	2200	Gas	0.31	5	4582	346	9312	4.23	7255.6				
Medium	2200	Gas	0.31	5	5662	275	3371	1.53	7180.9				
Small	1500	Gas	0.14	4	3827	257	3031	2.02	5685.8				
Medium	2200	Elect (HP)	0.1	5	10509		2977	1.35	7356.3				
		Elect											
Small	1500	(DHP)	0.14	4	7765		2623	1.75	5435.5				
MF (unit)	800	Elect.		4.5	5145		4912	6.14	3601.5				

Provide your best estimate of the construction cost (or cost savings) of your code change proposal? (See OFM Life Cycle Cost <u>Analysis tool</u> and <u>Instructions</u>; use these <u>Inputs</u>. Webinars on the tool can be found <u>Here</u> and <u>Here</u>)

For single family and attached townhouses: all prototypes weighted and combined:

\$1.29/square foot (added to 2015 requirements) (For residential projects, also provide \$3459/ dwelling unit)

For multi family

\$6.14/square foot (added to 2015 requirements)

(For residential projects, also provide \$4912/ dwelling unit)

Show calculations here, and list sources for costs/savings, or attach backup data pages. See Cost Documentation, Attachment.

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

For single family and attached townhouses: all prototypes weighted and combined:

7.6 KBTU/ square foot, 15534 KBTU / dwelling unit)

For multi family:

9.4 KBTU/ square foot, 7512 KBTU / dwelling unit)

Show calculations here, and list sources for energy savings estimates, or attach backup data pages. See Energy Savings Summary, attachment

List any code enforcement time for additional plan review or inspections that your proposal will require, in hours per permit application: The enforcement time should not be increased significantly since the evaluation of proposed options and documentation is unchanged by this proposal.

Cost Summaries

Sources and Compilation:

These tables show the initial incremental costs and sources for costs in this proposal.

First cost 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: Estimates were collected from various sources on the incremental costs of the measures that were used to develop the options in Table R406.2 (proposed). The first cost included in Tables 2 and 3 were developed from this information and these sources.

The cost of each option is included in Table 2 and 3. 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.

Component	Base Level	ase Level Measures Beyond Cost Base Level \$/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

 Table 1: Incremental measure cost estimates (\$/component area, SqFt or housing unit)

Component	Base Level	Measures Beyond Base Level	Cost \$/ft2 or \$/unit		Source
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
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 & Ventila	ation				
АСН	Tested Infiltration at 5 ACH 50	Tested Infiltration to 3 ACH50	\$	0.20	
АСН	Tested Infiltration at 5 ACH 50	Tested Infiltration to 2 ACH50	\$	0.50	RTF Workbook. ResWXSF_FY10v2_1.xls
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 1.5 ACH50	\$	0.80	passiveHouse consultant
АСН	Tested Infiltration at 5 ACH 50	Tested Infiltration to 0.6 ACH50	\$	1.50	
Exhaust Fan	Pt Source Exhaust Fan =0.75W/cf m	Pt Source Exhaust Fan <0.35W/cfm	\$	80.64	navigant 2013
ERV	No ERV	ERV with SHR>= 0.65	\$	0.75	\$400 for WhisperComfort and \$400 for 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)
HVAC System		1	1		1
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	SIW, linear regression from 9 HSPF pricing
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	ţ	51,400.00	Ecotope analysis of NEEA DHP pilot program database

Component	Base Level	Measures Beyond Base Level		Cost \$/ft2 or \$/unit	Source
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	ſ	1	1		
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

Table 2: Total Measure Costs by Single Family Prototypes

				Prototypes Weight % by Floor Area								
				1344			2200	2688		5000		
Option-Description	Credit Value	W Mea	eighted sure 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 - U24 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 - U20 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		\$ 230
3b - 9.5 HSPF HP	0.5	\$ 1,270	\$ 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

Option-Description	Credit Value	M	easure Cost
1a - 5% UA reduc			
1b - 15% UA reduc	1	\$	1,359
1c - 30% UA reduc	1.5	\$	2,615
1d - U24 Glaze	0.5	\$	554
1e - 40% UA reduc	2	\$	3,773
1f - U20 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

 Table 3: Total Measure Costs for Multifamily prototype

Energy Savings Calculations

Energy savings estimates used in the life cycle cost analysis were developed using SEEM. The SEEM energy simulation program was used to develop the energy savings targets and estimates for the 2009, 2012, and 2015 iterations of the residential portion of Washington State Energy Code. SEEM is used by the Northwest Power and Conservation Council and the RTF to estimate savings for most of the regional utility residential conservation programs.

The SEEM program is designed to model residential building energy use. The program consists of an hourly thermal simulation and an hourly moisture (humidity) simulation that interacts with duct specifications, equipment, and weather parameters to calculate the annual heating and cooling energy requirements of the home. 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. SEEM was recalibrated by the RTF in response to findings from the 2011 Residential Building Stock Assessment. This provides calibrated results for Pacific NW homes and makes it the tool of choice for residential energy assessment in our region.

For single family construction, the energy model is built using six RTF-approved prototype designs, including: a 1344 sf rambler (both on a slab and over a crawlspace), 2200 sf rambler (both on a slab and over a crawlspace), 2688 with half basement and 5000 sf full basement home. These six prototypes are then modeled with the three primary heating system types ("gas home", "Heat Pump Home" and "Electric Resistance Home") and then simulated in the two major climate zones in the state. The modeling protocol is intended to represent the wide variety of new homes constructed in Washington, to summarize the average savings that can be attributed to each option listed in Table R406.2. With all these variables considered, each energy conservation is then modeled independently in each of these scenarios.

For low-rise multifamily construction, the same method was used as for single family but only one prototype was modeled. The presumed, predominant construction-type was a 3-story, garden style (exterior entry) building. To simplify the model, a "sliver" of the overall building was modeled; meaning one stack of 3 apartments was modeled in the SEEM program. The annual energy use, utility savings, and incremental cost were then normalized to a per unit basis. The substantial increase in credit requirement for 2018 is supported by the updated credit values, which award more value to important and reasonable conservation measures related to low-rise construction. For instance, a ductless heat pump for multifamily will now earn 2 credits as opposed to a single credit on 2015.

These results are summarized in Table 1.

Savings are positive	Sm	mall Single Family (less than 1500sf)			Small Single Family (less than Medium Single Family 1500sf)				mily	Multifamily (R-2 occ)
	Gas	Home	Central HP	Zonal Elec	Gas I	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 - U24 Glaze	-2	17	150	315	-1	36	325	689	228	
1e - 40% UA reduc	-27	135	1193	2419	-30	229	2024	4316	1172	
1f - U20 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	

Table 1: Savings All Climates, All Systems

Life Cycle Cost Analysis of 2018 WSEC: R406 Carbon Accounting Code Change Proposal

Dave Baylon, Consultant Chuck Murray, Washington State Department of Commerce April 2019

The following documentation provides a life cycle cost assessment of the R406 carbon accounting code change proposal. This proposal modifies sections R402.4.1.2, R403.3.7, R405.3, and R406 using a separately submitted code change proposal.

The life cycle cost approach presented builds on the methodology used in previous code development cycles. The assumptions and inputs for this analysis is summarized in the other attachments to this code change proposal, "Cost Documentation" and "Energy Savings Summary" The life cycle cost analysis was completed using the Office of Financial Management Life Cycle Cost Tool, as approved by the State Building Code Council on March 18, 2019.

The analysis was developed by Dave Baylon, Ecotope and Chuck Murray, Washington State Department of Commerce. Ecotope provided the first cost estimates and the energy savings analysis. Commerce incorporated the results into the life cycle cost tool.

Carbon Accounting Proposal:

The following outlines the process used to develop the R406 Carbon Accounting code change proposal. The proposal is based on the R406 change proposal submitted by the Department of Commerce and the Northwest Energy Code group including Henry Odum from Ecotope. This proposal provided the frame work and the underlying energy savings from which the carbon accounting adjustments to R406 and the R406 option table were developed. The Life Cycle Cost Analysis (LCCA) included here provides substantial documentation on the cost effectiveness of the revised table implemented to meet the revised standards in the R406 section.

The code change uses the carbon emission table developed in the Commercial Energy code and passed by the SBCC in 2018. This table is reproduced in the change proposal, but it has the effect of increasing the emissions of electricity assuming that much of the new resources that would be required would be supplied by gas. The table was a compromise that selected a value halfway between the carbon generated by a gas fired system (as advocated by the Northwest Gas Association) and the actual current average generated by the State of Washington based on the 2016 electric generation system. This compromise has the effect of making electricity about 50% higher emissions than gas and thus the value of savings from electricity is marginally higher than direct fire gas.

The code change proposal is composed of three parts:

- 1. A new table designed to equalize the impact of the initial fuel choices. This table provide credits or deductions depending on the initial fuel selection.
 - The table has been normalized to gas forced air heating since this approach represents upwards of 80% of the new residential construction in Washington. For that system there is

no adjustment from this table.

- Heat pump systems using the federal minimum performance standard (including the installation requirements in the WSEC are given a single credit reflecting the impact of the relatively high efficiency heat pump required.
- Homes using electric resistance (which are restricted in the current code to multifamily and single family attached) are given a 0.5 negative credit which has the effect of requiring an extra point from the option table to meet the requirements.
- Homes using a combination of electric resistance heating and Ductless Heat Pumps (in compliance with the current code) are given 0.5 points toward their requirements from the options table.
- 2. The second table is identical to the proposed code revision. The only change is the credits given to some HVAC and DHW measures specifically condensing gas furnaces and condensing gas water heaters were both reduced by 0.5 points to reflect the carbon emissions table. The target number of points remain the same as the basic R406 code change proposal.
- 3. The Proposal revises the performance path requirements by introducing the carbon emissions table from the commercial performance section. The requirements introduced with the options table are the identical except these factors must used the carbon emissions accounting in demonstrating compliance of a proposed design.

LCCA Analysis

There are 5 separate analysis done that form a complete picture of the costs and net present value of this approach:

- 1. A small home (less than 1500 SF) with a forced air gas heating system and Gas DHW.
- 2. A small home (less than 1500 SF) with an electric zonal system with a DHP and an electric DHW.
- A medium size gas home (2200 SF) with a forced air gas heating system. This prototype was run with both an gas DHW system (Alternative 2) and an Electric DHW system (Alternative 3). Identical points were generated from the option table but electric DHW option were used in the second case.
- 4. A medium size heat pump home (2200 SF) with a conventional heat pump that meets the federal minimum heat pump performance standards. This home includes an electric DHW system.
- 5. A multifamily unit (800 SF) evaluate as part of a three story prototype but normalized as a single unit. The unit has an electric zonal heating system and a electric DHW system.

These five runs are included below in order. All the options for these prototypes have a positive NPV. The packages of options selected differ from the alternative R406 proposal to reflect the changes in points included in the proposed option table and the proposed fuel equalization table.

Life Cycle Cost Analysis

Life Cycle Cost Analysis (LCCA) is an analytical technique capable of comparing the present value of upfront capital cost to future operational costs. The State Building Code Council has adopted the use of Washington State Department of Financial Managements (OFM) life cycle cost tool for this analysis. The OFM life cycle cost tool used to provide these results is based on the methodology of National Institute of Standards, HANDBOOK 135 Life-Cycle Costing Manual. The OFM model is designed for state projects and

commercial construction. This model was modified to support residential construction. This primarily required changing the fuel escalation rates from commercial to a residential standard.

Standard inputs for Life cycle cost on all the submitted documents are included in the table below. A user value has been used to reflect the values adopted by the Council in March of 2019. As a result of not using OFM inputs, there will be warnings on each page of the output. These may be disregarded for this analysis.

Key Variables	OFM	 User 	Value			
Building Life	50	50	50			
Real Discount Rate	0.53%	1.93%	1.93%			
Standard Maintenance Escalation	1.00%	1.00%	1.00%			
General Inflation	3.12%	3.01%	3.01%			
Study Period (years)	50	50	50			
Fuel Escalation Assumptions Located	l on Fuel Esca	alation Page				
User Inputs are for sensitivity analysis only, final	submissions	must be ma	de using OFI			
Timing Variables	Year(s)					
Base Year (Generally Current Year) 2020						
Additional Construction Years beyond 2020	0	1st Operatio	on Year = 20			

Finance 1st Purchases for ->	Baseline	Alt. 1	Alt. 2
Down Payment (%)	20%	20%	20%
Term (Years)	30	30	30
Nominal Interest Rate	5.00%	5.00%	5.00%
Real Interest Rate	1.82%	1.82%	1.82%

Life Cycle Cost Reports

Below are the results of life cycle cost calculations for 5 prototypes. Most prototypes include 5 pages of report. One prototype includes 6 pages.

- **Executive report:** This page summarizes the total life cycle cost results for three alternatives based on a 50 year life cycle cost assessment.
- **Baseline:** The baseline report describes the life cycle cost impost for a 2015 WSEC compliant structure. Each includes the number of credits that would be required to meet the 2015 WSEC.
- Alt 1. This report provides the inputs for the 2018 WSEC proposal. The cost and benefits included reflect the information detailed in this report.
- Alt 2. This report is based on the options required to meet the alternative points assigned as a result of the carbon accounting. The results of this accounting can be directly compared to the requirements of the 2015 code and to the results of the alternative R406 code change proposal.
- Alt3. This report is selected only for the medium Gas home and shows the impact of selecting an electric DHW option instead of the gas DHW option in Alt 2.
- **Expenditure Report.** We have included the results of the expenditure report for each project. This allows the reader to view the year over year cash flow for each model.

Small	Gas	Home
-------	-----	------

Key Analysis Var	Building Characteristics				
Study Period (years)	50	Gross (Sq.Ft)	1,344		
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	1,344		
Maintenance Escalation	1.00%	Space Efficiency	100.0%		
Zero Year (Current Year)	2020	Project Phase	0		
Construction Years	0	Building Type	0		

Life Cycle Cost Analysis BEST												
Alternative		Baseline	Alt. 2									
Energy Use Intenstity (kBtu/sq.ft)		39.4		32.6		28.8						
1st Construction Costs	\$	255	\$	1,803	\$	3,031						
PV of Capital Costs	\$	511	\$	3,406	\$	5,303						
PV of Maintenance Costs	\$	-	\$	-	\$	-						
PV of Utility Costs	\$	33,189	\$	28,908	\$	24,897						
Total Life Cycle Cost (LCC)	\$	33,701	\$	32,314	\$	30,200						
Net Present Savings (NPS)		N/A	\$	1,387	\$	3,500						

Societal LCC takes into consideration the social cost of carbon dioxide emissions caused by operational energy consumption

(GHG) Social Life Cycle Cost			BEST
GHG Impact from Utility Consumption	Baseline	Alt. 1	Alt. 2
Tons of CO2e over Study Period	197	170	147
% CO2e Reduction vs. Baseline	N/A	14%	25%
Present Social Cost of Carbon (SCC)	\$ 12,501	\$ 10,788	\$ 9,339
Total LCC with SCC	\$ 46,202	\$ 43,102	\$ 39,539
NPS with SCC	N/A	\$ 3,100	\$ 6,663

Warning: OFM Assigned Variables Not Used



Small Gas Home

<-	Primary Filter	(Requires Level 1)		Open Prim	ary Filter	and Click OK to Re-filter								
	Office of	f Financial Management		Show A	All Entere	d Units (Requires Re-Filte	r)							
	Olympia	, Washington - Version: 2018-Residen	ntial											
	Life Cvc	le Cost Analysis Tool												
										Water		Natural Gas	Г	
	Basel	ine Input Page			l otal B	uilding Annual Utility An	alysis	\$	857	(CCF)	Electricity (KWH)	(Therms)		
						Annual Utility I	Bill [\$]	-		(,	\$ 473	\$ 385	j T	
					An	nual Utility Consumption	Not Entered Belov	v			4,895	414	t	
						Sum of Annual Utility Cor	sumption Below			-		(52)	F	
						Total Annual Utility C	-	4,895	362					
_					A	nnual Utility Bill ÷ Total U	ş -	\$ 0.097	\$ 1.062	2				
.	11-36				Useful		1st Year	Total	Component	Annual	Annual	Annual		
H H		ormat II Elemental Classification for	RFF	# of Units	Life	Installed Cost	Maintenance	Inst	alled Cost	Water	Electricity	Natural Gas	A	
0	Bu	ildings (Building Component List)	1.21		(Yrs.)	(\$/Unit)	Cost (\$/Unit)		(5's)	(CCE/Unit)	(KWH/Unit)	(Therm/Unit)		
w					(0000 (0) 01110	<u> </u>	(\$ 2)	(00.701.07	((L	
	A 0.1.1	Primary Entries Below: # of Units must b	e>0t	o be counte	d; Useful	Life must be >= 2		Ş	255	Entries Belo	w for Component	Specific Utility Ana	1V	
	A Subst	ructure						-					⊢	
x	A101098	small gas nome carbon						-					⊢	
	D Snell	orr						-			<u> </u>		⊢	
	D Serviv	2015						-			<u> </u>		+	
	E Caula	.cs						-			<u> </u>		⊢	
	E Speci	al Construction & Demolition						-			<u> </u>		⊢	
	G Build	ing Sitework						-			<u> </u>		⊢	
-	X Other	Categories						<u> </u>					+	
×	X90 Other	Categories						-					⊢	
X	X9010 B	ilding Envelope	<u> </u>										⊢	
x	V901001	1a - 5% LIA reduc	0.5		50	\$766.60		-			5.00	-25.20	⊢	
x	X901001	1b - 15% UA reduc	1		50	\$2.640.16		<u> </u>			5.09	-23.30	⊢	
×	X901002	1c - 20% LIA reduc	2		50	\$2,049.10		<u> </u>			11.25	-08.72	⊢	
x	X901003	1d - U- 24 Glaze	0.5		50	\$94,000.00		-			1.55	-16.89	+	
*	X901005	1e - 40% LIA reduc	3		50	\$7.641.34		-			26.84	-134.84	+	
×	X901005	1f - II- 20 Glaze	1		50	\$1,814.40					5.67	-29.19	+	
-	X901007	2a - 3ACH fan eff	0.5		50	\$349.44		-			-52.18	-13.70	+	
-	X901008	2b - 2 ACH HRV	1		50	\$1.680.00		-			312.51	-20.42	t	
-	X901009	2c-15ACH HRV	15		50	\$3,763,20					203.35	-20.42	+	
- v	X901010	2d-0.6 ACH HRV	2		50	\$5,765.20		<u> </u>			203.55	-46.08	+	
-	X9020 H	/40	~		50	\$5,570.00		<u> </u>			204.50	40.00	+	
x	X902001	3a - Furnace	1	1	18	\$230.25		s	230		0.00	-40.92	t	
x	X902002	3b - 9.5 HSPF HP	0.5	-	15	\$1,270.00		Ť	2.50				+	
x	X902003	3c - GSHP	1.5		20	\$10,900.00							t	
×	X902004	3d - DHP	1		18	\$1,400.00							t	
×	X902005	3e - 11.0 HSPF HP	1		15	\$5,400.00		<u> </u>					t	
x	X902006	3f - DHP (15% elec)	1.5		18	\$5,400.00							t	
x	X902007	4 - HVAC inside	1		50	\$300.00					-10.81	-46.38	t	
x	X9030 H	ot Water											t	
x	X903001	5a - DWR	0.5		50	\$400.00					0.00	-16.86	t	
x	X903002	5b - 0.80 gas DHW	0.5		15	\$586.00					0.00	-22.20	t	
x	X903003	5c - 0.91 gas DHW, GSHP	1		15	\$923.00					0.00	-32.11	t	
x	X903004	5d - Tier I HPWH	1.5		15	\$874.00							t	
x	X903005	5e - Tier III HPWH	2		15	\$874.00							t	
x	X903006	5f - Tier III HPWH Split	2.5		15	\$3,500.00							F	
x	X9040 01	ther											t	
x	X904001	6 - Solar pV	0.5		25	\$5,040.00					-1262.00	0.00	T	
x	X904002	7 - HP dryers, ES Appl	0.5		15	\$452.00					-840.00	0.00	F	
x	X904003	(legacy) 5a - low flow fixtures	0.5	1	50	\$25.00		\$	25		0	-11		
	Z Other	Project Costs												
	Z10 One T	ime - Upfront Costs		1	50									
	Z30 Re-O	ccurring Annual Cost (Track Inflation)		1	1									

Small Gas Home

<-	Primary Fi	Iter (Requires Level 1)		Open Prim	ary Filter	and Click OK to Re-filter						
	Office	of Financial Management		o Manua	I Special	Selection Only (Requires F	Refilter)			1		
	Olym	pia. Washington - Version: 2018-Resident	tial	 Show E 	Baseline I	Fields and Entered Units (F						
		vole Cost Analysis Tool		C Show [Differenc	es Between Alternative an	nd Baseline (Reg. F	Refilter	r)			
	Life C							T	.,	Water	1	Natural Gas
	Alte	rnative 1 Input Page			Total B	uilding Annual Utility Ana	alysis	\$	746	(CCF)	Electricity (KWH)	(Therms)
						Annual Utility E	Bill [\$]	-		()	\$ 451	\$ 296
					Ar	nual Utility Consumption	Not Entered Below	N			4,727	403
						Sum of Annual Utility Con	-	(63)	(125)			
						Total Annual Utility C	-	4,664	278			
					A	nnual Utility Bill ÷ Total Ut	tility Consumption	1		\$ -	\$ 0.097	\$ 1.062
_	Note: N	o Units Assigned to a Component with Entries						-				
s	1	niformat II Elemental Classification for			Useful	In the line of Count	1st Year	Total	Component	Annual	Annual	Annual
н	1 0	Duildings (Duilding Component List)	REF	# of Units	Life	(¢ / Unit)	Maintenance	Inst	talled Cost	Water	Electricity	Natural Gas
0		Buildings (Building Component List)			(Yrs.)	(S/Onit)	Cost (\$/Unit)		(\$'s)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)
l w		Primary Entries Below: # of Units	must	be > 0 to be	e counte	d∙Useful Life must be >= 2)	-		Entries Belo	w for Component '	Specific Utility Anal
	Match Ba	seline: Filter to Select All & Drag Copy 014:S14 & U14:AG14			E counce			\$	1,803	Lindies Belo		pecare ounty rule
	A Su	bstructure										
	A101098	small gas home carbon										
	B Sh	ell										
	C In	teriors										
	D Se	rvices										
	E Eq	uipment & Furnishings										
	F Sp	ecial Construction & Demolition										
	G Bu	ilding Sitework										
	X Of	her Categories						-				
	X90 Ot	her Categories						-				
	X9010	Building Envelope	0.5		50	6766.60		-				
	X901001	1a - 5% UA reduc	0.5		50	\$766.60		-			5	-21
	X901002	10 - 15% UA reduc	- 1		50	\$2,649.16		-			Б	-5/
	X901003	1d - U- 20 Glaze	0.5		50	\$4,000.00		-				-99
\vdash	X901004	16 - 40% LIA reduc	3		50	\$7.641.34		-			27	-17
	X901005	1f - U- 20 Glaze	1		50	\$1,814.40		-			5	-100
	X901007	2a - 3ACH fan eff	05	1	50	\$349.44		5	349		-52	-12
	X901008	2b - 2 ACH, HRV	1		50	\$1,680.00		۴.	0.5		313	-20
	X901009	2c - 1.5 ACH, HRV	1.5		50	\$3,763.20					203	-33
	X901010	2d - 0.6 ACH, HRV	2		50	\$5,376.00					205	-46
	X9020	HVAC										
	X902001	3a - Furnace	1	1	18	\$230.25		\$	230			-38
	X902002	3b - 9.5 HSPF HP	0.5		15	\$1,270.00						
	X902003	3c - GSHP	1.5		20	\$10,900.00						
	X902004	3d - DHP	1		18	\$1,400.00		L				
	X902005	3e - 11.0 HSPF HP	1		15	\$5,400.00		-				
	X902006	3f - DHP (15% elec)	1.5	1	18	\$5,400.00		6	200		11	42
	X902007	Hot Water	1	1	50	\$300.00		<u> </u>	500		-11	-40
	X002001	5a - DWP	0.5		50	\$400.00		-				-17
	X903001	5b - 0.80 gas DHW	0.5		15	\$586.00		-				-17
	X903003	5c - 0.91 gas DHW, GSHP	1.5	1	15	\$923.00		5	923			-32
	X903004	5d - Tier I HPWH	1.5		15	\$874.00		Ľ.				
	X903005	5e - Tier III HPWH	2		15	\$874.00						
	X903006	5f - Tier III HPWH Split	2.5		15	\$3,500.00						
	X9040	Other										
	X904001 6 - Solar pV 0.1		0.5		25	\$5,040.00					-1262	
	X904002	7 - HP dryers, ES Appl	0.5		15	\$462.00					-840	
	X904003 (legacy) 5a - low flow fixtures 0.5		0.5		50	\$25.00						-11
	Z Ot	her Project Costs										
	Z10 OI	ne Time - Upfront Costs		1	50							
	1Z30 Re	-Occurring Annual Cost (Track Inflation)		1	1							

Small Gas Home

e.	Primary Filter	r (Requires Level 1)		Open Prim	arv Filter	and Click OK to Re-filter							
	Office o	f Financial Management		O Manual Special Selection Only (Requires Refilter)									
	Olympia	Washington - Version: 2018-Deciden	tial	Show	Baseline	Fields and Entered Linits (1			
	Life Cur	le Cost Analysis Tool	uai	O Show	Differenc	es Between Alternative a							
	Life Cyc	ale Cost Analysis 1001		S SHOW	andrene	es servicen Alternative al			.,	Water	1	Natural Gas	Ŧ
	Alterr	native 2 Input Page		Total Building Annual Utility Analysis \$ 643						(CCF)	Electricity (KWH)	(Therms)	
						Annual Utility I	Bill [\$]	-			\$ 370	\$ 27	3
					Ar	nnual Utility Consumption	Not Entered Below	W			4,727	403	3
						Sum of Annual Utility Cor		- (898)	(146	٥Į			
						Total Annual Utility C	onsumption				3,829	257	4
	Note: No.I	Inite Assigned to a Component with Entries			A	nnual Utility Bill ÷ Total U	tility Consumption	1		\$	\$ 0.097	\$ 1.062	2
	NOLE. NO	billts Assigned to a Component with Endles						T			1		Т
S	Unif	format II Elemental Classification for			Useful	Installed Cost	1st Year	Total	Component	Annual	Annual	Annual	
	l Bu	uildinas (Buildina Component List)	REF	# of Units	Life	(\$/Unit)	Maintenance	Ins	talled Cost	Water	Electricity	Natural Gas	
w l	, v	5, 5, 1, ,			(Yrs.)		Cost (S/Unit)		(2.2)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)	
		Primary Entries Below: # of Units	s mus	t be > 0 to b	e counte	d; Useful Life must be >= 2	2			Entries Belo	w for Component	Specific Utility An	al
	Match Baseli	ine: Filter to Select All & Drag Copy O14:S14 & U14:AG14						\$	3,031			L	4
-	A Subs	tructure						-					+
\vdash	A101098	small gas nome carbon						-					+
\vdash	C Inter	lore						-					+
	D Servi	(PS						-					+
	E Equir	oment & Furnishings						-			+		+
	F Speci	al Construction & Demolition											1
	G Build	ing Sitework											1
	X Othe	r Categories											1
	X90 Othe	r Categories											Ι
	X9010 B	uilding Envelope											1
	X901001	1a - 5% UA reduc	0.5	1	50	\$766.60		\$	767		5	-21	1
	X901002	1b - 15% UA reduc	1		50	\$2,649.16		-			6	-57	4
	X901003	1c - 30% UA reduc	2		50	\$4,868.68		-			11	-99	+
	X901004	10 - U24 Glaze	0.5	<u> </u>	50	\$907.20		-			2	-1/	+
	X901005	1f - Us 20 Claze	1		50	\$7,041.34		-				-135	+
	X901000	2a - SACH fan eff	0.5	1	50	\$349.44		<	349		-52	-23	+
	X901008	2b - 2 ACH HRV	1		50	\$1 680 00		Ľ	545		313	-20	+
	X901009	2c - 1.5 ACH, HRV	1.5		50	\$3,763.20		-			203	-33	+
	X901010	2d - 0.6 ACH, HRV	2		50	\$5,376.00					205	-46	1
	X9020 H	VAC											1
	X902001	3a - Furnace	0.5	1	18	\$230.25		\$	230			-38	T
	X902002	3b - 9.5 HSPF HP	0.5		15	\$1,270.00							Ι
	X902003	3c - GSHP	1.5		20	\$10,900.00							1
	X902004	3d - DHP	1		18	\$1,400.00		_					4
	X902005	3e - 11.0 HSPF HP	1		15	\$5,400.00		-					+
	X902006	3T - DHP (15% elec)	1.5	- 1	18	\$5,400.00		6	200		11	42	+
\vdash	X902007	4 - HVAC INSIDE	1		50	\$500.00		3	500		-11	-45	+
\vdash	X903001	5a - DWR	0.5		50	\$400.00		-				-17	+
	X903002	5b - 0.80 gas DHW	0.5		15	\$586.00		-				-17	+
	X903003	5c - 0.91 gas DHW, GSHP	1	1	15	\$923.00		\$	923			-32	+
	X903004	5d - Tier I HPWH	1.5		15	\$874.00		Ľ.					†
	X903005	5e - Tier III HPWH	2		15	\$874.00							t
	X903006	5f - Tier III HPWH Split	2.5		15	\$3,500.00							T
	X9040 O	ther											I
	X904001	6 - Solar pV	0.5		25	\$5,040.00					-1262		T
	X904002	7 - HP dryers, ES Appl	0.5	1	15	\$462.00		\$	462		-840		1
	X904003	(legacy) 5a - low flow fixtures	0.5		50	\$25.00						-11	1
	Z Othe	r Project Costs											4
	210 One	Time - Uptront Costs		1	50				_				4
1.00	1/30 IRe-O	cruiting Annual Lost (Track Inflation)						1.1					41

Small Gas Home Expenditure Report Page In Constant 2020 \$'s

-

	С	umulative	e E>	kpenditur	e S	ummary		Annual E	хр	enditure	Su	mmary
Year		Baseline		Alt. 1		Alt. 2		Baseline		Alt. 1		Alt. 2
2020	\$	51	\$	361	\$	606	\$	51	\$	361	\$	606
2021	\$	926	\$	1,202	\$	1,405	\$	875	\$	841	\$	799
2022	\$	1,807	\$	2,047	\$	2,204	\$	881	\$	845	\$	799
2023	\$	2,697	\$	2,898	\$	3,007	\$	890	\$	852	\$	802
2024	\$	3,630	\$	3,783	\$	3,837	\$	933	\$	884	\$	830
2025	\$	4,592	\$	4,689	\$	4,684	\$	962	\$	906	\$	847
2026	\$	5,563	\$	5,601	\$	5,534	\$	971	\$	913	\$	850
2027	\$	6,547	\$	6,524	\$	6,390	\$	984	\$	922	\$	857
2028	\$	7,536	\$	7,449	\$	7,247	\$	989	\$	925	\$	857
2029	\$	8,536	\$	8,382	\$	8,109	\$	1,001	\$	933	\$	862
2030	\$	9,546	\$	9,320	\$	8,974	\$	1,009	\$	938	\$	865
2031	\$	10,559	\$	10,261	\$	9,840	\$	1,014	\$	941	\$	865
2032	\$	11,578	\$	11,205	\$	10,705	\$	1,018	\$	944	\$	866
2033	\$	12,601	\$	12,151	\$	11,572	\$	1,023	\$	946	\$	866
2034	Ś	13.632	Ś	13.103	Ś	12.441	Ś	1.031	Ś	952	Ś	870
2035	Ś	14.668	Ś	14.981	Ś	14.697	Ś	1.036	Ś	1.878	Ś	2.255
2036	Ś	15,707	Ś	15,937	Ś	15.567	Ś	1.039	Ś	956	Ś	870
2037	Ś	16 747	Ś	16 891	Ś	16 434	Ś	1 039	Ś	954	Ś	867
2038	Ś	18 024	Ś	18 082	Ś	17 535	Ś	1 278	Ś	1 190	Ś	1 101
2030	Ś	19,024	Ś	19 045	Ś	18 407	Ś	1,270	Ś	963	Ś	872
2035	¢ ¢	20 133	ې د	20 009	ې د	19 279	Ś	1,052	ې د	964	ې د	872
2040	¢ ¢	20,100	¢	20,003	¢	20 152	¢	1,050	¢	968	¢	872
2041	¢	21,155	ې د	20,577	ې د	20,132	¢	1,000	ې د	960	ې د	873
2042	ې د	22,237	ې د	21,540	ې د	21,020	¢	1,004	ې د	972	ې د	875
2043	¢ ¢	23,320	¢	22,510	¢	21,301	¢	1,003	¢	97/	¢	875
2044	¢	24,556	ې د	23,852	ç	22,770	¢	1,072	ې د	977	ې د	873
2045	¢	25,475	ې د	24,805	ç	23,035	¢	1,077	ې د	979	ې د	877
2040	ې د	20,550	ې د	25,040	ې د	24,550	¢	1,081	ې د	985	ې د	882
2047	ې د	27,043	ې د	20,835	ې د	25,411	¢	1,085	ې د	98/	ې د	879
2040	ې د	20,735	ې د	27,810	ې د	20,231	¢	1,005	ې د	986	ې د	875
2045	¢	20,020	ې د	20,002	ې د	27,171	¢	1,000	ې د	1 012	ې د	2 267
2050	ې د	30,923	ې د	21 660	ې د	29,438	ې د	1,097	ې د	1,912	ې د	2,207
2051	ې د	32,019	ې د	22 627	ې د	31,086	ې د	1,090	ې د	955	ې د	825
2052	ې د	24 222	ې د	22,027	ې د	21 014	ې د	1,100	ې د	958	ې د	020
2053	ې د	25 222	ې د	24 555	ې د	22 7/6	ې د	1,104	ې د	902	ې د	820
2055	¢	36,445	ې د	35 524	ې د	33 580	¢	1,100	ې د	969	ې د	835
2055	¢	27 702	ې د	26 727	ې د	34,648	¢	1,115	ې د	1 203	ې د	1 068
2050	ې د	29 012	ې د	27 702	ې د	25 490	ې د	1,347	ې د	1,203	ې د	2,008
2037	ې د	40.029	ې د	20 602	ې د	26 224	ې د	1,121	ې د	970	ې د	841
2038	ې د	40,038	ې د	20,667	ې د	27 1 21	ې د	1,123	ې د	980	ې د	044
2039	ې د	41,100	ې د	40 654	ې د	29 021	ç	1,130	ې د	<u> </u>	ې د	047
2000	ې د	42,502	ې د	40,034	ې د	20 005	ې د	1,134	ې د	907	ې د	830
2001	ې د	43,440	ې د	41,043	ې د	20,003	ې د	1,130	ې د	991	ې د	0J4 9E7
2002	ې د	44,382	ې د	42,039	ې د	40 601	ې د	1,142	ې د	994	ې د	860
2003	ې د	45,728	ې د	43,037	ې د	40,001	ې د	1,140	ې د	1 002	ې د	000
2064	ې د	46,879	Ş	44,639	Ş	41,464	Ş	1,151	Ş	1,002	ې د	205
2065	ې د	48,034	Ş	46,567	ې د	43,/15	Ş	1,155	ې د	1,928	ڊ د	2,251
2066	ې د	49,193	Ş	47,576	Ş	44,584	Ş	1,159	ې د	1,009	ڊ د	869
2067	Ş	50,356	ې د	48,588	ې د	45,456	Ş	1,163	Ş	1,012	Ş	8/2
2068	ې د	51,523	ې د	49,604	Ş	46,332	Ş	1,16/	ې د	1,016	ې د	8/5
2069	Ş	52,695	Ş	50,624	Ş	47,210	Ş	1,1/2	Ş	1,020	Ş	8/9
2070	Ş	53,820	Ş	50,980	Ş	47,118	Ş	1,125	Ş	357	Ş	(93)

Small Zone I	Electric Home
--------------	---------------

Key Analysis Var	iables	Building Characteristics				
Study Period (years)	50	Gross (Sq.Ft)	1,344			
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	1,344			
Maintenance Escalation	1.00%	Space Efficiency	100.0%			
Zero Year (Current Year)	2020	Project Phase	0			
Construction Years	0	Building Type	0			

Life Cycle Cost Analysis	 BEST							
Alternative	Baseline		Alt. 1		Alt. 2			
Energy Use Intenstity (kBtu/sq.ft)	24.6		16.4		19.7			
1st Construction Costs	\$ 1,425	\$	3,852	\$	2,623			
PV of Capital Costs	\$ 2,983	\$	7,358	\$	5,461			
PV of Maintenance Costs	\$ -	\$	-	\$	-			
PV of Utility Costs	\$ 36,467	\$	24,279	\$	29,239			
Total Life Cycle Cost (LCC)	\$ 39,451	\$	31,637	\$	34,700			
Net Present Savings (NPS)	N/A	\$	7,813	\$	4,750			

Societal LCC takes into consideration the social cost of carbon dioxide emissions caused by operational energy consumption

(GHG) Social Life Cycle Cost		BEST	
GHG Impact from Utility Consumption	Baseline	Alt. 1	Alt. 2
Tons of CO2e over Study Period	199	133	160
% CO2e Reduction vs. Baseline	N/A	33%	20%
Present Social Cost of Carbon (SCC)	\$ 12,658	\$ 8,427	\$ 10,149
Total LCC with SCC	\$ 52,109	\$ 40,065	\$ 44,849
NPS with SCC	N/A	\$ 12,044	\$ 7,259

Warning: OFM Assigned Variables Not Used



Small Zone Electric Home

<-	Primary	Filter (Requires Level 1)		Open Prima	ary Filter	and Click OK to Re-filter						
	Offic	e of	Financial Management		Show A	All Entere	d Units (Requires Re-Filter						
	Olvm	nnia	Washington - Version: 2018-Residen	tial									
	Life	Cycl	e Cost Analysis Tool	- Chan									
			e cost Analysis 1001								Water		Natural Gas
	Bas	seli	ne Input Page			Total B	uilding Annual Utility An	alysis	\$	936	(CCF)	Electricity (KWH)	(Therms)
						Annual Utility Bill [\$]						\$ 936	\$ -
						An	nual Utility Consumption	Not Entered Belov	v			11,734	
							Sum of Annual Utility Con	sumption Below			-	(2,050)	-
							Total Annual Utility C	onsumption			-	9,684	-
						A	nnual Utility Bill ÷ Total Ut I	liity Consumption	1		\$ -	5 0.097	\$ -
s	Ι ι	Unifo	rmat II Elemental Classification for			Useful	Installed Cost	1st Year	Total	Component	Annual	Annual	Annual
H		Bui	Idinas (Building Component List)	REF	# of Units	Life	(\$/Unit)	Maintenance	Ins	talled Cost	Water	Electricity	Natural Gas
		Dui	langs (Balang Component List)			(Yrs.)		Cost (\$/Unit)		(\$'s)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)
1"			Primary Entries Below: # of Units must be	e > 0 to	be counted	d; Useful	Life must be >= 2		\$	1,425	Entries Belo	w for Component	Specific Utility Ana
	A S	Substr	ucture										
x	A10109	98	Small Zone Electric										
	B	Shell											
	C	Interio	rs						-				
	0	Service	25						-				
	E	Equipn	nent & Furnishings						-			<u> </u>	
	G	Special	Sitework						-			<u> </u>	
	X	Other (Categories	-					-				
- x	X90	Other (Categories						-				
x	X9010	Bui	Iding Envelope										
x	X90100	01	1a - 5% UA reduc	0.5		50	\$766.60					-477	
x	X90100)2	1b - 15% UA reduc	1		50	\$2,649.16					-1034	
х	X90100)3	1c - 30% UA reduc	2		50	\$4,868.68					-1787	
x	X90100)4	1d - U24 Glaze	0.5		50	\$907.20					-315	
х	X90100)5	1e - 40% UA reduc	3		50	\$7,641.34					-2419	
x	X90100	06	1f - U20 Glaze	1		50	\$1,814.40		-			-541	
x	X90100	07	2a - 3ACH, fan eff	0.5		50	\$349.44		-			-313	
×	X90100	18	20 - 2 ACH, HRV	1 5		50	\$1,680.00		-			4	
X	X90100	10	20 - 0.5 ACH, HRV	2.5		50	\$5,763.20		-			-551	
×	X9020	LU I				50	\$3,370.00		-			-500	
×	X90200	01	3a - Furnace	1		18	\$230.25		-				
x	X90200)2	3b - 9.5 HSPF HP	0.5		15	\$1,270.00						
×	X90200	03	3c - GSHP	1.5		20	\$10,900.00						
х	X90200)4	3d - DHP	1	1	18	\$1,400.00		S	1,400		-1835	
х	X90200)5	3e - 11.0 HSPF HP	1		15	\$5,400.00						
x	X90200	06	3f - DHP (15% elec)	1.5		18	\$5,400.00					-1928	
x	X90200	07 4	4 - HVAC inside	1		50	\$300.00						
x	X9030	Hot	t water	0.5		50	£400.00		-			200	
x	X90300	22	5a - DWK	0.5		50	\$400.00		-			-322	
×	X90300	13	5c - 0.91 gas DHW GSHP	1		15	\$923.00		-				
×	X90300	14	5d - Tier I HPWH	15		15	\$874.00		-			-1236	
×	X90300)5	5e - Tier III HPWH	2		15	\$874.00					-1623	
x	X90300	06	5f - Tier III HPWH Split	2.5		15	\$3,500.00					-1836	
x	X9040	Oth	her										
x	X90400	01	6 - Solar pV	0.5		25	\$5,040.00					-1262.00	
x	X90400)2	7 - HP dryers, ES Appl	0.5		15	\$462.00					-840.00	
x	X90400	03	(legacy) 5a - low flow fixtures	0.5	1	50	\$25.00		\$	25		-215	
	Z	Other I	Project Costs										
	210	Une Ti	me - Uptront Costs		1	50							
1	1230 I	ne-ucc	surring Annual Cost (Track Inflation)		1	1							

Small Zone Electric Home

<- Primary Filter (Requires Level 1)			Open Prima	ary Filter	and Click OK to Re-filter						
Office of Financial M	anagement		C Manua	I Special	Selection Only (Requires F] [
Olympia, Washington - Version: 2018-Residential Show Baseline Fields and Entered Units (Requires Refilter)									1		
Life Cycle Cost Appl	reis Tool	- i - i - i - i - i - i - i - i - i - i	0 Show [lifference	ar Patwaan Altornative an	d Pasalina (Pag. P	ofiltor	-1			
Life Cycle Cost Anal			L SHOWL	Show Differences between Alternative and baseline (Neq. Reliter)							Network Con-
Alternative 1 li	nput Page			Total E	Building Annual Utility Ana	alysis	s	623	(CCF)	Electricity (KWH)	Natural Gas (Therms)
				Annual Utility Bill [\$]						\$ 623	\$-
				An	nual Utility Consumption	Not Entered Below	N			11,360	
			L		Sum of Annual Utility Con	sumption Below				(4,912)	-
			<u> </u>		Total Annual Utility C	onsumption			-	6,448	
Note: No Unite Assigned to	a Component with Entries			A	nnual Utility Bill ÷ Total Ut	tility Consumption			<u></u> ۲ -	\$ 0.097	۶ -
Note: No onita Assigned to	a component with Entries							Total			
Uniformat II Elem	ental Classification for			Useful	Installed Cost	1st Year	6	omponent	Annual	Annual	Annual
Buildings (Build	ing Component List)	REF	# of Units	Life	(S/Unit)	Maintenance	Ins	talled Cost	Water (CCF/Unit)	Electricity	Natural Gas
w				(Yrs.)		Cost (\$/Unit)		(\$'s)		(KWH/Unit)	(Therm/Unit)
	Primary Entries Below: # of Unit	s must	t be > 0 to b	e counte	d; Useful Life must be >= 2	2			Entries Belo	w for Component S	Specific Utility Ana
Match Baseline: Filter to Select Al	l & Drag Copy 014:514 & U14:AG14						\$	3,852			
A Substructure											
A101098 Small Zone Electr	ic										
B Shell							L				
C Interiors							-				
D Services							⊢				
E Equipment & Furnishing	<u>35</u>						-				
F Special Construction &	Demolition						⊢				
G Building Sitework							-				
X Other Categories							-				
X0010 Pullding Fausters							-				
V901001 1a - 5% UA reduc		0.5	1	50	\$766.60		c.	767		477	
V901002 1b - 15% UA reduc	c	1	-	50	\$2,649,16		13	767		-4//	
X901002 10-15% 04 redu	5	2		50	\$4,858,68		-			-1034	
X901004 1d - U- 24 Glaze		0.5		50	\$907.20		-			-315	
X901005 1e - 40% UA redu	¢	3		50	\$7.641.34		-			-2419	
X901006 1f - U20 Glaze	-	- 1		50	\$1,814.40		-			-454	
X901007 2a - 3ACH , fan ei	ff	0.5	1	50	\$349.44		s	349		-313	
X901008 2b - 2 ACH, HRV		1		50	\$1,680.00		<u> </u>			4	
X901009 2c - 1.5 ACH, HRV		1.5		50	\$3,763.20					-331	
X901010 2d - 0.6 ACH, HRV	ſ	2		50	\$5,376.00					-560	
X9020 HVAC											
X902001 3a - Furnace		1		18	\$230.25						
X902002 3b - 9.5 HSPF HP		0.5		15	\$1,270.00						
X902003 3c - GSHP		1.5		20	\$10,900.00						
X902004 3d - DHP		1	1	18	\$1,400.00		\$	1,400		-1659	
X902005 3e - 11.0 HSPF HP	-1	1		15	\$5,400.00		-			1000	
X902006 3t - DHP (15% ele	c)	1.5		18	\$5,400.00		⊢			-1928	
V9020 Hist Water		1		50	\$300.00		-				
V902001 5a DWP		0.5		50	\$400.00		⊢			222	
12903002 5b - 0.80 esc DHV	v	0.5		15	\$586.00		-			-522	
X903003 5c - 0.91 mm	V GSHP	1		15	\$923.00		-				
X903004 5d - Tier I HPWH		1.5		15	\$874.00		-			-1236	
X903005 Se - Tier III HPWH	1	2	1	15	\$874.00		5	874		-1623	
X903006 5f - Tier III HPWH	Split	2.5		15	\$3,500.00		Ľ.			-1836	
X9040 Other	-										
X904001 6 - Solar pV		0.5		25	\$5,040.00					-1262	
X904002 7 - HP dryers, ES /	Appl	0.5	1	15	\$462.00		\$	462		-840	
X904003 (legacy) 5a - low f	flow fixtures	0.5		50	\$25.00					-215	
Z Other Project Costs											
Z10 One Time - Upfront Cos	ts		1	50							
Z30 Re-Occurring Annual Co	st (Track Inflation)		1	1							

Small Zone Electric Home

ج.	Primary Filter	r (Requires Level 1)		Open Prim	ary Filter	and Click OK to Re-filter							
	Office o	f Financial Management		Manual Special Selection Only (Requires Refilter) Show Baseline Fields and Entered Units (Requires Refilter)									
	Olympia	a, Washington - Version: 2018-Resider	ntial										
	Life Cyc	le Cost Analysis Tool		O Show I	Differenc	es Between Alternative ar	nd Baseline (Req. F	Refilte	r)				
	Alterr	native 2 Input Page			Total B	uilding Annual Utility An	alysis	\$	750	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)	Τ
						Annual Utility E	Bill [\$]				\$ 750	\$	-
					An	nual Utility Consumption	Not Entered Below	N		-	· 11,360		
						Sum of Annual Utility Con	sumption Below				(3,595)	L	4
				L		Total Annual Utility C	onsumption				7,765	<u> </u>	4
	Note: No I	Unite Assigned to a Component with Entries			A	nnual Utility Bill ÷ Total Ut	tility Consumption	1		\$.	\$ 0.097	\$	-
s	Unif	format II Elemental Classification for	DEE	H = 6 =i+=	Useful	Installed Cost	1st Year	Total	Component	Annual	Annual	Annual	Ţ
6	Bu	uildings (Building Component List)	KEF	# or Units	(Vrc.)	(\$/Unit)	Cost (\$/Upit)	Ins	(\$'c)	(CCE/Lipit)	(KWH/Unit)	(Therm/Lloit)	
w					(115.)		Cost (3/ Onit)		(25)	(ccr/onit)	(KWH/OHIL)	(mennyonic)	\bot
		Primary Entries Below: # of Unit	s must	t be > 0 to b	e counte	d; Useful Life must be >= 2	2	1.6	2,622	Entries Belo	w for Component S	specific Utility An	al
_	Match Baseli	ine: Filter to Select All & Drag Copy O14:S14 & U14:AG14						>	2,623			l	+
	A Subst	tructure						-					+
	A101098	Small Zone Electric						-					+
	D Snell	lorg						-					+
	D Soni	lois						-					+
	E Equir	ament & Eurnichings	_					-					+
	E Speci	ial Construction & Demolition						-					+
	G Build	ling Sitework						-					+
	X Othe	r Categories	_										$^{+}$
	X90 Othe	r Categories											+
	X9010 B	uilding Envelope						-					$^{+}$
	X901001	1a - 5% UA reduc	0.5		50	\$766.60					-477		+
	X901002	1b - 15% UA reduc	1		50	\$2,649.16					-1034		1
	X901003	1c - 30% UA reduc	2		50	\$4,868.68					-1787		t
	X901004	1d - U24 Glaze	0.5		50	\$907.20					-315		T
	X901005	1e - 40% UA reduc	3		50	\$7,641.34					-2419		T
	X901006	1f - U20 Glaze	1		50	\$1,814.40					-454		T
	X901007	2a - 3ACH , fan eff	0.5	1	. 50	\$349.44		\$	349		-313		T
	X901008	2b - 2 ACH, HRV	1		50	\$1,680.00					4		T
	X901009	2c - 1.5 ACH, HRV	1.5		50	\$3,763.20					-331		Τ
	X901010	2d - 0.6 ACH, HRV	2		50	\$5,376.00					-560		Ι
	X9020 H	VAC											1
	X902001	3a - Furnace	1		18	\$230.25							
	X902002	3b - 9.5 HSPF HP	0.5		15	\$1,270.00		L					4
	X902003	3c - GSHP	1.5		20	\$10,900.00						ļ	4
	X902004	3d - DHP	1	1	18	\$1,400.00		\$	1,400		-1659		4
	X902005	36 - 11.0 HSPF HP	1		15	\$5,400.00		-			1020		+
	X902006	3T - DHP (15% elec)	1.5		18	\$5,400.00		-			-1928	l	+
	X902007	ot Water	1		50	\$300.00		-					+
	X9030 H		0.5		50	\$400.00		-			200		+
	X903001	5b - 0.80 gas DHW	0.5		15	\$586.00		-			-522		+
	X903002	5c - 0.91 gas DHW, GSHP	1		15	\$923.00		-					+
	X903004	5d - Tier I HPWH	15		15	\$874.00		-			-1236		+
	X903005	Se - Tier III HPWH	2.5	1	15	\$874.00		5	874		-1623		+
	X903006	5f - Tier III HPWH Solit	25	-	15	\$3 500 00		Ť	0/4		-1836		+
	X9040 0	ther	2.5		- 13	\$5,500.00		-			1000		+
	X904001	6 - Solar pV	0.5		25	\$5,040.00		-			-1262		+
	X904002	7 - HP dryers, ES Appl	0.5		15	\$462.00		-			-840		$^{+}$
	X904003	(legacy) 5a - low flow fixtures	0.5		50	\$25.00					-215		$^{+}$
	Z Othe	r Project Costs							_				t
	Z10 One 1	Time - Upfront Costs		1	50								T
	Z30 Re-O	ccurring Annual Cost (Track Inflation)		1	1								ſ

Small Zone Electric Home Expenditure Report Page In Constant 2020 \$'s

	С	umulative	e Ex	kpenditur	e S	ummary		Annual E	хр	enditure	Sui	mmary
Year		Baseline		Alt. 1		Alt. 2		Baseline		Alt. 1		Alt. 2
2020	\$	285	\$	770	\$	525	\$	285	\$	770	\$	525
2021	\$	1,302	\$	1,593	\$	1,414	\$	1,017	\$	823	\$	890
2022	\$	2,336	\$	2,423	\$	2,315	\$	1,034	\$	830	\$	901
2023	\$	3,387	\$	3,260	\$	3,228	\$	1,051	\$	837	\$	913
2024	\$	4,455	\$	4,104	\$	4,152	\$	1,068	\$	844	\$	924
2025	\$	5,541	\$	4,956	\$	5,089	\$	1,086	\$	852	\$	936
2026	\$	6,644	\$	5,815	\$	6,037	\$	1,103	\$	859	\$	948
2027	\$	7,764	\$	6,682	\$	6,997	\$	1,120	\$	867	\$	960
2028	\$	8,892	\$	7,551	\$	7,962	\$	1,128	\$	869	\$	965
2029	\$	10,028	\$	8,422	\$	8,931	\$	1,136	\$	871	\$	969
2030	\$	11,173	\$	9,294	\$	9,905	\$	1,144	\$	872	\$	974
2031	\$	12,325	\$	10,169	\$	10,883	\$	1,152	\$	874	\$	979
2032	\$	13,485	\$	11,045	\$	11,867	\$	1,160	\$	877	\$	983
2033	\$	14,653	\$	11,924	\$	12,855	\$	1,168	Ş	879	\$	988
2034	\$	15,830	\$	12,806	\$	13,848	\$	1,176	Ş	881	\$	993
2035	\$	17,015	\$	15,025	\$	15,721	\$	1,185	\$	2,220	\$	1,872
2036	\$	18,198	\$	15,905	\$	16,716	\$	1,183	\$	880	\$	996
2037	Ş t	19,380	Ş	16,782	Ş	17,710	Ş	1,182	Ş	876	Ş t	993
2038	Ş	21,970	Ş	19,061	Ş	20,108	Ş	2,590	Ş	2,279	Ş	2,399
2039	Ş	23,169	Ş	19,943	Ş	21,112	Ş	1,199	Ş	882	Ş	1,004
2040	Ş	24,366	Ş	20,821	Ş	22,114	Ş	1,197	Ş	879	Ş	1,002
2041	Ş	25,572	Ş	21,703	Ş	23,121	Ş	1,206	Ş	882	Ş	1,007
2042	\$ ¢	26,776	Ş	22,582	Ş	24,126	\$	1,205	Ş	879	Ş	1,005
2043	\$ ¢	27,990	Ş	23,464	Ş	25,137	\$	1,213	Ş	882	Ş	1,011
2044	Ş	29,202	Ş	24,343	Ş	26,145	Ş	1,212	Ş	879	Ş	1,009
2045	Ş	30,422	Ş	25,226	Ş	27,160	\$	1,221	Ş	883	Ş	1,014
2046	ې د	31,642	Ş	26,106	ې د	28,172	Ş	1,220	ې د	880	ې د	1,012
2047	ې د	32,870	ې د	20,969	ې د	29,190	Ş	1,220	Ş	004	ې د	1,018
2046	ې د	25 220	ې د	27,870	ې د	21 225	ې د	1,227	ې د	001	ې د	1,017
2049	ې د	26 561	ې د	20,731	ې د	22 110	ې د	1,230	ې د	2 217	ې د	1,010
2050	ې د	30,301	ې د	21 772	ې د	33,118	ç	1,233	ې د	2,217	ې د	1,893
2051	ې د	38,080	ې د	22 570	ې د	35,058	ې د	1,207	ې د	804	ې د	908
2052	ې د	38,980 40 195	ې د	33 388	ې د	36,032	ې د	1,211	ې د	800	ې د	971
2055	ې د	40,133	ې د	34 199	ې د	37,010	¢	1,219	ې د	812	ې د	977
2055	Ś	42,637	Ś	35,014	Ś	37,990	Ś	1,223	Ś	814	Ś	981
2056	Ś	45,263	Ś	37,230	Ś	40.374	Ś	2,627	Ś	2.217	Ś	2.384
2057	\$	46.494	\$	38.050	\$	41.360	\$	1.231	\$	819	\$	987
2058	Ś	47.729	Ś	38.872	Ś	42.350	\$	1.234	Ś	822	Ś	990
2059	Ś	48.967	Ś	39.696	Ś	43,343	\$	1.238	Ś	824	Ś	993
2060	Ś	50.209	Ś	40.523	Ś	44.339	Ś	1.242	Ś	827	Ś	996
2061	\$	51,455	\$	41,353	\$	45,338	\$	1,246	\$	830	\$	999
2062	\$	52,705	\$	42,185	\$	46,340	\$	1,250	\$	832	\$	1,002
2063	\$	53,959	\$	43,020	\$	47,346	\$	1,254	\$	835	\$	1,005
2064	\$	55,217	\$	43,857	\$	48,354	\$	1,258	\$	837	\$	1,008
2065	\$	56,478	\$	46,033	\$	50,239	\$	1,261	\$	2,176	\$	1,885
2066	\$	57,743	\$	46,875	\$	51,254	\$	1,265	\$	842	\$	1,015
2067	\$	59,013	\$	47,720	\$	52,272	\$	1,269	\$	845	\$	1,018
2068	\$	60,286	\$	48,568	\$	53,292	\$	1,273	\$	848	\$	1,021
2069	\$	61,563	\$	49,418	\$	54,316	\$	1,277	\$	850	\$	1,024
2070	\$	62,532	\$	49,069	\$	54,449	\$	970	\$	(349)	\$	133

Medium	Gas	Home
--------	-----	------

Key Analysis Var	Building Ch	aracteristics	
Study Period (years)	50	Gross (Sq.Ft)	2,200
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	2,200
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	31.1	25.5	22.8
1st Construction Costs	\$ 1,737	\$ 3,620	\$ 9,312
PV of Capital Costs	\$ 2,974	\$ 5,517	\$ 11,138
PV of Maintenance Costs	\$ -	\$ -	\$ -
PV of Utility Costs	\$ 40,603	\$ 32,869	\$ 31,369
Total Life Cycle Cost (LCC)	\$ 43,576	\$ 38,387	\$ 42,507
Net Present Savings (NPS)	N/A	\$ 5,190	\$ 1,069

Societal LCC takes into consideration the social cost of carbon dioxide emissions caused by operational energy consumption

(GHG) Social Life Cycle Cost	BEST								
GHG Impact from Utility Consumption		Baseline		Alt. 1		Alt. 2			
Tons of CO2e over Study Period		244		198		186			
% CO2e Reduction vs. Baseline		N/A		19%		29%			
Present Social Cost of Carbon (SCC)	\$	15,456	\$	12,539	\$	11,827			
Total LCC with SCC	\$	59,033	\$	50,925	\$	54,334			
NPS with SCC		N/A	\$	8,107	\$	4,698			

Warning: OFM Assigned Variables Not Used



Medium Gas Home DHWe

Key Analysis Var	Building Characteristics				
Study Period (years)	50	Gross (Sq.Ft)	2,200		
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	2,200		
Maintenance Escalation	1.00%	Space Efficiency	100.0%		
Zero Year (Current Year)	2020	Project Phase	0		
Construction Years	0	Building Type	0		

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 3	
Energy Use Intenstity (kBtu/sq.ft)	31.1	21.3	
1st Construction Costs	\$ 1,737	\$ 3,371	\$ -
PV of Capital Costs	\$ 2,974	\$ 4,991	\$ -
PV of Maintenance Costs	\$ -	\$ -	\$ -
PV of Utility Costs	\$ 40,603	\$ 32,511	\$ -
Total Life Cycle Cost (LCC)	\$ 43,576	\$ 37,502	\$ -
Net Present Savings (NPS)	N/A	\$ 6,074	\$ -

Societal LCC takes into consideration the social cost of carbon dioxide emissions caused by operational energy consumption

(GHG) Social Life Cycle Cost	 	 BEST	
GHG Impact from Utility Consumption	Baseline	Alt. 3	
Tons of CO2e over Study Period	244	190	
% CO2e Reduction vs. Baseline	N/A	22%	
Present Social Cost of Carbon (SCC)	\$ 15,456	\$ 12,029	
Total LCC with SCC	\$ 59,033	\$ 49,531	\$ -
NPS with SCC	N/A	\$ 9,502	\$ _

Warning: OFM Assigned Variables Not Used MAJOR ERROR ON:

Alt. 2



<-	Primary	/ Filter	(Requires Level 1)		Open Prima	ary Filter	and Click OK to Re-filter							
	Offi	ce of	f Financial Management		Show A	All Entere	d Units (Requires Re-Filter		1					
	Olyr	mpia	, Washington - Version: 2018-Residen	tial										
	Life	Cvc	le Cost Analysis Tool											
	Ba	sel	ine Input Page			Total B	uilding Annual Utility An	alysis	s	1,050	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)	T
							Annual Utility E	Bill [\$]				\$ 516	\$ 534	ŧ
						An	nual Utility Consumption	Not Entered Belov	v			5,390	670	J
							Sum of Annual Utility Con	sumption Below			-	(52)	(167)	4
							Total Annual Utility C	onsumption				5,338	503	3
	-					A	nnuai Utility Bill ÷ Total Ut I	liity Consumption	<u> </u>		\$ -	\$ 0.097	S 1.062	4
s		Unif	ormat II Elemental Classification for			Useful	Installed Cost	1st Year	Total	Component	Annual	Annual	Annual	L
H		Bu	ildings (Building Component List)	REF	# of Units	Life	(\$/Unit)	Maintenance	Inst	alled Cost	Water	Electricity	Natural Gas	ľ
1 w			indinge (Bananig Compensite Liet)			(Yrs.)	(4) =,	Cost (\$/Unit)		(S's)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)	
			Primary Entries Below: # of Units must be	e > 0 to	o be counte	d; Useful	Life must be >= 2		\$	1,737	Entries Belo	w for Component S	pecific Utility Ana	al
	A	Subst	ructure											4
x	A1010	098	Medium Home - Gas carbon											+
	B	Shell												+
	n	Servio												+
	E	Fauio	ment & Furnishings											t
	F	Speci	al Construction & Demolition											t
	G	Buildi	ng Sitework											t
×	Х	Other	Categories											Ι
×	X90	Other	Categories											1
x	X9010) Bu	ilding Envelope											4
×	X9010	001	1a - 5% UA reduc	0.5		50	\$1,171					5.25	-41.39	4
x	X9010	002	10 - 15% UA reduc	1		50	\$4,568		<u> </u>			5.15	-99.81	+
×	X9010	103	1d - U- 24 Glaze	2		50	\$1.661					11.51	-106.76	+
- ×	X9010	005	1e - 40% UA reduc	3		50	\$12 569					30.42	-228.96	t
×	X9010	006	1f - U20 Glaze	1		50	\$3,323					6.96	-61.76	t
×	X9010	007	2a - 3ACH , fan eff	0.5	1	50	\$533		\$	533		-51.66	-38.63	t
×	X9010	008	2b - 2 ACH, HRV	1		50	\$2,829					313.45	-56.09	T
×	X9010	009	2c - 1.5 ACH, HRV	1.5		50	\$6,338					203.87	-75.40	I
x	X9010	010	2d - 0.6 ACH, HRV	2		50	\$9,054					204.90	-99.77	4
×	X9020		/AC				6000		6			0.00	70.77	+
x	X9020	201	3a - Furnace 3b - 0.5 HSDE HD	1	1	20	\$230		>	230		0.00	-/2.//	+
×	X9020	002	3c - GSHP	15		20	\$10,900							t
×	X9020	004	3d - DHP	1		18	\$1,400							t
×	X9020	005	3e - 11.0 HSPF HP	1		15	\$5,400							t
x	X9020	006	3f - DHP (15% elec)	1.5		18	\$5,400							I
×	X9020	007	4 - HVAC inside	1		50	\$300					-13.26	-60.11	1
x	X9020	008	Other											4
x	X9020	J09 110	Other						<u> </u>					+
×	X9020) H	t Water											+
×	X9030	001	5a - DWR	0.5		50	\$400					0.00	-19.23	+
×	X9030	002	5b - 0.80 gas DHW	0.5		18	\$586					0.00	-24.41	t
x	X9030	003	5c - 0.91 gas DHW, GSHP	1	1	18	\$923		\$	923		0.00	-39.62	t
×	X9030	004	5d - Tier I HPWH	1.5		18	\$874							Ι
x	X9030	005	5e - Tier III HPWH	2		18	\$874							4
×	X9030	006	5f - Tier III HPWH Split	2.5		18	\$3,500		<u> </u>					4
x	X9030	J07	Other						<u> </u>					+
×	X0020	008	Other						-					+
×	X9030	010	Other						-					t
×	X9040	0 01	ther											t
×	X9040	001	6 - Solar pV	0.5		50	\$5,040					-1262.00	0.00	t
x	X9040	002	7 - HP dryers, ES Appl	0.5		15	\$462					-840.00	0.00	T
×	X9040	003	(legacy) 5a - low flow fixtures	0.5	1	50	\$50		\$	50		0	-16	ſ
	Z	Other	Project Costs											4
	Z10	One T	Ime - Upfront Costs		1	50								4
1	1230	TRE-OC	curring Annual Cost (Track Inflation)		1	1								4

<- Pr	imary Fi	Iter (Requires Level 1)		Open Prim	ary Filte	r and Click OK to Re-filter							
	Office	of Financial Management		O Manua	al Special	Selection Only (Requires							
	Olvm	pia. Washington - Version: 2018-Resident	tial	 Show I 	Baseline	Fields and Entered Units (Requires Refilter)						
		vole Cost Analysis Tool		O Show I	Differenc	es Between Alternative a	nd Baseline (Reg.)	Refilter)					
	Life G	ycle cost Analysis Tool					in pasenine (riedi.	1		Water		Natural Car	T
	Alte	rnative 1 Input Page			Total E	Building Annual Utility An	alysis	\$	850	(CCE)	Electricity (KWH)	(Therms)	
				<u> </u>		Annual Utility	Bill (\$1	-		(001)	\$ 407	7 5 44	3
					Ar	nual Utility Consumption	Not Entered Belo	w			5.115	65/	4
						Sum of Annual Utility Cor	sumption Below			-	(899	(237	n -
						Total Annual Utility C	onsumption			-	4,216	417	7
					A	nnual Utility Bill ÷ Total U	tility Consumptior	۱		\$ -	\$ 0.097	/\$ 1.062	2
	Note: N	o Units Assigned to a Component with Entries											_
s		niformat II Elemental Classification for			Useful	In the line of Court	1st Year	Total C	Component	Annual	Annual	Annual	
н	0	Buildings (Building Component List)	REF	# of Units	Life	(\$/Linit)	Maintenance	Insta	lled Cost	Water	Electricity	Natural Gas	Ar
0		Buildings (Building Component List)			(Yrs.)	(3/0111)	Cost (\$/Unit)	1	(\$'s)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)	
1		Primary Entries Below: # of Units	must	t be > 0 to b	e counte	d: Useful Life must be >= :	2			Entries Belo	w for Component	Specific Utility An	alvs
	Match Ba	seline: Filter to Select All & Drag Copy O14:S14 & U14:AG14						\$	3,620				T
	A Si	bstructure											T
	A101098	Medium Home - Gas carbon											T
	B Sł	ell											
	C In	teriors										L	\perp
	D Se	rvices											+
	E Ec	uipment & Furnishings									<u> </u>		+
	F Sp	ecial Construction & Demolition						<u> </u>			<u> </u>		+
H;		har Catagories						-			<u> </u>		+
H;		her Categories						-			<u> </u>	<u> </u>	+
H,	X90 10	Building Envelope						<u> </u>			<u> </u>	<u> </u>	+
	X901001	1a - 5% LIA reduc	0.5	1	50	\$1 171		5	1 171		5	-35	+
	X901002	1b - 15% UA reduc	1	-	50	\$4,568		۴,	2,272		5	-100	+
	X901003	1c - 30% UA reduc	2		50	\$8,417					12	-169	+
	X901004	1d - U24 Glaze	0.5		50	\$1,661					1	-36	+
	X901005	1e - 40% UA reduc	3		50	\$12,569					30	-229	T
	X901006	1f - U20 Glaze	1		50	\$3,323					7	-62	
2	X901007	2a - 3ACH , fan eff	0.5	1	50	\$533		\$	533		-52	-43	
2	X901008	2b - 2 ACH, HRV	1		50	\$2,829					313	-48	
	X901009	2c - 1.5 ACH, HRV	1.5		50	\$6,338					204	-75	1
	X901010	2d - 0.6 ACH, HRV	2		50	\$9,054		-			205	-100	+
	X9020	[HVAC									<u> </u>		+
	X902001	3d - FUMACE	0.5	1	20	\$230		\$	230		<u> </u>	-70	+
	X902002	30 - 9.5 H3PF HP	1.5		20	\$270		-			<u> </u>		+
H,	X902003	3d - DHP	1.5		18	\$1,500		<u> </u>			<u> </u>	<u> </u>	+
H,	X902004	3e - 11 0 HSPE HP	1		15	\$5,400							+
	X902006	3f - DHP (15% elec)	1.5		18	\$5,400		<u> </u>					+
	X902007	4 - HVAC inside	1	1	50	\$300		\$	300		-12	-54	+
	X902008	Other				,		<u> </u>					T
	X902009	Other											T
	X902010	Other											
2	X9030	Hot Water											
	X903001	5a - DWR	0.5		50	\$400						-19	
	X903002	5b - 0.80 gas DHW	0.5		18	\$586						-24	+
	X903003	5c - 0.91 gas DHW, GSHP	1.5	1	18	\$923		\$	923			-36	+
	X903004	5d - Tier I HPWH	1.5		18	\$874		_			<u> </u>		+
\mathbb{H}^{2}	A903005	De - HEF III HPWH Sf Tier III HDWH Solit	2		18	\$874		-					+
\parallel	V005009	51 - Her III HEWH Split	2.5		18	\$3,500		-					+
	v203001	Other						-					+
H.	X903009	Other						-					+
	X903010	Other						L					+
	X9040	Other						-					+
	X904001	6 - Solar pV	0.5		50	\$5.040					-1262		+
	X904002	7 - HP dryers, ES Appl	0.5	1	15	\$462		\$	462		-840		T
	X904003	(legacy) 5a - low flow fixtures	0.5		50	\$50						-16	T
	Z O	her Project Costs											
	Z10 0	ne Time - Upfront Costs		1	50								
	Z30 Re	-Occurring Annual Cost (Track Inflation)		1	1								

<- Primary Filter (Requires Level 1) Office of Financial Management	Open Prim O Manua	a <mark>ry Filter</mark> I Special	and Click OK to Re-filter Selection Only (Requires F	Refilter)					
Olympia, Washington - Version: 2018-Residential	 Show I 	Baseline f	Fields and Entered Units (F	Requires Refilter)					
Life Cycle Cost Analysis Tool	O Show I	Differenc	es Between Alternative an	nd Baseline (Req. F	Refilter)			
Alternative 2 Input Page		Total B	Building Annual Utility Ana	alysis	\$	810	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
			Annual Utility B	Sill [\$]	· · ·			\$ 443	\$ 368
		An	nual Utility Consumption	Not Entered Belov	N		-	5,115	654
	L		Sum of Annual Utility Con	sumption Below			-	(533)	(308)
	<u> </u>	Δ	nnual Litility Bill – Total Lit	ility Consumption				4,582	\$ 1.052
Note: No Units Assigned to a Component with Entries			indui otinty bin i rotai ot	anty consumption			Ş	0.057	5 1.002
S Uniformat II Elemental Classification for Buildings (Building Component List)	# of Units	Useful Life (Yrs.)	Installed Cost (S/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Inst	Component alled Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)
Primary Entries Below: # of Units mu	t be > 0 to b	e counte	d: Useful Life must be >= 2		-		Entries Belo	w for Component S	pecific Utility Ana
Match Baseline: Filter to Select All & Drag Copy O14:514 & U14:AG14					\$	9,312			
. A Substructure									
A101098 Medium Home - Gas carbon									
B Shell									
C Interiors					L				
U Services					—				
E Equipment & Furnishings					<u> </u>				
Special Construction & Demolition G Ruilding Sitework					<u> </u>				
X Other Categories					-				
X90 Other Categories	<u> </u>								
X9010 Building Envelope					-				
X901001 1a - 5% UA reduc 0.	5	50	\$1.171					5	-35
X901002 1b - 15% UA reduc	1 1	50	\$4,568		\$	4,568		5	-100
X901003 1c - 30% UA reduc	2	50	\$8,417					12	-169
X901004 1d - U24 Glaze 0.1	5	50	\$1,661					1	-36
X901005 1e - 40% UA reduc	3	50	\$12,569					30	-229
X901006 1f - U20 Glaze	1	50	\$3,323					7	-62
X901007 2a - 3ACH , fan eff 0.	5	50	\$533					-52	-43
X901008 2b - 2 ACH, HRV	1 1	50	\$2,829		\$	2,829		313	-48
X901009 2C-1.5 ACH, HRV 1.		50	\$5,338		<u> </u>			204	-/5
X901010 20-0.6 ACH, HKV		50	\$9,034		<u> </u>			205	-100
X902001 3a - Euroace 01	5 1	20	\$230		4	230			-70
X902002 3b - 9.5 HSPF HP 0.1	5	15	\$270		Ľ	2.50			
X902003 3c - GSHP 1.	5	20	\$10,900						
X902004 3d - DHP	1	18	\$1,400						
X902005 3e - 11.0 HSPF HP	1	15	\$5,400						
X902006 3f - DHP (15% elec) 1.	5	18	\$5,400						
X902007 4 - HVAC inside	1 1	50	\$300		\$	300		-12	-54
X902008 Other					<u> </u>				
X902009 Other									
V9030 Hot Water					-				
X903001 5a - DWR 01	5	50	\$400		<u> </u>				-19
X903002 5b - 0.80 gas DHW	5	18	5586		<u> </u>				-24
X903003 5c - 0.91 gas DHW, GSHP	1 1	18	\$923		5	923			-36
X903004 5d - Tier I HPWH 1.	5	18	\$874		Ľ.				
X903005 5e - Tier III HPWH	2	18	\$874						
X903006 5f - Tier III HPWH Split 2.	5	18	\$3,500						
X903007									
X903008 Other									
X903009 Other					<u> </u>				
X903010 Other					—				
X9040 Uther			<u>(5.040</u>		—			1000	
V904002 7- HP dryage ES Appl	1	50	\$5,040		¢	462		-1262	
V904003 (Jegacy) 5a - Jow flow fixtures	1	50	5462		<u> </u>	402		-040	-16
Z Other Project Costs		50	330						-10
Z10 One Time - Upfront Costs	1	50							
Z30 Re-Occurring Annual Cost (Track Inflation)	1	1							

<-	Primary Filter (Requires Level 1) Office of Financial Management Olympia, Washington - Version: 2018-Resid Life Cycle Cost Analysis Tool	den	Open Primary Filter and Click OK to Re-filter O Manual Special Selection Only (Requires Refilter) en Show Baseline Fields and Entered Units (Requires Refilter) O Show Differences Between Alternative and Baseline (Req. Refil									•••
	Alternative 3 Input Page		Tota	l Build	ing Annual Utility	Analysis	\$	839	Water (CCE)	Electricity (KWH)	Natural Gas (Therms)	
					Annual Utility I	Bill [\$]			10011	\$ 547	\$ 292	
				Annua	Utility Consumption	Not Entered B	elow			5,115	654	r
				Surr	n of Annual Utility Co	nsumption Belo	DW		-	547	(379)	
					Total Annual Utility C	Consumption			-	5,662	275	-
	Next No Unite Accident days of Compared with			Annu	al Utility Bill ÷ Total U	tility Consumpt	ion		\$.	\$ 0.097	\$ 1.062	
_	Note: No onits Assigned to a Component with	n CI	uies				Т	leto				
s	Uniformat II Elemental Classification for	BE	# of	Usefu	Installed Cost	1st Year	Com	nonent	Annual	Annual	Annual	
н	Buildings (Building Component List)	F	Units	l Life	(\$/Unit)	Maintenance	Inst	talled	Water	Electricity	Natural Gas	
0	Buildings (Building Component List)	·		(Yrs.)	(4.5)	Cost (\$/Unit)	Cos	t(\$'s)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)	
w	Primary Entries Below: # of Units i	must	be > 0 to l	be cour	ited; Useful Life must	be>⊧2		· ¥ =	Entries Belo	w for Compone	ent Specific Utili	ity
	Match Baseline: Filter to Select All & Drag Copy 014:S14 &						\$	3,371				
•	B Shell	-										-
_	L Interiors											
	E Equipment & Furnishings											-
	F Special Construction & Demolition											
_	X Other Categories	-										-
_	X90 Other Categories											
_	X9010 Building Envelope											-
_	X901001 1a - 5% UA reduc	0.5	1	50	\$1,171		\$	1,171		5	-35	r
_	X901002 1b - 15% UA reduc	1		50	\$4,568		Ť			5	-100	
	X901003 1c - 30% UA reduc	2		50	\$8,417					12	-169	
	X901004 1d - U24 Glaze	0.5		50	\$1,661					1	-36	
	X901005 1e - 40% UA reduc	3		50	\$12,569					30	-229	
	X901006 If - U20 Glaze	1		50	\$3,323					7	-62	6
	X901007 Za-3ACH, kan elt	0.5	1	50	\$533		\$	533		-52	-43	-
_	X301008 20-2 ACH, HRV Y901009 20-15 ACH HDV	15		50	\$2,823					313	-48	-
_	X901010 2d-0.6 ACH HBV	2		50	\$9,050					204	-100	
_	X9020 HVAC	-			40,001					200	-100	
_	X902001 3a - Furnace	0.5	1	20	\$230		\$	230			-70	r
	X902002 3b - 9.5 HSPF HP	0.5		15	\$270							
	X902003 3c - GSHP	1.5		20	\$10,900							
	X902004 3d-DHP	1		18	\$1,400							6
	X902005 3e - 11.0 HSPF HP	1		15	\$5,400							6
_	A302006 31 - DHF (10% eléc) X902007 4 - HV&C inside	1.0	1	18	\$5,400		*	200		.12	.54	
	X902008 Other	-		50	\$300		÷	500		-12	-34	-
_	X902009 Other											-
	X902010 Other											
	X9030 Hot Water											
	X903001 5a - DWR	0.5		50	\$400						-19	
	X903002 5b - 0.80 gas DHW	0.5		18	\$586						-24	
_	X903003 [5c - 0.9] gas DHW, GSHP	1.5		18	\$923						-36	
	X903007 56 Tier III HP\/H	1.0	1	18	\$6/4 \$974		¢	974		-1822		
	X903006 5f - Tier III HPWH Solit	2.5	-	18	\$3,500		÷	014		-1025		-
_	X903007	2.0			\$0,000		<u> </u>					-
_	X903008 Electrical Systems		1	18	\$500		\$	500		3269		
	X903009 gas		1	18	\$700		\$	(700)			-178	
	X903010 Other											
	X9040 Other											
_	X904001 [6 - Solar pV V9940992 [7] UD dware FC Appl	0.5		50	\$5,040		*	100		-1262		
_	X304002 7 - HM dryers, ES Appl X904002 (Jegson) Es, Jon flow fintures	0.5	1	15	\$462 #E0		\$	462		-840	10	
_	7 Other Project Costs	0.0		50	\$00						-10	
												- CO.

Z Other Project Costs

Medium Gas Home Expenditure Report Page In Constant 2020 \$'s

			_			-					_	
	C	Cumulative	9 E	xpenditur	e	Summary		Annual E	хр	enditure s	Su	mmary
Maan		Desellers			1	Alt. 2		Deseller				
Year	ć	Baseline	ć	Alt. 1 724	ć	Alt. 2	ć	Baseline	ć	Alt. 1 724	ć	Alt. 2
2020	ې د	1 400	ې د	1 760	ې د	1,802	ې د	1 1 4 2	ې د	1 026	ې د	1,802
2021	ې د	2,490	ې د	2 704	ې د	3,143	ې د	1,142	ې د	1,030	ې د	1,203
2022	ې د	2,033	ې د	2,794	ې د	4,419	ې د	1,143	ې د	1,033	ې د	1,274
2023	ې د	3,788	ې د	3,632	ې د	5,086	ې د	1,135	ې د	1,038	ې د	1,209
2024	ې د	6 2 2 0	ې د	6,912	ې خ	8 208	ې د	1,203	ې د	1,080	ې د	1,230
2025	ې د	7 / 91	ې د	7 126	ې خ	9,607	Ś	1,245	ې د	1,105	ې د	1,312
2020	ې د	8 756	ې د	8 2/13	ې خ	10.916	Ś	1,251	ې د	1,105	ې د	1,305
2027	ې د	10 024	ې د	9 359	ې د	12 219	Ś	1,205	ې د	1,117	ې د	1,305
2020	ې د	11 305	ې د	10 / 8/	ې خ	13 5 2 1	Ś	1,200	ې د	1,110	ې د	1,302
2025	ې د	12 595	ې د	11 613	ې د	14 821	Ś	1,202	ې د	1,125	ې د	1,303
2030	ې د	12,595	ې د	12 7/2	ې د	14,821	ې د	1,290	ې د	1,129	ې د	1,300
2031	ې د	15,889	ې د	12,742	ې د	17/03	ې د	1,293	ې د	1,129	ې د	1,234
2032	ې د	15,180	ې د	15,071	ې د	17,405	Ś	1,207	ې د	1,125	ې د	1,200
2033	ې د	17 795	ې د	15,001	ې د	19,005	Ś	1,300	ې د	1,130	ې د	1,202
2034	ې د	10,102	ې د	10,133	ې خ	21 704	ې د	1,303	ې د	1,134	ې د	1,201
2035	ې د	20 424	ې د	18 867	ې خ	21,704	ې د	1,313	ې د	1,337	ې د	1,738
2030	ې د	20,424	ې د	20,000	ې خ	22,374	ې د	1,310	ې د	1,130	ې د	1,270
2037	ې د	21,730	ې د	20,000	ې د	24,230	ې د	2,314	ې د	2,152	ې د	2 194
2030	ې د	25,965	ې د	22,000	ې د	20,420	ې د	2,240	ې د	2,000	ې د	2,104
2035	ې د	25,512	ې د	23,198	ې خ	27,077	ې د	1,527	ې د	1,130	ې د	1,237
2040	ې د	20,873	ې د	24,308	ې د	29,100	ې د	1,301	ې د	1,370	ې د	1,405
2041	ې د	20,200	ې د	25,708	ې د	21 655	ې د	1,333	ې د	1,141	ې د	1,249
2042	ې د	29,340	ې د	20,830	ې د	22 007	ې د	1,559	ې د	1,142	ې د	1,243
2045	ې د	20,869	ې د	27,994	ې د	32,097	Ş	1,542	ې د	1,145	ې د	1,242
2044	Ş	32,233	ې د	29,159	ې د	34,130	Ş	1,540	ې د	1,145	ې د	1,239
2045	ې د	24 040	ې د	21 / 22	ې د	35,575	ې د	1,550	ې د	1,140	ې د	1,237
2040	ې د	34,940	ې د	22 5 27	ې د	27 8/1	ې د	1,534	ې د	1,140	ې د	1,235
2047	ې د	30,304	ې د	22,387	ې خ	37,841	ې د	1,304	ې د	1,154	ې د	1,235
2040	ې د	30,000	ې د	34 802	ې خ	40.296	ې د	1,303	ې د	1,152	ې د	1,223
2049	ې د	40 404	ې د	36 500	ې خ	40,290	ې د	1,307	ې د	1,155	ې د	1,220
2050	ې د	40,404	ې د	30,503	ې خ	41,982	ې د	1,371	ې د	1,017	ې د	1,080
2051	ې د	41,744	ې د	38 683	ې د	43,018	ې د	1,340	ې د	1,085	ې د	1,030
2052	ې د	43,089	ې د	20,083	ې د	44,038	ې د	1,345	ې د	1,083	ې د	1,040
2053	ې د	44,440	ې د	40.874	ې د	45,102	ې د	1,351	ې د	1,093	ې د	1,044
2055	Ś	47 157	ې د	41 976	¢	47 201	Ś	1 361	ې د	1,000	ې د	1,040
2055	ې د	47,137	ې د	41,570	ې خ	47,201	Ś	2 289	ې د	2 029	ې د	1,032
2057	Ś	50 818	ې د	45 116	¢	50 239	Ś	1 372	ې د	1 110	ې د	1,060
2058	Ś	52 195	ې د	46 231	¢	51 303	Ś	1 377	ې د	1,115	ې د	1,000
2050	ې د	52,133	ې د	40,231	ې خ	52 371	Ś	1 382	ې د	1,115	ې د	1,004
2055	¢	55 195	ç	47,550	ې د	53 673	Ś	1,502	ې د	1,115	ې د	1,000
2000	¢	56 588	ç	40,703	ې د	54 748	¢	1 393	ې د	1,334	ې د	1,502
2001	ې د	57,986	ې د	50.963	ې خ	55 828	Ś	1,393	ې د	1,120	ې د	1,070
2002	ې د	59,389	ې د	52,000	ې خ	55,828	Ś	1,558	ې د	1,132	ې د	1,080
2064	ې د	60 792	ې د	53 240	ې د	57,999	ې د	1 409	ب د	1 120	ہ د	1 022
2065	ہ د	67 717	ہ د	53,240	ہ د	50,555	ہ د	1 /11/	ې د	1 607	ہ د	1,000
2066	ې د	63 631	ې د	55 995	ې د	60 648	ې د	1 410	ب د	1 1/0	ہ د	1 096
2000	ې د	65 055	ې د	57 1/10	ې د	61 7/12	¢	1 /1 2/	ب د	1 152	ر د	1 100
2068	ب د	66 485	ې د	58 306	ر د	67 851	ہ د	1 420	ب د	1 152	ر د	1 10/
2069	ې د	67 920	ې د	59 462	ې د	62,001	ې د	1 425	ب د	1 167	ہ د	1 102
2005	ہ د	69 0/0	ہ د	60 006	ہ د	67 AAD	ہ د	1 120	ې د	538	ہ د	1,100
2070	ډ	09,040	ډ	00,000	د	04,442	ç	1,120	ډ ا	220	ç	400

Medium Gas Home DHWe

Life Cycle Cost Analysis Tool Expenditure Report Page In Constant 2020 \$'s

	Cu	mulative	e Ex	penditur	e Su	mmary	Annual Expenditure Summary							
Year	в	aseline		Alt. 3			B	aseline		Alt.3				
2020	\$	347	\$	674	\$		\$	347	\$	674	\$			
2021	\$	1,490	\$	1,688	\$	-	\$	1,142	\$	1,013	\$			
2022	\$	2,635	\$	2,704	\$	-	\$	1,145	\$	1,017	\$			
2023	\$	3,788	\$	3,727	\$	-	\$	1,153	\$	1,023	\$			
2024	\$	4,997	\$	4,783	\$	-	\$	1,209	\$	1,055	\$			
2025	\$	6,239	\$	5,859	\$		\$	1,243	\$	1,076	\$			
2026	\$	7,491	\$	6,942	\$	-	\$	1,251	\$	1,083	\$			
2027	\$	8,756	\$	8,034	\$	-	\$	1,265	\$	1,093	\$			
2028	\$	10,024	\$	9,129	\$	-	\$	1,268	\$	1,094	\$	-		
2029	\$	11,305	\$	10,230	\$	-	\$	1,282	\$	1,101	\$			
2030	\$	12,595	\$	11,336	\$	-	\$	1,290	\$	1,106	\$			
2031	\$	13,889	\$	12,443	\$	-	\$	1,293	\$	1,108	\$			
2032	\$	15,186	\$	13,553	\$	-	\$	1,297	\$	1,110	\$			
2033	\$	16,486	\$	14,665	\$	-	\$	1,300	\$	1,112	\$			
2034	\$	17,795	\$	15,781	\$	-	\$	1,309	\$	1,117	\$			
2035	\$	19,108	\$	17,362	\$	-	\$	1,313	\$	1,581	\$			
2036	\$	20,424	\$	18,480	\$	-	\$	1,316	\$	1,118	\$			
2037	\$	21,738	\$	19,595	\$	-	\$	1,314	\$	1,115	\$			
2038	\$	23,985	\$	21,389	\$	-	\$	2,246	\$	1,794	\$			
2039	\$	25,312	\$	22,512	\$	-	\$	1,327	\$	1,123	\$			
2040	\$	26.873	\$	23,866	\$	-	\$	1,561	\$	1.353	\$			
2041	\$	28,208	\$	24,991	\$	-	\$	1.335	\$	1,126	\$			
2042	\$	29,546	\$	26,117	\$	-	\$	1,339	\$	1,126	\$			
2043	\$	30,889	\$	27.246	\$	-	\$	1.342	\$	1,129	\$			
2044	\$	32,235	\$	28,375	\$		\$	1,346	\$	1,129	\$			
2045	\$	33,585	\$	29,507	\$	-	\$	1,350	\$	1,132	\$			
2046	\$	34,940	\$	30,640	\$	-	\$	1,354	\$	1,133	\$			
2047	\$	36,304	\$	31,778	\$		\$	1,364	\$	1,139	\$			
2048	\$	37,666	\$	32,915	\$	-	\$	1,363	\$	1,136	\$			
2049	\$	39,033	\$	34,053	\$	-	\$	1,367	\$	1,138	\$			
2050	\$	40,404	\$	35,655	\$	-	\$	1,371	\$	1,602	\$			
2051	\$	41,744	\$	36,729	\$	-	\$	1,340	\$	1,074	\$			
2052	\$	43,089	\$	37,807	\$	-	\$	1,345	\$	1,078	\$	-		
2053	\$	44,440	\$	38,889	\$	-	\$	1,351	\$	1,082	\$	-		
2054	\$	45,796	\$	39,975	\$	-	\$	1,356	\$	1,086	\$	-		
2055	\$	47,157	\$	41,065	\$	-	\$	1,361	\$	1,090	\$	-		
2056	\$	49,446	\$	42,833	\$	-	\$	2,289	\$	1,768	\$	-		
2057	\$	50,818	\$	43,931	\$	-	\$	1,372	\$	1,098	\$	-		
2058	\$	52,195	\$	45,033	\$	-	\$	1,377	\$	1,102	\$	-		
2059	\$	53,577	\$	46,139	\$	-	\$	1,382	\$	1,106	\$	-		
2060	\$	55,195	\$	47,479	\$	-	\$	1,618	\$	1,340	\$	-		
2061	\$	56,588	\$	48,593	\$	-	\$	1,393	\$	1,114	\$	-		
2062	\$	57,986	\$	49,711	\$	-	\$	1,398	\$	1,118	\$	-		
2063	\$	59,389	\$	50,833	\$	-	\$	1,403	\$	1,122	\$	-		
2064	\$	60,798	\$	51,959	\$	-	\$	1,409	\$	1,126	\$	-		
2065	\$	62,212	\$	53,550	\$	-	\$	1,414	\$	1,592	\$	-		
2066	\$	63,631	\$	54,684	\$	-	\$	1,419	\$	1,134	\$	-		
2067	\$	65,055	\$	55,822	\$	-	\$	1,424	\$	1,138	\$	-		
2068	\$	66,485	\$	56,963	\$	-	\$	1,430	\$	1,142	\$	-		
2069	\$	67,920	\$	58,109	\$	-	\$	1,435	\$	1,146	\$	-		
2070	\$	69,040	\$	58,686	\$	-	\$	1,120	\$	577	\$	-		
2074	*	00.040	*	FOCOC	*						*			

Medium	ΗP	Home
--------	----	------

Key Analysis Var	iables	Building Characteristics					
Study Period (years)	50	Gross (Sq.Ft)	2,200				
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	2,200				
Maintenance Escalation	1.00%	Space Efficiency	100.0%				
Zero Year (Current Year)	2020	Project Phase	0				
Construction Years	0	Building Type	0				

Life Cycle Cost Analysis	BEST									
Alternative	Baseline		Alt. 1		Alt. 2					
Energy Use Intenstity (kBtu/sq.ft)	17.9		14.5		16.3					
1st Construction Costs	\$ 2,444	\$	4,610	\$	2,977					
PV of Capital Costs	\$ 5,588	\$	8,412	\$	6,115					
PV of Maintenance Costs	\$ -	\$	-	\$	-					
PV of Utility Costs	\$ 43,427	\$	35,173	\$	39,574					
Total Life Cycle Cost (LCC)	\$ 49,015	\$	43,585	\$	45,689					
Net Present Savings (NPS)	N/A	\$	5,430	\$	3,326					

Societal LCC takes into consideration the social cost of carbon dioxide emissions caused by operational energy consumption

(GHG) Social Life Cycle Cost	BEST									
GHG Impact from Utility Consumption		Baseline		Alt. 1		Alt. 2				
Tons of CO2e over Study Period		237		192		216				
% CO2e Reduction vs. Baseline		N/A		19%		9%				
Present Social Cost of Carbon (SCC)	\$	15,074	\$	12,209	\$	13,737				
Total LCC with SCC	\$	64,089	\$	55,794	\$	59,425				
NPS with SCC		N/A	\$	8,295	\$	4,663				

Warning: OFM Assigned Variables Not Used



Medium HP Home

<- Pri	mary Filte	er (Requires Level 1)		Open Prim	ary Filter	and Click OK to Re-filter								
0	Office o	of Financial Management		Show A	All Entere	d Units (Requires Re-Filte	r)			1				
	Dlympi	a, Washington - Version: 2018-Resider	ntial											
L	.ife Cyo	cle Cost Analysis Tool									-		_	
- 1	Rase	line Innut Page			Total E	Building Annual Utility An	alysis	s	1.114	Water	Electricity (KWH)	Natural Gas	Т	
	J u50	into input i ago		<u> </u>			-		,	(CCF)	C 1114	(Therms)	+	
				<u> </u>	A.	Annual Utility	Not Enterod Roles				3 1,114		+	
				<u> </u>	A	Sum of Annual Utility Con	sumption Below	<i>x</i>			- (2.340)		-	
						Total Annual Utility C	Consumption				11.533		t	
					A	nnual Utility Bill ÷ Total U	tility Consumption			\$ ·	· \$ 0.097	\$	-	
					Useful		1st Year	Total	Component	Annual	Annual	Annual	Τ	
н	Uni	format II Elemental Classification for	RFF	# of Units	life	Installed Cost	Maintenance	Inst	alled Cost	Water	Electricity	Natural Gas	1	
0	В	uildings (Building Component List)			(Yrs.)	(S/Unit)	Cost (\$/Unit)		(\$'s)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)		
w	_	Drimour Entries Bolow # of Units must b	0.+	o ho counto	d. Usoful	lifa must ha >− 0	,	6	0.444	Entries Role	For Component	Constitute An		
	Subs	Primary Entries Below. # of Onits must b	e > 0 l	o be counte	a; oserui	Life must be >= 2		>	2,444	Entries Beig	w for Component.	specific Otility Ar		
× A	101098	Medium Home - HP carbon						-					+	
B	Shel												$^{+}$	
c	Inter	riors											T	
0	Serv	ices											T	
E	Equi	pment & Furnishings											Τ	
F	Spec	cial Construction & Demolition											T	
G	Build	ding Sitework												
x X	Othe	er Categories												
хХ	90 Othe	er Categories										L	4	
x X	9010 E	Building Envelope										L	4	
x X	901001	1a - 5% UA reduc	0.5		50	\$1,171					-355		+	
x X	901002	1b - 15% UA reduc	1		50	\$4,568					-908	L	+	
X X	901003	1c - 30% UA reduc	2		50	\$8,417		-			-1519		+	
X X	901004	1d - U24 Glaze	0.5		50	\$1,661		-			-325		+	
x X	901005	16 - 40% UA reduc	3		50	\$12,569		-			-2024		+	
X A	901008	11 - U-2U GIdZe 25 - 2ACH fan eff	1		50	\$3,525					-540		+	
	001007	26-3ACH, IAI EI	1		50	\$3,930					-440		+	
	901008	2c - 1 5 ACH HRV	15		50	\$6,338					-231		+	
	901009	2d-0.6 ACH HRV	2		50	\$9,555					-737		+	
XX	9020	IVAC	-			\$5,654					157		+	
xX	902001	3a - Furnace	1		20	\$230							+	
x X	902002	3b - 9.5 HSPF HP	1	1	15	\$1,270		S	1,270		-327		+	
×Х	902003	3c - GSHP	1.5		20	\$10,900		<u> </u>	,		-1301		+	
×Х	902004	3d - DHP	1		18	\$1,400							+	
хХ	902005	3e - 11.0 HSPF HP	1		15	\$5,400					-784		T	
×Х	902006	3f - DHP (15% elec)	1.5		18	\$5,400							T	
хХ	902007	4 - HVAC inside	1	1	50	\$300		\$	300		-621			
хХ	902008	Other												
×Х	902009	Other											1	
x X	902010	Other										L	-	
x X	9030	Hot Water	0.5					-					+	
× X	903001	5a - DWR	0.5		50	5400		-			-368	L	+	
XX	903002	50 - 0.80 gas DHW	0.5		15	\$586		-					+	
XX	903003	Sc - 0.91 gas DRW, GSRP	1 5	1	15	5923		6	074		1202		+	
XX	903004	Se - Tier III HDW/H	1.5	1	15	58/4		>	8/4		-1393		+	
	903005	St - Tier III HDWH Solit	25		15	\$3,500		-			-1823		+	
	903007	or nerminewiropic	2.2		15	\$3,300		<u> </u>			-2004		+	
	903008	Other						<u> </u>					+	
xx	903009	Other											+	
x x	903010	Other											+	
x x	9040 0	Other											+	
x X	904001	6 - Solar pV	0.5		50	\$5.040					-1262		+	
x X	904002	7 - HP dryers, ES Appl	0.5		15	\$462					-840		+	
x X	904003	(legacy) 5a - low flow fixtures	0.5		50	\$50					-307		+	
Z	Othe	er Project Costs											t	
Z	10 One	Time - Upfront Costs		1	50									
Z	30 Re-C	Occurring Annual Cost (Track Inflation)		1	1								T	

Medium HP Home

<- Prima	ry Filter	(Requires Level 1)		Open Prim	ary Filter	and Click OK to Re-filter									
Of	fice of	f Financial Management		O Manua	al Special	Selection Only (Requires I	IIIII								
Oly	ympia	, Washington - Version: 2018-Resider	ntial	 Show B 	Baseline I	Fields and Entered Units (F	Requires Refilter)								
Lif	e Cvc	le Cost Analysis Tool		O Show I	Differenc	es Between Alternative ar	nd Baseline (Req. F	efilter)						
A	ltern	ative 1 Input Page			Total B	uilding Annual Utility An	alysis	\$	902	Water (CCE)	Electricity (KWH)	Natural Gas	I		
				<u> </u>		Annual Utility E	Bill (\$1			(001)	\$ 902	(mems)	t		
					An	nual Utility Consumption	Not Entered Belov	v			13,291		t		
						Sum of Annual Utility Con	sumption Below			-	- (3,950) -				
						Total Annual Utility C	onsumption			-	9,341		·		
					A	nnual Utility Bill ÷ Total Ut	\$ -	\$ 0.097	\$ -	ł					
Not	te: No U	Inits Assigned to a Component with Entries									,		т		
s	Unif	ormat II Elemental Classification for			Useful	Installed Cost	1st Year	Total	Component	Annual	Annual	Annual	I		
н	Bu	ildings (Building Component List)	REF	# of Units	Life	(\$/Unit)	Maintenance	Inst	alled Cost	Water	Electricity	Natural Gas	l		
l	Du	indings (Building Component List)			(Yrs.)	(0) 01110)	Cost (\$/Unit)		(\$'s)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)	I		
**		Primary Entries Below: # of Unit	ts must	t be > 0 to b	e counte	d; Useful Life must be >= 2	2			Entries Belo	w for Component S	Specific Utility An	i		
Mat	tch Baselir	ne: Filter to Select All & Drag Copy O14:S14 & U14:AG14						\$	4,610				I		
. A	Subst	ructure											1		
A10	1098	Medium Home - HP carbon											4		
В	Shell												ł		
	Interi	ors						I					ł		
F	Fauin	nent & Furnichings	_					—					ł		
C	Specia	al Construction & Demolition	-										ł		
G	Buildi	ng Sitework	_										t		
X	Other	Categories	_										t		
X90	Other	Categories											t		
X90:	10 Bu	ilding Envelope											t		
X90:	1001	1a - 5% UA reduc	0.5	1	50	\$1,171		\$	1,171		-329		I		
X90:	1002	1b - 15% UA reduc	1		50	\$4,568					-908		I		
X90:	1003	1c - 30% UA reduc	2		50	\$8,417					-1519		Į		
X90:	1004	1d - U24 Glaze	0.5		50	\$1,661					-325		1		
X90:	1005	1e - 40% UA reduc	3		50	\$12,569					-2024		4		
X90	1005	11 - U-20 Glaze	1		50	\$3,323		6	500		-546		ł		
X90.	1007	28 - SACH, ran err	0.5		50	\$233		\$	535		-440		ł		
X90	1008	2c-15 ACH HRV	15		50	\$2,825					-520		ł		
X90	1010	2d - 0.6 ACH. HRV	2.5		50	\$9,054					-737		t		
X902	20 H	AC											t		
X90	2001	3a - Furnace	1		20	\$230							t		
X902	2002	3b - 9.5 HSPF HP	1	1	15	\$1,270		\$	1,270		-328		Ī		
X902	2003	3c - GSHP	1.5		20	\$10,900					-1301		I		
X902	2004	3d - DHP	1		18	\$1,400							4		
X902	2005	3e - 11.0 HSPF HP	1		15	\$5,400					-784		ł		
X90.	2005	3T - DHP (15% elec)	1.5	1	18	\$5,400		ć	200		621		ł		
100	2007	Other	1	1	50	\$300		3	500		-021		ł		
X902	2009	Other											t		
X90	2010	Other											t		
X903	30 Ho	t Water											t		
X903	3001	5a - DWR	0.5		50	\$400					-368		Ĵ		
X903	3002	5b - 0.80 gas DHW	0.5		15	\$586							ĺ		
X903	3003	5c - 0.91 gas DHW, GSHP	1		15	\$923							4		
X903	3004	5d - Tier I HPWH	1.5	1	15	\$874		\$	874		-1393		4		
X903	3005	Se - Her III HPWH	2		15	\$874		<u> </u>			-1823		+		
X903	2005	DI - HELIH NPWH SPIIT	2.5		15	\$3,500					-2064		ł		
X903	3007	Other						-					ł		
X903	3009	Other						-					t		
1000	3010	Other											t		
X904	40 Ot	her											t		
X904	4001	6 - Solar pV	0.5		50	\$5,040					-1262		t		
X904	4002	7 - HP dryers, ES Appl	0.5	1	15	\$462		\$	462		-840		Ĵ		
X904	4003	(legacy) 5a - low flow fixtures	0.5		50	\$50					-307		I		
Z	Other	Project Costs											ſ		
Z10	One T	ime - Upfront Costs		1	50								4		
Z30	Re-Oc	curring Annual Cost (Track Inflation)		1	1								1		

Medium HP Home

<- Primar	ry Filter	r (Requires Level 1)		Open Prim	ary Filte	r and Click OK to Re-filter							
Off	ice o	f Financial Management		O Manua	al Special	Selection Only (Requires	Refilter)						
Olv	/mpia	. Washington - Version: 2018-Resident	tial	Show i	Baseline	Fields and Entered Units (Requires Refilter)			1 C C			
Life	Cvc	le Cost Analysis Tool		O Show I	Differenc	es Between Alternative ar	nd Baseline (Reg.	Refilter	r)				
	e Cyc	ie cost Analysis 1001						T	,	Water	1	Natural Gas	Ē
Aľ	terr	native 2 Input Page			Total E	Building Annual Utility An	alysis	\$	1,015	(CCF)	Electricity (KWH)	(Therms)	
				<u> </u>		Annual Utility I	Bill (\$1	-		(001)	\$ 1.015	(menna)	t
					Ar	nual Utility Consumption	Not Entered Belo	w			13.291		t
						Sum of Annual Utility Cor	sumption Below				(2.782)		t
						Total Annual Utility C	onsumption				10,509		t
					A	nnual Utility Bill ÷ Total U	tility Consumption	1		\$.	\$ 0.097	\$	-
Note	e: No l	Units Assigned to a Component with Entries								_			
s	Unif	iarmat II Elemental Classification for			Useful		1st Year	Total	Component	Annual	Annual	Annual	Ι.
н	Unii	ormat il Elemental Classification for	REF	# of Units	Life	Installed Cost	Maintenance	Ins	talled Cost	Water	Electricity	Natural Gas	I^4
0	BI	liaings (Building Component List)			(Yrs.)	(S/Unit)	Cost (\$/Unit)		(\$'s)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)	
w	_	Primary Entries Below: # of Units	1001161	the > 0 to b	e counte	d-llcaful lifa must ba ≻= ′	,	-		Entries Belo	w for Component I	Spacific Litility An	
Mato	ch Baseli	ine: Filter to Select All & Drag Copy O14:514 & U14:AG14	mus		Counte	a, oseiai Lite mast be >- 1	-	5	2.977	Litutes Delu	w for component.	specific othry An	Ť
A	Subst	tructure						<u>۲</u>	-,				t
A101	1098	Medium Home - HP carbon											t
B	Shell												t
С	Interi	iors											t
D	Servi	ces											Γ
E	Equip	oment & Furnishings											Г
F	Speci	al Construction & Demolition											Γ
G	Build	ing Sitework											1
X	Other	r Categories										L	1
X90	Other	r Categories										L	1
X901	LO BU	uilding Envelope											+
X901	1001	1a - 5% UA reduc	0.5		50	\$1,170.98					-329	L	+
X901	1002	10 - 15% UA reduc	1		50	\$4,567.51		-			-908		╀
X901	1003	1c - 30% UA reduc	2		50	\$8,416.67		-			-1519		+
X901	1004	10 - 0-24 Gidze	0.5		50	\$1,001.40					-325		+
X901	1005	1f - 1J - 20 Glaze	1	<u> </u>	50	\$12,303.10		-			-2024		+
X901	007	2a - 3ACH fan eff	0.5	1	50	\$5,522.00		5	533		-440		+
X901	1008	2b - 2 ACH HRV	1		50	\$2,829.30		Ľ			-214		t
X901	1009	2c - 1.5 ACH, HRV	1.5		50	\$6,337.63					-520		t
X901	1010	2d - 0.6 ACH, HRV	2		50	\$9,053.76					-737		t
X902	20 H	VAC											t
X902	2001	3a - Furnace	1		20	\$230.25							t
X902	2002	3b - 9.5 HSPF HP	1	1	15	\$1,270.00		\$	1,270		-328		Γ
X902	2003	3c - GSHP	1.5		20	\$10,900.00					-1301		
X902	2004	3d - DHP	1		18	\$1,400.00							
X902	2005	3e - 11.0 HSPF HP	1		15	\$5,400.00					-784		4
X902	2006	3f - DHP (15% elec)	1.5		18	\$5,400.00						L	+
X902	2007	4 - HVAC Inside	1	1	50	\$300.00		\$	300		-621	L	+
X902	2008	Other						-					+
X902	2009	Other	_					-					+
X902	1010 1010	ot Water											+
X903		5a - DWR	0.5		50	\$400.00		-			-368		+
X903	3002	5b - 0.80 gas DHW	0.5		15	\$586.00		1			500		t
X903	3003	5c - 0.91 gas DHW, GSHP	.1		15	\$923.00							t
X903	3004	5d - Tier I HPWH	1.5	1	15	\$874.00		\$	874		-1393		t
X903	3005	5e - Tier III HPWH	2		15	\$874.00					-1823		T
X903	3006	5f - Tier III HPWH Split	2.5		15	\$3,500.00					-2064		Γ
X903	3007												Γ
X903	3008	Other											Γ
X903	3009	Other											F
X903	3010	Other											1
X904	10 O1	ther											ſ
X904	001	6 - Solar pV	0.5		50	\$5,040.00					-1262		1
X904	1002	7 - HP dryers, ES Appl	0.5		15	\$462.00					-840	L	4
X904	1003	(legacy) 5a - low flow fixtures	0.5		50	\$50.00					-307		÷
Z 710	Other	r Project Costs	_		50								4
210	One T	Time - Optront Costs	_	1	50								ŧ
230	rce-O	courring Annual Cost (Track Inflation)		1	1								41

Medium HP Home Expenditure Report Page In Constant 2020 \$'s

	C	Cumulative	e E	xpenditur	e S	ummary	Annual Expenditure Summary					
Year		Baseline		Alt. 1		Alt. 2		Baseline		Alt. 1		Alt. 2
2020	\$	489	\$	922	\$	595	\$	489	\$	922	\$	595
2021	\$	1,737	\$	2,065	\$	1,771	\$	1,248	\$	1,143	\$	1,175
2022	\$	3,005	\$	3,220	\$	2,962	\$	1,268	\$	1,155	\$	1,192
2023	\$	4,291	\$	4,386	\$	4,170	\$	1,287	\$	1,167	\$	1,208
2024	\$	5,598	\$	5,565	\$	5,395	\$	1,306	\$	1,179	\$	1,225
2025	\$	6,924	\$	6,756	\$	6,637	\$	1,326	\$	1,191	\$	1,242
2026	\$	8,270	\$	7,959	\$	7,896	\$	1,346	\$	1,203	\$	1,259
2027	\$	9,635	\$	9,175	\$	9,171	\$	1,365	\$	1,216	\$	1,276
2028	\$	11,009	\$	10,395	\$	10,454	\$	1,374	\$	1,219	\$	1,282
2029	\$	12,391	\$	11,618	\$	11,743	\$	1,382	\$	1,223	\$	1,289
2030	\$	13,782	\$	12,845	\$	13,039	\$	1,391	\$	1,227	\$	1,296
2031	\$	15,182	\$	14,076	\$	14,342	\$	1,400	\$	1,231	\$	1,303
2032	\$	16,590	\$	15,311	\$	15,653	\$	1,408	\$	1,235	\$	1,310
2033	\$	18,008	\$	16,550	\$	16,970	\$	1,417	\$	1,239	\$	1,318
2034	\$	19,434	\$	17,794	\$	18,295	\$	1,426	\$	1,244	\$	1,325
2035	Ś	23.013	Ś	21.649	Ś	21.772	Ś	3.579	Ś	3.855	Ś	3.476
2036	Ś	24.446	Ś	22.893	Ś	23.101	Ś	1.433	Ś	1.244	Ś	1.330
2037	Ś	25.876	Ś	24.132	Ś	24.428	Ś	1.430	Ś	1.240	Ś	1.327
2038	Ś	27.316	Ś	25.377	\$	25.762	Ś	1.440	Ś	1.245	Ś	1.334
2039	Ś	28,765	Ś	26.627	Ś	27.105	Ś	1.449	Ś	1.250	Ś	1.342
2040	Ś	30,212	Ś	27.873	Ś	28,444	Ś	1.447	Ś	1,246	Ś	1.340
2041	Ś	31 668	Ś	29 124	Ś	29 792	Ś	1 456	Ś	1 251	Ś	1 348
2042	Ś	33 123	Ś	30 371	Ś	31 137	Ś	1 454	ې د	1 247	Ś	1 345
2043	Ś	34 586	Ś	31 624	Ś	32,490	Ś	1 464	ې د	1 253	Ś	1 353
2044	Ś	36.048	Ś	32 874	Ś	33 841	Ś	1 462	ې د	1 249	Ś	1 351
2045	Ś	37 520	Ś	34 129	Ś	35,200	Ś	1 472	Ś	1 255	Ś	1 359
2046	Ś	38,990	Ś	35 381	Ś	36 557	Ś	1 470	Ś	1 252	Ś	1 357
2047	Ś	40,469	Ś	36.639	Ś	37,922	Ś	1,480	Ś	1,252	Ś	1,365
2048	Ś	41.947	Ś	37,894	Ś	39,286	Ś	1,478	Ś	1,255	Ś	1,363
2049	Ś	43 428	Ś	39 150	Ś	40 651	Ś	1 481	ې د	1 256	Ś	1 366
2050	Ś	47 056	Ś	43 012	Ś	44 163	Ś	3 628	ې د	3 862	Ś	3 512
2050	Ś	48 494	¢	44 177	¢	45 473	¢	1 438	¢	1 165	¢	1 310
2051	¢ ¢	49 936	¢ ¢	45 345	ې د	46 788	Ś	1 443	ې د	1 168	ې د	1 315
2052	¢ ¢	51 383	¢ ¢	46 517	ې د	48,106	Ś	1 447	ې د	1 172	ې د	1 319
2053	Ś	52,835	Ś	47 693	Ś	49 429	Ś	1 452	Ś	1 176	Ś	1 323
2055	Ś	54,291	Ś	48,872	Ś	50,756	Ś	1.456	Ś	1,180	Ś	1.327
2056	Ś	55,752	Ś	50.056	Ś	52,088	Ś	1.461	Ś	1,183	Ś	1.331
2057	Ś	57,218	Ś	51,242	Ś	53,423	Ś	1,465	Ś	1,187	Ś	1.335
2058	Ś	58 688	Ś	52 433	Ś	54 763	Ś	1 470	Ś	1 191	Ś	1 340
2059	Ś	60 163	Ś	53 628	Ś	56 107	Ś	1 475	Ś	1 194	Ś	1 344
2060	Ś	61 642	Ś	54 826	Ś	57 455	Ś	1 479	Ś	1 198	Ś	1 348
2061	Ś	63 126	Ś	56 028	Ś	58 807	Ś	1 484	Ś	1 202	Ś	1 352
2062	Ś	64 614	Ś	57 233	Ś	60 163	Ś	1 488	Ś	1 206	Ś	1 356
2063	Ś	66 107	Ś	58 442	Ś	61 524	Ś	1 493	Ś	1 209	Ś	1 361
2064	ې د	67 605	ې د	50,442	ې د	67 880	¢	1 492	ې د	1 212	ې د	1 365
2065	ې د	71 251	ې د	63 478	ې د	66 402	¢	2 646	ې د	2 872	ب د	2 512
2005	ې د	77 752	ب د	64 600	ہ د	67 775	¢	1 507	ې د	1 220	ہ د	1 272
2000	ب د	7/ 260	ب د	65 072	ہ د	69 152	¢	1 511	ې د	1 22/	ہ د	1 277
2068	ب د	75 725	ب د	67 151	ہ د	70 53/	¢	1 516	ب د	1 224	ب د	1 387
2000	ې د	77 306	ب د	68 383	ہ د	71 919	¢	1 521	ې د	1 727	ہ د	1 386
2005	ې د	77,300	ہ د	67 820	ہ د	71 880	¢	1,521 QA	ہ د	(502)	ہ د	(20)
2070	Ļ	,,,,,02	Ļ	07,000	Ļ	, 1,000	Ļ	30	Ļ	(502)	Ŷ	(39)

Key Analysis Var	iables	Building Characteristics					
Study Period (years)	50	Gross (Sq.Ft)	820				
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	820				
Maintenance Escalation	1.00%	Space Efficiency	100.0%				
Zero Year (Current Year)	2020	Project Phase	0				
Construction Years	0	Building Type	0				

Life Cycle Cost Analysis	BEST									
Alternative	Baseline		Alt. 1		Alt. 2					
Energy Use Intenstity (kBtu/sq.ft)	30.6		21.6		21.4					
1st Construction Costs	\$ 553	\$	3,990	\$	4,912					
PV of Capital Costs	\$ 977	\$	8,208	\$	9,119					
PV of Maintenance Costs	\$ -	\$	-	\$	-					
PV of Utility Costs	\$ 27,661	\$	19,533	\$	19,376					
Total Life Cycle Cost (LCC)	\$ 28,638	\$	27,741	\$	28,494					
Net Present Savings (NPS)	N/A	\$	897	\$	144					

Societal LCC takes into consideration the social cost of carbon dioxide emissions caused by operational energy consumption

(GHG) Social Life Cycle Cost	BEST										
GHG Impact from Utility Consumption	Baseline		Alt. 1		Alt. 2						
Tons of CO2e over Study Period	151		107		106						
% CO2e Reduction vs. Baseline	N/A		29%		30%						
Present Social Cost of Carbon (SCC)	\$ 9,601	\$	6,780	\$	6,726						
Total LCC with SCC	\$ 38,240	\$	34,521	\$	35,220						
NPS with SCC	N/A	\$	3,718	\$	3,020						

Warning: OFM Assigned Variables Not Used



ج.	Primary	Filter	(Requires Level 1)		Open Prima	ary Filter	and Click OK to Re-filter							
	Offic	e of	f Financial Management		Show A	All Entere	d Units (Requires Re-Filter							
	Olyn	npia	Washington - Version: 2018-Residen	tial							•			
	Life	Cvc	le Cost Analysis Tool											
	Bas	sel	ine Input Page			Total B	Building Annual Utility An	alysis	\$	710	Water (CCE)	Electricity (KWH)	Natural Gas (Therms)	Γ
							Annual Utility E	Bill [\$]			(00.7)	\$ 710	(1121112)	t
						Ar	nual Utility Consumption	Not Entered Belov	v			9,166		t
							Sum of Annual Utility Con	sumption Below			-	(1,820)	· ·	Ē
							Total Annual Utility C	onsumption			-	7,346		·
_						A	nnual Utility Bill ÷ Total Ut	tility Consumption			s -	\$ 0.097	\$ -	-
S H	Uniformat II Elemental Classification for Buildings (Building Component List)				# of Units	Useful Life	Installed Cost	1st Year Maintenance	Total (Insta	Component alled Cost	Annual Water	Annual Electricity	Annual Natural Gas	A
		Du	indings (Building Component List)			(Yrs.)	(0) 01110/	Cost (\$/Unit)		(S's)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)	
1"			Primary Entries Below: # of Units must be	e > 0 to	o be counte	d; Useful	Life must be >= 2		\$	553	Entries Belo	w for Component	Specific Utility An	aly
	A :	Subst	ructure											
x	A1010	98	MF- Zonal Elec carbon											L
	B	Shell												1
	C	Interi	ors											1
	D	Servic	ces											4
	E	Equip	ment & Furnishings											1
	F	Specia	al Construction & Demolition											4
	G	Buildi	ng Sitework											4
x	X	Other	Categories									ļ		⊢
x	X90	Other	Categories											⊢
x	X9010	Bu	ilding Envelope	0.5			6400							╄
x	X90100	01	1a - 5% UA reduc	0.5		50	\$192					-33/		⊢
x	X90100	02	10 - 15% UA reduc	1		50	\$1,359		-			-51/		⊢
x	X90100	03	1C - 30% UA reduc	2		50	\$2,015		<u> </u>			-898		╀
x	X90100	04	10 - 0-24 Gid2e	0.5		50	\$224		<u> </u>			-220		╀
x	X90100	05	1f - 1L 20 Glaze	1		50	\$1.107		-			-11/2		⊢
×	X90100	00	2a - 3ΔCH fan eff	0.5	1	50	\$245		5	245		-475		t
- ×	X90100	0.8	2b - 2 ACH HRV	1	-	50	\$1.025		Ľ,	245		-939		t
- v	X90100	09	2c - 1.5 ACH. HRV	1.5		50	\$2,295					-1284		t
- N	X90101	10	2d - 0.6 ACH, HRV	2		50	\$3,280					-1533		t
x	X9020	H	/AC			0	00,200					1300		t
×	X90200	01	3a - Furnace	1		18								t
x	X90200	02	3b - 9.5 HSPF HP	0.5		15								t
x	X90200	03	3c - GSHP	1.5		20								t
x	X90200	04	3d - DHP	1		18	\$2,800					-1132		t
х	X90200	05	3e - 11.0 HSPF HP	1		15								Γ
x	X90200	06	3f - DHP (15% elec)	1.5		18	\$4,800					-1193		Γ
x	X90200	07	4 - HVAC inside	1		50								Γ
x	X90200	08	Other			0								Ĺ
x	X90200	09	Other			0								L
x	X90201	10	Other			0								1
x	X9030	Ho	ot Water			0								L
x	X90300	01	5a - DWR	0.5		50	\$133		-			-265		F
x	X90300	02	50 - 0.80 gas DHW	0.5		15			<u> </u>					4
x	X90300	03	5c - 0.91 gas DHW, GSHP	1		15								∔
x	X90300	04	Su - Her I HPWH	1.5	1	15	5291		\$	291		-1038		+
x	X90300	05	Se - Her III HPWH	2		15	\$291					-1369		⊢
x	X90300	05	St - Her III HPWH Split	2.5		15	51,16/					-1547		⊢
x	X90300	0/	Other			0			—					+
×	X90300	08	Other			0			-					+
×	X90300	10	Other			0								+
×	V0040	10	har			0			<u> </u>					t
×	X9040	01	6 - Solar oV	0.5		25	\$5.040		<u> </u>			-1262		+
×	X90400	02	7 - HP drivers ES Appl	0.5		15	\$3,040		-			-612		+
×	X90400	03	(legacy) 5a - low flow fixtures	0.5	1	50	\$17		5	17		-307		+
-	7	Other	Project Costs	0.5	-	50	517		Ľ.	17		-307		t
	Z10	One T	ime - Upfront Costs		1	50								t
	Z30	Re-Oc	curring Annual Cost (Track Inflation)		1	1								t

<- Prir	mary Filter	(Requires Level 1)	0	Open Prima	ary Filter	and Click OK to Re-filter							
0	Office of	f Financial Management	(o Manua	l Special	Selection Only (Requires I							
0	Divmpia	. Washington - Version: 2018-Residentia	al 🖣	 Show B 	aseline F	ields and Entered Units (F	Requires Refilter)			•			
1	ife Cvc	le Cost Analysis Tool	0	O Show D	Difference	es Between Alternative ar	d Baseline (Reg. F	(efilter)					
-			- F	-				, 		Water		Natural Gas	Т
	Altern	ative 1 Input Page			Total B	uilding Annual Utility An	alysis	\$	501	(CCF)	Electricity (KWH)	(Therms)	
			F			Annual Utility E	sill (\$1			(001)	\$ 501	S	+
			F		An	nual Utility Consumption	Not Entered Belov	v			8,776		+
			F			Sum of Annual Utility Con	sumption Below	-		-	(3,589)		-
						Total Annual Utility C	onsumption			-	5,187		-
					A	nnual Utility Bill ÷ Total U1	ility Consumption			\$-	\$ 0.097	\$	-
N	lote: No L	Inits Assigned to a Component with Entries	_								· · · · · · · · · · · · · · · · · · ·		_
s	Lloif	ormat II Elemental Classification for			Useful		1st Year	Total C	Component	Annual	Annual	Annual	Ι.
н		vildings (Duilding Component List)	EF #	# of Units	Life	(C/Linit)	Maintenance	Insta	alled Cost	Water	Electricity	Natural Gas	A
0	В	linaings (Building Component List)			(Yrs.)	(S/ Unit)	Cost (\$/Unit)		(\$'s)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)	
w		Primary Entries Below: # of Linits m	ust k	he > 0 to he	e counter	l∙ Liseful Life must be >= 2				Entries Belo	w for Component	Specific I Itility An	alv
N	/latch Baseli	ne: Filter to Select All & Drag Copy 014:S14 & U14:AG14			counted	a, oserar ene mase be - 1		\$	3,990	Entres bero	r for component c	peene otinty vii	T
. A	Subst	ructure											+
A	101098	MF- Zonal Elec carbon											T
В	Shell												t
C	Interi	ors											
D	Servio	ces											
E	Equip	ment & Furnishings											F
F	Speci	al Construction & Demolition											1
G	i Buildi	ng Sitework											
X	Other	Categories											+
X	90 Other	Categories											+
X	9010 Bu	ilding Envelope											+
X	901001	1a - 5% UA reduc C	0.5	1	50	\$192		\$	192				+
X	901002	1b - 15% UA reduc	1		50	\$1,359					-517		+
X	901003	1c - 30% UA reduc	2		50	\$2,615					-898		+
	901004	10 - U24 Glaze	2.5		50	\$554 69 779					-228		+
	901005	16 - 40% OA reduc	1		50	\$3,7/3		<u> </u>			-11/2		+
	901006	22 20CH fan off	1	1	50	\$1,107		6	245		-591		+
	001007		1	1	50	\$245		2	245		-4/5		+
	001008	2c-15 ACH HRV 1	15		50	\$2,025		<u> </u>			-1284		+
X	901010	2d - 0.6 ACH HRV	2		50	\$3,280		<u> </u>			-1533		+
X	9020 HV	/40	-			\$5,200		<u> </u>			1200		+
X	902001	3a - Furnace	1		18								+
X	902002	3b - 9.5 HSPF HP 0	0.5		15								+
X	902003	3c - GSHP 1	1.5		20								+
X	902004	3d - DHP	1	1	18	\$2,800		\$	2,800		-1132		T
X	902005	3e - 11.0 HSPF HP	1		15								T
X	902006	3f - DHP (15% elec) 1	1.5		18	\$4,800					-1193		Т
X	902007	4 - HVAC inside	1		50								F
X	902008	Other											ſ
X	902009	Other											
X	902010	Other											
X	9030 Ho	bt Water											+
X	903001	58 - DWK (0.5		50	\$133		<u> </u>			-265		+
	903002	50 - 0.80 gas DHW CSUP	0.5		15			<u> </u>					+
	903003	DC - U.91 gas DHW, GSHP	1		15	Č004		<u> </u>			1038		+
	903004 00200E	Du - Her I HPWH	2.1	1	15	5291		c	201		-1038		+
	002005	St - Tier III HDWH Solit	2 5	1	15	\$291		<u> </u>	291		-1509		+
	903006	2 Inter III newn spirc	2.5		15	\$1,107					-154/		+
	903007	Other	-					<u> </u>					+
	903008	Other	-					<u> </u>					+
	903010	Other	-					<u> </u>					+
	9040 01	her	-										+
X	904001	6 - Solar pV	0.5		25	\$5.040					-1262		+
X	904002	7 - HP drvers, ES Appl	0.5	1	15	\$462		5	462		-612		+
X	904003	(legacy) 5a - low flow fixtures	0.5	-	50	\$17		Ľ.			-307		t
Z	Other	Project Costs				Q1 ,							t
Z	10 One T	ime - Upfront Costs		1	50								F
Z	30 Re-Oo	ccurring Annual Cost (Track Inflation)		1	1								F

<- P	rimary	Filter (Requires Level 1)		Open Prim	ary Filter	and Click OK to Re-filter								
	Offic	ce of Financial Management		O Manua	al Special	Selection Only (Requires F								
	Olyn	npia, Washington - Version: 2018-Resi	dential	Show I	Baseline I	Fields and Entered Units (F	Requires Refilter)							
	Life	Cycle Cost Analysis Tool		O Show I	Differenc	es Between Alternative an	nd Baseline (Req.	Refilter)					
	Alte	ernative 2 Input Page			Total B	uilding Annual Utility An	alysis	\$	497	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)		
						Annual Utility E	Bill [\$]	<u> </u>			\$ 497			
				L	An	nual Utility Consumption	Not Entered Belo	N		-	8,776			
				<u> </u>		Sum of Annual Utility Con	sumption Below			- (3,631) -				
				<u> </u>	Δ	nnual Utility Bill ÷ Total Ut	tility Consumption	1		- <u>5,145</u> -				
	Note:	No Units Assigned to a Component with Entries		L		initian office, pair of rotar of	\$	3 - 3 0.097 3 -						
5					Useful		1st Year	Total	Component	Annual	Annual	Annual		
H	'	Uniformat il Elemental Glassification for	REF	# of Units	Life	Installed Cost	Maintenance	Inst	talled Cost	Water	Electricity	Natural Gas		
0		Buildings (Building Component List)			(Yrs.)	(S/Unit)	Cost (\$/Unit)		(\$'s)	(CCF/Unit)	(KWH/Unit)	(Therm/Unit)		
W		Primary Entries Below: # of	Units mus	t be > 0 to b	e counte	d; Useful Life must be >= 2	2			Entries Belo	w for Component	Specific Utility Anal		
	Match	Baseline: Filter to Select All & Drag Copy 014:S14 & U14:AG14						\$	4,912					
	A S	Substructure	_					-						
	A1010	98 MF- Zonal Elec carbon	_					-						
	C	Interiors						-						
	D 9	Services												
	E I	Equipment & Furnishings												
	F S	Special Construction & Demolition												
	G	Building Sitework	_					-						
	X VOO	Other Categories	_					-						
	X9010	Building Envelope	_					-						
	X90100	01 1a - 5% UA reduc	0.5	5	50									
	X90100	02 1b - 15% UA reduc	1	. 1	50	\$1,359		\$	1,359		-517			
	X90100	03 1c - 30% UA reduc	2	2	50	\$2,615					-898			
	X90100	04 1d - U24 Glaze	0.5		50	\$554		-			-228			
<u> </u>	X90100	05 1f-1l-20 Glaze			50	\$5,775		-			-11/2			
	X90100	07 2a - 3ACH . fan eff	0.5	5	50	\$245		-			-475			
	X90100	08 2b - 2 ACH, HRV	1	l	50	\$1,025					-939			
	X90100	09 2c - 1.5 ACH, HRV	1.5	5	50	\$2,296					-1284			
	X90101	10 2d - 0.6 ACH, HRV	1	2	50	\$3,280					-1533			
	X9020	HVAC			10			-						
	X90200	01 36 - PURIALE 02 36 - 9 5 HSPE HP	0	5	10			-						
	X90200	03 3c - GSHP	1.5	5	20									
	X90200	04 3d - DHP	1.5	5 1	18	\$2,800		\$	2,800		-1132			
	X90200	05 3e - 11.0 HSPF HP	1		15									
	X90200	06 3f - DHP (15% elec)	1.5	5	18	\$4,800		-			-1193			
	X90200	07 4 - HVAC Inside	1		50			-						
	X90200	09 Other						-						
	X90201	10 Other												
	X9030	Hot Water												
	X90300	01 5a - DWR	0.5		50	\$133		L			-265			
	X90300	02 50 - 0.80 gas DHW	0.5		15			⊢						
	X90300	03 St - 0.91 gas Drive, GSRP 04 Sd - Tier I HPWH	19	5	15	\$291					-1038			
	X90300	05 Se - Tier III HPWH	1	2 1	15	\$291		\$	291		-1369			
	X90300	06 5f - Tier III HPWH Split	2.5	5	15	\$1,167					-1547			
	X903007													
	X90300	08 Other						-						
	X90300	10 Other												
	X9040	Other						-						
	X90400	01 6 - Solar pV	5	25	\$5,040					-1262				
	X904001 0 - Solar pv 0.1 X904002 7 - HP dryers, ES Appl 0.1		i 1	15	\$462		\$	462		-612				
	X904003 (legacy) 5a - low flow fixtures 0.1			5	50	\$17								
Z Other Project Costs					50									
	730	One Time - Upfront Costs Re-Occurring Annual Cost (Track Inflation)		1	50									
1		ne occaring rinnan cost (riack initation)		-	-									

Multifamily Unit Expenditure Report Page In Constant 2020 \$'s

	С	Cumulative	e Ex	xpenditur	e S	ummary		Annual Expenditure Summary					
Year	1	Baseline		Alt. 1		Alt. 2		Baseline		Alt. 1		Alt. 2	
2020	\$	111	\$	798	\$	982	\$	111	\$	798	\$	982	
2021	\$	855	\$	1,505	\$	1,731	\$	745	\$	707	\$	749	
2022	\$	1,614	\$	2,215	\$	2,483	\$	758	\$	711	\$	752	
2023	\$	2,386	\$	2,931	\$	3,238	\$	772	\$	715	\$	755	
2024	\$	3,172	\$	3,651	\$	3,996	\$	786	\$	720	\$	758	
2025	\$	3,972	\$	4,376	\$	4,757	\$	800	\$	725	\$	761	
2026	\$	4,786	\$	5,106	\$	5,522	\$	814	\$	730	\$	765	
2027	\$	5,614	\$	5,841	\$	6,291	\$	828	\$	735	\$	769	
2028	\$	6,448	\$	6,576	\$	7,059	\$	834	\$	735	\$	768	
2029	\$	7,289	\$	7,311	\$	7,826	\$	841	\$	735	\$	767	
2030	\$	8,137	\$	8,047	\$	8,593	\$	848	\$	736	\$	766	
2031	\$	8,991	\$	8,784	\$	9,358	\$	854	\$	736	\$	766	
2032	\$	9 <i>,</i> 853	\$	9,521	\$	10,124	\$	861	\$	737	\$	766	
2033	\$	10,720	\$	10,259	\$	10,889	\$	868	\$	738	\$	765	
2034	\$	11,595	\$	10,998	\$	11,655	\$	875	\$	739	\$	765	
2035	\$	12,768	\$	12,491	\$	13,173	\$	1,173	\$	1,494	\$	1,519	
2036	\$	13,648	\$	13,228	\$	13,934	\$	881	\$	736	\$	761	
2037	\$	14,529	\$	13,960	\$	14,690	\$	880	\$	732	\$	756	
2038	\$	15,416	\$	17,494	\$	18,246	\$	887	\$	3,534	\$	3,556	
2039	\$	16,310	\$	18,229	\$	19,004	\$	894	\$	735	\$	757	
2040	\$	17,203	\$	18,961	\$	19,756	\$	893	\$	732	\$	753	
2041	\$	18,103	\$	19,695	\$	20,510	\$	900	\$	734	\$	754	
2042	\$	19,003	\$	20,426	\$	21,260	\$	900	\$	731	\$	750	
2043	\$	19,910	\$	21,158	\$	22,011	\$	907	\$	733	\$	751	
2044	\$	20,816	\$	21,888	\$	22,759	\$	906	\$	729	\$	747	
2045	Ş	21,729	Ş	22,619	\$	23,507	Ş	913	Ş	732	\$	749	
2046	\$	22,642	\$	23,348	\$	24,252	\$	913	\$	729	\$	745	
2047	Ş	23,561	Ş	24,079	Ş	24,999	Ş	920	Ş	731	Ş	747	
2048	Ş	24,481	Ş	24,807	Ş	25,743	Ş	919	Ş	728	Ş	743	
2049	Ş	25,402	Ş	25,535	Ş	26,485	Ş	922	\$ \$	728	Ş	742	
2050	Ş	26,618	Ş	27,016	Ş	27,980	Ş	1,216	Ş	1,481	Ş	1,495	
2051	Ş	27,534	Ş	27,663	Ş	28,621	Ş	916	Ş t	647	Ş	642	
2052	Ş	28,453	Ş	28,311	Ş	29,265	Ş	919	Ş	649	Ş	644	
2053	Ş	29,375	Ş	28,962	Ş	29,910	Ş	922	Ş	651	Ş	646	
2054	Ş	30,299	Ş	29,615	Ş	30,558	Ş	925	Ş	653	Ş	648	
2055	Ş	31,227	Ş	30,270	Ş	31,208	Ş	928	Ş	655	Ş	650	
2056	Ş	32,157	Ş	33,/2/	Ş	34,660	\$	931	Ş	3,457	Ş	3,452	
2057	Ş	33,091	Ş	34,387	Ş	35,313	Ş	933	Ş	659	Ş	654	
2058	Ş	34,027	Ş	35,048	Ş	35,969	Ş	936	Ş	661	Ş	656	
2059	Ş	34,967	Ş	35,711	Ş	36,627	\$	939	Ş	663	Ş	658	
2060	Ş	35,909	Ş	36,377	Ş	37,287	\$	942	Ş	665	Ş	660	
2061	Ş	36,854	Ş	37,044	Ş	37,949	Ş	945	Ş	667	Ş	662	
2062	Ş	37,802	ې د	37,713	Ş	38,614	Ş	948	ې د	670	ې د	664	
2063	Ş	38,/53	ې د	38,385	Ş	39,280	Ş	951	Ş	6/2	ې د	666	
2064	Ş	39,707	ې د	39,059	Ş	39,948	Ş	954	ې د	6/4	ې د	668	
2065	Ş	40,955	ې د	40,488	Ş	41,371	Ş	1,248	ې د	1,429	ې د	1,424	
2066	ç	41,915	ې د	41,105	Ş	42,044	Ş	960	ې د	6/8	ې د	6/2	
2067	ې د	42,8/8	ې د	41,845	ې د	42,/18	Ş	963	ې د	680	ې د	674	
2000	ې د	40,043	ې د	42,527	ې د	43,395	ې د	900	ې د	C01	ې د	670 670	
2009	ې د	44,012	ې د	43,211	ې د	44,073	ڊ د	209 	ې د	(420)	ې د	(111)	
2070	Ş	45,589	Ş	42,773	Ş	43,029	Ş	111	Ş	(438)	Ş	(444)	