



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

- | | |
|--|---|
| <input type="checkbox"/> Addresses a critical life/safety need. | <input type="checkbox"/> Consistency with state or federal regulations. |
| <input type="checkbox"/> The amendment clarifies the intent or application of the code. | <input type="checkbox"/> Addresses a unique character of the state. |
| <input checked="" type="checkbox"/> Addresses a specific state policy or statute.
(Note that energy conservation is a state policy) | <input type="checkbox"/> Corrects errors and omissions. |

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

- | | | |
|---|---|--|
| <input checked="" type="checkbox"/> Single family/duplex/townhome | <input type="checkbox"/> Multi-family 4 + stories | <input type="checkbox"/> Institutional |
| <input checked="" type="checkbox"/> Multi-family 1 – 3 stories | <input type="checkbox"/> Commercial / Retail | <input type="checkbox"/> 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.nwccouncil.org/> This is a federally mandated multi-state compact that develops the efficiency resources for the region's electric utilities
- Navigant is a business consulting firm which provides resource planning for both gas and electric utilities, including gas utilities in Washington State. <http://www.navigant.com/industries/energy/>
- CEE is the Consortium for Energy Efficiency. CEE is the US and Canadian consortium of gas and electric efficiency program administrators. <http://www.cee1.org/>
- This study also uses cost information provided to the SBCC by Ecotope

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

Table 1: Total Measure Costs by Single Family Prototypes

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

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

Table 2: Total Measure Costs for Multifamily prototype

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

Energy Savings Estimates

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

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

Table 3: Savings All Climates, All Systems

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

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

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

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

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

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

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

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

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

Component	Base Level	Measures Beyond Base Level	Cost \$/ft2 or \$/unit	Source
Envelope				
Ceiling	R-49	R-49 RH Ceiling Insulation	\$ 0.20	ResSFEStarBuiltGreenHomesWA2014_v2_5.xlsm
Ceiling	R-49	R-60 RH Ceiling Insulation	\$ 0.23	CERF
Wall	R-21 Std	R-21 int Wall + R4 Foam Sheathing	\$ 0.96	RTF RESnew.xls 6th plan
Wall	R-21 Std	R-21 int Wall + R12 Foam Sheathing	\$ 2.25	RTF RESnew.xls passiveHouse Consultant
Wall	R-21 Std	R-21 int Wall + R16 Foam Sheathing	\$ 3.00	passiveHouse Consultant
Floor	R-30	R-38 Floor	\$ 0.38	RTF-ResNCMTHouseID_v_3_0 .xlsm April 4, 2018; ShellCosts tab
Floor	R-30	R-48 Floor	\$ 1.50	Assuming high density foam (R-6.inch) installed in std 12" joists
Slab	R-10 2' perim	Slab R-10 Full	\$ 0.91	6th Plan Appendix G
Slab	R-10 2' perim	Slab R-20 Full	\$ 1.22	NextStepHomes data
Window	U-0.30	Window U-0.28	\$ 0.80	NPCC Standard workbook
Window	U-0.30	Window U-0.25	\$ 4.50	NPCC Standard workbook
Window	U-0.30	Window U-0.24	\$ 4.50	NPCC Standard workbook
Window	U-0.30	Window U-0.22	\$ 6.60	NPCC Standard workbook
Window	U-0.30	Window U-0.18	\$ 9.00	MF bids (tripleglaze-BidPrices.xl)
Air Sealing & Ventilation				
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 3 ACH50	\$ 0.20	RTF Workbook. ResWXS_FY10v2_1.xls passiveHouse consultant
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 2 ACH50	\$ 0.50	
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 1.5 ACH50	\$ 0.80	
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 0.6 ACH50	\$ 1.50	
Exhaust Fan	Pt Source Exhaust Fan =0.75W/cfm	Pt Source Exhaust Fan <0.35W/cfm	\$ 80.64	navigant 2013
ERV	No ERV	ERV with SHR>= 0.65	\$ 0.75	Whispercomfort and minimal ducting
ERV	No ERV	ERV with SHR>= 0.75	\$ 2.00	renewaire or lifebreath
ERV	No ERV	ERV with SHR>= 0.80	\$ 2.50	high efficiency HRV with ducting (venmar, zhender)

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				
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

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



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STATE BUILDING CODE COUNCIL

Washington State Energy Code Development Standard Energy Code Proposal Form

May 2018

Log No. _____ **19-WSEC-R36**

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 underline 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. The duct system shall be located completely within the continuous air barrier and within the building thermal envelope.
2. 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. Metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic.
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 ~~carbon emissions energy consumption~~ shall be less than or equal to ~~80~~ 70 percent of the annual ~~carbon emissions energy consumption~~ of the *standard reference design*.
- For single family structures (including townhouses) 1,500 to 5,000 square feet of conditioned floor area, the annual ~~carbon emissions energy consumption~~ shall be no more than ~~72~~ 62 percent of the *standard reference design*.
- For single family structures (including townhouses) over 5,000 square feet of conditioned floor area, the annual ~~carbon emissions 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 ~~carbon emissions energy consumption~~ shall be less than or equal to ~~85~~ 70 percent of the annual ~~carbon emissions energy consumption~~ of the *standard reference design*.

TABLE R405.3
CARBON EMISSIONS
FACTORS

Type	CO2e (lb/unit)	Unit
Electricity	0.70	kWh
Natural Gas	11.7	Therm
Oil	19.2	Gallon
Propane	10.5	Gallon
Other ^a	195.00	mmBtu
On-site renewable energy	0.00	

^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. The credits from both Table R406.2(1) and Table R406.2(2) are required.

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:

- 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.
- Medium Dwelling Unit: ~~3.5~~ 5.0 credits
All dwelling units that are not included in #1, ~~or #3, or #4.~~
~~Exception: Dwelling units serving R-2 occupancies shall require 2.5 credits.~~
- 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.~~
- ~~Additions less than 500 square feet: 0.5 credits~~
- Dwelling units serving R-2 occupancies: 4.5 credits (from Group R-2 Credit column in Table R406.2)
- 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.

Table R406.2(1) Fuel Emissions Credits

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

TABLE R406.2(2) ENERGY CREDITS

OPTION	DESCRIPTION	CREDIT(S) Single Family and townhouse	CREDIT(S) (Group R-2)
1a	EFFICIENT BUILDING ENVELOPE 1a: Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration U = 0.28 Floor R-38 Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab or Compliance based on Section R402.1.4: Reduce the Total <u>conductive</u> ^a UA by 5%.	0.5	<u>N/A</u> ^e
1b	EFFICIENT BUILDING ENVELOPE 1b: Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration U = 0.25 Wall R-21 <u>int</u> plus R-4 <u>ci</u> Floor R-38 Basement wall R-21 <u>int</u> plus R-5 <u>ci</u> 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%.	1.0	<u>1.0</u>
1c	EFFICIENT BUILDING ENVELOPE 1c: Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration U = 0.22 Ceiling and single-rafter or joist-vaulted R-49 advanced Wood frame wall R-21 <u>int</u> plus R-12 <u>ci</u> Floor R-38 Basement wall R-21 <u>int</u> plus R-12 <u>ci</u> 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 30%.	2.0	<u>1.5</u>

1d ^a	<p>EFFICIENT BUILDING ENVELOPE 1d: Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration U = 0.24</p>	0.5	<u>0.5</u>
1e	<p>EFFICIENT BUILDING ENVELOPE 1e: Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration U = 0.18 Ceiling and single-rafter or joist-vaulted R-60 advanced Wood frame wall R-21 int plus R-16 ci Floor R-48 Basement wall R-21 int plus R-16 ci Slab on grade R-20 perimeter and under entire slab Below grade slab R-20 perimeter and under entire slab or Compliance based on Section R402.1.4: Reduce the Total conductive^a UA by 40%.</p>	3.0	<u>2.0</u>
1f ^c	<p>EFFICIENT BUILDING ENVELOPE 1f: Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration U = 0.20</p>	<u>1.0</u>	<u>1.0</u>
2a	<p>AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION 2a: Compliance based on R402.4.1.2: Reduce the tested air leakage to 3.0 air changes per hour maximum <u>at 50 pascals</u> Or For R-2 construction, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.3 cfm/ft² maximum at 50 pascals and All whole house ventilation requirements as determined by Section M1507.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> 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.</p>	0.5	<u>1.0</u>
2b	<p>AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION 2b: 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> Or For R-2 construction, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.25 cfm/ft² maximum at 50 pascals and All whole house ventilation requirements as determined by Section M1507.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.70 <u>0.65</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.</p>	1.0	<u>1.5</u>
2c	<p>AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION 2c: Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 1.5 air changes per hour maximum <u>at 50 pascals</u> 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 ventilation requirements as determined by Section M1507.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> 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.</p>	1.5	<u>2.0</u>

<u>2d</u>	<p><u>AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION 2d:</u> <u>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.6 air changes per hour maximum at 50 pascals</u> <u>Or</u> <u>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 pascals</u> <u>and</u> <u>All whole house ventilation requirements as determined by Section M1507.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> 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.</u> <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.</u></p>	<u>2.0</u>	<u>2.5</u>
<u>3a</u> <u>b</u> <u>d</u>	<p><u>HIGH EFFICIENCY HVAC EQUIPMENT 3a:</u> <u>Energy Star Rated (U.S. North) Gas or propane or oil-fired furnace with minimum AFUE of 94%95%, or Energy Star Rated Gas or propane or oil-fired boiler with minimum AFUE of 92%90%</u> <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.</u></p>	<u>1.0</u> <u>0.5</u>	<u>1.0</u> <u>0.5</u>
<u>3b</u> <u>b</u> <u>d</u>	<p><u>HIGH EFFICIENCY HVAC EQUIPMENT 3b:</u> <u>Air-source heat pump with minimum HSPF of 9.09.5</u> <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.</u></p>	<u>1.0</u>	<u>N/A^e</u>
<u>3c</u> <u>b</u> <u>d</u>	<p><u>HIGH EFFICIENCY HVAC EQUIPMENT 3c:</u> <u>Closed-loop ground source heat pump; with a minimum COP of 3.3</u> <u>or</u> <u>Open loop water source heat pump with a maximum pumping hydraulic head of 150 feet and minimum COP of 3.6</u> <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.</u></p>	<u>1.5</u>	<u>1.0</u>
<u>3d</u> <u>b</u> <u>d</u>	<p><u>HIGH EFFICIENCY HVAC EQUIPMENT 3d:</u> <u>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.</u> <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.</u></p>	<u>1.0</u>	<u>1.5</u>
<u>3e</u> <u>d</u>	<p><u>HIGH EFFICIENCY HVAC EQUIPMENT 3e:</u> <u>Air-source heat pump with minimum HSPF of 11.0</u> <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.</u></p>	<u>1.0</u>	<u>NA</u>
<u>3f</u> <u>d</u>	<p><u>HIGH EFFICIENCY HVAC EQUIPMENT 3f:</u> <u>Ductless Split System Heat Pumps with no electric resistance heating in the primary living areas. A ductless heat pump system with a minimum HSPF of 10 shall be sized and installed to provide heat to entire housing unit at the design outdoor air temperature. Up to 15% of the rated heating capacity of the ductless heat pump system is permitted to be an alternative heating source.</u> <u>To qualify to claim this credit, the building permit drawings shall specify the option being selected, the heating equipment type, the minimum equipment efficiency, and total installed heat capacity (divided out by equipment type)</u></p>	<u>1.5</u>	<u>2.5</u>

4	<p>HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM:</p> <p>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.</p> <p>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 nylon straps and installed using a plastic strapping tensioning tool. Ducts located outside the conditioned space must be insulated to a minimum of R-8.</p> <p><u>HVAC and duct system installation shall comply with requirements of Section R403.3.7</u></p> <p>Locating system components in conditioned crawl spaces is not permitted under this option.</p> <p>Electric resistance heat and ductless heat pumps are not permitted under this option.</p> <p>Direct combustion heating equipment with AFUE less than 80% is not permitted under this option.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and shall show the location of the heating and cooling equipment and all the ductwork.</p>	1.0	<u>N/A</u>
5a	<p>EFFICIENT WATER HEATING 5a:</p> <p>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.⁶</p> <p>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.</p> <p><u>EFFICIENT WATER HEATING 5a:</u></p> <p><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.</u></p> <p><u>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.</u></p>	0.5	<u>0.5</u>
5b	<p>EFFICIENT WATER HEATING 5b:</p> <p>Water heating system shall include one of the following: Gas or propane or oil water heater with a minimum EF of 0.80.</p> <p>or</p> <p>Water heater heated by ground source heat pump meeting the requirements of Option 3c.</p> <p>or</p> <p>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.</p> <p>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.</p>	1.0 0.5	<u>0.5</u>

5c	<p>EFFICIENT WATER HEATING 5c: Water heating system shall include one of the following: Gas or propane or oil water heater with a minimum EF of 0.91 or Solar water heating supplementing a minimum standard water heater. Solar water heating will provide a rated minimum savings of 85 therms or 2000 kWh based on the Solar Rating and Certification Corporation (SRCC) Annual Performance of OG-300 Certified Solar Water Heating Systems. or Water heater heated by ground source heat pump meeting the requirements of <u>Option 3c.</u> 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 heater equipment type and the minimum equipment efficiency and, for solar water heating systems, the calculation of the minimum energy savings.</p>	1-5 <u>1.0</u>	<u>1.0</u>
5d	<p>EFFICIENT WATER HEATING 5d: 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 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. or 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.</p>	0-5 <u>1.5</u>	<u>2.0</u>
<u>5e</u>	<p>EFFICIENT WATER HEATING 5e: Water heating system shall include one of the following: For R-2 occupancy, an electric heat pump water heater with a minimum UEF of 2.6. Water heater shall supply DHW to all units. If supplying more than one unit, water loop shall be insulated with R-8 minimum pipe insulation. or 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 equipment efficiency.</p>	<u>2.0</u>	<u>2.5</u>
<u>5f</u>	<p>EFFICIENT WATER HEATING 5f: Water heating system shall include one of the following: For R-2 occupancy, an electric heat pump water heater with a minimum UEF of 2.9 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. or 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.</p>	2-0 <u>2.5</u>	2-5 <u>3.0</u>

6	<p>RENEWABLE ELECTRIC ENERGY: 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.</p>	0.5	<u>0.5</u>
7	<p>APPLIANCE PACKAGE: <u>All of the following appliances shall be provided with the dwelling unit and shall meet the following standards:</u> Dishwasher – Energy Star Rated Refrigerator – Energy Star Rated Washing Machine – Energy Star Rated Dryer – Energy Star Rated and utilizing full Heat Pump Technology <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.</u></p>	<u>0.5</u>	<u>1.5</u>

- a. Conductive UA as defined by Equation 1 and 2 in Section R402.1.4.
- b. Projects using this option may not use Option 1a, 1b, ~~or~~ 1c, 1e or 1f.
- c. Projects using this option may not use Option 1a, 1b, 1c, 1d or 1e.
- d. Projects may only include credit from one space heating option, 3a, 3b, 3c, ~~or~~ 3d, 3e or 3f. 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 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 in 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 in the 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 place 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 must meet one of the following criteria. Select at least one:

- | | |
|--|--|
| <input type="checkbox"/> Addresses a critical life/safety need. | <input checked="" type="checkbox"/> Consistency with state or federal regulations. |
| <input type="checkbox"/> The amendment clarifies the intent or application of the code. | <input type="checkbox"/> Addresses a unique character of the state. |
| <input checked="" type="checkbox"/> Addresses a specific state policy or statute.
(Note that energy conservation is a state policy) | <input type="checkbox"/> Corrects errors and omissions. |

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

- | | | |
|---|---|--|
| <input checked="" type="checkbox"/> Single family/duplex/townhome | <input type="checkbox"/> Multi-family 4 + stories | <input type="checkbox"/> Institutional |
| <input checked="" type="checkbox"/> Multi-family 1 – 3 stories | <input type="checkbox"/> Commercial / Retail | <input type="checkbox"/> Industrial |

Co-proposers

Your name	Chuck Murray,	Email address	chuck.murray@commerce.wa.gov
Your organization	Department of Commerce	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	poppy.storm@2050-institute.org
Your Organization	Shift Zero	Phone Number	_____ 206 650-7240

~~Instructions: Send this form as an email attachment, along with any other documentation available, to: sbcc@des.wa.gov. 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)									
Prototype	Size	Fuel	Weight	Credits	kWh	Th	First Cost (\$)	First Cost (\$/SF)	carbon (#/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
Small	1500	Elect (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 [Analysis tool](#) and [Instructions](#); use these [Inputs](#). [Webinars on the tool can be found Here and Here](#))

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.

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

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.

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

Component	Base Level	Measures Beyond Base Level	Cost \$/ft2 or \$/unit	Source
Envelope				
Ceiling	R-49	R-49 RH Ceiling Insulation	\$ 0.20	ResSFEStarBuiltGreenHomesWA2014_v2_5.xlsm
Ceiling	R-49	R-60 RH Ceiling Insulation	\$ 0.23	CERF
Wall	R-21 Std	R-21 int Wall + R4 Foam Sheathing	\$ 0.96	RTF RESnew.xls 6th plan
Wall	R-21 Std	R-21 int Wall + R12 Foam Sheathing	\$ 2.25	RTF RESnew.xls passiveHouse Consultant
Wall	R-21 Std	R-21 int Wall + R16 Foam Sheathing	\$ 3.00	passiveHouse Consultant
Floor	R-30	R-38 Floor	\$ 0.38	RTF-ResNCMTHouseID_v_3_0 .xlsm April 4, 2018; ShellCosts tab
Floor	R-30	R-48 Floor	\$ 1.50	Assuming high density foam (R-6.inch) installed in std 12" joists

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 & Ventilation				
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 3 ACH50	\$ 0.20	RTF Workbook. ResWXS_FY10v2_1.xls passiveHouse consultant
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 2 ACH50	\$ 0.50	
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 1.5 ACH50	\$ 0.80	
ACH	Tested Infiltration at 5 ACH 50	Tested Infiltration to 0.6 ACH50	\$ 1.50	
Exhaust Fan	Pt Source Exhaust Fan =0.75W/cfm	Pt Source Exhaust Fan <0.35W/cfm	\$ 80.64	navigant 2013
ERV	No ERV	ERV with SHR>= 0.65	\$ 0.75	\$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				
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	\$1,400.00	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. ResSFEExistingHVAC
multizone 11.0 DHP	8.2 HSPF	10 HSPF efficiency with no electric resistance. Reduction in elec heat but higher tonnage	\$5,400	Ecotope analysis of NEEA DHP pilot program database
Domestic Hot Water				
Water Htr	0.59 EF	Gas Water Heater >=0.80 EF	\$ 586.00	NREL, 2013
Water Htr	0.59 EF	Gas Water Heater >=0.91 EF	\$ 923.00	NREL, 2013
Water Htr	0.95 EF	Heat Pump Water Heater 2 EF	\$ 874.00	RTF ResHPWH.xls
DWHR	none	Drain water heat recovery pipe	\$ 400.00	RTF RESDHWDrainWaste.xls
Water Htr	0.95 EF	Tier 3 Water Heater 3 EF	\$ 874.00	RTF ResHPWH.xls
Water Htr	0.95 EF	CO2 Water Heater 4 EF	\$ 3,500.00	RTF ResHPWH.xls
Appliances				
Dryers, refr, dishwasher	Fed pre-empted	ventless dryers, ES appliances	\$ 462.000	RTF-ResClothesDryers, ResRef, HD.com \$420 for HP dryer, +\$40 for Cloth washer, +\$90 for refr

Table 2: Total Measure Costs by Single Family Prototypes

			Prototypes Weight % by Floor Area			
			1344	2200	2688	5000
Option-Description	Credit Value	Weighted Measure Cost	15%	72%	11%	2%
1a - 5% UA reduc	0.5	\$ 1,102	\$ 767	\$ 1,097	\$ 1,667	\$ 676
1b - 15% UA reduc	1	\$ 4,311	\$ 2,649	\$ 4,565	\$ 4,582	\$ 6,127
1c - 30% UA reduc	2	\$ 7,947	\$ 4,869	\$ 8,537	\$ 7,609	\$ 11,659
1d - U-.24 Glaze	0.5	\$ 1,583	\$ 907	\$ 1,638	\$ 1,818	\$ 3,375
1e - 40% UA reduc	3	\$ 11,889	\$ 7,641	\$ 12,925	\$ 10,191	\$ 15,828
1f - U-.20 Glaze	1	\$ 3,166	\$ 1,814	\$ 3,276	\$ 3,636	\$ 6,750

2a - 3ACH , fan eff	0.5	\$ 517	\$ 349	\$ 521	\$ 618	\$ 1,081
2b - 2 ACH, HRV	1	\$ 2,727	\$ 1,680	\$ 2,750	\$ 3,360	\$ 6,250
2c - 1.5 ACH, HRV	1.5	\$ 6,108	\$ 3,763	\$ 6,160	\$ 7,526	\$ 14,000
2d - 0.6 ACH, HRV	2	\$ 8,725	\$ 5,376	\$ 8,800	\$ 10,752	\$ 20,000
3a - Furnace	1	\$ 230	\$ 230	\$ 230	\$ 230	\$ 230
3b - 9.5 HSPF HP	0.5	\$ 1,270	\$ 1,270	\$ 1,270	\$ 1,270	\$ 1,270
3c - GSHP	1.5	\$ 11,034	\$ 10,900	\$ 10,900	\$ 10,900	\$ 17,600
3d - DHP	1	\$ 1,400	\$ 1,400	\$ 1,400	\$ 1,400	\$ 1,400
3e - 11.0 HSPF HP	1	\$ 5,400	\$ 5,400	\$ 5,400	\$ 5,400	\$ 5,400
3f - DHP (15% elec)	1.5	\$ 5,400	\$ 5,400	\$ 5,400	\$ 5,400	\$ 5,400
4 - HVAC inside	1	\$ 300	\$ 300	\$ 300	---	---
5a - DWR	0.5	\$ 400	\$ 400	\$ 400	\$ 400	\$ 400
5b - 0.80 gas DHW	0.5	\$ 586	\$ 586	\$ 586	\$ 586	\$ 586
5c - 0.91 gas DHW, GSHP	1	\$ 923	\$ 923	\$ 923	\$ 923	\$ 923
5d - Tier I HPWH	1.5	\$ 874	\$ 874	\$ 874	\$ 874	\$ 874
5e - Tier III HPWH	2	\$ 874	\$ 874	\$ 874	\$ 874	\$ 874
5f - Tier III HPWH Split	2.5	\$ 3,500	\$ 3,500	\$ 3,500	\$ 3,500	\$ 3,500
6 - Solar pV	0.5	\$ 5,040	\$ 5,040	\$ 5,040	\$ 5,040	\$ 5,040
7 - ES Appl+ventless Dryer	0.5	\$ 462	\$ 462	\$ 462	\$ 462	\$ 462

Table 3: Total Measure Costs for Multifamily prototype

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

Energy Savings 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.

Table 1: Savings All Climates, All Systems

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

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 use 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.
3. 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 on Fuel Escalation Page			
User Inputs are for sensitivity analysis only, final submissions must be made using OFM			
Timing Variables	Year(s)		
Base Year (Generally Current Year)	2020		
Additional Construction Years beyond 2020	0		
1st Operation Year = 20:			
Finance 1st Purchases for ->	<input checked="" type="checkbox"/> Baseline	<input checked="" type="checkbox"/> Alt. 1	<input checked="" type="checkbox"/> 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

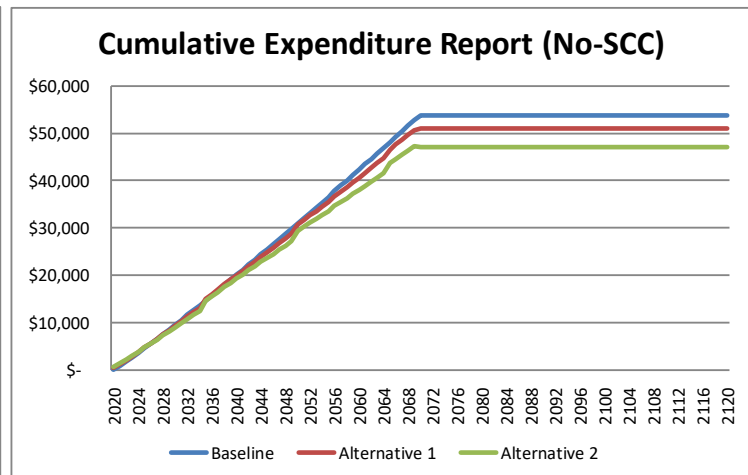
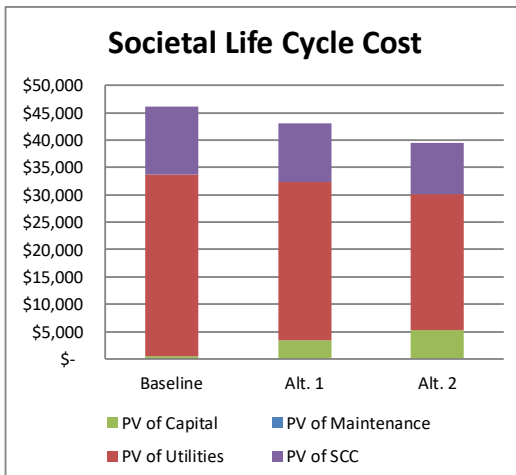
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	1,344
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	1,344
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intensity (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 Primary Filter and Click OK to Re-filter

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Baseline Input Page

Show All Entered Units (Requires Re-Filter)



Baseline Input Page			Total Building Annual Utility Analysis					\$	857	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)							
			Annual Utility Bill [\$]							\$	473	\$	385						
			Annual Utility Consumption Not Entered Below								4,895		414						
			Sum of Annual Utility Consumption Below							-	-		(52)						
			Total Annual Utility Consumption							-	4,895		362						
			Annual Utility Bill ÷ Total Utility Consumption							\$	-	\$	0.097	\$	1.062				
S	H	W	Uniformat II Elemental Classification for Buildings (Building Component List)		REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)	Ar					
Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2															\$	255	Entries Below for Component Specific Utility Analysis		
	A		Substructure																
x	A101098		small gas home carbon																
	B		Shell																
	C		Interiors																
	D		Services																
	E		Equipment & Furnishings																
	F		Special Construction & Demolition																
	G		Building Sitework																
x	X		Other Categories																
x	X90		Other Categories																
x	X9010		Building Envelope																
x	X901001		1a - 5% UA reduc	0.5		50	\$766.60					5.09	-25.30						
x	X901002		1b - 15% UA reduc	1		50	\$2,649.16					5.61	-57.17						
x	X901003		1c - 30% UA reduc	2		50	\$4,868.68					11.35	-98.72						
x	X901004		1d - U-24 Glaze	0.5		50	\$907.20					1.97	-16.89						
x	X901005		1e - 40% UA reduc	3		50	\$7,641.34					26.84	-134.84						
x	X901006		1f - U-20 Glaze	1		50	\$1,814.40					5.67	-29.19						
x	X901007		2a - 3ACH, fan eff	0.5		50	\$349.44					-52.18	-13.70						
x	X901008		2b - 2 ACH, HRV	1		50	\$1,680.00					312.61	-20.42						
x	X901009		2c - 1.5 ACH, HRV	1.5		50	\$3,763.20					203.35	-33.29						
x	X901010		2d - 0.6 ACH, HRV	2		50	\$5,376.00					204.58	-46.08						
x	X9020		HVAC																
x	X902001		3a - Furnace	1	1	18	\$230.25			\$	230		0.00	-40.92					
x	X902002		3b - 9.5 HSPF HP	0.5		15	\$1,270.00												
x	X902003		3c - GSHP	1.5		20	\$10,900.00												
x	X902004		3d - DHP	1		18	\$1,400.00												
x	X902005		3e - 11.0 HSPF HP	1		15	\$5,400.00												
x	X902006		3f - DHP (15% elec)	1.5		18	\$5,400.00												
x	X902007		4 - HVAC inside	1		50	\$300.00					-10.81	-46.38						
x	X9030		Hot Water																
x	X903001		5a - DWR	0.5		50	\$400.00					0.00	-16.86						
x	X903002		5b - 0.80 gas DHW	0.5		15	\$586.00					0.00	-22.20						
x	X903003		5c - 0.91 gas DHW, GSHP	1		15	\$923.00					0.00	-32.11						
x	X903004		5d - Tier I HPWH	1.5		15	\$874.00												
x	X903005		5e - Tier III HPWH	2		15	\$874.00												
x	X903006		5f - Tier III HPWH Split	2.5		15	\$3,500.00												
x	X9040		Other																
x	X904001		6 - Solar pV	0.5		25	\$5,040.00					-1262.00	0.00						
x	X904002		7 - HP dryers, ES Appl	0.5		15	\$462.00					-840.00	0.00						
x	X904003		(legacy) 5a - low flow fixtures	0.5	1	50	\$25.00			\$	25		0	-11					
Z			Other Project Costs																
Z10			One Time - Upfront Costs			1	50												
Z30			Re-Occurring Annual Cost (Track Inflation)			1	1												

Small Gas Home

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Alternative 1 Input Page

Open Primary Filter and Click OK to Re-filter

<input type="checkbox"/> Manual Special Selection Only (Requires Refilter)				
<input checked="" type="checkbox"/> Show Baseline Fields and Entered Units (Requires Refilter)				
<input type="checkbox"/> Show Differences Between Alternative and Baseline (Req. Refilter)				
Total Building Annual Utility Analysis		\$	746	
Annual Utility Bill [\$]				
Annual Utility Consumption Not Entered Below				
Sum of Annual Utility Consumption Below		-	(63)	(125)
Total Annual Utility Consumption		-	4,664	278
Annual Utility Bill + Total Utility Consumption		\$	-	\$ 0.097 \$ 1.062

Note: No Units Assigned to a Component with Entries

S H O W	Uniformat II Elemental Classification for Buildings (Building Component List)		REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Anal		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14								\$ 1,803		
A	Substructure										
	A101098	small gas home carbon									
B	Shell										
C	Interiors										
D	Services										
E	Equipment & Furnishings										
F	Special Construction & Demolition										
G	Building Sitework										
X	Other Categories										
X90	Other Categories										
X9010	Building Envelope										
	X901001	1a - 5% UA reduc	0.5		50	\$766.60				5	-21
	X901002	1b - 15% UA reduc	1		50	\$2,649.16				6	-57
	X901003	1c - 30% UA reduc	2		50	\$4,868.68				11	-99
	X901004	1d - U-24 Glaze	0.5		50	\$907.20				2	-17
	X901005	1e - 40% UA reduc	3		50	\$7,641.34				27	-135
	X901006	1f - U-20 Glaze	1		50	\$1,814.40				6	-29
	X901007	2a - 3ACH, fan eff	0.5	1	50	\$349.44		\$ 349		-52	-12
	X901008	2b - 2 ACH, HRV	1		50	\$1,680.00				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					
	X902005	3e - 11.0 HSPF HP	1		15	\$5,400.00					
	X902006	3f - DHP (15% elec)	1.5		18	\$5,400.00					
	X902007	4 - HVAC inside	1	1	50	\$300.00		\$ 300		-11	-43
X9030	Hot Water										
	X903001	5a - DWR	0.5		50	\$400.00					-17
	X903002	5b - 0.80 gas DHW	0.5		15	\$586.00					-22
	X903003	5c - 0.91 gas DHW, GSHP	1.5	1	15	\$923.00		\$ 923			-32
	X903004	5d - Tier I HPWH	1.5		15	\$874.00					
	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	0.5		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					-11
Z	Other Project Costs										
Z10	One Time - Upfront Costs			1	50						
Z30	Re-Occurring Annual Cost (Track Inflation)			1	1						

Small Gas Home

< Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Alternative 2 Input Page

Open Primary Filter and Click OK to Re-filter

<input type="radio"/> Manual Special Selection Only (Requires Refilter)				
<input checked="" type="radio"/> Show Baseline Fields and Entered Units (Requires Refilter)				
<input type="radio"/> Show Differences Between Alternative and Baseline (Req. Refilter)				
Total Building Annual Utility Analysis		\$	643	
Annual Utility Bill [\$]				
Annual Utility Consumption Not Entered Below		-	4,727	403
Sum of Annual Utility Consumption Below		-	(898)	(146)
Total Annual Utility Consumption		-	3,829	257
Annual Utility Bill ÷ Total Utility Consumption		\$	-	\$ 0.097 \$ 1.062

Note: No Units Assigned to a Component with Entries

S H O W	Uniformat II Elemental Classification for Buildings (Building Component List)	REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							Entries Below for Component Specific Utility Analysis		
	Match Baseline: Filter to Select All & Drag Copy O14-S14 & U14-AG14						\$ 3,031			
A	Substructure									
A101098	small gas home carbon									
B	Shell									
C	Interiors									
D	Services									
E	Equipment & Furnishings									
F	Special Construction & Demolition									
G	Building Sitework									
X	Other Categories									
X90	Other Categories									
X9010	Building Envelope									
X901001	1a - 5% UA reduc	0.5	1	50	\$766.60		\$ 767		5	-21
X901002	1b - 15% UA reduc	1		50	\$2,649.16				6	-57
X901003	1c - 30% UA reduc	2		50	\$4,868.68				11	-99
X901004	1d - U-24 Glaze	0.5		50	\$907.20				2	-17
X901005	1e - 40% UA reduc	3		50	\$7,641.34				27	-135
X901006	1f - U-20 Glaze	1		50	\$1,814.40				6	-29
X901007	2a - 3ACH, fan eff	0.5	1	50	\$349.44		\$ 349		-52	-12
X901008	2b - 2 ACH, HRV	1		50	\$1,680.00				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	0.5	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					
X902005	3e - 11.0 HSPF HP	1		15	\$5,400.00					
X902006	3f - DHP (15% elec)	1.5		18	\$5,400.00					
X902007	4 - HVAC inside	1	1	50	\$300.00		\$ 300		-11	-43
X9030	Hot Water									
X903001	5a - DWR	0.5		50	\$400.00					-17
X903002	5b - 0.80 gas DHW	0.5		15	\$586.00					-22
X903003	5c - 0.91 gas DHW, GSHP	1	1	15	\$923.00		\$ 923			-32
X903004	5d - Tier I HPWH	1.5		15	\$874.00					
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	0.5		25	\$5,040.00				-1262	
X904002	7 - HP dryers, ES Appl	0.5	1	15	\$462.00		\$ 462		-840	
X904003	(legacy) 5a - low flow fixtures	0.5		50	\$25.00					-11
Z	Other Project Costs									
Z10	One Time - Upfront Costs		1	50						
Z30	Re-Occurring Annual Cost (Track Inflation)		1	1						

Small Gas Home

Expenditure Report Page In Constant 2020 \$'s

	Cumulative Expenditure Summary			Annual Expenditure Summary		
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	\$ 13,632	\$ 13,103	\$ 12,441	\$ 1,031	\$ 952	\$ 870
2035	\$ 14,668	\$ 14,981	\$ 14,697	\$ 1,036	\$ 1,878	\$ 2,255
2036	\$ 15,707	\$ 15,937	\$ 15,567	\$ 1,039	\$ 956	\$ 870
2037	\$ 16,747	\$ 16,891	\$ 16,434	\$ 1,039	\$ 954	\$ 867
2038	\$ 18,024	\$ 18,082	\$ 17,535	\$ 1,278	\$ 1,190	\$ 1,101
2039	\$ 19,077	\$ 19,045	\$ 18,407	\$ 1,052	\$ 963	\$ 872
2040	\$ 20,133	\$ 20,009	\$ 19,279	\$ 1,056	\$ 964	\$ 872
2041	\$ 21,193	\$ 20,977	\$ 20,152	\$ 1,060	\$ 968	\$ 873
2042	\$ 22,257	\$ 21,946	\$ 21,026	\$ 1,064	\$ 969	\$ 873
2043	\$ 23,326	\$ 22,918	\$ 21,901	\$ 1,069	\$ 972	\$ 875
2044	\$ 24,398	\$ 23,892	\$ 22,776	\$ 1,072	\$ 974	\$ 875
2045	\$ 25,475	\$ 24,869	\$ 23,653	\$ 1,077	\$ 977	\$ 877
2046	\$ 26,556	\$ 25,848	\$ 24,530	\$ 1,081	\$ 979	\$ 877
2047	\$ 27,645	\$ 26,833	\$ 25,411	\$ 1,089	\$ 985	\$ 882
2048	\$ 28,733	\$ 27,816	\$ 26,291	\$ 1,089	\$ 984	\$ 879
2049	\$ 29,826	\$ 28,802	\$ 27,171	\$ 1,093	\$ 986	\$ 881
2050	\$ 30,923	\$ 30,714	\$ 29,438	\$ 1,097	\$ 1,912	\$ 2,267
2051	\$ 32,019	\$ 31,669	\$ 30,260	\$ 1,096	\$ 955	\$ 822
2052	\$ 33,119	\$ 32,627	\$ 31,086	\$ 1,100	\$ 958	\$ 825
2053	\$ 34,223	\$ 33,589	\$ 31,914	\$ 1,104	\$ 962	\$ 828
2054	\$ 35,332	\$ 34,555	\$ 32,746	\$ 1,108	\$ 966	\$ 832
2055	\$ 36,445	\$ 35,524	\$ 33,580	\$ 1,113	\$ 969	\$ 835
2056	\$ 37,792	\$ 36,727	\$ 34,648	\$ 1,347	\$ 1,203	\$ 1,068
2057	\$ 38,913	\$ 37,703	\$ 35,489	\$ 1,121	\$ 976	\$ 841
2058	\$ 40,038	\$ 38,683	\$ 36,334	\$ 1,125	\$ 980	\$ 844
2059	\$ 41,168	\$ 39,667	\$ 37,181	\$ 1,130	\$ 984	\$ 847
2060	\$ 42,302	\$ 40,654	\$ 38,031	\$ 1,134	\$ 987	\$ 850
2061	\$ 43,440	\$ 41,645	\$ 38,885	\$ 1,138	\$ 991	\$ 854
2062	\$ 44,582	\$ 42,639	\$ 39,741	\$ 1,142	\$ 994	\$ 857
2063	\$ 45,728	\$ 43,637	\$ 40,601	\$ 1,146	\$ 998	\$ 860
2064	\$ 46,879	\$ 44,639	\$ 41,464	\$ 1,151	\$ 1,002	\$ 863
2065	\$ 48,034	\$ 46,567	\$ 43,715	\$ 1,155	\$ 1,928	\$ 2,251
2066	\$ 49,193	\$ 47,576	\$ 44,584	\$ 1,159	\$ 1,009	\$ 869
2067	\$ 50,356	\$ 48,588	\$ 45,456	\$ 1,163	\$ 1,012	\$ 872
2068	\$ 51,523	\$ 49,604	\$ 46,332	\$ 1,167	\$ 1,016	\$ 875
2069	\$ 52,695	\$ 50,624	\$ 47,210	\$ 1,172	\$ 1,020	\$ 879
2070	\$ 53,820	\$ 50,980	\$ 47,118	\$ 1,125	\$ 357	\$ (93)

Small Zone Electric Home

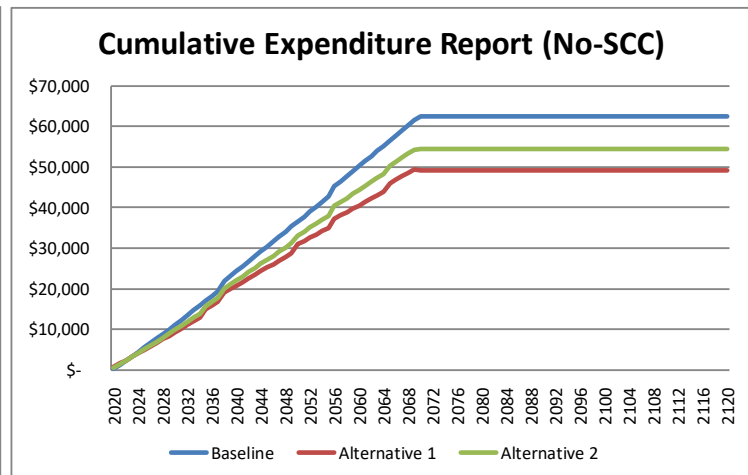
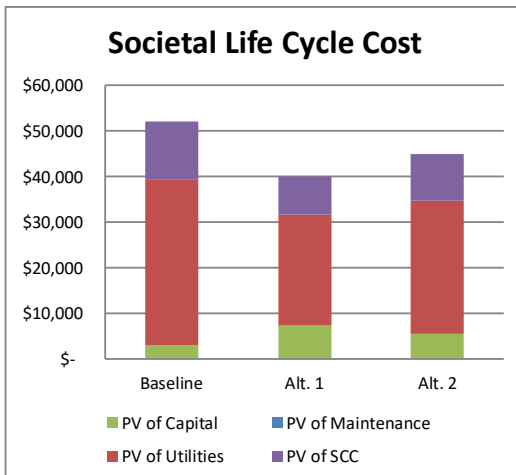
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	1,344
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	1,344
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intensity (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)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Baseline Input Page

Open Primary Filter and Click OK to Re-filter

Show All Entered Units (Requires Re-Filter)



Baseline Input Page			Total Building Annual Utility Analysis					\$	936	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)		
			Annual Utility Bill [\$]								\$	936	\$	-
			Annual Utility Consumption Not Entered Below									11,734		-
			Sum of Annual Utility Consumption Below								-	(2,050)		-
			Total Annual Utility Consumption								-	9,684		-
			Annual Utility Bill ÷ Total Utility Consumption								\$	-	\$	0.097
S H O W	Uniformat II Elemental Classification for Buildings (Building Component List)		REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)			
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							\$	1,425	Entries Below for Component Specific Utility Analysis				
	A	Substructure												
x	A101098	Small Zone Electric												
	B	Shell												
	C	Interiors												
	D	Services												
	E	Equipment & Furnishings												
	F	Special Construction & Demolition												
	G	Building Sitework												
x	X	Other Categories												
x	X90	Other Categories												
x	X9010	Building Envelope												
x	X901001	1a - 5% UA reduc	0.5		50	\$766.60					-477			
x	X901002	1b - 15% UA reduc	1		50	\$2,649.16					-1034			
x	X901003	1c - 30% UA reduc	2		50	\$4,868.68					-1787			
x	X901004	1d - U-24 Glaze	0.5		50	\$907.20					-315			
x	X901005	1e - 40% UA reduc	3		50	\$7,641.34					-2419			
x	X901006	1f - U-20 Glaze	1		50	\$1,814.40					-541			
x	X901007	2a - 3ACH, fan eff	0.5		50	\$349.44					-313			
x	X901008	2b - 2 ACH, HRV	1		50	\$1,680.00					4			
x	X901009	2c - 1.5 ACH, HRV	1.5		50	\$3,763.20					-331			
x	X901010	2d - 0.6 ACH, HRV	2		50	\$5,376.00					-560			
x	X9020	HVAC												
x	X902001	3a - Furnace	1		18	\$230.25								
x	X902002	3b - 9.5 HSPF HP	0.5		15	\$1,270.00								
x	X902003	3c - GSHP	1.5		20	\$10,900.00								
x	X902004	3d - DHP	1	1	18	\$1,400.00		\$	1,400		-1835			
x	X902005	3e - 11.0 HSPF HP	1		15	\$5,400.00								
x	X902006	3f - DHP (15% elec)	1.5		18	\$5,400.00					-1928			
x	X902007	4 - HVAC inside	1		50	\$300.00								
x	X9030	Hot Water												
x	X903001	5a - DWR	0.5		50	\$400.00					-322			
x	X903002	5b - 0.80 gas DHW	0.5		15	\$586.00								
x	X903003	5c - 0.91 gas DHW, GSHP	1		15	\$923.00								
x	X903004	5d - Tier I HPWH	1.5		15	\$874.00					-1236			
x	X903005	5e - Tier III HPWH	2		15	\$874.00					-1623			
x	X903006	5f - Tier III HPWH Split	2.5		15	\$3,500.00					-1836			
x	X9040	Other												
x	X904001	6 - Solar pV	0.5		25	\$5,040.00					-1262.00			
x	X904002	7 - HP dryers, ES Appl	0.5		15	\$462.00					-840.00			
x	X904003	(legacy) 5a - low flow fixtures	0.5	1	50	\$25.00		\$	25		-215			
Z	Other Project Costs													
Z10	One Time - Upfront Costs			1	50									
Z30	Re-Occurring Annual Cost (Track Inflation)			1	1									

Small Zone Electric Home

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Alternative 1 Input Page

Open Primary Filter and Click OK to Re-filter

Manual Special Selection Only (Requires Refilter)				
Show Baseline Fields and Entered Units (Requires Refilter)				
Show Differences Between Alternative and Baseline (Req. Refilter)				
Total Building Annual Utility Analysis		\$ 623	Water (CCF)	Electricity (KWH)
Annual Utility Bill (\$)				\$ 623
Annual Utility Consumption Not Entered Below				11,360
Sum of Annual Utility Consumption Below				(4,912)
Total Annual Utility Consumption				6,448
Annual Utility Bill ÷ Total Utility Consumption		\$	\$	0.097

Note: No Units Assigned to a Component with Entries

S H O W	Uniformat II Elemental Classification for Buildings (Building Component List)	REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							Entries Below for Component Specific Utility Anal		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14						\$ 3,852			
A	Substructure									
A101098	Small Zone Electric									
B	Shell									
C	Interiors									
D	Services									
E	Equipment & Furnishings									
F	Special Construction & Demolition									
G	Building Sitework									
X	Other Categories									
X90	Other Categories									
X9010	Building Envelope									
X901001	1a - 5% UA reduc	0.5	1	50	\$766.60		\$ 767		-477	
X901002	1b - 15% UA reduc	1		50	\$2,649.16				-1034	
X901003	1c - 30% UA reduc	2		50	\$4,868.68				-1787	
X901004	1d - U-.24 Glaze	0.5		50	\$907.20				-315	
X901005	1e - 40% UA reduc	3		50	\$7,641.34				-2419	
X901006	1f - U-.20 Glaze	1		50	\$1,814.40				-454	
X901007	2a - 3ACH, fan eff	0.5	1	50	\$349.44		\$ 349		-313	
X901008	2b - 2 ACH, HRV	1		50	\$1,680.00				4	
X901009	2c - 1.5 ACH, HRV	1.5		50	\$3,763.20				-331	
X901010	2d - 0.6 ACH, HRV	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		15	\$5,400.00					
X902006	3f - DHP (15% elec)	1.5		18	\$5,400.00				-1928	
X902007	4 - HVAC inside	1		50	\$300.00					
X9030	Hot Water									
X903001	5a - DWR	0.5		50	\$400.00				-322	
X903002	5b - 0.80 gas DHW	0.5		15	\$586.00					
X903003	5c - 0.91 gas DHW, GSHP	1		15	\$923.00					
X903004	5d - Tier I HPWH	1.5		15	\$874.00				-1236	
X903005	5e - Tier II HPWH	2	1	15	\$874.00		\$ 874		-1623	
X903006	5f - Tier III HPWH Split	2.5		15	\$3,500.00				-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 flow fixtures	0.5		50	\$25.00				-215	
Z	Other Project Costs									
Z10	One Time - Upfront Costs		1	50						
Z30	Re-Occurring Annual Cost (Track Inflation)		1	1						

Small Zone Electric Home

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Alternative 2 Input Page

Open Primary Filter and Click OK to Re-filter

☐ Manual Special Selection Only (Requires Refilter)

☒ Show Baseline Fields and Entered Units (Requires Refilter)

☐ Show Differences Between Alternative and Baseline (Req. Refilter)

Total Building Annual Utility Analysis		Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [\$]	\$ 750		\$ 750	\$ -
Annual Utility Consumption Not Entered Below		-	11,360	-
Sum of Annual Utility Consumption Below		-	(3,595)	-
Total Annual Utility Consumption		-	7,765	-
Annual Utility Bill + Total Utility Consumption		\$ -	\$ 0.097	\$ -

Note: No Units Assigned to a Component with Entries

S H O W	Uniformat II Elemental Classification for Buildings (Building Component List)	REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2						Entries Below for Component Specific Utility Analysis			
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14						\$ 2,623			
A	Substructure									
A101098	Small Zone Electric									
B	Shell									
C	Interiors									
D	Services									
E	Equipment & Furnishings									
F	Special Construction & Demolition									
G	Building Sitework									
X	Other Categories									
X90	Other Categories									
X9010	Building Envelope									
X901001	1a - 5% UA reduc	0.5		50	\$766.60				-477	
X901002	1b - 15% UA reduc	1		50	\$2,649.16				-1034	
X901003	1c - 30% UA reduc	2		50	\$4,868.68				-1787	
X901004	1d - U-24 Glaze	0.5		50	\$907.20				-315	
X901005	1e - 40% UA reduc	3		50	\$7,641.34				-2419	
X901006	1f - U-20 Glaze	1		50	\$1,814.40				-454	
X901007	2a - 3ACH, fan eff	0.5	1	50	\$349.44		\$ 349		-313	
X901008	2b - 2 ACH, HRV	1		50	\$1,680.00				4	
X901009	2c - 1.5 ACH, HRV	1.5		50	\$3,763.20				-331	
X901010	2d - 0.6 ACH, HRV	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		15	\$5,400.00					
X902006	3f - DHP (15% elec)	1.5		18	\$5,400.00				-1928	
X902007	4 - HVAC inside	1		50	\$300.00					
X9030	Hot Water									
X903001	5a - DWR	0.5		50	\$400.00				-322	
X903002	5b - 0.80 gas DHW	0.5		15	\$586.00					
X903003	5c - 0.91 gas DHW, GSHP	1		15	\$923.00					
X903004	5d - Tier I HPWH	1.5		15	\$874.00				-1236	
X903005	5e - Tier III HPWH	2	1	15	\$874.00		\$ 874		-1623	
X903006	5f - Tier III HPWH Split	2.5		15	\$3,500.00				-1836	
X9040	Other									
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	Other Project Costs									
Z10	One Time - Upfront Costs		1	50						
Z30	Re-Occurring Annual Cost (Track Inflation)		1	1						

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

	Cumulative Expenditure Summary			Annual Expenditure Summary		
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	\$ 879	\$ 988
2034	\$ 15,830	\$ 12,806	\$ 13,848	\$ 1,176	\$ 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	\$ 19,380	\$ 16,782	\$ 17,710	\$ 1,182	\$ 876	\$ 993
2038	\$ 21,970	\$ 19,061	\$ 20,108	\$ 2,590	\$ 2,279	\$ 2,399
2039	\$ 23,169	\$ 19,943	\$ 21,112	\$ 1,199	\$ 882	\$ 1,004
2040	\$ 24,366	\$ 20,821	\$ 22,114	\$ 1,197	\$ 879	\$ 1,002
2041	\$ 25,572	\$ 21,703	\$ 23,121	\$ 1,206	\$ 882	\$ 1,007
2042	\$ 26,776	\$ 22,582	\$ 24,126	\$ 1,205	\$ 879	\$ 1,005
2043	\$ 27,990	\$ 23,464	\$ 25,137	\$ 1,213	\$ 882	\$ 1,011
2044	\$ 29,202	\$ 24,343	\$ 26,145	\$ 1,212	\$ 879	\$ 1,009
2045	\$ 30,422	\$ 25,226	\$ 27,160	\$ 1,221	\$ 883	\$ 1,014
2046	\$ 31,642	\$ 26,106	\$ 28,172	\$ 1,220	\$ 880	\$ 1,012
2047	\$ 32,870	\$ 26,989	\$ 29,190	\$ 1,228	\$ 884	\$ 1,018
2048	\$ 34,097	\$ 27,870	\$ 30,207	\$ 1,227	\$ 881	\$ 1,017
2049	\$ 35,328	\$ 28,751	\$ 31,225	\$ 1,230	\$ 881	\$ 1,018
2050	\$ 36,561	\$ 30,968	\$ 33,118	\$ 1,233	\$ 2,217	\$ 1,893
2051	\$ 37,768	\$ 31,772	\$ 34,087	\$ 1,207	\$ 804	\$ 968
2052	\$ 38,980	\$ 32,579	\$ 35,058	\$ 1,211	\$ 806	\$ 971
2053	\$ 40,195	\$ 33,388	\$ 36,032	\$ 1,215	\$ 809	\$ 974
2054	\$ 41,414	\$ 34,199	\$ 37,010	\$ 1,219	\$ 812	\$ 977
2055	\$ 42,637	\$ 35,014	\$ 37,990	\$ 1,223	\$ 814	\$ 981
2056	\$ 45,263	\$ 37,230	\$ 40,374	\$ 2,627	\$ 2,217	\$ 2,384
2057	\$ 46,494	\$ 38,050	\$ 41,360	\$ 1,231	\$ 819	\$ 987
2058	\$ 47,729	\$ 38,872	\$ 42,350	\$ 1,234	\$ 822	\$ 990
2059	\$ 48,967	\$ 39,696	\$ 43,343	\$ 1,238	\$ 824	\$ 993
2060	\$ 50,209	\$ 40,523	\$ 44,339	\$ 1,242	\$ 827	\$ 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

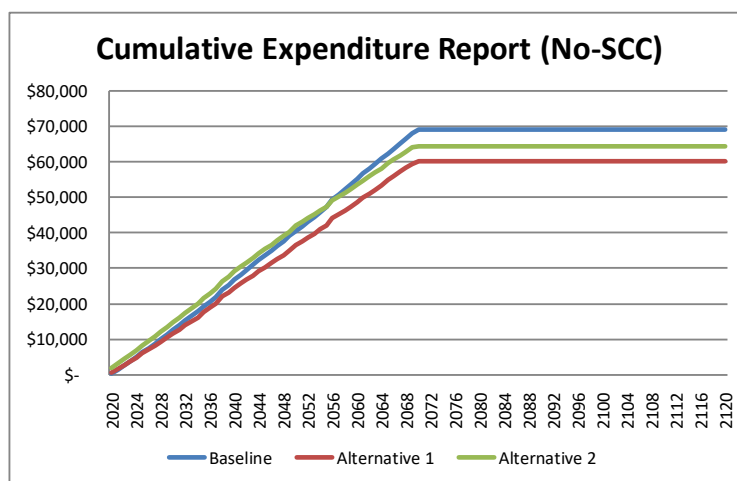
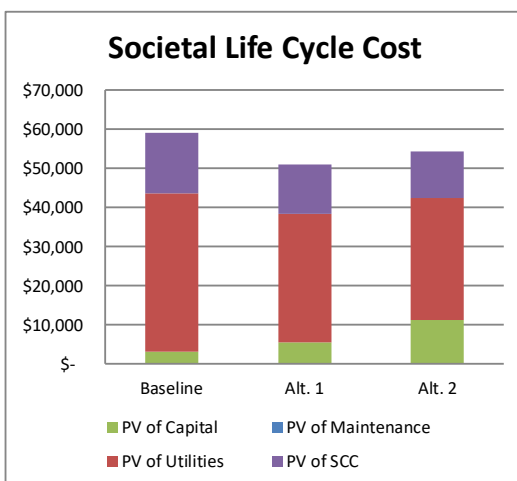
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	2,200
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	2,200
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intensity (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 Variables		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 Intensity (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	\$ -

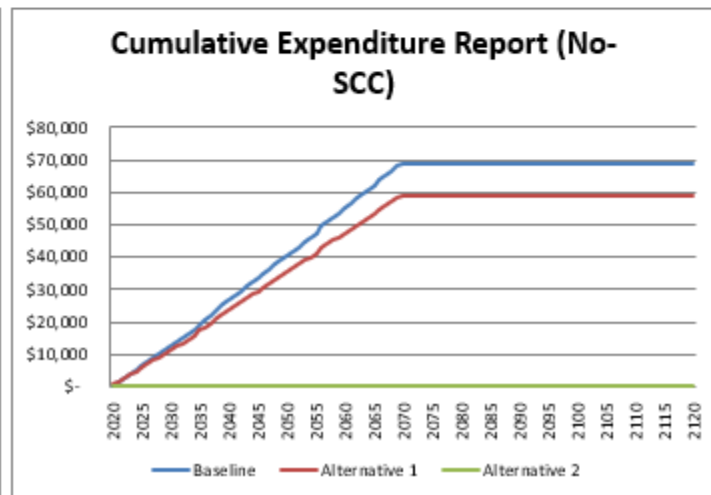
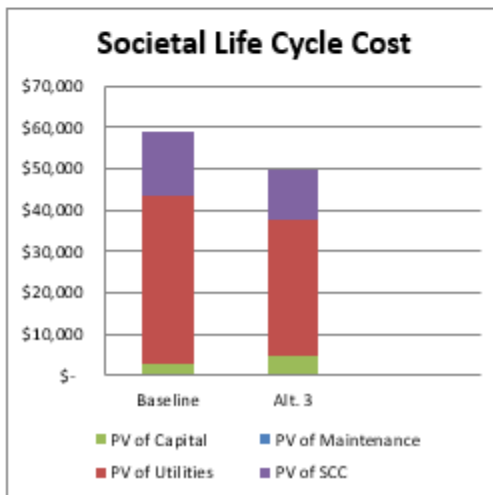
Societal LCC takes into consideration the social cost of carbon dioxide emissions caused by operational energy consumption

(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



Medium Gas Home

<- Primary Filter (Requires Level 1)

Open Primary Filter and Click OK to Re-filter

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Baseline Input Page

☒ Show All Entered Units (Requires Re-Filter)



Baseline Input Page			Total Building Annual Utility Analysis				\$ 1,050	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)	
			Annual Utility Bill (\$)						\$ 516	\$ 534	
			Annual Utility Consumption Not Entered Below						5,390	670	
			Sum of Annual Utility Consumption Below						(52)	(167)	
			Total Annual Utility Consumption						5,338	503	
			Annual Utility Bill + Total Utility Consumption					\$ -	\$ 0.097	\$ 1.062	
S H O W	Uniformat II Elemental Classification for Buildings (Building Component List)		REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							\$ 1,737	Entries Below for Component Specific Utility Analysis		
	A	Substructure									
x	A101098	Medium Home - Gas carbon									
	B	Shell									
	C	Interiors									
	D	Services									
	E	Equipment & Furnishings									
	F	Special Construction & Demolition									
	G	Building Sitework									
x	X	Other Categories									
x	X90	Other Categories									
x	X9010	Building Envelope									
x	X901001	1a - 5% UA reduc	0.5		50	\$1,171				5.25	-41.39
x	X901002	1b - 15% UA reduc	1		50	\$4,568				5.15	-99.81
x	X901003	1c - 30% UA reduc	2		50	\$8,417				11.51	-168.78
x	X901004	1d - U-24 Glaze	0.5		50	\$1,661				1.35	-35.73
x	X901005	1e - 40% UA reduc	3		50	\$12,569				30.42	-228.96
x	X901006	1f - U-20 Glaze	1		50	\$3,323				6.96	-61.76
x	X901007	2a - 3ACH , fan eff	0.5	1	50	\$533		\$ 533		-51.66	-38.63
x	X901008	2b - 2 ACH, HRV	1		50	\$2,829				313.45	-56.09
x	X901009	2c - 1.5 ACH, HRV	1.5		50	\$6,338				203.87	-75.40
x	X901010	2d - 0.6 ACH, HRV	2		50	\$9,054				204.90	-99.77
x	X9020	HVAC									
x	X902001	3a - Furnace	1	1	20	\$230		\$ 230		0.00	-72.77
x	X902002	3b - 9.5 HSPF HP	0.5		15	\$270					
x	X902003	3c - GSHP	1.5		20	\$10,900					
x	X902004	3d - DHP	1		18	\$1,400					
x	X902005	3e - 11.0 HSPF HP	1		15	\$5,400					
x	X902006	3f - DHP (15% elec)	1.5		18	\$5,400					
x	X902007	4 - HVAC inside	1		50	\$300				-13.26	-60.11
x	X902008	Other									
x	X902009	Other									
x	X902010	Other									
x	X9030	Hot Water									
x	X903001	5a - DWR	0.5		50	\$400				0.00	-19.23
x	X903002	5b - 0.80 gas DHW	0.5		18	\$586				0.00	-24.41
x	X903003	5c - 0.91 gas DHW, GSHP	1	1	18	\$923		\$ 923		0.00	-39.62
x	X903004	5d - Tier I HPWH	1.5		18	\$874					
x	X903005	5e - Tier III HPWH	2		18	\$874					
x	X903006	5f - Tier III HPWH Split	2.5		18	\$3,500					
x	X903007										
x	X903008	Other									
x	X903009	Other									
x	X903010	Other									
x	X9040	Other									
x	X904001	6 - Solar pV	0.5		50	\$5,040				-1262.00	0.00
x	X904002	7 - HP dryers, ES Appl	0.5		15	\$462				-840.00	0.00
x	X904003	(legacy) 5a - low flow fixtures	0.5	1	50	\$50		\$ 50		0	-16
Z	Other Project Costs										
Z10	One Time - Upfront Costs			1	50						
Z30	Re-Occurring Annual Cost (Track Inflation)			1	1						

Medium Gas Home

< Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Alternative 1 Input Page

Open Primary Filter and Click OK to Re-filter

- ☐ Manual Special Selection Only (Requires Refilter)
☒ Show Baseline Fields and Entered Units (Requires Refilter)
☐ Show Differences Between Alternative and Baseline (Req. Refilter)

Total Building Annual Utility Analysis	\$	850	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [\$]				\$ 407	\$ 443
Annual Utility Consumption Not Entered Below				5,115	654
Sum of Annual Utility Consumption Below			-	(899)	(237)
Total Annual Utility Consumption			-	4,216	417
Annual Utility Bill + Total Utility Consumption	\$	-	\$	0.097	\$ 1.062

Note: No Units Assigned to a Component with Entries

SHOW	Uniformat II Elemental Classification for Buildings (Building Component List)	REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)	Ann
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2						Entries Below for Component Specific Utility Analysis				
	Match Baseline: Filter to Select All & Drag copy O14-S14 & U14-AG14						\$ 3,620				
A	Substructure										
A101098	Medium Home - Gas carbon										
B	Shell										
C	Interiors										
D	Services										
E	Equipment & Furnishings										
F	Special Construction & Demolition										
G	Building Sitework										
X	Other Categories										
X90	Other Categories										
X9010	Building Envelope										
X901001	1a - 5% UA reduc	0.5	1	50	\$1,171		\$ 1,171		5	-35	
X901002	1b - 15% UA reduc	1		50	\$4,568				5	-100	
X901003	1c - 30% UA reduc	2		50	\$8,417				12	-169	
X901004	1d - U-24 Glaze	0.5		50	\$1,661				1	-36	
X901005	1e - 40% UA reduc	3		50	\$12,569				30	-229	
X901006	1f - U-20 Glaze	1		50	\$3,323				7	-62	
X901007	2a - 3ACH, fan eff	0.5	1	50	\$533		\$ 533		-52	-43	
X901008	2b - 2 ACH, HRV	1		50	\$2,829				313	-48	
X901009	2c - 1.5 ACH, HRV	1.5		50	\$6,338				204	-75	
X901010	2d - 0.6 ACH, HRV	2		50	\$9,054				205	-100	
X9020	HVAC										
X902001	3a - Furnace	1	1	20	\$230		\$ 230			-70	
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						
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										
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 - 0.91 gas DHW, GSHP	1.5	1	18	\$923		\$ 923			-36	
X903004	5d - Tier I HPWH	1.5		18	\$874						
X903005	5e - Tier III HPWH	2		18	\$874						
X903006	5f - Tier III HPWH Split	2.5		18	\$3,500						
X903007	Other										
X903008	Other										
X903009	Other										
X903010	Other										
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		
X904003	(legacy) 5a - low flow fixtures	0.5		50	\$50					-16	
Z	Other Project Costs										
Z10	One Time - Upfront Costs		1	50							
Z30	Re-Occurring Annual Cost (Track Inflation)		1	1							

Medium Gas Home

< Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Alternative 2 Input Page

Open Primary Filter and Click OK to Re-filter

- ☐ Manual Special Selection Only (Requires Refilter)
☒ Show Baseline Fields and Entered Units (Requires Refilter)
☐ Show Differences Between Alternative and Baseline (Req. Refilter)

Total Building Annual Utility Analysis		Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [\$]	\$ 810		\$ 443	\$ 368
Annual Utility Consumption Not Entered Below		-	5,115	654
Sum of Annual Utility Consumption Below		-	(533)	(308)
Total Annual Utility Consumption		-	4,582	346
Annual Utility Bill ÷ Total Utility Consumption		\$ -	\$ 0.097	\$ 1.062

Note: No Units Assigned to a Component with Entries

S	H	O	W	Uniformat II Elemental Classification for Buildings (Building Component List)	REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)
Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2													
Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14										\$ 9,312			
A				Substructure									
A101098				Medium Home - Gas carbon									
B				Shell									
C				Interiors									
D				Services									
E				Equipment & Furnishings									
F				Special Construction & Demolition									
G				Building Sitework									
X				Other Categories									
X90				Other Categories									
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 - U-24 Glaze	0.5		50	\$1,661				1	-36
X901005				1e - 40% UA reduc	3		50	\$12,569				30	-229
X901006				1f - U-20 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	1.5		50	\$6,338				204	-75
X901010				2d - 0.6 ACH, HRV	2		50	\$9,054				205	-100
X9020				HVAC									
X902001				3a - Furnace	0.5	1	20	\$230		\$ 230			-70
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					
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									
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 - 0.91 gas DHW, GSHP	1	1	18	\$923		\$ 923			-36
X903004				5d - Tier I HPWH	1.5		18	\$874					
X903005				5e - Tier III HPWH	2		18	\$874					
X903006				5f - Tier III HPWH Split	2.5		18	\$3,500					
X903007				Other									
X903008				Other									
X903009				Other									
X903010				Other									
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	
X904003				(legacy) 5a - low flow fixtures	0.5		50	\$50					-16
Z				Other Project Costs									
Z10				One Time - Upfront Costs		1	50						
Z30				Re-Occurring Annual Cost (Track Inflation)		1	1						

Medium Gas Home

< - Primary Filter (Requires Level 1)

Office of Financial Management

Olympia, Washington - Version: 2018-Residen

Life Cycle Cost Analysis Tool

Alternative 3 Input Page

Open Primary Filter and Click OK to Re-filter

☐ Manual Special Selection Only (Requires Refilter)

☒ Show Baseline Fields and Entered Units (Requires Refilter)

☐ Show Differences Between Alternative and Baseline (Req. Refil

Total Building Annual Utility Analysis		Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill (\$)			\$ 547	\$ 292
Annual Utility Consumption Not Entered Below			5,115	654
Sum of Annual Utility Consumption Below		-	547	(379)
Total Annual Utility Consumption		-	5,662	275
Annual Utility Bill ÷ Total Utility Consumption		\$ -	\$ 0.097	\$ 1.062

Note: No Units Assigned to a Component with Entries

SHO W	Uniformat II Elemental Classification for Buildings (Building Component List)	RE F	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							Entries Below for Component Specific Utility		
	Match Baseline: Filter to Select All & Drag Copy 014:\$14 &						\$ 3,371			
	A Substructure									
	B Shell									
	C Interiors									
	D Services									
	E Equipment & Furnishings									
	F Special Construction & Demolition									
	G Building Sitework									
	X Other Categories									
	X90 Other Categories									
	X9010 Building Envelope									
	X901001 1a - 5% UA reduc	0.5	1	50	\$1,171		\$ 1,171		5	-35
	X901002 1b - 15% UA reduc	1		50	\$4,568				5	-100
	X901003 1c - 30% UA reduc	2		50	\$8,417				12	-169
	X901004 1d - U-24 Glaze	0.5		50	\$1,661				1	-36
	X901005 1e - 40% UA reduc	3		50	\$12,569				30	-229
	X901006 1f - U-20 Glaze	1		50	\$3,323				7	-62
	X901007 2a - 3ACH, fan eff	0.5	1	50	\$533		\$ 533		-52	-43
	X901008 2b - 2 ACH, HRV	1		50	\$2,829				313	-48
	X901009 2c - 1.5 ACH, HRV	1.5		50	\$6,338				204	-75
	X901010 2d - 0.6 ACH, HRV	2		50	\$9,054				205	-100
	X9020 HVAC									
	X902001 3a - Furnace	0.5	1	20	\$230		\$ 230			-70
	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					
	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									
	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 - 0.91 gas DHW, GSHP	1.5		18	\$923					-36
	X903004 5d - Tier I HPWH	1.5		18	\$874					
	X903005 5e - Tier III HPWH	2	1	18	\$874		\$ 874		-1823	
	X903006 5f - Tier III HPWH Split	2.5		18	\$3,500					
	X903007									
	X903008 Electrical Systems		1	18	\$500		\$ 500		3269	
	X903009 gas		1	18	\$700		\$ (700)			-178
	X903010 Other									
	X9040									
	X904001 6 - Solar pV	0.5		50	\$5,040				-1262	
	X904002 7 - HP dryers, ES Appl	0.5	1	15	\$462		\$ 462		-840	
	X904003 (legacy) 5a - low flow fixtures	0.5		50	\$50					-16
	Z Other Project Costs									

Medium Gas Home

Expenditure Report Page In Constant 2020 \$'s

	Cumulative Expenditure Summary			Annual Expenditure Summary		
Year	Baseline	Alt. 1	Alt. 2	Baseline	Alt. 1	Alt. 2
2020	\$ 347	\$ 724	\$ 1,862	\$ 347	\$ 724	\$ 1,862
2021	\$ 1,490	\$ 1,760	\$ 3,145	\$ 1,142	\$ 1,036	\$ 1,283
2022	\$ 2,635	\$ 2,794	\$ 4,419	\$ 1,145	\$ 1,035	\$ 1,274
2023	\$ 3,788	\$ 3,832	\$ 5,688	\$ 1,153	\$ 1,038	\$ 1,269
2024	\$ 4,997	\$ 4,912	\$ 6,986	\$ 1,209	\$ 1,080	\$ 1,298
2025	\$ 6,239	\$ 6,017	\$ 8,298	\$ 1,243	\$ 1,105	\$ 1,312
2026	\$ 7,491	\$ 7,126	\$ 9,607	\$ 1,251	\$ 1,109	\$ 1,309
2027	\$ 8,756	\$ 8,243	\$ 10,916	\$ 1,265	\$ 1,117	\$ 1,309
2028	\$ 10,024	\$ 9,359	\$ 12,219	\$ 1,268	\$ 1,116	\$ 1,302
2029	\$ 11,305	\$ 10,484	\$ 13,521	\$ 1,282	\$ 1,125	\$ 1,303
2030	\$ 12,595	\$ 11,613	\$ 14,821	\$ 1,290	\$ 1,129	\$ 1,300
2031	\$ 13,889	\$ 12,742	\$ 16,115	\$ 1,293	\$ 1,129	\$ 1,294
2032	\$ 15,186	\$ 13,871	\$ 17,403	\$ 1,297	\$ 1,129	\$ 1,288
2033	\$ 16,486	\$ 15,001	\$ 18,685	\$ 1,300	\$ 1,130	\$ 1,282
2034	\$ 17,795	\$ 16,135	\$ 19,966	\$ 1,309	\$ 1,134	\$ 1,281
2035	\$ 19,108	\$ 17,732	\$ 21,704	\$ 1,313	\$ 1,597	\$ 1,738
2036	\$ 20,424	\$ 18,867	\$ 22,974	\$ 1,316	\$ 1,136	\$ 1,270
2037	\$ 21,738	\$ 20,000	\$ 24,236	\$ 1,314	\$ 1,132	\$ 1,261
2038	\$ 23,985	\$ 22,060	\$ 26,420	\$ 2,246	\$ 2,060	\$ 2,184
2039	\$ 25,312	\$ 23,198	\$ 27,677	\$ 1,327	\$ 1,138	\$ 1,257
2040	\$ 26,873	\$ 24,568	\$ 29,160	\$ 1,561	\$ 1,370	\$ 1,483
2041	\$ 28,208	\$ 25,708	\$ 30,409	\$ 1,335	\$ 1,141	\$ 1,249
2042	\$ 29,546	\$ 26,850	\$ 31,655	\$ 1,339	\$ 1,142	\$ 1,245
2043	\$ 30,889	\$ 27,994	\$ 32,897	\$ 1,342	\$ 1,143	\$ 1,242
2044	\$ 32,235	\$ 29,139	\$ 34,136	\$ 1,346	\$ 1,145	\$ 1,239
2045	\$ 33,585	\$ 30,285	\$ 35,373	\$ 1,350	\$ 1,146	\$ 1,237
2046	\$ 34,940	\$ 31,433	\$ 36,606	\$ 1,354	\$ 1,148	\$ 1,233
2047	\$ 36,304	\$ 32,587	\$ 37,841	\$ 1,364	\$ 1,154	\$ 1,235
2048	\$ 37,666	\$ 33,739	\$ 39,070	\$ 1,363	\$ 1,152	\$ 1,229
2049	\$ 39,033	\$ 34,892	\$ 40,296	\$ 1,367	\$ 1,153	\$ 1,226
2050	\$ 40,404	\$ 36,509	\$ 41,982	\$ 1,371	\$ 1,617	\$ 1,686
2051	\$ 41,744	\$ 37,594	\$ 43,018	\$ 1,340	\$ 1,085	\$ 1,036
2052	\$ 43,089	\$ 38,683	\$ 44,058	\$ 1,345	\$ 1,089	\$ 1,040
2053	\$ 44,440	\$ 39,777	\$ 45,102	\$ 1,351	\$ 1,093	\$ 1,044
2054	\$ 45,796	\$ 40,874	\$ 46,149	\$ 1,356	\$ 1,098	\$ 1,048
2055	\$ 47,157	\$ 41,976	\$ 47,201	\$ 1,361	\$ 1,102	\$ 1,052
2056	\$ 49,446	\$ 44,005	\$ 49,180	\$ 2,289	\$ 2,029	\$ 1,979
2057	\$ 50,818	\$ 45,116	\$ 50,239	\$ 1,372	\$ 1,110	\$ 1,060
2058	\$ 52,195	\$ 46,231	\$ 51,303	\$ 1,377	\$ 1,115	\$ 1,064
2059	\$ 53,577	\$ 47,350	\$ 52,371	\$ 1,382	\$ 1,119	\$ 1,068
2060	\$ 55,195	\$ 48,703	\$ 53,673	\$ 1,618	\$ 1,354	\$ 1,302
2061	\$ 56,588	\$ 49,831	\$ 54,748	\$ 1,393	\$ 1,128	\$ 1,076
2062	\$ 57,986	\$ 50,963	\$ 55,828	\$ 1,398	\$ 1,132	\$ 1,080
2063	\$ 59,389	\$ 52,099	\$ 56,911	\$ 1,403	\$ 1,136	\$ 1,084
2064	\$ 60,798	\$ 53,240	\$ 57,999	\$ 1,409	\$ 1,140	\$ 1,088
2065	\$ 62,212	\$ 54,846	\$ 59,553	\$ 1,414	\$ 1,607	\$ 1,554
2066	\$ 63,631	\$ 55,995	\$ 60,648	\$ 1,419	\$ 1,149	\$ 1,096
2067	\$ 65,055	\$ 57,149	\$ 61,748	\$ 1,424	\$ 1,153	\$ 1,100
2068	\$ 66,485	\$ 58,306	\$ 62,851	\$ 1,430	\$ 1,158	\$ 1,104
2069	\$ 67,920	\$ 59,468	\$ 63,959	\$ 1,435	\$ 1,162	\$ 1,108
2070	\$ 69,040	\$ 60,006	\$ 64,442	\$ 1,120	\$ 538	\$ 483

Medium Gas Home DHWe

Life Cycle Cost Analysis Tool

Expenditure Report Page In Constant 2020 \$'s

Cumulative Expenditure Summary				Annual Expenditure Summary			
Year	Baseline	Alt. 3		Baseline	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	\$ -	

Medium HP Home

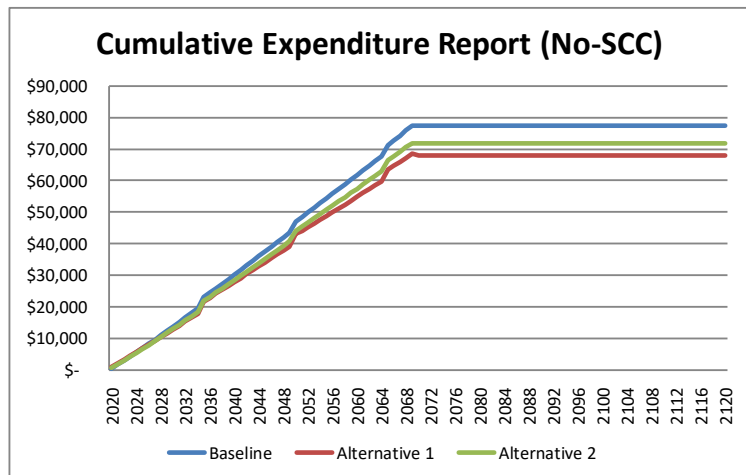
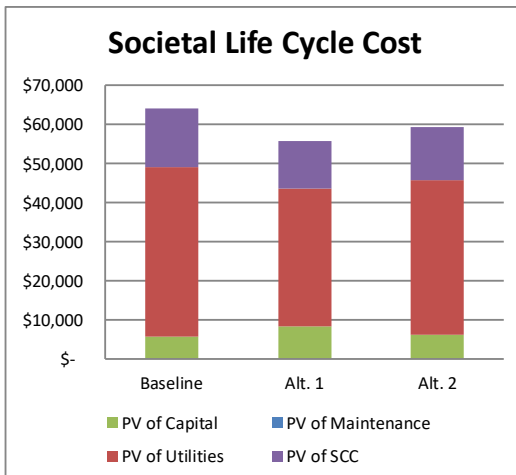
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	2,200
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	2,200
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intensity (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

<- Primary Filter (Requires Level 1)

Open Primary Filter and Click OK to Re-filter

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool

Show All Entered Units (Requires Re-Filter)

Baseline Input Page

Baseline Input Page			Total Building Annual Utility Analysis				\$ 1,114	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)		
			Annual Utility Bill (\$)						\$ 1,114			
			Annual Utility Consumption Not Entered Below						13,873			
			Sum of Annual Utility Consumption Below						(2,340)	-		
			Total Annual Utility Consumption						11,533	-		
			Annual Utility Bill + Total Utility Consumption					\$ -	\$ 0.097	\$ -		
S H O W	Uniformat II Elemental Classification for Buildings (Building Component List)		REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)	A
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2						\$ 2,444	Entries Below for Component Specific Utility Analysis				
	A	Substructure										
x	A101098	Medium Home - HP carbon										
	B	Shell										
	C	Interiors										
	D	Services										
	E	Equipment & Furnishings										
	F	Special Construction & Demolition										
	G	Building Sitework										
x	X	Other Categories										
x	X90	Other Categories										
x	X9010	Building Envelope										
x	X901001	1a - 5% UA reduc	0.5		50	\$1,171				-355		
x	X901002	1b - 15% UA reduc	1		50	\$4,568				-908		
x	X901003	1c - 30% UA reduc	2		50	\$8,417				-1519		
x	X901004	1d - U-.24 Glaze	0.5		50	\$1,661				-325		
x	X901005	1e - 40% UA reduc	3		50	\$12,569				-2024		
x	X901006	1f - U-.20 Glaze	1		50	\$3,323				-546		
x	X901007	2a - 3ACH , fan eff	0.5		50	\$533				-440		
x	X901008	2b - 2 ACH, HRV	1		50	\$2,829				-231		
x	X901009	2c - 1.5 ACH, HRV	1.5		50	\$6,338				-520		
x	X901010	2d - 0.6 ACH, HRV	2		50	\$9,054				-737		
x	X9020	HVAC										
x	X902001	3a - Furnace	1		20	\$230						
x	X902002	3b - 9.5 HSPF HP	1	1	15	\$1,270		\$ 1,270		-327		
x	X902003	3c - GSHP	1.5		20	\$10,900				-1301		
x	X902004	3d - DHP	1		18	\$1,400						
x	X902005	3e - 11.0 HSPF HP	1		15	\$5,400				-784		
x	X902006	3f - DHP (15% elec)	1.5		18	\$5,400						
x	X902007	4 - HVAC inside	1	1	50	\$300		\$ 300		-621		
x	X902008	Other										
x	X902009	Other										
x	X902010	Other										
x	X9030	Hot Water										
x	X903001	5a - DWR	0.5		50	\$400				-368		
x	X903002	5b - 0.80 gas DHW	0.5		15	\$586						
x	X903003	5c - 0.91 gas DHW, GSHP	1		15	\$923						
x	X903004	5d - Tier I HPWH	1.5	1	15	\$874		\$ 874		-1393		
x	X903005	5e - Tier III HPWH	2		15	\$874				-1823		
x	X903006	5f - Tier III HPWH Split	2.5		15	\$3,500				-2064		
x	X903007											
x	X903008	Other										
x	X903009	Other										
x	X903010	Other										
x	X9040	Other										
x	X904001	6 - Solar pV	0.5		50	\$5,040				-1262		
x	X904002	7 - HP dryers, ES Appl	0.5		15	\$462				-840		
x	X904003	(legacy) 5a - low flow fixtures	0.5		50	\$50				-307		
Z	Other Project Costs											
Z10	One Time - Upfront Costs			1	50							
Z30	Re-Occurring Annual Cost (Track Inflation)			1	1							

Medium HP Home

< Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Alternative 1 Input Page

Open Primary Filter and Click OK to Re-filter

- ☐ Manual Special Selection Only (Requires Refilter)
☒ Show Baseline Fields and Entered Units (Requires Refilter)
☐ Show Differences Between Alternative and Baseline (Req. Refilter)

Total Building Annual Utility Analysis	\$	902	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill (\$)				\$ 902	
Annual Utility Consumption Not Entered Below				13,291	
Sum of Annual Utility Consumption Below			-	(3,950)	-
Total Annual Utility Consumption			-	9,341	-
Annual Utility Bill + Total Utility Consumption	\$	-	\$	0.097	\$

Note: No Units Assigned to a Component with Entries

S	H	O	W	Uniformat II Elemental Classification for Buildings (Building Component List)	REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)
Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2													
Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14										\$	4,610		
A				Substructure									
A101098				Medium Home - HP carbon									
B				Shell									
C				Interiors									
D				Services									
E				Equipment & Furnishings									
F				Special Construction & Demolition									
G				Building Sitework									
X				Other Categories									
X90				Other Categories									
X9010				Building Envelope									
X901001				1a - 5% UA reduc	0.5	1	50	\$1,171		\$ 1,171		-329	
X901002				1b - 15% UA reduc	1		50	\$4,568				-908	
X901003				1c - 30% UA reduc	2		50	\$8,417				-1519	
X901004				1d - U-24 Glaze	0.5		50	\$1,661				-325	
X901005				1e - 40% UA reduc	3		50	\$12,569				-2024	
X901006				1f - U-20 Glaze	1		50	\$3,323				-546	
X901007				2a - 3ACH, fan eff	0.5	1	50	\$533		\$ 533		-440	
X901008				2b - 2 ACH, HRV	1		50	\$2,829				-214	
X901009				2c - 1.5 ACH, HRV	1.5		50	\$6,338				-520	
X901010				2d - 0.6 ACH, HRV	2		50	\$9,054				-737	
X9020				HVAC									
X902001				3a - Furnace	1		20	\$230					
X902002				3b - 9.5 HSPF HP	1	1	15	\$1,270		\$ 1,270		-328	
X902003				3c - GSHP	1.5		20	\$10,900				-1301	
X902004				3d - DHP	1		18	\$1,400					
X902005				3e - 11.0 HSPF HP	1		15	\$5,400				-784	
X902006				3f - DHP (15% elec)	1.5		18	\$5,400					
X902007				4 - HVAC inside	1	1	50	\$300		\$ 300		-621	
X902008				Other									
X902009				Other									
X902010				Other									
X9030				Hot Water									
X903001				5a - DWR	0.5		50	\$400				-368	
X903002				5b - 0.80 gas DHW	0.5		15	\$586					
X903003				5c - 0.91 gas DHW, GSHP	1		15	\$923					
X903004				5d - Tier I HPWH	1.5	1	15	\$874		\$ 874		-1393	
X903005				5e - Tier III HPWH	2		15	\$874				-1823	
X903006				5f - Tier III HPWH Split	2.5		15	\$3,500				-2064	
X903007				Other									
X903008				Other									
X903009				Other									
X903010				Other									
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	
X904003				(legacy) 5a - low flow fixtures	0.5		50	\$50				-307	
Z				Other Project Costs									
Z10				One Time - Upfront Costs		1	50						
Z30				Re-Occurring Annual Cost (Track Inflation)		1	1						

Medium HP Home

< Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Alternative 2 Input Page

Open Primary Filter and Click OK to Re-filter

- ☐ Manual Special Selection Only (Requires Refilter)
☒ Show Baseline Fields and Entered Units (Requires Refilter)
☐ Show Differences Between Alternative and Baseline (Req. Refilter)



Total Building Annual Utility Analysis		Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [\$]	\$ 1,015		\$ 1,015	
Annual Utility Consumption Not Entered Below		-	13,291	-
Sum of Annual Utility Consumption Below		-	(2,782)	-
Total Annual Utility Consumption		-	10,509	-
Annual Utility Bill + Total Utility Consumption	\$	-	\$ 0.097	\$

Note: No Units Assigned to a Component with Entries

S	H	O	W	Uniformat II Elemental Classification for Buildings (Building Component List)	REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)	At
Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2														
Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14										\$ 2,977	Entries Below for Component Specific Utility Analysis			
				A Substructure										
				A101098 Medium Home - HP carbon										
				B Shell										
				C Interiors										
				D Services										
				E Equipment & Furnishings										
				F Special Construction & Demolition										
				G Building Sitework										
				X Other Categories										
				X90 Other Categories										
				X9010 Building Envelope										
				X901001 1a - 5% UA reduc	0.5		50	\$1,170.98				-329		
				X901002 1b - 15% UA reduc	1		50	\$4,567.51				-908		
				X901003 1c - 30% UA reduc	2		50	\$8,416.67				-1519		
				X901004 1d - U-.24 Glaze	0.5		50	\$1,661.40				-325		
				X901005 1e - 40% UA reduc	3		50	\$12,569.16				-2024		
				X901006 1f - U-.20 Glaze	1		50	\$3,322.80				-546		
				X901007 2a - 3ACH, fan eff	0.5	1	50	\$533.33		\$ 533		-440		
				X901008 2b - 2 ACH, HRV	1		50	\$2,829.30				-214		
				X901009 2c - 1.5 ACH, HRV	1.5		50	\$6,337.63				-520		
				X901010 2d - 0.6 ACH, HRV	2		50	\$9,053.76				-737		
				X9020 HVAC										
				X902001 3a - Furnace	1		20	\$230.25						
				X902002 3b - 9.5 HSPF HP	1	1	15	\$1,270.00		\$ 1,270		-328		
				X902003 3c - GSHP	1.5		20	\$10,900.00				-1301		
				X902004 3d - DHP	1		18	\$1,400.00						
				X902005 3e - 11.0 HSPF HP	1		15	\$5,400.00				-784		
				X902006 3f - DHP (15% elec)	1.5		18	\$5,400.00						
				X902007 4 - HVAC inside	1	1	50	\$300.00		\$ 300		-621		
				X902008 Other										
				X902009 Other										
				X902010 Other										
				X9030 Hot Water										
				X903001 5a - DWR	0.5		50	\$400.00				-368		
				X903002 5b - 0.80 gas DHW	0.5		15	\$586.00						
				X903003 5c - 0.91 gas DHW, GSHP	1		15	\$923.00						
				X903004 5d - Tier I HPWH	1.5	1	15	\$874.00		\$ 874		-1393		
				X903005 5e - Tier III HPWH	2		15	\$874.00				-1823		
				X903006 5f - Tier III HPWH Split	2.5		15	\$3,500.00				-2064		
				X903007 Other										
				X903008 Other										
				X903009 Other										
				X903010 Other										
				X9040 Other										
				X904001 6 - Solar pV	0.5		50	\$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	\$50.00				-307		
				Z Other Project Costs										
				Z10 One Time - Upfront Costs		1	50							
				Z30 Re-Occurring Annual Cost (Track Inflation)		1	1							

Medium HP Home

Expenditure Report Page In Constant 2020 \$'s

Cumulative Expenditure Summary				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	\$ 23,013	\$ 21,649	\$ 21,772	\$ 3,579	\$ 3,855	\$ 3,476
2036	\$ 24,446	\$ 22,893	\$ 23,101	\$ 1,433	\$ 1,244	\$ 1,330
2037	\$ 25,876	\$ 24,132	\$ 24,428	\$ 1,430	\$ 1,240	\$ 1,327
2038	\$ 27,316	\$ 25,377	\$ 25,762	\$ 1,440	\$ 1,245	\$ 1,334
2039	\$ 28,765	\$ 26,627	\$ 27,105	\$ 1,449	\$ 1,250	\$ 1,342
2040	\$ 30,212	\$ 27,873	\$ 28,444	\$ 1,447	\$ 1,246	\$ 1,340
2041	\$ 31,668	\$ 29,124	\$ 29,792	\$ 1,456	\$ 1,251	\$ 1,348
2042	\$ 33,123	\$ 30,371	\$ 31,137	\$ 1,454	\$ 1,247	\$ 1,345
2043	\$ 34,586	\$ 31,624	\$ 32,490	\$ 1,464	\$ 1,253	\$ 1,353
2044	\$ 36,048	\$ 32,874	\$ 33,841	\$ 1,462	\$ 1,249	\$ 1,351
2045	\$ 37,520	\$ 34,129	\$ 35,200	\$ 1,472	\$ 1,255	\$ 1,359
2046	\$ 38,990	\$ 35,381	\$ 36,557	\$ 1,470	\$ 1,252	\$ 1,357
2047	\$ 40,469	\$ 36,639	\$ 37,922	\$ 1,480	\$ 1,258	\$ 1,365
2048	\$ 41,947	\$ 37,894	\$ 39,286	\$ 1,478	\$ 1,255	\$ 1,363
2049	\$ 43,428	\$ 39,150	\$ 40,651	\$ 1,481	\$ 1,256	\$ 1,366
2050	\$ 47,056	\$ 43,012	\$ 44,163	\$ 3,628	\$ 3,862	\$ 3,512
2051	\$ 48,494	\$ 44,177	\$ 45,473	\$ 1,438	\$ 1,165	\$ 1,310
2052	\$ 49,936	\$ 45,345	\$ 46,788	\$ 1,443	\$ 1,168	\$ 1,315
2053	\$ 51,383	\$ 46,517	\$ 48,106	\$ 1,447	\$ 1,172	\$ 1,319
2054	\$ 52,835	\$ 47,693	\$ 49,429	\$ 1,452	\$ 1,176	\$ 1,323
2055	\$ 54,291	\$ 48,872	\$ 50,756	\$ 1,456	\$ 1,180	\$ 1,327
2056	\$ 55,752	\$ 50,056	\$ 52,088	\$ 1,461	\$ 1,183	\$ 1,331
2057	\$ 57,218	\$ 51,242	\$ 53,423	\$ 1,465	\$ 1,187	\$ 1,335
2058	\$ 58,688	\$ 52,433	\$ 54,763	\$ 1,470	\$ 1,191	\$ 1,340
2059	\$ 60,163	\$ 53,628	\$ 56,107	\$ 1,475	\$ 1,194	\$ 1,344
2060	\$ 61,642	\$ 54,826	\$ 57,455	\$ 1,479	\$ 1,198	\$ 1,348
2061	\$ 63,126	\$ 56,028	\$ 58,807	\$ 1,484	\$ 1,202	\$ 1,352
2062	\$ 64,614	\$ 57,233	\$ 60,163	\$ 1,488	\$ 1,206	\$ 1,356
2063	\$ 66,107	\$ 58,442	\$ 61,524	\$ 1,493	\$ 1,209	\$ 1,361
2064	\$ 67,605	\$ 59,655	\$ 62,889	\$ 1,498	\$ 1,213	\$ 1,365
2065	\$ 71,251	\$ 63,478	\$ 66,402	\$ 3,646	\$ 3,823	\$ 3,513
2066	\$ 72,758	\$ 64,699	\$ 67,775	\$ 1,507	\$ 1,220	\$ 1,373
2067	\$ 74,269	\$ 65,923	\$ 69,152	\$ 1,511	\$ 1,224	\$ 1,377
2068	\$ 75,785	\$ 67,151	\$ 70,534	\$ 1,516	\$ 1,228	\$ 1,382
2069	\$ 77,306	\$ 68,382	\$ 71,919	\$ 1,521	\$ 1,232	\$ 1,386
2070	\$ 77,402	\$ 67,880	\$ 71,880	\$ 96	\$ (502)	\$ (39)

Multifamily Unit

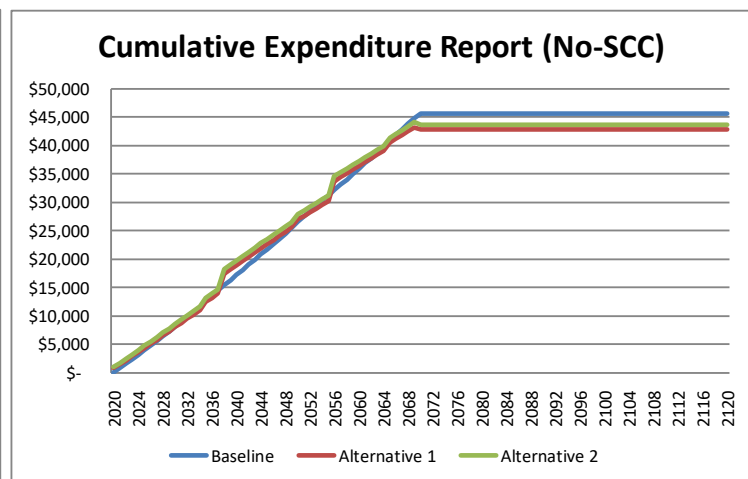
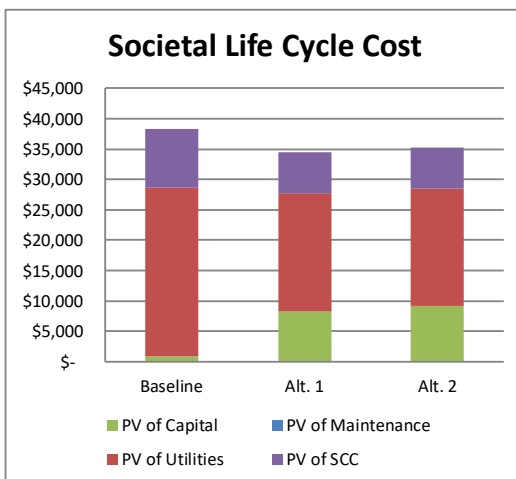
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	820
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	820
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intensity (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



Multifamily Unit

< Primary Filter (Requires Level 1)

Open Primary Filter and Click OK to Re-filter

Show All Entered Units (Requires Re-Filter)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Baseline Input Page



Baseline Input Page			Total Building Annual Utility Analysis					\$	710	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
			Annual Utility Bill (\$)							\$	710	
			Annual Utility Consumption Not Entered Below								9,166	
			Sum of Annual Utility Consumption Below							-	(1,820)	-
			Total Annual Utility Consumption							-	7,346	-
			Annual Utility Bill ÷ Total Utility Consumption							\$	-	\$
S H O W	Uniformat II Elemental Classification for Buildings (Building Component List)		REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)	
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							\$	553	Entries Below for Component Specific Utility Analysis		
	A	Substructure										
	x	A101098 MF-Zonal Elec carbon										
	B	Shell										
	C	Interiors										
	D	Services										
	E	Equipment & Furnishings										
	F	Special Construction & Demolition										
	G	Building Sitework										
x	X	Other Categories										
x	X90	Other Categories										
x	X9010	Building Envelope										
x	X901001	1a - 5% UA reduc	0.5		50	\$192				-337		
x	X901002	1b - 15% UA reduc	1		50	\$1,359				-517		
x	X901003	1c - 30% UA reduc	2		50	\$2,615				-898		
x	X901004	1d - U- 24 Glaze	0.5		50	\$554				-228		
x	X901005	1e - 40% UA reduc	3		50	\$3,773				-1172		
x	X901006	1f - U- 20 Glaze	1		50	\$1,107				-391		
x	X901007	2a - 3ACH , fan eff	0.5	1	50	\$245	\$	245		-475		
x	X901008	2b - 2 ACH, HRV	1		50	\$1,025				-939		
x	X901009	2c - 1.5 ACH, HRV	1.5		50	\$2,296				-1284		
x	X901010	2d - 0.6 ACH, HRV	2		50	\$3,280				-1533		
x	X9020	HVAC			0							
x	X902001	3a - Furnace	1		18							
x	X902002	3b - 9.5 HSPF HP	0.5		15							
x	X902003	3c - GSHP	1.5		20							
x	X902004	3d - DHP	1		18	\$2,800				-1132		
x	X902005	3e - 11.0 HSPF HP	1		15							
x	X902006	3f - DHP (15% elec)	1.5		18	\$4,800				-1193		
x	X902007	4 - HVAC inside	1		50							
x	X902008	Other			0							
x	X902009	Other			0							
x	X902010	Other			0							
x	X9030	Hot Water			0							
x	X903001	5a - DWR	0.5		50	\$133				-265		
x	X903002	5b - 0.80 gas DHW	0.5		15							
x	X903003	5c - 0.91 gas DHW, GSHP	1		15							
x	X903004	5d - Tier I HPWH	1.5	1	15	\$291	\$	291		-1038		
x	X903005	5e - Tier III HPWH	2		15	\$291				-1369		
x	X903006	5f - Tier III HPWH Split	2.5		15	\$1,167				-1547		
x	X903007				0							
x	X903008	Other			0							
x	X903009	Other			0							
x	X903010	Other			0							
x	X9040	Other			0							
x	X904001	6 - Solar pV	0.5		25	\$5,040				-1262		
x	X904002	7 - HP dryers, ES Appl	0.5		15	\$462				-612		
x	X904003	(legacy) 5a - low flow fixtures	0.5	1	50	\$17	\$	17		-307		
Z	Other Project Costs											
Z10	One Time - Upfront Costs			1	50							
Z30	Re-Occurring Annual Cost (Track Inflation)			1	1							

Multifamily Unit

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool
Alternative 1 Input Page

Open Primary Filter and Click OK to Re-filter

☐ Manual Special Selection Only (Requires Refilter)

☒ Show Baseline Fields and Entered Units (Requires Refilter)

☐ Show Differences Between Alternative and Baseline (Req. Refilter)

Total Building Annual Utility Analysis		\$	501	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill (\$)					\$ 501	\$ -
Annual Utility Consumption Not Entered Below					8,776	-
Sum of Annual Utility Consumption Below				-	(3,589)	-
Total Annual Utility Consumption				-	5,187	-
Annual Utility Bill ÷ Total Utility Consumption		\$	-	\$	0.097	\$ -

Note: No Units Assigned to a Component with Entries

S H O W	Uniformat II Elemental Classification for Buildings (Building Component List)		REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)	A ₁
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							Entries Below for Component Specific Utility Analysis				
	Match Baseline: Filter to Select All & Drag Copy O14-S14 & U14:AG14											
	A	Substructure						\$ 3,990				
	A101098	MF- Zonal Elec carbon										
	B	Shell										
	C	Interiors										
	D	Services										
	E	Equipment & Furnishings										
	F	Special Construction & Demolition										
	G	Building Sitework										
	X	Other Categories										
	X90	Other Categories										
	X9010	Building Envelope										
	X901001	1a - 5% UA reduc	0.5	1	50	\$192		\$ 192				
	X901002	1b - 15% UA reduc	1		50	\$1,359				-517		
	X901003	1c - 30% UA reduc	2		50	\$2,615				-898		
	X901004	1d - U-24 Glaze	0.5		50	\$554				-228		
	X901005	1e - 40% UA reduc	3		50	\$3,773				-1172		
	X901006	1f - U-20 Glaze	1		50	\$1,107				-391		
	X901007	2a - 3ACH, fan eff	0.5	1	50	\$245		\$ 245		-475		
	X901008	2b - 2 ACH, HRV	1		50	\$1,025				-939		
	X901009	2c - 1.5 ACH, HRV	1.5		50	\$2,296				-1284		
	X901010	2d - 0.6 ACH, HRV	2		50	\$3,280				-1533		
	X9020	HVAC										
	X902001	3a - Furnace	1		18							
	X902002	3b - 9.5 HSPF HP	0.5		15							
	X902003	3c - GSHP	1.5		20							
	X902004	3d - DHP	1	1	18	\$2,800		\$ 2,800		-1132		
	X902005	3e - 11.0 HSPF HP	1		15							
	X902006	3f - DHP (15% elec)	1.5		18	\$4,800				-1193		
	X902007	4 - HVAC inside	1		50							
	X902008	Other										
	X902009	Other										
	X902010	Other										
	X9030	Hot Water										
	X903001	5a - DWR	0.5		50	\$133				-265		
	X903002	5b - 0.80 gas DHW	0.5		15							
	X903003	5c - 0.91 gas DHW, GSHP	1		15							
	X903004	5d - Tier I HPWH	1.5		15	\$291				-1038		
	X903005	5e - Tier III HPWH	2	1	15	\$291		\$ 291		-1369		
	X903006	5f - Tier III HPWH Split	2.5		15	\$1,167				-1547		
	X903007	Other										
	X903008	Other										
	X903009	Other										
	X903010	Other										
	X9040	Other										
	X904001	6 - Solar pV	0.5		25	\$5,040				-1262		
	X904002	7 - HP dryers, ES Appl	0.5	1	15	\$462		\$ 462		-612		
	X904003	(legacy) 5a - low flow fixtures	0.5		50	\$17				-307		
	Z	Other Project Costs										
	Z10	One Time - Upfront Costs		1	50							
	Z30	Re-Occurring Annual Cost (Track Inflation)		1	1							

Multifamily Unit

<- Primary Filter (Requires Level 1)

Office of Financial Management

Olympia, Washington - Version: 2018-Residential
Life Cycle Cost Analysis Tool

Alternative 2 Input Page

Open Primary Filter and Click OK to Re-filter

☐ Manual Special Selection Only (Requires Refilter)

☒ Show Baseline Fields and Entered Units (Requires Refilter)

☐ Show Differences Between Alternative and Baseline (Req. Refilter)

Total Building Annual Utility Analysis		Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [\$]	\$ 497		\$ 497	
Annual Utility Consumption Not Entered Below		-	8,776	
Sum of Annual Utility Consumption Below		-	(3,631)	-
Total Annual Utility Consumption		-	5,145	-
Annual Utility Bill + Total Utility Consumption	\$	-	\$ 0.097	\$ -

Note: No Units Assigned to a Component with Entries

S	H	O	W	Unifomat II Elemental Classification for Buildings (Building Component List)	REF	# of Units	Useful Life (Yrs.)	Installed Cost (\$/Unit)	1st Year Maintenance Cost (\$/Unit)	Total Component Installed Cost (\$'s)	Annual Water (CCF/Unit)	Annual Electricity (KWH/Unit)	Annual Natural Gas (Therm/Unit)
Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2													
Match Baseline: Filter to Select All & Drag Copy Q14:S14 & U14:AG14										\$ 4,912			
A				Substructure									
				A101098 MF- Zonal Elec carbon									
B				Shell									
C				Interiors									
D				Services									
E				Equipment & Furnishings									
F				Special Construction & Demolition									
G				Building Sitework									
X				Other Categories									
X90				Other Categories									
X9010				Building Envelope									
				X901001 1a - 5% UA reduc	0.5		50						
				X901002 1b - 15% UA reduc	1	1	50	\$1,359		\$ 1,359		-517	
				X901003 1c - 30% UA reduc	2		50	\$2,615				-898	
				X901004 1d - U- 24 Glaze	0.5		50	\$554				-228	
				X901005 1e - 40% UA reduc	3		50	\$3,773				-1172	
				X901006 1f - U- 20 Glaze	1		50	\$1,107				-391	
				X901007 2a - 3ACH, fan eff	0.5		50	\$245				-475	
				X901008 2b - 2 ACH, HRV	1		50	\$1,025				-939	
				X901009 2c - 1.5 ACH, HRV	1.5		50	\$2,296				-1284	
				X901010 2d - 0.6 ACH, HRV	2		50	\$3,280				-1533	
X9020				HVAC									
				X902001 3a - Furnace	1		18						
				X902002 3b - 9.5 HSPF HP	0.5		15						
				X902003 3c - GSHP	1.5		20						
				X902004 3d - DHP	1.5	1	18	\$2,800		\$ 2,800		-1132	
				X902005 3e - 11.0 HSPF HP	1		15						
				X902006 3f - DHP (15% elec)	1.5		18	\$4,800				-1193	
				X902007 4 - HVAC inside	1		50						
				X902008 Other									
				X902009 Other									
				X902010 Other									
X9030				Hot Water									
				X903001 5a - DWR	0.5		50	\$133				-265	
				X903002 5b - 0.80 gas DHW	0.5		15						
				X903003 5c - 0.91 gas DHW, GSHP	1		15						
				X903004 5d - Tier I HPWH	1.5		15	\$291				-1038	
				X903005 5e - Tier III HPWH	2	1	15	\$291		\$ 291		-1369	
				X903006 5f - Tier III HPWH Split	2.5		15	\$1,167				-1547	
				X903007 Other									
				X903008 Other									
				X903009 Other									
				X903010 Other									
X9040				Other									
				X904001 6 - Solar pV	0.5		25	\$5,040				-1262	
				X904002 7 - HP dryers, ES Appl	0.5	1	15	\$462		\$ 462		-612	
				X904003 (legacy) 5a - low flow fixtures	0.5		50	\$17					
Z				Other Project Costs									
Z10				One Time - Upfront Costs		1	50						
Z30				Re-Occurring Annual Cost (Track Inflation)		1	1						

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

Cumulative Expenditure Summary				Annual Expenditure Summary		
Year	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	\$ 9,853	\$ 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	\$ 21,729	\$ 22,619	\$ 23,507	\$ 913	\$ 732	\$ 749
2046	\$ 22,642	\$ 23,348	\$ 24,252	\$ 913	\$ 729	\$ 745
2047	\$ 23,561	\$ 24,079	\$ 24,999	\$ 920	\$ 731	\$ 747
2048	\$ 24,481	\$ 24,807	\$ 25,743	\$ 919	\$ 728	\$ 743
2049	\$ 25,402	\$ 25,535	\$ 26,485	\$ 922	\$ 728	\$ 742
2050	\$ 26,618	\$ 27,016	\$ 27,980	\$ 1,216	\$ 1,481	\$ 1,495
2051	\$ 27,534	\$ 27,663	\$ 28,621	\$ 916	\$ 647	\$ 642
2052	\$ 28,453	\$ 28,311	\$ 29,265	\$ 919	\$ 649	\$ 644
2053	\$ 29,375	\$ 28,962	\$ 29,910	\$ 922	\$ 651	\$ 646
2054	\$ 30,299	\$ 29,615	\$ 30,558	\$ 925	\$ 653	\$ 648
2055	\$ 31,227	\$ 30,270	\$ 31,208	\$ 928	\$ 655	\$ 650
2056	\$ 32,157	\$ 33,727	\$ 34,660	\$ 931	\$ 3,457	\$ 3,452
2057	\$ 33,091	\$ 34,387	\$ 35,313	\$ 933	\$ 659	\$ 654
2058	\$ 34,027	\$ 35,048	\$ 35,969	\$ 936	\$ 661	\$ 656
2059	\$ 34,967	\$ 35,711	\$ 36,627	\$ 939	\$ 663	\$ 658
2060	\$ 35,909	\$ 36,377	\$ 37,287	\$ 942	\$ 665	\$ 660
2061	\$ 36,854	\$ 37,044	\$ 37,949	\$ 945	\$ 667	\$ 662
2062	\$ 37,802	\$ 37,713	\$ 38,614	\$ 948	\$ 670	\$ 664
2063	\$ 38,753	\$ 38,385	\$ 39,280	\$ 951	\$ 672	\$ 666
2064	\$ 39,707	\$ 39,059	\$ 39,948	\$ 954	\$ 674	\$ 668
2065	\$ 40,955	\$ 40,488	\$ 41,371	\$ 1,248	\$ 1,429	\$ 1,424
2066	\$ 41,915	\$ 41,165	\$ 42,044	\$ 960	\$ 678	\$ 672
2067	\$ 42,878	\$ 41,845	\$ 42,718	\$ 963	\$ 680	\$ 674
2068	\$ 43,843	\$ 42,527	\$ 43,395	\$ 966	\$ 682	\$ 676
2069	\$ 44,812	\$ 43,211	\$ 44,073	\$ 969	\$ 684	\$ 678
2070	\$ 45,589	\$ 42,773	\$ 43,629	\$ 777	\$ (438)	\$ (444)