073
TAG Modification
5/27/22

STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development

Standard Energy Code Proposal Form

Log No. 21-GP2-073

Code being amended: ☐ Commercial Provisions ☒ Residential Provisions

Code Section # **R405.3, R406, Chapter 6**

Brief Description: **This proposal updates Section R406 and requires additional energy efficiency credits.**

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.)

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 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. Energy u se derived from simulation analysis shall be expressed in pounds of carbon per square foot of *conditioned floor area* as follows:~~

1. The requirements of the sections indicated within Table R405.2

~~1.2.~~ For structures less than 1,500 square feet of conditioned floor area, the annual carbon emissions shall be less than or equal to ~~73~~ 64 percent of the annual carbon emissions of the *standard reference design*.

~~2.~~3. For structures 1,500 to 5,000 square feet of conditioned floor area, the annual carbon emissions shall be no more than ~~56~~ 47 percent of the *standard reference design*.

~~3.~~4. For structures over 5,000 square feet of conditioned floor area, the annual carbon emissions shall be no more than ~~50~~ 41 percent of the *standard reference design*.

~~4.~~5. For structures serving Group R-2 occupancies, the annual carbon emissions shall be less than or equal to ~~70~~ 61 percent of the annual carbon emissions of the *standard reference design*.

SECTION R406

ADDITIONAL ENERGY EFFICIENCY REQUIREMENTS

R406.1 Scope. This section establishes additional energy efficiency requirements for all new construction covered by this code, including additions subject to Section R502 and change of occupancy or use subject to Section R505 unless specifically exempted in Section R406. Credit from both Sections R406.2 and R406.3 are required.

R406.2 Carbon emission equalization. This section establishes a base equalization between fuels used to define the equivalent carbon emissions of the options specified. The permit shall define the base fuel selection to be used and the points specified in Table R406.2 shall be used to modify the requirements in Section R406.3. ~~The sum of credits from Tables R406.2 and R406.3 shall meet the requirements of Section R406.3.~~

R406.3 Additional energy efficiency requirements. Each dwelling unit in a residential building shall comply with sufficient options from Table R406.2 and R406.3 so as to achieve the following minimum number of credits:

1. Small Dwelling Unit: ..... ~~3.0~~5.0 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.
2. Medium Dwelling Unit: ..... ~~6.0~~8.0 credits
   All dwelling units that are not included in #1, #3 or #4.
3. Large Dwelling Unit: ..... ~~7.0~~9.0 credits
   Dwelling units exceeding 5000 square feet of conditioned floor area.
4. Dwelling units serving R-2 occupancies: ..... ~~4.5~~6.5 credits
5. Additions ~~less than or equal to~~ 100 to 500 square feet: ..... ~~1.5~~2.0 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
FUEL NORMALIZATION CREDITS

System Type	Description of Primary Heating Source	Credits	
		~~All Other~~	~~Group R-2~~
~~1~~	~~Combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(4) or C403.3.2(5)~~	~~0~~	~~0~~
~~2~~	~~For an initial heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(1)C or C403.3.2(2) or~~ ~~Air to water heat pump units that are configured to provide both heating and cooling and are rated in accordance with AHRI 550/590~~	~~1.0~~	~~1.0~~
~~3~~	~~For heating system based on electric resistance only (either forced air or Zonal)~~	~~-1.0~~	~~-1.0~~
~~4~~	~~For heating system based on electric resistance with a ductless mini-split heat pump system in accordance with Section R403.7.1 including the exception~~	~~0.5~~	~~N/A~~
~~5~~	~~All other heating systems~~	~~-1~~	~~-0.5~~

System Type	Description of Primary Heating Source	Credits	
		~~R-3~~All Other	R-2
1	For combustion heating system using equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(4) or C403.3.2(5)	0	0
~~2~~	~~For an initial heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(1)C or C403.3.2(2)~~ ~~or~~ ~~Air to water heat pump units that are configured to provide both heating and cooling and are rated in accordance with AHRI 550/590~~	~~3.0~~	~~2.0~~
~~3~~2	~~When~~ For ~~dwelling unit is located in climate zone 4C (as shown in Table R301.1)~~ ~~with~~ a primary heating system using a heat pump that meets federal standards for the equipment listed in C403.3.2(2) and a secondary heating provided by a combustion furnace meeting minimum standard listed in Table C403.3.2(4)* ~~or~~	1.5	0
	~~When dwelling unit is located in climate zone 5B (as shown in Table R301.1) with a primary heating system using a heat pump that meets federal standards for the equipment listed in C403.3.2(2) and a secondary heating provided by a combustion furnace meeting minimum standard listed in Table C403.3.2(4)*~~		
~~5~~3	For heating system based on electric resistance only (either forced air or Zonal)	0.5	-0.5
~~2~~4	For an initial heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(1)C or C403.3.2(2) **or** Air to water heat pump units that are configured to provide both heating and cooling and are rated in accordance with AHRI 550/590	3.0	2.0
~~4~~5	For heating system based on electric resistance with a ductless mini-split heat pump system in accordance with Section R403.7.1 including the exception	2.0	0
~~5~~	~~For heating system based on electric resistance only (either forced air or Zonal)~~	~~0.5~~	~~-0.5~~

*The gas back-up furnace will operate as fan-Only when the heat pump is operating. The heat pump shall operate at all temperatures above 38F (or lower). Below that "changeover" temperature the heat pump would not operate to provide space heating. The gas furnace provides heating below 38F (or lower).

†Additional points for this HVAC system are included in Table R406.3

TABLE R406.3
ENERGY CREDITS

Occupancy Type		All Other		Group R-2
Primary Heating Fuel		Table R406.2 System Type ~~1, 3, 5~~ 1, 2, 3	Table R406.2 System Type ~~2, 4~~ 4, 5	Any
OPTION	**DESCRIPTION**	**CREDIT(S)**		
	1. EFFICIENT BUILDING ENVELOPE OPTIONS Only one option from Items 1.1 through ~~1.7~~1.6 may be selected in this category. Compliance with the conductive UA targets is demonstrated using Section ~~R402.1.4~~ R402.1.5, Total UA alternative, where [1-(Proposed UA/Target UA)] > the required %UA reduction			
1.1	Prescriptive compliance is based on Table ~~R402.1.1~~R402.1.3 with the following modifications: Vertical fenestration U = 0.24.	0.5	0.5	0.5
1.2	Prescriptive compliance is based on Table ~~R402.1.1~~R402.1.3 with the following modifications: Vertical fenestration U = 0.20.	1.0	1.0	1.0
1.3	Prescriptive compliance is based on Table ~~R402.1.1~~R402.1.3 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~~R402.1.5: Reduce the Total conductive UA by 5%.	0.5	N/A	N/A
1.4	Prescriptive compliance is based on Table ~~R402.1.1~~R402.1.3 with the following modifications: Vertical fenestration U = ~~0.25~~0.24 ~~Wall R-21 plus R-4 ci~~ Floor R-38 Basement wall R-21 int plus R-5 ci Ceiling and single-rafter or joist-vaulted R-60 advanced 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~~R402.1.5: Reduce the Total conductive UA by 15%.	1.0	0.5	1.0
1.5	Prescriptive compliance is based on Table ~~R402.1.1~~R402.1.3 with the following modifications: Vertical fenestration U = ~~0.22~~0.18 Ceiling and single-rafter or joist-vaulted R-~~49~~60 advanced ~~Wood frame wall R-21 int plus R-12 ci~~ Floor R-38 Basement wall R-21 int plus R-12 ci Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab **or** Compliance based on Section ~~R402.1.4~~R402.1.5: Reduce the Total conductive UA by ~~30%~~22.5%.	~~2.0~~ 1.5	1.0	1.5

TABLE R406.3 (continued)
ENERGY CREDITS

OPTION	DESCRIPTION	CREDIT(S)		
		Table R406.2 System Type ~~1, 3, 5~~ 1,2,3	Table R406.2 System Type ~~2, 4~~ 4,5	Group R-2
1.6	Prescriptive compliance is based on Table ~~R402.1.1~~R402.1.3 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~~R402.1.5: Reduce the Total conductive UA by ~~40%~~30%.	~~3.0~~ 2.5	1.5	2.0
~~1.7~~	~~Advanced framing and raised heel trusses or rafters~~ ~~Vertical Glazing U-0.28~~ ~~R-49 Advanced (U-0.020) as listed in Section A102.2.1, Ceilings below a vented attic~~ ~~**and**~~ ~~R-49 vaulted ceilings with full height of uncompressed insulation extending over the wall top plate at the eaves.~~	~~0.5~~		~~0.5~~
	2. AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION OPTIONS Only one option from Items 2.1 through 2.4 may be selected in this category.			
~~2.1~~	~~Compliance based on Section R402.4.1.2:~~ ~~Reduce the tested air leakage to 3.0 air changes per hour maximum at 50 Pascals~~ ~~**or**~~ ~~For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.3 cfm/ft2 maximum at 50 Pascals~~ ~~**and**~~ ~~All whole house ventilation requirements as determined by Section M1505.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* shall be met with a high efficiency fan(s) (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, the maximum tested building air leakage, and shall show the qualifying ventilation system and its control sequence of operation.~~	~~0.5~~		~~1.0~~

TABLE R406.3 (continued)
ENERGY CREDITS

OPTION	DESCRIPTION	CREDIT(S)		
		~~All Other~~ Table R406.2 System Type ~~1, 3, 5~~ 1,2,3	Table R406.2 System Type ~~2, 4~~ 4,5	Group R-2
2.~~2~~1	Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 2.0 air changes per hour maximum at 50 Pascals **or** For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.25 cfm/ft2 maximum at 50 Pascals **and** All whole house ventilation requirements as determined by Section M1507.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.65. 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.	1.0	0.5	~~1.5~~ 1.0
2.~~3~~2	Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 1.5 air changes per hour maximum at 50 Pascals **or** For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.20 cfm/ft2 maximum at 50 Pascals **and** All whole house ventilation requirements as determined by Section M1507.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.75. 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.	1.5	1.0	~~2.0~~ 1.5
2.~~4~~3	Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.6 air changes per hour maximum at 50 Pascals **or** For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.15 cfm/ft2 maximum at 50 Pascals **and** All whole house ventilation requirements as determined by Section M1507.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.80. Duct installation shall comply with Section R403.3.7. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.	2.0	1.5	~~2.5~~ 2.0

TABLE R406.3 (continued)
ENERGY CREDITS

OPTION	DESCRIPTION	CREDIT(S)		
		~~All Other~~ Table R406.2 System Type ~~1, 3, 5~~ 1,2,3	Table R406.2 System Type ~~2, 4~~ 4,5	Group R-2
3. HIGH EFFICIENCY HVAC EQUIPMENT OPTIONS Only one option from Items 3.1 through 3.6 may be selected in this category.				
3.1[a]	Energy Star rated (U.S. North) Gas or propane furnace with minimum AFUE of 95% **or** Energy Star rated (U.S. North) Gas or propane boiler with minimum AFUE of 90%. 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.	1.0	N/A	1.0
3.2[a]	Air-source centrally ducted heat pump with minimum HSPF of 9.5. 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.	~~1.0~~ N/A	0.5	N/A
3.3[a]	Closed-loop ground source heat pump; with a minimum COP of 3.3 **or** Open loop water source heat pump with a maximum pumping hydraulic head of 150 feet and minimum COP of 3.6. 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.	~~1.5~~ N/A	1.5	1.0
3.4	Ductless mini-split heat pump system, zonal control: In homes where the primary space heating system is zonal electric heating, a ductless mini-split heat pump system with a minimum HSPF of 10.0 shall be installed and provide heating to the largest zone of the housing unit. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.	~~1.5~~ N/A	1.5	2.0
3.5[a]	Air-source, centrally ducted heat pump with minimum HSPF of 11.0. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.	~~1.5~~ N/A	1.0	N/A
3.6[a]	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 dwelling unit at the design outdoor air temperature. To qualify to claim this credit, the building permit drawings shall specify the option being selected, the heated floor area calculation, the heating equipment type(s), the minimum equipment efficiency, and total installed heat capacity (by equipment type).	~~2.0~~ N/A	2.0	3.0

TABLE R406.3 (continued)
ENERGY CREDITS

OPTION	DESCRIPTION	CREDIT(S)		
		~~All Other~~ Table R406.2 System Type ~~1, 3, 5~~ 1,2,3	Table R406.2 System Type ~~2, 4~~ 4,5	Group R-2
	4. HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM OPTIONS			
4.1	All supply and return ducts located in an unconditioned attic shall be deeply buried in ceiling insulation in accordance with Section R403.3.~~6~~3. For mechanical equipment located outside the conditioned space, a maximum of 10 linear feet of return duct and 5 linear feet of supply duct connections to the equipment may be outside the deeply buried insulation. 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. Duct leakage shall be limited to 3 cfm per 100 square feet of conditioned floor area. Air handler(s) shall be located within the conditioned space.	~~0.5~~ 1.0	0.5	0.5
4.2	HVAC equipment and associated duct system(s) installation shall comply with the requirements of Section R403.3.~~7~~2. ~~Locating system components in conditioned crawl spaces is not permitted under this option.~~ Electric resistance heat and ductless heat pumps are not permitted under this option. Direct combustion heating equipment with AFUE less than 80% is not permitted under this option. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and shall show the location of the heating and cooling equipment and all the ductwork.	~~1.0~~ 1.5	1.0	N/A
OPTION	**DESCRIPTION**	**CREDIT(S)**		
		~~All Other~~ Table R406.2 System Type ~~1, 3, 5~~ 1,2,3	Table R406.2 System Type ~~2, 4~~ 4,5	Group R-2
	5. EFFICIENT WATER HEATING OPTIONS Only one option from Items 5.2 through 5.6 may be selected in this category. Item 5.1 may be combined with any option.			

TABLE R406.3 (continued)
ENERGY CREDITS

5.1	A drain water heat recovery unit(s) shall be installed, which captures waste water heat from at least two showers, including shower/tub combinations. It is acceptable, but not required, for sink water to be connected. Unit shall have~~all and only the showers, and has~~ a minimum efficiency of 40% if installed for equal flow or a minimum efficiency of 54% if installed for unequal flow. Such units shall be rated in accordance with CSA B55.1 or IAPMO IGC 346-2017 and be so labeled. To qualify to claim this credit, the building permit drawings shall include a plumbing diagram that specifies the drain water heat recovery units and the plumbing layout needed to install it. Labels or other documentation shall be provided that demonstrates that the unit complies with the standard.	0.5	0.5	0.5

OPTION	DESCRIPTION	CREDIT(S)		
		~~All Other~~ Table R406.2 System Type ~~1, 3, 5~~ 1,2,3	Table R406.2 System Type ~~2, 4~~ 4,5	Group R-2
5.2	Water heating system shall include one of the following: Energy Star rated gas or propane water heater with a minimum UEF of 0.80. 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.	0.5	0.5	0.5
5.3	Water heating system shall include one of the following: Energy Star rated gas or propane water heater with a minimum UEF 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 Option 3.3. 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.	1.0	1.0	1.0
~~5.4~~	~~Water heating system shall include one of the following:~~ ~~Electric heat pump water heater meeting the standards for Tier I of NEEA's advanced water heating specification~~ ~~or~~ ~~For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier I of NEEA's advanced water heating specification, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation.~~ ~~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.~~	~~1.5~~		~~2.0~~

TABLE R406.3 (continued)
ENERGY CREDITS

5.~~5~~4	Water heating system shall include one of the following: Electric heat pump water heater meeting the standards for Tier III of NEEA's advanced water heating specification **or** For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation. 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.	2.0	2.0	2.5

OPTION	DESCRIPTION	CREDIT(S)		
		~~All Other~~ Table R406.2 System Type ~~1, 3, 5~~ 1,2,3	Table R406.2 System Type ~~2, 4~~ 4,5	Group R-2
5.~~6~~5	Water heating system shall include one of the following: 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 Section 4, requirements for all units, of the NEEA standard Advanced Water Heating Specification with the UEF noted above **or** For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification and utilizing a split system configuration with the air-to-refrigerant heat exchanger located outdoors, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation. 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.	2.5	2.5	3.0
6. RENEWABLE ELECTRIC ENERGY OPTION				
6.1	For each ~~12~~600 kWh of electrical generation per housing unit provided annually by on-site wind or solar equipment ~~a 1.0~~0.5 credit shall be allowed, up to ~~3~~ 4.5 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 or approved alternate by the code official. 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.	~~1.0~~0.5-4.5	0.5-4.5	~~1.0~~0.5-4.5

7. APPLIANCE PACKAGE OPTION				
7.1	All of the following appliances shall be new and installed in the dwelling unit and shall meet the following standards: 1. Dishwasher, Standard – Energy Star rated, Most Efficient 2021 **or** Dishwasher, Compact – Energy Star rated (Version 6.0) 2. Refrigerator (if provided) – Energy Star rated (Version 5.1) 3. Washing machine (Residential ~~or Commercial~~) – Energy Star rated (Version 8.1) **Exception:** For Group R-2, a new Commercial Clothes Washer rated to Energy Star Version 8.1 and installed in the same *building* as the dwelling unit shall be an acceptable compliance alternative for this requirement. 4. Dryer – Energy Star rated, Most Efficient 2022~~ventless dryer with a minimum CEF rating of 5.2~~.	0.5	0.5	1.5
	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 are not permitted to be installed in the dwelling unit.			

a. An alternative heating source sized at a maximum of 0.5 Watts/ft^2 (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in the dwelling unit.

Purpose of code change:

Incremental Improvements in Energy Efficiency consistent with RCW 19.27a.160. This proposal is designed to meet the high-level goal of RCW 19.27a.160. This 2021 Section R406 code change proposal is expected to lead a 10% energy reduction over a 2006 WSEC compliant home. These savings are primarily attributed to the credits required to comply with code in Section R406.3, along with prescriptive envelope upgrades.

Calculate Building Energy Use for the base code and section 406 options: The base code (prescriptive) changes made in 2018 and by the 2021 IECC additions are first assessed to determine the base energy use of seven modeled prototype buildings (representing the wide range of residential construction within the state). Based on this, the value of each credit is reassessed and if needed, reassigned.

- Option 1.5 reduces the total conductive UA from 30% to 22.5% due to more aggressive prescriptive envelope requirements.
- Option 1.6 reduces the total conductive UA from 40% to 30% due to more aggressive prescriptive envelope requirements.
- Option 1.7 has been removed due to more aggressive prescriptive envelope requirements. Option 1.6 is as aggressive as reasonable with the updated prescriptive requirements.
- Dual fuel heat pump (gas backup) for space conditioning has been added to Table R406.2 Fuel Normalization
- Updates have been made for credit 7.1 Appliance Package
- Credit values awarded for load reduction measures (envelope and air tightness) have been broken out between two space heating system categories. Those systems with higher annual energy end use intensities, in some cases, can achieve greater credit values for load reduction measures.

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

☐ Addresses a critical life/safety need.

☐ The amendment clarifies the intent or application of the code.

☒ Addresses a specific state policy or statute.
(Note that energy conservation is a state policy)

☒ Consistency with state or federal regulations.

☐ Addresses a unique character of the state.

☐ Corrects errors and omissions.

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

- [x] Single family/duplex/townhome
- [x] Multi-family 1 – 3 stories
- [ ] Multi-family 4 + stories
- [ ] Commercial / Retail
- [ ] Institutional
- [ ] Industrial

Your name	Henry Odum, PE	Email address	henry@ecotope.com
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Other contact name	David Baylon		

Economic Impact Data Sheet

Is there an economic impact: ☒ Yes ☐ No

Briefly summarize your proposal's primary economic impacts and benefits to building owners, tenants, and businesses. If you answered "No" above, explain your reasoning.

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 multifamily dwelling units (modeled a 2 story, exterior entry, low-rise building and a 3-story double loaded corridor). For each building both cost and energy savings are estimated for each prototype and each measure.

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

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

The cost of each option will be included in final draft. 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 will be shown.

Energy Savings Estimates

The energy savings estimates will be included in final draft. They are being 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) is modeled and located in various weather climates within the state. The energy savings attributed to each option are then weighted to consolidate energy savings estimates for the 4 primary categories of homes in Section R406.3 (small, medium, large, and R-2 dwelling units). Large homes (greater than 5000sf) only compromise 2% of the total building stock – therefore energy savings estimates used for the Life Cycle Cost Analysis will be omitted from this economic analysis.

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

Table 1: Total Measure Costs by Single Family Prototypes

				Prototypes Weight % by Floor Area			
				1344	2200	2688	5000
Option-Description	Gas Credit Value	HP Credit Value	**Weighted Measure Cost**	15%	72%	11%	2%
1.1 - U-.24 Glaze	0.5	0.5	**$ 1,730**	$ 991	$ 1,790	$ 1,987	$ 3,688
1.2 - U-.20 Glaze	1	1	**$ 2,537**	$ 1,454	$ 2,625	$ 2,914	$ 5,409
1.3 - 5% UA reduc	0.5	0.5	**$ 1,261**	$ 955	$ 1,270	$ 1,762	$ 476
1.4 - 15% UA reduc	1	1	**$ 3,263**	$ 1,925	$ 3,255	$ 4,676	$ 5,802
1.5 - 22.5% UA reduc	2	1.5	**$ 4,721**	$ 2,938	$ 4,850	$ 5,735	$ 7,852
1.6 - 30% UA reduc	3	2.5	**$ 11,235**	$ 6,819	$ 12,095	$ 10,587	$ 16,991
2.1 - 2 ACH, HRV	1	0.5	**$ 2,264**	$ 1,395	$ 2,284	$ 2,790	$ 5,190
2.2 - 1.5 ACH, HRV	1.5	1	**$ 5,411**	$ 3,334	$ 5,457	$ 6,667	$ 12,402
2.3 - 0.6 ACH, HRV	2	1.5	**$ 6,988**	$ 4,306	$ 7,048	$ 8,612	$ 16,019
3.1a - Furnace	1	1	**$ 252**	$ 252	$ 252	$ 252	$ 252
3.2a - 9.5 HSPF HP	0.5	0.5	**$ 1,388**	$ 1,388	$ 1,388	$ 1,388	$ 1,388
3.3a - GSHP	1.5	1.5	**$ 11,034**	$ 10,900	$ 10,900	$ 10,900	$ 17,600
3.4 - DHP	1.5	1.5	**$ 1,530**	$ 1,530	$ 1,530	$ 1,530	$ 1,530
3.5a - 11.0 HSPF HP	1	1	**$ 1,530**	$ 1,530	$ 1,530	$ 1,530	$ 1,530
3.6a - DHP (15% elec)	2	2	**$ 5,901**	$ 5,901	$ 5,901	$ 5,901	$ 5,901
4.1 - Deeply buried	1	0.5	**$ -**	$ -	$ -	$ -	$ -
4.2 - HVAC inside	1.5	1	**$ 328**	$ 328	$ 328	$ 328	$ 328
5.1 - DWR	0.5	0.5	**$ 437**	$ 437	$ 437	$ 437	$ 437
5.2 - 0.80 gas DHW	0.5	0.5	**$ 640**	$ 640	$ 640	$ 640	$ 640
5.3 - 0.91 gas DHW, GSHP	1	1	**$ 1,009**	$ 1,009	$ 1,009	$ 1,009	$ 1,009
5.4 - Tier III HPWH	2	2	**$ 955**	$ 955	$ 955	$ 955	$ 955
5.5 - CO2 HPWH	2.5	2.5	**$ 3,824**	$ 3,824	$ 3,824	$ 3,824	$ 3,824
6.1 - Solar pV	1	1	**$ 5,040**	$ 5,040	$ 5,040	$ 5,040	$ 5,040
7.1 - ES Appl+ventless Dryer	0.5	0.5	**$ 505**	$ 505	$ 505	$ 505	$ 505

Table 2: Total Measure Costs for Multifamily prototype

Option-Description	Credit Value		Measure Cost
1.1 - U-.24 Glaze	0.5		---
1.2 - U-.20 Glaze	1		**$ 887**
1.3 - 5% UA reduc	---		**$ 173**
1.4 - 15% UA reduc	1		**$ 947**
1.5 - 22.5% UA reduc	1.5		**$ 1,383**
1.6 - 30% UA reduc	2		**$ 3,779**
2.1 - 2 ACH, HRV	0.5		**$ 851**
2.2 - 1.5 ACH, HRV	1		**$ 2,034**
2.3 - 0.6 ACH, HRV	1.5		**$ 2,627**
3.1a - Furnace	1		**$ 252**
3.2a - 9.5 HSPF HP	---		---
3.3a - GSHP	1		---
3.4 - DHP	2		**$ 3,060**
3.5a - 11.0 HSPF HP	---		**$ -**
3.6a - DHP (15% elec)	3		**$ 5,245**
4.1 - Deeply buried	0.5		**$ -**
4.2 - HVAC inside	---		---
5.1 - DWR	---		**$ 505**
5.2 - 0.80 gas DHW	0.5		---
5.3 - 0.91 gas DHW, GSHP	1		---
5.4 - Tier III HPWH	2.5		**$ 318**
5.5 - CO2 HPWH	3		**$ 1,275**
6.1 - Solar pV	1		**$ 5,040**
7.1 - ES Appl+ventless Dryer	1.5		**$ 505**

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)

Energy Savings Estimates

The energy savings estimates below have been developed using 6 single family and two multi-family prototypes. 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 406.3 were then weighted to consolidate energy savings estimates for the 4 primary categories of homes in Section R406.3 (small, medium, large, and R-2 dwelling units). As shown in Table 1, large homes (greater than 5000sf) only compromise 2% of the total building stock – therefore energy savings estimates used for the Life Cycle Cost Analysis have been omitted from this economic analysis.

Table 3: Savings All Climates, All Systems

	S				M				MF
	gfac	gfac	ashp	zonl	gfac	gfac	ashp	zonl	zonl
Options Table 2021	kWh	Therm	kWh	kWh	kWh	Therm	kWh	kWh	kWh
mandatory req's	0	0	0	0	0	0	0	0	0
windows U=0.24	114	5	1143	173	292	5	302	348	132
windows U=0.2	160	12	1192	291	369	18	492	597	263
envelope 3 - 5% UA	18	0	1101	94	-70	-2	59	122	-34
envelope 4 - 15% UA	151	24	1243	406	288	28	528	648	223
envelope 5 - 22.5% UA	303	33	1315	581	577	41	817	1015	420
envelope 6 - 30%UA	348	55	1430	821	887	69	1158	1456	555
air leakage 1 hrv	-116	3	1059	-10	-271	19	105	111	329
air leakage 2 hrv	4	45	283	344	87	67	504	664	642
air leakage 3 hrv	91	54	414	487	530	78	762	997	934
AFUE .95	-84	34	-	-	55	51	-	-	
HSPF 9.5	-	-	248	-	-	-	328	-	
DHP HSPF 10(zonal only)	-	-	-	689	-	-	-	1129	-41
HSPF 11	-	-	371	-	-	-	980	-	
DHP HSPF 10 whole house (zonal only)	-	-	-	1154	-	-	-	2185	740
ducts inside	356	32	385	-	781	38	666	-	
drain water heat recovery	76	23	260	247	-55	33	282	318	182
dwh gas UEF 0.80	18	27	-	-	3	34	-	-	
dwh gas UEF 0.91	-28	39	-	-	12	48	-	-	
hpwh Tier III	-930	121	1407	1395	-1167	153	1761	1790	973
UEF 2.9	-813	121	1536	1512	-1099	156	1916	1941	1055
Energy Star appliances	722		824	784	625		750	776	629

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

Component	Base Level	Measures Beyond Base Level	Cost (2021) $s $/ft2 or $/unit	Source
Envelope				
Ceiling	R-60	R-60 RH Ceiling Insulation	$ 0.22	CERF
Ceiling	R-60	R-49 Advanced	$ 0.25	CERF
Wall	R-13 int Wall + R10 Foam Sheathing	R-21 int Wall + R12 Foam Sheathing	$ 1.05	6th plan
Wall	R-13 int Wall + R10 Foam Sheathing	R-21 int Wall + R-4 Foam Sheathing	$ 2.46	6th plan
Wall	R-13 int Wall + R10 Foam Sheathing	R-21 int Wall + R16 Foam Sheathing	$ 3.28	6th plan
Floor	R-30	R-38 Floor	$ 0.42	RTF-ResNCMTHouseID_v_3_0 .xlsm April 4, 2018; ShellCosts tab
Slab	R-10 4' perim	Slab R-15 4' perim	$ 0.99	6th Plan Appendix G
Slab	R-10 4' perim	Slab R-10 Full	$ 0.99	6th Plan Appendix G
Slab	R-10 4' perim	Slab R-20 Full	$ 1.33	6th Plan Appendix G
Window	U-0.30	Window U-0.25	$ 4.92	NPCC Standard workbook
Window	U-0.30	Window U-0.24	$ 4.92	NPCC Standard workbook
Window	U-0.30	Window U-0.22	$ 7.21	NPCC Standard workbook
Window	U-0.30	Window U-0.20	$ 7.21	NPCC Standard workbook
Window	U-0.30	Window U-0.18	$ 9.83	MF bids (tripleglaze-BidPrices.xl) Costs from ecowindows bids are about 26.50/sf or 8.50 incremental with contractor mark-up
Air Sealing & Ventilation				
ACH	Tested Infiltration at 3 ACH 50	Tested Infiltration to 2 ACH50	$ 0.22	RTF Workbook. ResWXSF_FY10v2_1.xls, at $.18/ft^2 per 1ACH50 reduction. Dan W
ACH	Tested Infiltration at 3 ACH 50	Tested Infiltration to 1.5 ACH50	$ 0.30	
ACH	Tested Infiltration at 3 ACH 50	Tested Infiltration to 0.6 ACH50	$ 0.47	
Exhaust Fan	Pt Source Exhaust Fan =0.75W/cfm	Pt Source Exhaust Fan <0.35W/cfm	$ 88.12	navigant 2013
ERV	No ERV	ERV with SHR>= 0.65	$ 0.82	$400 for WhisperComfort and $400 for ducting
ERV	No ERV	ERV with SHR>= 0.75	$ 2.19	renewaire or lifebreath
ERV	No ERV	ERV with SHR>= 0.80	$ 2.73	high efficiency HRV with ducting (venmar, zhender)
HVAC System				
Ducts	Code level is sealed	Ducts Inside	$ 327.81	NPCC Sixth Power Plan, Support documentation
Furnace	0.8	Furnace Upgrade to 94AFUE	$ 251.59	Navigant Sept 2011 Report for NEEP
Heat Pump	8.2 HSPF	9.5 HSPF	$ 1,387.73	SIW, linear regression from 9 HSPF pricing
DHP	Zonal Resistance	1-ton single zone DHP	$ 3,059.56	Ecotope analysis of NEEA DHP pilot program database
11.0 DHP	8.2 DHP	1-ton single zone DHP	$ 1,529.78	Ecotope analysis of NEEA DHP pilot program database
Heat Pump	8.2 HSPF	11 HSPF	$ 5,900.58	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	$ 5,900.58	Ecotope analysis of NEEA DHP pilot program database
Domestic Hot Water				
Water Htr	0.59 EF	Gas Water Heater >=0.80 EF	$ 640.32	NREL, 2013
Water Htr	0.59 EF	Gas Water Heater >=0.91 EF	$ 1,008.56	NREL, 2013
Water Htr	0.95 EF	Heat Pump Water Heater 2 EF	$ 955.02	RTF ResHPWH.xls
DWHR	none	Drain water heat recovery pipe	$ 437.08	RTF RESDHWDrainWaste.xls
Water Htr	0.95 EF	Tier 3 Water Heater 3 EF	$ 955.02	RTF ResHPWH.xls
Water Htr	0.95 EF	CO2 Water Heater 4 EF	$ 3,824.45	RTF ResHPWH.xls
Appliances				
Dryers, refr, dishwasher	Fed pre-empted	Heat pump dryers, ES appliances	$ 504.83	RTF-ResClothesDryers, ResRef, HD.com $420 for HP dryer, +$40 for Cloth washer, +$90 for refr

List any **code enforcement** time for additional plan review or inspections that your proposal will require, in hours per permit application: No expected additional plan review. Structure of table is the same as previous code cycles

Housing Affordability. Describe economic impacts on housing affordability: Small homes are required to have fewer efficiency credits than larger homes. This is consistent with previous code cycles.

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 360-407-9255.

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

Life Cycle Cost Analysis of 2021 WSEC: R406 Code Change Proposal

Henry Odum, Paul Kintner, Jenny Haan - Ecotope

David Baylon

Kevin Rose, Tess Studley - NEEA

April 2022

The following documentation provides a life cycle cost assessment of the R406 code change proposal. This proposal modifies section R406. It is anticipated that adoption of this code change, along with prescriptive updates sourced from the 2021 IECC, will reduce energy use in typical new homes and low-rise apartments by 10% over a 2018 code-compliant home.

The life cycle cost approach presented builds on the methodology used in previous code development cycles. However, all energy modeling was completed from the 'ground-up' – meaning all modeled energy use, energy savings, and code-to-code comparisons were completely redone for this analysis. No assumptions or previous models were carried over from past years. The life cycle cost analysis was completed using the Office of Financial Management Life Cycle Cost Tool (Version 2020-A).

The analysis was developed by Henry Odum, Paul Kintner, Jenny Haan (all of Ecotope) and David Baylon. Ecotope completed the energy modeling, provided the first cost estimates, and the energy savings analysis. David Baylon completed the carbon equalization credit calculations, backed by Ecotope's energy modeling analysis.

Approach to the development of the R406 energy code proposal:

The following outlines the process used to develop the R406 code change proposal. It is a process with multiple steps.

Change in Scope: For the 2021 WSEC Section R406, this proposal includes credit values specific to homes with varying levels of space heating energy end use. Space heating systems without a coefficient of performance (aka gas furnace and electric resistance) use 2-3x more heating energy than a heat pump system. For this reason, load reduction measures (air tightness, envelope insulation, duct measures) have a greater impact on energy savings for this end use. The revisions to Table R406.3 are intended to capture this difference in energy savings, and reward homes with higher heating energy use with greater credit values.

Table R406.2 (Fuel Normalization credits) have also been updated to match the proposed commercial code carbon content of Washington State's electrical grid (Cambium model from NREL is calculated as 0.44 #CO2e/KWH).

Consider clarifications and implementation changes: To provide clear enforceable code language, several editorial changes have been included. Credit requirements for appliances have been strengthened. Several envelope measures have been removed and/or recalibrated to account for prescriptive code upgrades of the building envelope.

Add New Heating system: To continue to provide a diverse set of options for implementation, a dual fuel heat pump measure has been added to the fuel normalization table. This system assumes a switchover to gas heating at temperatures below ~37F.

Calculate Building Energy Use for the base code and section 406 options: The base code (prescriptive) changes made in 2018 and by the 2021 IECC additions, are first assessed to determine the base energy

use of the prototype buildings. This ultimately impacts the credits awarded by Section R406 options. Baseline envelope options improve the stringency pf the code by roughly 8%.

After the new base code energy use is established, the value of each credit is reassessed and if needed, reassigned. While this analysis is focused on the relative savings and cost of Section R406, the savings attributed to prescriptive 2021 IECC measures are not 'lost' in the analysis however, as the energy savings is now reflected in the 2021 baseline (prescriptive) energy use of the residential sector.

Assess the number of credits required to achieve the objectives of RCW 19.27a.160: This proposal is designed to meet the high-level goal of RCW 19.27a.160. This 2021 Section R406 code change proposal, along with prescriptive updates, is expected to lead a 10% energy reduction over a 2018 WSEC compliant home.

Adjust the targets for systems analysis approach, section 405.3: The last step is to assess the performance-based approach. The targets under this section have been reduced by an additional 9% over the 2018 prescriptive code requirements. This accounts for both the required increase in efficiency and the somewhat lower energy use baseline.

Energy Savings Estimates

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 2009-2018 iterations of the residential portion of Washington State Energy Code. SEEM is used by the Northwest Power and Conservation Council RTF to estimate savings for most of the regional utility conservation programs. 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 R406.3 and estimate the overall consumption of the residential sector for each code cycle.

The SEEM program is designed to model small scale 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. In order for the SEEM model to be used in efficiency measure assessments, it must be calibrated to baseline and efficient-case consumption. Calibration for single family, multi-family, and manufactured homes are separate endeavors that utilize metered data from a sample of homes in the NW to estimate energy consumption. SEEM was recalibrated in response to findings from the 2011 Residential Building Stock Assessment. This provides calibrated results for Pacific NW homes.

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. Each energy conservation measure (option in Table R406.3) is then modeled independently in each of these scenarios, with the energy savings weighted down to a representative credit value shown in Table R406.3.

For low-rise multifamily construction, the same method was used as for single family 3. The presumed predominant construction-types are a 2-story, garden style (exterior entry) building and a 3-story

'double loaded corridor' building. The annual energy use, utility savings, and incremental cost were then normalized to a per unit basis.

After individual measures were modeled independently and associated savings determined, each prototype summarized in this LCCA analysis was modeled with a selection (package) of R406 options required to be code compliant (both in 2018 and 2021). This important step not only illustrated the code-to-code savings, but it also accounts for interaction between different credit options within the table. As more measures are utilized in a home, more interaction occurs between measures, and the individual savings attributed to that measure are not realized when paired with a host of other options. For instance, higher envelope insulation will de-rate the savings available from increased equipment efficiencies. It is important to capture this interaction through the modeling exercise or else the anticipated savings estimates will be overinflated. It is the annual energy savings obtained from these packages of measures that are used in determining the life cycle cost of the code change proposal.

First Cost method:

First cost and energy savings estimates have been developed using an estimating procedure used by the Northwest Power and Conservation Council (NPCC) and ran through the Office of Financial Management Life Cycle Cost Tool. The first costs were developed using multiple sources of information:

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

All costs shown are incremental costs for each measure, the base cost is related to the prescriptive requirement of the code and the incremental costs are associated with the option requirement of Table R406.2. Keeping this in mind, the incremental cost for a ductless minisplit, in single family, is the added equipment cost associated with purchasing a higher efficiency heat pump (since DHPs are required in the prescriptive code in electric zonal single-family homes); while in multifamily, the incremental cost of a heat pump is higher because it is compared to electric baseboards. Water heating systems in multifamily are assumed to serve more than one unit, therefore their incremental costs are lower than for single family.

The cost analyses provided in this report use a weighted average cost method to represent the wide range of new homes constructed in Washington. Each of the predominant dwellings, as defined in Section R406.2, are shown in the LCCA case studies (large dwelling units represent a minor fraction of the overall building stock, therefore were omitted from the analysis). For each single-family dwelling unit size, the predominant heating system types are shown individually ("Gas Home", "Heat Pump Home" and "Electric Zonal Home") in order to show cost effectiveness for all available heating system types. The cost model is built using the five 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. The costs associated with the crawl space and slab prototypes were normalized into each of the dwelling unit sizes per Section R406.2. Multifamily costs were based on an electric zonal heating system. A first cost estimate is developed for each option and for each prototype. Then, the incremental

cost of each prototype is weighted by the expected construction volumes to provide an overall average measure cost. The tables, Incremental Cost of Single Family Options and Incremental Cost of MF Options, provides both prototype and weighted measure cost.

Unlike the energy savings estimates, the first cost numbers are a fixed value for each energy measure and do not change based on the selected package of measures modeled for the LCCA. This assumes that incremental costs of each option do not have the any interdependency – contrary to the associated energy savings, as stated earlier. This will no longer be the case as buildings become more efficient. Higher levels of envelope insulation and tighter construction leads to smaller HVAC systems, and therefore a cost credit should be applied. But as mentioned, this approach was not applied in this analysis.

Energy and Cost Summary Tables:

Table 1: Incremental Cost of Single Family options, by home size

Incremental Cost of Single Family Options

				Prototypes Weight % by Floor Area			
				1344	2200	2688	5000
Option-Description	Gas Credit Value	HP Credit Value	**Weighted Measure Cost**	15%	72%	11%	2%
1.1 - U-.24 Glaze	0.5	0.5	**$ 1,730**	$ 991	$ 1,790	$ 1,987	$ 3,688
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1.3 - 5% UA reduc	0.5	0.5	**$ 1,261**	$ 955	$ 1,270	$ 1,762	$ 476
1.4 - 15% UA reduc	1	1	**$ 3,263**	$ 1,925	$ 3,255	$ 4,676	$ 5,802
1.5 - 22.5% UA reduc	2	1.5	**$ 4,721**	$ 2,938	$ 4,850	$ 5,735	$ 7,852
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2.2 - 1.5 ACH, HRV	1.5	1	**$ 5,411**	$ 3,334	$ 5,457	$ 6,667	$ 12,402
2.3 - 0.6 ACH, HRV	2	1.5	**$ 6,988**	$ 4,306	$ 7,048	$ 8,612	$ 16,019
3.1a - Furnace	1	1	**$ 252**	$ 252	$ 252	$ 252	$ 252
3.2a - 9.5 HSPF HP	0.5	0.5	**$ 1,388**	$ 1,388	$ 1,388	$ 1,388	$ 1,388
3.3a - GSHP	1.5	1.5	**$ 11,034**	$ 10,900	$ 10,900	$ 10,900	$ 17,600
3.4 - DHP	1.5	1.5	**$ 1,530**	$ 1,530	$ 1,530	$ 1,530	$ 1,530
3.5a - 11.0 HSPF HP	1	1	**$ 1,530**	$ 1,530	$ 1,530	$ 1,530	$ 1,530
3.6a - DHP (15% elec)	2	2	**$ 5,901**	$ 5,901	$ 5,901	$ 5,901	$ 5,901
4.1 - Deeply buried	1	0.5	**$ -**	$ -	$ -	$ -	$ -
4.2 - HVAC inside	1.5	1	**$ 328**	$ 328	$ 328	$ 328	$ 328
5.1 - DWR	0.5	0.5	**$ 437**	$ 437	$ 437	$ 437	$ 437
5.2 - 0.80 gas DHW	0.5	0.5	**$ 640**	$ 640	$ 640	$ 640	$ 640
5.3 - 0.91 gas DHW, GSHP	1	1	**$ 1,009**	$ 1,009	$ 1,009	$ 1,009	$ 1,009
5.4 - Tier III HPWH	2	2	**$ 955**	$ 955	$ 955	$ 955	$ 955
5.5 - CO2 HPWH	2.5	2.5	**$ 3,824**	$ 3,824	$ 3,824	$ 3,824	$ 3,824
6.1 - Solar pV	1	1	**$ 5,040**	$ 5,040	$ 5,040	$ 5,040	$ 5,040
7.1 - ES Appl+ventless Dryer	0.5	0.5	**$ 505**	$ 505	$ 505	$ 505	$ 505

Table 2: Modeled Energy Savings - Single Family, by home size and heating system type

	S				M				MF
	gfac	gfac	ashp	zonl	gfac	gfac	ashp	zonl	zonl
Options Table 2021	kWh	Therm	kWh	kWh	kWh	Therm	kWh	kWh	kWh
mandatory req's	0	0	0	0	0	0	0	0	0
windows U=0.24	114	5	1143	173	292	5	302	348	132
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air leakage 3 hrv	91	54	414	487	530	78	762	997	934
AFUE .95	-84	34	-	-	55	51	-	-	
HSPF 9.5	-	-	248	-	-	-	328	-	
DHP HSPF 10(zonal only)	-	-	-	689	-	-	-	1129	-41
HSPF 11	-	-	371	-	-	-	980	-	
DHP HSPF 10 whole house (zonal only)	-	-	-	1154	-	-	-	2185	740
ducts inside	356	32	385	-	781	38	666	-	
drain water heat recovery	76	23	260	247	-55	33	282	318	182
dwh gas UEF 0.80	18	27	-	-	3	34	-	-	
dwh gas UEF 0.91	-28	39	-	-	12	48	-	-	
hpwh Tier III	-930	121	1407	1395	-1167	153	1761	1790	973
UEF 2.9	-813	121	1536	1512	-1099	156	1916	1941	1055
Energy Star appliances	722		824	784	625		750	776	629

Table 3: Incremental Cost of Multifamily options and Modeled Energy Savings (Zonal Electric only)

Option-Description	Credit Value		**Measure Cost**
1.1 - U-.24 Glaze	0.5		**---**
1.2 - U-.20 Glaze	1		**$ 887**
1.3 - 5% UA reduc	---		**$ 173**
1.4 - 15% UA reduc	1		**$ 947**
1.5 - 22.5% UA reduc	1.5		**$ 1,383**
1.6 - 30% UA reduc	2		**$ 3,779**
2.1 - 2 ACH, HRV	0.5		**$ 851**
2.2 - 1.5 ACH, HRV	1		**$ 2,034**
2.3 - 0.6 ACH, HRV	1.5		**$ 2,627**
3.1a - Furnace	1		**$ 252**
3.2a - 9.5 HSPF HP	---		**---**
3.3a - GSHP	1		**---**
3.4 - DHP	2		**$ 3,060**
3.5a - 11.0 HSPF HP	---		**$ -**
3.6a - DHP (15% elec)	3		**$ 5,245**
4.1 - Deeply buried	0.5		**$ -**
4.2 - HVAC inside	---		**---**
5.1 - DWR	---		**$ 505**
5.2 - 0.80 gas DHW	0.5		**---**
5.3 - 0.91 gas DHW, GSHP	1		**---**
5.4 - Tier III HPWH	2.5		**$ 318**
5.5 - CO2 HPWH	3		**$ 1,275**
6.1 - Solar pV	1		**$ 5,040**
7.1 - ES Appl+ventless Dryer	1.5		**$ 505**

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. LCCA helps decision makers determine which project designs are likely to deliver the lowest total Life Cycle Cost (LCC).

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.

Key Variables	◉ OFM	○ User	Value
Building Life	50	50	50
Real Discount Rate	0.70%	70.00%	0.70%
Standard Maintenance Escalation	1.00%	1.00%	1.00%
General Inflation	2.42%	2.42%	2.42%
Study Period (years)	50	50	50
Fuel Escalation Assumptions Located on Fuel Escalation Page			

Timing Variables	Year(s)	
Base Year (Generally Current Year)	2022	
Additional Construction Years beyond 2022	0	1st Operation Year = 2023

Finance 1st Purchases for ->	☐ aseline	☐ Alt. 1	☐ Alt. 2
Down Payment (%)	20%	20%	20%
Term (Years)	25	25	25
Nominal Interest Rate	3.14%	3.14%	3.14%
Real Interest Rate	0.70%	0.70%	0.70%

Life Cycle Cost Reports

Below are the results of life cycle cost calculations for 5 of the 6 single family prototype buildings, each with a central heat pump, gas furnace, and zonal electric as well as the multifamily prototype with zonal electric heat. Each prototype includes 5 pages of report.

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 impact for a 2018 WSEC compliant structure. Each includes the number of credits that would be required to meet the 2018 WSEC.
Alt 1. This report provides the inputs for the 2021 WSEC proposal. The cost and benefits included reflect the information detailed in this report.
Alt 2. This report is identical to Alt1, except $0.75 per square foot of floor area is added to the cost. This provides a buffer to cover uncertainty about the first cost assessment.
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.

LCCA Results

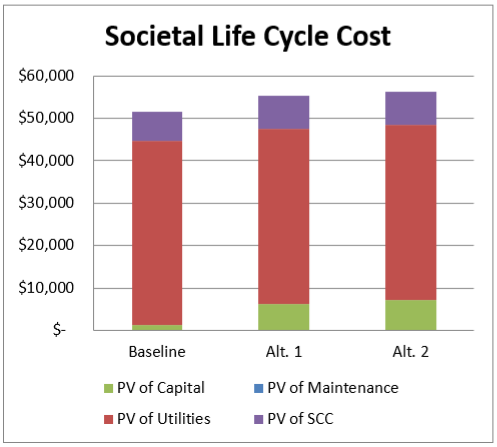
Small Gas Home – Executive Report

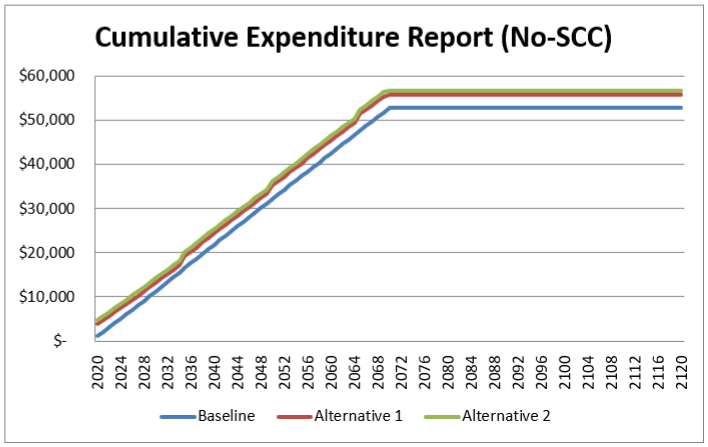
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	1,344
Nominal Discount Rate	3.14%	Useable (Sq.Ft)	1,344
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis	BEST		
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	35.7	36.5	36.5
1st Construction Costs	$ 1,207	$ 3,895	$ 4,903
PV of Capital Costs	$ 1,207	$ 6,156	$ 7,099
PV of Maintenance Costs	$ -	$ -	$ -
PV of Utility Costs	$ 43,408	$ 41,254	$ 41,254
Total Life Cycle Cost (LCC)	**$ 44,615**	**$ 47,410**	**$ 48,354**
Net Present Savings (NPS)	**N/A**	**$ (2,796)**	**$ (3,739)**

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	83	93	93
% CO2e Reduction vs. Baseline	N/A	-13%	-11%
Present Social Cost of Carbon (SCC)	$ 6,828	$ 7,784	$ 7,784
Total LCC with SCC	**$ 51,442**	**$ 55,195**	**$ 56,138**
NPS with SCC	**N/A**	**$ (3,753)**	**$ (4,696)**





LCCA Results

Small Gas Home – Baseline Input

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
Life Cycle Cost Analysis Tool

Baseline Input Page

Open Primary Filter and Click OK to Re-filter

☑ Show All Entered Units (Requires Re-Filter)

Total Building Annual Utility Analysis	$ 957	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 752	$ 205
Annual Utility Consumption Not Entered Below			8,352	195
Sum of Annual Utility Consumption Below		-	-	-
Total Annual Utility Consumption		-	8,352	195
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ 1.05

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)	A
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							$ 1,207	Entries Below for Component Specific Utility Analy			
	A	**Substructure**										
	B	**Shell**										
	C	**Interiors**										
	D	**Services**										
	E	**Equipment & Furnishings**										
	F	**Special Construction & Demolition**										
	G	**Building Sitework**										
x	X9010	Building Envelope										
x	X901001	1.1 - U-.24 Glaze	0.5		50	$991.30				-114	-5	
x	X901002	1.2 - U-.20 Glaze	1		50	$1,453.90				-160	-12	
x	X901003	1.3 - 5% UA reduc	0.5		50	$955.15				-18	0	
x	X901004	1.4 - 15% UA reduc	1		50	$1,925.40				-151	-24	
x	X901005	1.5 - 22.5% UA reduc	2		50	$2,937.75				-303	-33	
x	X901006	1.6 - 30% UA reduc	3		50	$6,819.02				-348	-55	
x	X901007	2.1 - 2 ACH, HRV	1		50	$1,395.16				116	-3	
x	X901008	2.2 - 1.5 ACH, HRV	1.5		50	$3,333.70				-4	-45	
x	X901009	2.3 - 0.6 ACH, HRV	2		50	$4,305.90				-91	-54	
x	X9020	HVAC										
x	X902001	3.1a - Furnace	1		18	$251.59				84	-34	
x	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,387.73						
x	X902003	3.3a - GSHP	1.5		20	$10,900.00						
x	X902004	3.4 - DHP	1.5		18	$1,529.78						
x	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78						
x	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58						
x	X902007	4.1 - Deeply buried	1		50	$0.00						
x	X902008	4.2 - HVAC inside	1.5		50	$327.81				-356	-32	
x	X9030	Hot Water										
x	X903001	5.1 - DWR	0.5		50	$437.08				-76	-23	
x	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32				-18	-27	
x	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56				28	-39	
x	X903004	5.4 - Tier III HPWH	2		15	$955.02						
x	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45						
x	X9040	Other										
x	X904001	6.1 - Solar pV	1		25	$5,040.00						
x	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-722		
x	X9050	2018 Compliant Building Cost		1	50	$1,206.61		$ 1,207				
x	X9060	Added Cost			55	$0.75						
x	X9070	3ACH & Continuous Insulation			50	$1,405.00						
	Z	**Other Project Costs**										
	Z10	**One Time - Upfront Costs**		1	50							
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1							

LCCA Results

Small Gas Home – ALT 1

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 887	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 619	$ 268
Annual Utility Consumption Not Entered Below			7,166	321
Sum of Annual Utility Consumption Below		-	(291)	(66)
Total Annual Utility Consumption		-	6,876	255
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ 1.05

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Analy		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14							$ 3,895			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5		50	$991				-114	-5
	X901002	1.2 - U-.20 Glaze	1		50	$1,454				-160	-12
	X901003	1.3 - 5% UA reduc	0.5	1	50	$955		$ 955		-18	0
	X901004	1.4 - 15% UA reduc	1		50	$1,925				-151	-24
	X901005	1.5 - 22.5% UA reduc	2		50	$2,938				-303	-33
	X901006	1.6 - 30% UA reduc	3		50	$6,819				-348	-55
	X901007	2.1 - 2 ACH, HRV	1		50	$1,395				116	-3
	X901008	2.2 - 1.5 ACH, HRV	1.5		50	$3,334				-4	-45
	X901009	2.3 - 0.6 ACH, HRV	2		50	$4,306				-91	-54
	X9020	HVAC									
	X902001	3.1a - Furnace	1	1	18	$252		$ 252		84	-34
	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,388					
	X902003	3.3a - GSHP	1.5		20	$10,900					
	X902004	3.4 - DHP	1.5		18	$1,530					
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,530					
	X902006	3.6a - DHP (15% elec)	2		18	$5,901					
	X902007	4.1 - Deeply buried	1		50						
	X902008	4.2 - HVAC inside	1.5	1	50	$328		$ 328		-356	-32
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5		50	$437				-76	-23
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640				-18	-27
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,009				28	-39
	X903004	5.4 - Tier III HPWH	2	1	15	$955		$ 955			
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824					
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040					
	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$505				-722	
	X9050	2018 Compliant Building Cost			50	$1,207					
	X9060	Added Cost			55	$0.75					
	X9070	3ACH & Continuous Insulation		1	50	$1,405		$ 1,405			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Small Gas Home – ALT 2

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 887	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 619	$ 268
Annual Utility Consumption Not Entered Below		-	$ 7,166	$ 321
Sum of Annual Utility Consumption Below		-	(291)	(66)
Total Annual Utility Consumption		-	6,876	255
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ 1.05

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Analy		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14							$ 4,903			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5		50	$991				-114	-5
	X901002	1.2 - U-.20 Glaze	1		50	$1,454				-160	-12
	X901003	1.3 - 5% UA reduc	0.5	1	50	$955		$ 955		-18	0
	X901004	1.4 - 15% UA reduc	1		50	$1,925				-151	-24
	X901005	1.5 - 22.5% UA reduc	2		50	$2,938				-303	-33
	X901006	1.6 - 30% UA reduc	3		50	$6,819				-348	-55
	X901007	2.1 - 2 ACH, HRV	1		50	$1,395				116	-3
	X901008	2.2 - 1.5 ACH, HRV	1.5		50	$3,334				-4	-45
	X901009	2.3 - 0.6 ACH, HRV	2		50	$4,306				-91	-54
	X9020	HVAC									
	X902001	3.1a - Furnace	1	1	18	$252		$ 252		84	-34
	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,388					
	X902003	3.3a - GSHP	1.5		20	$10,900					
	X902004	3.4 - DHP	1.5		18	$1,530					
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,530					
	X902006	3.6a - DHP (15% elec)	2		18	$5,901					
	X902007	4.1 - Deeply buried	1		50						
	X902008	4.2 - HVAC inside	1.5	1	50	$328		$ 328		-356	-32
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5		50	$437				-76	-23
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640				-18	-27
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,009				28	-39
	X903004	5.4 - Tier III HPWH	2	1	15	$955		$ 955			
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824					
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040					
	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$505				-722	
	X9050	2018 Compliant Building Cost			50	$1,207					
	X9060	Added Cost		1344	55	$1		$ 1,008			
	X9070	3ACH & Continuous Insulation		1	50	$1,405		$ 1,405			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Small Gas Home – Expenditure Report

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	$ 1,207	$ 3,895	$ 4,903	$ 1,207	$ 3,895	$ 4,903
2021	$ 2,171	$ 4,788	$ 5,796	$ 965	$ 893	$ 893
2022	$ 3,136	$ 5,681	$ 6,689	$ 965	$ 893	$ 893
2023	$ 4,110	$ 6,584	$ 7,592	$ 975	$ 902	$ 902
2024	$ 5,089	$ 7,491	$ 8,499	$ 979	$ 908	$ 908
2025	$ 6,089	$ 8,420	$ 9,428	$ 1,000	$ 929	$ 929
2026	$ 7,109	$ 9,367	$ 10,375	$ 1,020	$ 947	$ 947
2027	$ 8,134	$ 10,319	$ 11,327	$ 1,024	$ 952	$ 952
2028	$ 9,160	$ 11,274	$ 12,282	$ 1,026	$ 955	$ 955
2029	$ 10,188	$ 12,231	$ 13,239	$ 1,028	$ 957	$ 957
2030	$ 11,238	$ 13,217	$ 14,225	$ 1,051	$ 987	$ 987
2031	$ 12,303	$ 14,218	$ 15,226	$ 1,064	$ 1,001	$ 1,001
2032	$ 13,359	$ 15,213	$ 16,221	$ 1,057	$ 995	$ 995
2033	$ 14,420	$ 16,213	$ 17,221	$ 1,061	$ 1,000	$ 1,000
2034	$ 15,485	$ 17,218	$ 18,226	$ 1,065	$ 1,005	$ 1,005
2035	$ 16,550	$ 19,178	$ 20,186	$ 1,065	$ 1,960	$ 1,960
2036	$ 17,609	$ 20,180	$ 21,188	$ 1,059	$ 1,001	$ 1,001
2037	$ 18,668	$ 21,181	$ 22,189	$ 1,059	$ 1,001	$ 1,001
2038	$ 19,721	$ 22,430	$ 23,438	$ 1,053	$ 1,249	$ 1,249
2039	$ 20,776	$ 23,430	$ 24,438	$ 1,055	$ 1,000	$ 1,000
2040	$ 21,823	$ 24,424	$ 25,432	$ 1,047	$ 994	$ 994
2041	$ 22,873	$ 25,421	$ 26,429	$ 1,049	$ 996	$ 996
2042	$ 23,914	$ 26,411	$ 27,419	$ 1,042	$ 990	$ 990
2043	$ 24,958	$ 27,403	$ 28,411	$ 1,044	$ 993	$ 993
2044	$ 25,993	$ 28,389	$ 29,397	$ 1,036	$ 986	$ 986
2045	$ 27,031	$ 29,378	$ 30,386	$ 1,038	$ 989	$ 989
2046	$ 28,071	$ 30,370	$ 31,378	$ 1,040	$ 992	$ 992
2047	$ 29,113	$ 31,364	$ 32,372	$ 1,042	$ 994	$ 994
2048	$ 30,147	$ 32,352	$ 33,360	$ 1,034	$ 988	$ 988
2049	$ 31,183	$ 33,342	$ 34,350	$ 1,036	$ 990	$ 990
2050	$ 32,213	$ 35,284	$ 36,292	$ 1,030	$ 1,942	$ 1,942
2051	$ 33,244	$ 36,271	$ 37,279	$ 1,030	$ 987	$ 987
2052	$ 34,274	$ 37,259	$ 38,267	$ 1,030	$ 988	$ 988
2053	$ 35,304	$ 38,248	$ 39,256	$ 1,030	$ 989	$ 989
2054	$ 36,335	$ 39,238	$ 40,246	$ 1,030	$ 990	$ 990
2055	$ 37,365	$ 40,229	$ 41,237	$ 1,031	$ 991	$ 991
2056	$ 38,396	$ 41,472	$ 42,480	$ 1,031	$ 1,243	$ 1,243
2057	$ 39,427	$ 42,465	$ 43,473	$ 1,031	$ 992	$ 992
2058	$ 40,457	$ 43,458	$ 44,466	$ 1,031	$ 993	$ 993
2059	$ 41,488	$ 44,452	$ 45,460	$ 1,031	$ 994	$ 994
2060	$ 42,519	$ 45,447	$ 46,455	$ 1,031	$ 995	$ 995
2061	$ 43,550	$ 46,443	$ 47,451	$ 1,031	$ 996	$ 996
2062	$ 44,581	$ 47,439	$ 48,447	$ 1,031	$ 997	$ 997
2063	$ 45,612	$ 48,437	$ 49,445	$ 1,031	$ 997	$ 997
2064	$ 46,643	$ 49,435	$ 50,443	$ 1,031	$ 998	$ 998
2065	$ 47,674	$ 51,389	$ 52,397	$ 1,031	$ 1,954	$ 1,954
2066	$ 48,705	$ 52,389	$ 53,397	$ 1,031	$ 1,000	$ 1,000
2067	$ 49,736	$ 53,390	$ 54,398	$ 1,031	$ 1,001	$ 1,001
2068	$ 50,768	$ 54,391	$ 55,399	$ 1,031	$ 1,002	$ 1,002
2069	$ 51,799	$ 55,394	$ 56,402	$ 1,031	$ 1,002	$ 1,002
2070	$ 52,831	$ 55,704	$ 56,621	$ 1,031	$ 311	$ 219

LCCA Results

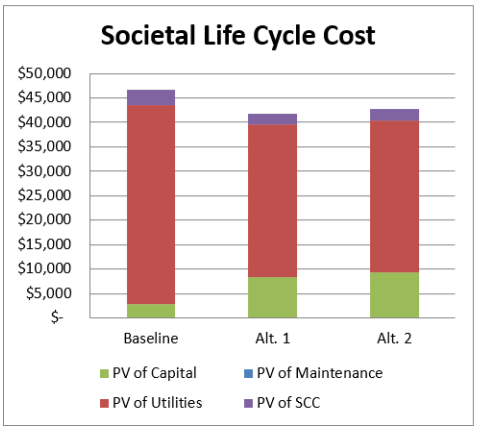
Small Heat Pump Home – Executive Report

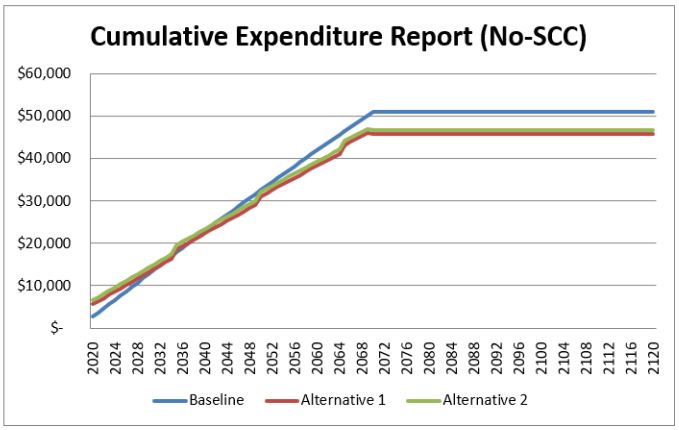
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	1,344
Nominal Discount Rate	3.14%	Useable (Sq.Ft)	1,344
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	27.0	20.6	20.6
1st Construction Costs	$ 2,783	$ 5,642	$ 6,650
PV of Capital Costs	$ 2,783	$ 8,378	$ 9,322
PV of Maintenance Costs	$ -	$ -	$ -
PV of Utility Costs	$ 40,807	$ 31,127	$ 31,127
Total Life Cycle Cost (LCC)	**$ 43,590**	**$ 39,506**	**$ 40,449**
Net Present Savings (NPS)	**N/A**	**$ 4,084**	**$ 3,140**

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	39	30	30
% CO2e Reduction vs. Baseline	N/A	24%	31%
Present Social Cost of Carbon (SCC)	$ 2,998	$ 2,287	$ 2,287
Total LCC with SCC	**$ 46,588**	**$ 41,793**	**$ 42,736**
NPS with SCC	**N/A**	**$ 4,795**	**$ 3,852**





LCCA Results

Small Heat Pump Home – Baseline Input

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
Life Cycle Cost Analysis Tool

Baseline Input Page

Open Primary Filter and Click OK to Re-filter

☑ Show All Entered Units (Requires Re-Filter)

Total Building Annual Utility Analysis	$ 959	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 959	$ -
Annual Utility Consumption Not Entered Below			10,654	
Sum of Annual Utility Consumption Below		-	-	-
Total Annual Utility Consumption		-	10,654	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							$ 2,783	Entries Below for Component Specific Utility Anal		
	A	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
x	X9010	Building Envelope									
x	X901001	1.1 - U-.24 Glaze	0.5		50	$991.30				-1,143	
x	X901002	1.2 - U-.20 Glaze	1		50	$1,453.90				-1,192	
x	X901003	1.3 - 5% UA reduc	0.5		50	$955.15				-1,101	
x	X901004	1.4 - 15% UA reduc	1		50	$1,925.40				-1,243	
x	X901005	1.5 - 22.5% UA reduc	1.5		50	$2,937.75				-1,315	
x	X901006	1.6 - 30% UA reduc	2.5		50	$6,819.02				-1,430	
x	X901007	2.1 - 2 ACH, HRV	0.5		50	$1,395.16				-1,059	
x	X901008	2.2 - 1.5 ACH, HRV	1		50	$3,333.70				-283	
x	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$4,305.90				-414	
x	X9020	HVAC									
x	X902001	3.1a - Furnace	1		18	$251.59					
x	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,387.73				-248	
x	X902003	3.3a - GSHP	1.5		20	$10,900.00					
x	X902004	3.4 - DHP	1.5		18	$1,529.78					
x	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78				-371	
x	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58					
x	X902007	4.1 - Deeply buried	0.5		50	$0.00					
x	X902008	4.2 - HVAC inside	1		50	$327.81				-385	
x	X9030	Hot Water									
x	X903001	5.1 - DWR	0.5		50	$437.08				-260	
x	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32					
x	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56					
x	X903004	5.4 - Tier III HPWH	2		15	$955.02				-1,407	
x	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45				-1,536	
x	X9040	Other									
x	X904001	6.1 - Solar pV	1		25	$5,040.00					
x	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-824	
x	X9050	2018 Compliant Building Cost		1	50	$2,782.89		$ 2,783			
x	X9060	Added Cost			55	$0.75					
x	X9070	3ACH & Continuous Insulation			50	$1,405.00					
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Small Heat Pump Home – ALT 1

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 731	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 731	
Annual Utility Consumption Not Entered Below			10,626	
Sum of Annual Utility Consumption Below		-	(2,499)	-
Total Annual Utility Consumption		-	8,127	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Analy		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14							$ 5,642			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5		50	$991.30				-1143	
	X901002	1.2 - U-.20 Glaze	1	1	50	$1,453.90		$ 1,454		-1192	
	X901003	1.3 - 5% UA reduc	0.5		50	$955.15				-1101	
	X901004	1.4 - 15% UA reduc	1		50	$1,925.40				-1243	
	X901005	1.5 - 22.5% UA reduc	2		50	$2,937.75				-1315	
	X901006	1.6 - 30% UA reduc	3		50	$6,819.02				-1430	
	X901007	2.1 - 2 ACH, HRV	1	1	50	$1,395.16		$ 1,395		-1059	
	X901008	2.2 - 1.5 ACH, HRV	1.5		50	$3,333.70				-283	
	X901009	2.3 - 0.6 ACH, HRV	2		50	$4,305.90				-414	
	X9020	HVAC									
	X902001	3.1a - Furnace	1		18	$251.59					
	X902002	3.2a - 9.5 HSPF HP	0.5	1	15	$1,387.73		$ 1,388		-248	
	X902003	3.3a - GSHP	1.5		20	$10,900.00					
	X902004	3.4 - DHP	1.5		18	$1,529.78					
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78				-371	
	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58					
	X902007	4.1 - Deeply buried	1		50						
	X902008	4.2 - HVAC inside	1.5		50	$327.81				-385	
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5		50	$437.08				-260	
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32					
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56					
	X903004	5.4 - Tier III HPWH	2		15	$955.02				-1407	
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45				-1536	
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040.00					
	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-824	
	X9050	2018 Compliant Building Cost			50	$2,782.89					
	X9060	Added Cost			55	$0.75					
	X9070	3ACH & Continuous Insulation		1	50	$1,405.00		$ 1,405			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Small Heat Pump Home – ALT 2

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 731	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 731	$ -
Annual Utility Consumption Not Entered Below		-	$ 10,626	$ -
Sum of Annual Utility Consumption Below		-	(2,499)	-
Total Annual Utility Consumption		-	8,127	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	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							$ 6,650			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5		50	$991.30				-1143	
	X901002	1.2 - U-.20 Glaze	1	1	50	$1,453.90		$ 1,454		-1192	
	X901003	1.3 - 5% UA reduc	0.5		50	$955.15				-1101	
	X901004	1.4 - 15% UA reduc	1		50	$1,925.40				-1243	
	X901005	1.5 - 22.5% UA reduc	1.5		50	$2,937.75				-1315	
	X901006	1.6 - 30% UA reduc	2.5		50	$6,819.02				-1430	
	X901007	2.1 - 2 ACH, HRV	0.5	1	50	$1,395.16		$ 1,395		-1059	
	X901008	2.2 - 1.5 ACH, HRV	1		50	$3,333.70				-283	
	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$4,305.90				-414	
	X9020	HVAC									
	X902001	3.1a - Furnace	1		18	$251.59					
	X902002	3.2a - 9.5 HSPF HP	0.5	1	15	$1,387.73		$ 1,388		-248	
	X902003	3.3a - GSHP	1.5		20	$10,900.00					
	X902004	3.4 - DHP	1.5		18	$1,529.78					
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78				-371	
	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58					
	X902007	4.1 - Deeply buried	0.5		50						
	X902008	4.2 - HVAC inside	1		50	$327.81				-385	
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5		50	$437.08				-260	
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32					
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56					
	X903004	5.4 - Tier III HPWH	2		15	$955.02				-1407	
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45				-1536	
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040.00					
	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-824	
	X9050	2018 Compliant Building Cost			50	$2,782.89					
	X9060	Added Cost		1344	55	$0.75		$ 1,008			
	X9070	3ACH & Continuous Insulation		1	50	$1,405.00		$ 1,405			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Small Heat Pump Home – Expenditure Report

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	$ 2,783	$ 5,642	$ 6,650	$ 2,783	$ 5,642	$ 6,650
2021	$ 3,752	$ 6,381	$ 7,389	$ 969	$ 739	$ 739
2022	$ 4,721	$ 7,120	$ 8,128	$ 969	$ 739	$ 739
2023	$ 5,699	$ 7,866	$ 8,874	$ 979	$ 747	$ 747
2024	$ 6,678	$ 8,613	$ 9,621	$ 979	$ 747	$ 747
2025	$ 7,677	$ 9,375	$ 10,383	$ 999	$ 762	$ 762
2026	$ 8,696	$ 10,152	$ 11,160	$ 1,019	$ 777	$ 777
2027	$ 9,714	$ 10,929	$ 11,937	$ 1,019	$ 777	$ 777
2028	$ 10,733	$ 11,706	$ 12,714	$ 1,019	$ 777	$ 777
2029	$ 11,752	$ 12,483	$ 13,491	$ 1,019	$ 777	$ 777
2030	$ 12,771	$ 13,260	$ 14,268	$ 1,019	$ 777	$ 777
2031	$ 13,799	$ 14,045	$ 15,053	$ 1,029	$ 785	$ 785
2032	$ 14,818	$ 14,822	$ 15,830	$ 1,019	$ 777	$ 777
2033	$ 15,837	$ 15,599	$ 16,607	$ 1,019	$ 777	$ 777
2034	$ 16,856	$ 16,376	$ 17,384	$ 1,019	$ 777	$ 777
2035	$ 17,874	$ 18,541	$ 19,549	$ 1,019	$ 2,165	$ 2,165
2036	$ 18,883	$ 19,311	$ 20,319	$ 1,009	$ 769	$ 769
2037	$ 19,892	$ 20,080	$ 21,088	$ 1,009	$ 769	$ 769
2038	$ 20,891	$ 20,842	$ 21,850	$ 999	$ 762	$ 762
2039	$ 21,890	$ 21,604	$ 22,612	$ 999	$ 762	$ 762
2040	$ 22,878	$ 22,358	$ 23,366	$ 989	$ 754	$ 754
2041	$ 23,867	$ 23,113	$ 24,121	$ 989	$ 754	$ 754
2042	$ 24,846	$ 23,859	$ 24,867	$ 979	$ 747	$ 747
2043	$ 25,825	$ 24,606	$ 25,614	$ 979	$ 747	$ 747
2044	$ 26,794	$ 25,345	$ 26,353	$ 969	$ 739	$ 739
2045	$ 27,762	$ 26,084	$ 27,092	$ 969	$ 739	$ 739
2046	$ 28,731	$ 26,823	$ 27,831	$ 969	$ 739	$ 739
2047	$ 29,700	$ 27,562	$ 28,570	$ 969	$ 739	$ 739
2048	$ 30,659	$ 28,293	$ 29,301	$ 959	$ 731	$ 731
2049	$ 31,618	$ 29,025	$ 30,033	$ 959	$ 731	$ 731
2050	$ 32,566	$ 31,136	$ 32,144	$ 949	$ 2,112	$ 2,112
2051	$ 33,513	$ 31,858	$ 32,866	$ 947	$ 722	$ 722
2052	$ 34,458	$ 32,579	$ 33,587	$ 945	$ 721	$ 721
2053	$ 35,401	$ 33,298	$ 34,306	$ 943	$ 719	$ 719
2054	$ 36,342	$ 34,016	$ 35,024	$ 941	$ 718	$ 718
2055	$ 37,281	$ 34,732	$ 35,740	$ 939	$ 716	$ 716
2056	$ 38,218	$ 35,447	$ 36,455	$ 937	$ 715	$ 715
2057	$ 39,152	$ 36,160	$ 37,168	$ 935	$ 713	$ 713
2058	$ 40,085	$ 36,871	$ 37,879	$ 933	$ 712	$ 712
2059	$ 41,016	$ 37,582	$ 38,590	$ 931	$ 710	$ 710
2060	$ 41,945	$ 38,290	$ 39,298	$ 929	$ 709	$ 709
2061	$ 42,872	$ 38,997	$ 40,005	$ 927	$ 707	$ 707
2062	$ 43,797	$ 39,703	$ 40,711	$ 925	$ 705	$ 705
2063	$ 44,720	$ 40,407	$ 41,415	$ 923	$ 704	$ 704
2064	$ 45,640	$ 41,109	$ 42,117	$ 921	$ 702	$ 702
2065	$ 46,559	$ 43,198	$ 44,206	$ 919	$ 2,089	$ 2,089
2066	$ 47,476	$ 43,897	$ 44,905	$ 917	$ 699	$ 699
2067	$ 48,391	$ 44,595	$ 45,603	$ 915	$ 698	$ 698
2068	$ 49,304	$ 45,291	$ 46,299	$ 913	$ 696	$ 696
2069	$ 50,215	$ 45,986	$ 46,994	$ 911	$ 695	$ 695
2070	$ 51,124	$ 45,754	$ 46,671	$ 909	$ (232)	$ (323)

LCCA Results

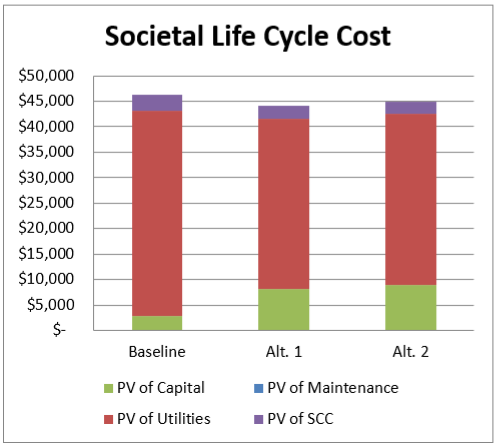
Small Zonal Electric Home – Executive Report

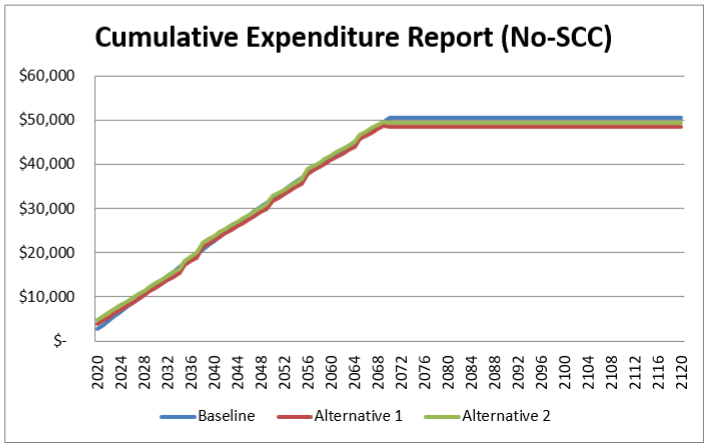
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	1,344
Nominal Discount Rate	3.14%	Useable (Sq.Ft)	1,344
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	26.8	22.2	22.2
1st Construction Costs	$ 2,783	$ 3,890	$ 4,898
PV of Capital Costs	$ 2,783	$ 8,073	$ 9,016
PV of Maintenance Costs	$ -	$ -	$ -
PV of Utility Costs	$ 40,425	$ 33,490	$ 33,490
Total Life Cycle Cost (LCC)	**$ 43,208**	**$ 41,563**	**$ 42,506**
Net Present Savings (NPS)	**N/A**	**$ 1,645**	**$ 702**

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	39	32	32
% CO2e Reduction vs. Baseline	N/A	17%	21%
Present Social Cost of Carbon (SCC)	$ 2,970	$ 2,461	$ 2,461
Total LCC with SCC	**$ 46,178**	**$ 44,023**	**$ 44,967**
NPS with SCC	**N/A**	**$ 2,155**	**$ 1,212**





LCCA Results

Small Zonal Electric Home – Baseline Input

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
Life Cycle Cost Analysis Tool

Baseline Input Page

Open Primary Filter and Click OK to Re-filter

☑ Show All Entered Units (Requires Re-Filter)

Total Building Annual Utility Analysis	$ 950	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 950	$ -
Annual Utility Consumption Not Entered Below			10,554	
Sum of Annual Utility Consumption Below		-	-	-
Total Annual Utility Consumption		-	10,554	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							$ 2,783	Entries Below for Component Specific Utility Anal		
	A	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
x	X9010	Building Envelope									
x	X901001	1.1 - U-.24 Glaze	0.5		50	$991.30				-173	
x	X901002	1.2 - U-.20 Glaze	1		50	$1,453.90				-291	
x	X901003	1.3 - 5% UA reduc	0.5		50	$955.15				-94	
x	X901004	1.4 - 15% UA reduc	1		50	$1,925.40				-406	
x	X901005	1.5 - 22.5% UA reduc	1.5		50	$2,937.75				-581	
x	X901006	1.6 - 30% UA reduc	2.5		50	$6,819.02				-821	
x	X901007	2.1 - 2 ACH, HRV	0.5		50	$1,395.16				10	
x	X901008	2.2 - 1.5 ACH, HRV	1		50	$3,333.70				-344	
x	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$4,305.90				-487	
x	X9020	HVAC									
x	X902001	3.1a - Furnace	1		18	$251.59					
x	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,387.73					
x	X902003	3.3a - GSHP	1.5		20	$10,900.00					
x	X902004	3.4 - DHP	1.5		18	$1,529.78				-689	
x	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78					
x	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58				-1,154	
x	X902007	4.1 - Deeply buried	0.5		50	$0.00					
x	X902008	4.2 - HVAC inside	1		50	$327.81					
x	X9030	Hot Water									
x	X903001	5.1 - DWR	0.5		50	$437.08				-247	
x	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32					
x	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56					
x	X903004	5.4 - Tier III HPWH	2		15	$955.02				-1,395	
x	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45				-1,512	
x	X9040	Other									
x	X904001	6.1 - Solar pV	1		25	$5,040.00					
x	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-784	
x	X9050	2018 Compliant Building Cost		1	50	$2,782.89		$ 2,783			
x	X9060	Added Cost			55	$0.75					
x	X9070	3ACH & Continuous Insulation			50	$1,405.00					
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Small Zonal Electric Home – ALT 1

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 787	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 787	
Annual Utility Consumption Not Entered Below			10,827	
Sum of Annual Utility Consumption Below		-	(2,083)	-
Total Annual Utility Consumption		-	8,743	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Analy		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14							$ 3,890			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5		50	$991				-173	
	X901002	1.2 - U-.20 Glaze	1		50	$1,454				-291	
	X901003	1.3 - 5% UA reduc	0.5		50	$955				-94	
	X901004	1.4 - 15% UA reduc	1		50	$1,925				-406	
	X901005	1.5 - 22.5% UA reduc	2		50	$2,938				-581	
	X901006	1.6 - 30% UA reduc	3		50	$6,819				-821	
	X901007	2.1 - 2 ACH, HRV	1		50	$1,395				10	
	X901008	2.2 - 1.5 ACH, HRV	1.5		50	$3,334				-344	
	X901009	2.3 - 0.6 ACH, HRV	2		50	$4,306				-487	
	X9020	HVAC									
	X902001	3.1a - Furnace	1		18	$252					
	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,388					
	X902003	3.3a - GSHP	1.5		20	$10,900					
	X902004	3.4 - DHP	1.5	1	18	$1,530		$ 1,530		-689	
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,530					
	X902006	3.6a - DHP (15% elec)	2		18	$5,901				-1154	
	X902007	4.1 - Deeply buried	1		50						
	X902008	4.2 - HVAC inside	1.5		50	$328					
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5		50	$437				-247	
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640					
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,009					
	X903004	5.4 - Tier III HPWH	2	1	15	$955		$ 955		-1395	
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824				-1512	
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040					
	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$505				-784	
	X9050	2018 Compliant Building Cost			50	$2,783					
	X9060	Added Cost			55	$1					
	X9070	3ACH & Continuous Insulation		1	50	$1,405		$ 1,405			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Small Zonal Electric Home – ALT 2

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 787	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 787	
Annual Utility Consumption Not Entered Below		-	$ 10,827	
Sum of Annual Utility Consumption Below		-	(2,083)	-
Total Annual Utility Consumption		-	8,743	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Analy		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14							$ 4,898			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5		50	$991				-173	
	X901002	1.2 - U-.20 Glaze	1		50	$1,454				-291	
	X901003	1.3 - 5% UA reduc	0.5		50	$955				-94	
	X901004	1.4 - 15% UA reduc	1		50	$1,925				-406	
	X901005	1.5 - 22.5% UA reduc	1.5		50	$2,938				-581	
	X901006	1.6 - 30% UA reduc	2.5		50	$6,819				-821	
	X901007	2.1 - 2 ACH, HRV	0.5		50	$1,395				10	
	X901008	2.2 - 1.5 ACH, HRV	1		50	$3,334				-344	
	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$4,306				-487	
	X9020	HVAC									
	X902001	3.1a - Furnace	1		18	$252					
	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,388					
	X902003	3.3a - GSHP	1.5		20	$10,900					
	X902004	3.4 - DHP	1.5	1	18	$1,530		$ 1,530		-689	
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,530					
	X902006	3.6a - DHP (15% elec)	2		18	$5,901				-1154	
	X902007	4.1 - Deeply buried	0.5		50						
	X902008	4.2 - HVAC inside	1		50	$328					
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5		50	$437				-247	
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640					
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,009					
	X903004	5.4 - Tier III HPWH	2	1	15	$955		$ 955		-1395	
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824				-1512	
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040					
	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$505				-784	
	X9050	2018 Compliant Building Cost			50	$2,783					
	X9060	Added Cost		1344	55	$1		$ 1,008			
	X9070	3ACH & Continuous Insulation		1	50	$1,405		$ 1,405			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Small Zonal Electric Home– Expenditure Report

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	$ 2,783	$ 3,890	$ 4,898	$ 2,783	$ 3,890	$ 4,898
2021	$ 3,743	$ 4,685	$ 5,693	$ 960	$ 795	$ 795
2022	$ 4,702	$ 5,480	$ 6,488	$ 960	$ 795	$ 795
2023	$ 5,672	$ 6,283	$ 7,291	$ 970	$ 803	$ 803
2024	$ 6,642	$ 7,087	$ 8,095	$ 970	$ 803	$ 803
2025	$ 7,631	$ 7,906	$ 8,914	$ 989	$ 820	$ 820
2026	$ 8,640	$ 8,742	$ 9,750	$ 1,009	$ 836	$ 836
2027	$ 9,650	$ 9,579	$ 10,587	$ 1,009	$ 836	$ 836
2028	$ 10,659	$ 10,415	$ 11,423	$ 1,009	$ 836	$ 836
2029	$ 11,668	$ 11,251	$ 12,259	$ 1,009	$ 836	$ 836
2030	$ 12,677	$ 12,087	$ 13,095	$ 1,009	$ 836	$ 836
2031	$ 13,696	$ 12,931	$ 13,939	$ 1,019	$ 844	$ 844
2032	$ 14,706	$ 13,767	$ 14,775	$ 1,009	$ 836	$ 836
2033	$ 15,715	$ 14,603	$ 15,611	$ 1,009	$ 836	$ 836
2034	$ 16,724	$ 15,439	$ 16,447	$ 1,009	$ 836	$ 836
2035	$ 17,733	$ 17,230	$ 18,238	$ 1,009	$ 1,791	$ 1,791
2036	$ 18,733	$ 18,058	$ 19,066	$ 999	$ 828	$ 828
2037	$ 19,732	$ 18,886	$ 19,894	$ 999	$ 828	$ 828
2038	$ 20,721	$ 21,236	$ 22,244	$ 989	$ 2,349	$ 2,349
2039	$ 21,711	$ 22,055	$ 23,063	$ 989	$ 820	$ 820
2040	$ 22,690	$ 22,867	$ 23,875	$ 980	$ 812	$ 812
2041	$ 23,670	$ 23,678	$ 24,686	$ 980	$ 812	$ 812
2042	$ 24,640	$ 24,482	$ 25,490	$ 970	$ 803	$ 803
2043	$ 25,609	$ 25,285	$ 26,293	$ 970	$ 803	$ 803
2044	$ 26,569	$ 26,080	$ 27,088	$ 960	$ 795	$ 795
2045	$ 27,529	$ 26,875	$ 27,883	$ 960	$ 795	$ 795
2046	$ 28,489	$ 27,670	$ 28,678	$ 960	$ 795	$ 795
2047	$ 29,448	$ 28,465	$ 29,473	$ 960	$ 795	$ 795
2048	$ 30,398	$ 29,252	$ 30,260	$ 950	$ 787	$ 787
2049	$ 31,348	$ 30,039	$ 31,047	$ 950	$ 787	$ 787
2050	$ 32,288	$ 31,773	$ 32,781	$ 940	$ 1,734	$ 1,734
2051	$ 33,226	$ 32,550	$ 33,558	$ 938	$ 777	$ 777
2052	$ 34,162	$ 33,326	$ 34,334	$ 936	$ 775	$ 775
2053	$ 35,096	$ 34,099	$ 35,107	$ 934	$ 774	$ 774
2054	$ 36,028	$ 34,872	$ 35,880	$ 932	$ 772	$ 772
2055	$ 36,958	$ 35,642	$ 36,650	$ 930	$ 771	$ 771
2056	$ 37,886	$ 37,941	$ 38,949	$ 928	$ 2,299	$ 2,299
2057	$ 38,812	$ 38,708	$ 39,716	$ 926	$ 767	$ 767
2058	$ 39,737	$ 39,474	$ 40,482	$ 924	$ 766	$ 766
2059	$ 40,659	$ 40,237	$ 41,245	$ 922	$ 764	$ 764
2060	$ 41,579	$ 41,000	$ 42,008	$ 920	$ 762	$ 762
2061	$ 42,497	$ 41,760	$ 42,768	$ 918	$ 761	$ 761
2062	$ 43,413	$ 42,520	$ 43,528	$ 916	$ 759	$ 759
2063	$ 44,328	$ 43,277	$ 44,285	$ 914	$ 757	$ 757
2064	$ 45,240	$ 44,033	$ 45,041	$ 912	$ 756	$ 756
2065	$ 46,150	$ 45,742	$ 46,750	$ 910	$ 1,709	$ 1,709
2066	$ 47,059	$ 46,494	$ 47,502	$ 908	$ 752	$ 752
2067	$ 47,965	$ 47,245	$ 48,253	$ 906	$ 751	$ 751
2068	$ 48,869	$ 47,994	$ 49,002	$ 904	$ 749	$ 749
2069	$ 49,772	$ 48,742	$ 49,750	$ 902	$ 748	$ 748
2070	$ 50,672	$ 48,511	$ 49,428	$ 900	$ (231)	$ (322)

LCCA Results

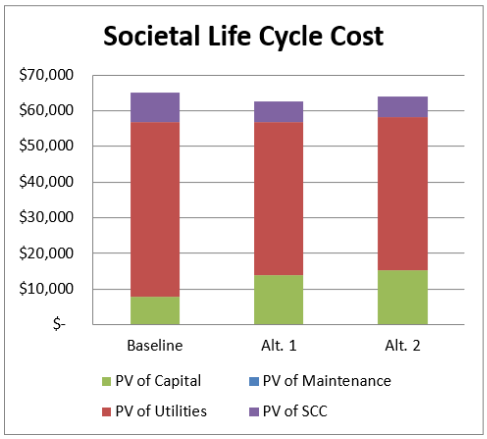
Medium Gas Home – Executive Report

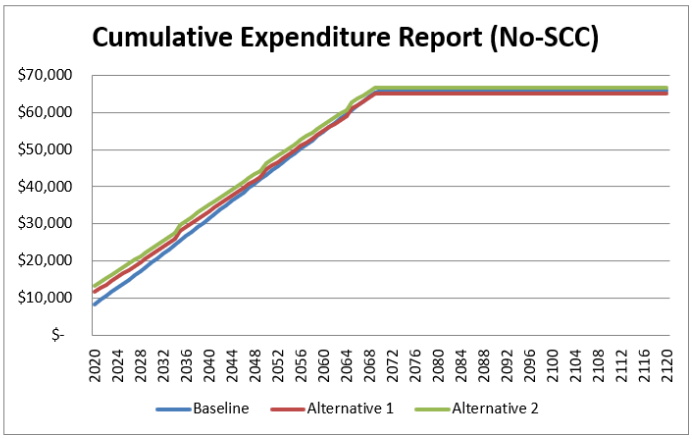
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	2,200
Nominal Discount Rate	3.14%	Useable (Sq.Ft)	2,200
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	25.3	20.5	20.5
1st Construction Costs	$ 8,340	$ 11,666	$ 13,316
PV of Capital Costs	$ 7,805	$ 13,763	$ 15,308
PV of Maintenance Costs	$ -	$ -	$ -
PV of Utility Costs	$ 48,921	$ 42,905	$ 42,905
Total Life Cycle Cost (LCC)	**$ 56,726**	**$ 56,668**	**$ 58,213**
Net Present Savings (NPS)	**N/A**	**$ 58**	**$ (1,486)**

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	100	72	72
% CO2e Reduction vs. Baseline	N/A	28%	39%
Present Social Cost of Carbon (SCC)	$ 8,249	$ 5,859	$ 5,859
Total LCC with SCC	**$ 64,976**	**$ 62,527**	**$ 64,072**
NPS with SCC	**N/A**	**$ 2,448**	**$ 904**





LCCA Results

Medium Gas Home – Baseline Input

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
Life Cycle Cost Analysis Tool

Baseline Input Page

Open Primary Filter and Click OK to Re-filter

☑ Show All Entered Units (Requires Re-Filter)

Total Building Annual Utility Analysis	$ 1,069	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 806	$ 263
Annual Utility Consumption Not Entered Below			8,958	250
Sum of Annual Utility Consumption Below		-	-	-
Total Annual Utility Consumption		-	8,958	250
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ 1.05

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							$ 8,340	Entries Below for Component Specific Utility Analy		
	A	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
x	X9010	Building Envelope									
x	X901001	1.1 - U-.24 Glaze	0.5		50	$1,789.84				-292	-5
x	X901002	1.2 - U-.20 Glaze	1		50	$2,625.10				-369	-18
x	X901003	1.3 - 5% UA reduc	0.5		50	$1,270.23				70	2
x	X901004	1.4 - 15% UA reduc	1		50	$3,255.06				-288	-28
x	X901005	1.5 - 22.5% UA reduc	2		50	$4,849.92				-577	-41
x	X901006	1.6 - 30% UA reduc	3		50	$12,094.52				-887	-69
x	X901007	2.1 - 2 ACH, HRV	1		50	$2,283.74				271	-19
x	X901008	2.2 - 1.5 ACH, HRV	1.5		50	$5,456.94				-87	-67
x	X901009	2.3 - 0.6 ACH, HRV	2		50	$7,048.35				-530	-78
x	X9020	HVAC									
x	X902001	3.1a - Furnace	1		18	$251.59				-55	-51
x	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,387.73					
x	X902003	3.3a - GSHP	1.5		20	$10,900.00					
x	X902004	3.4 - DHP	1.5		18	$1,529.78					
x	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78					
x	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58					
x	X902007	4.1 - Deeply buried	1		50	$0.00					
x	X902008	4.2 - HVAC inside	1.5		50	$327.81				-781	-38
x	X9030	Hot Water									
x	X903001	5.1 - DWR	0.5		50	$437.08				55	-33
x	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32				-3	-34
x	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56				-12	-48
x	X903004	5.4 - Tier III HPWH	2		15	$955.02				-1,761	
x	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45				-1,916	
x	X9040	Other									
x	X904001	6.1 - Solar pV	1		25	$5,040.00					
x	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-625	
x	X9050	2018 Compliant Building Cost		1	55	$8,340.00		$ 8,340			
x	X9060	Added Cost			55	$0.75					
x	X906001	3ACH, continuous ins			55	$2,561.00					
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Medium Gas Home – ALT 1

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 961	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 809	$ 153
Annual Utility Consumption Not Entered Below			8,903	481
Sum of Annual Utility Consumption Below		-	81	(336)
Total Annual Utility Consumption		-	8,984	145
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ 1.05

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Analy		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14							$ 11,666			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5		50	$1,789.84				-292	-5
	X901002	1.2 - U-.20 Glaze	1		50	$2,625.10				-369	-18
	X901003	1.3 - 5% UA reduc	0.5		50	$1,270.23				70	2
	X901004	1.4 - 15% UA reduc	1		50	$3,255.06				-288	-28
	X901005	1.5 - 22.5% UA reduc	2	1	50	$4,849.92		$ 4,850		-577	-41
	X901006	1.6 - 30% UA reduc	3		50	$12,094.52				-887	-69
	X901007	2.1 - 2 ACH, HRV	1	1	50	$2,283.74		$ 2,284		271	-19
	X901008	2.2 - 1.5 ACH, HRV	1.5		50	$5,456.94				-87	-67
	X901009	2.3 - 0.6 ACH, HRV	2		50	$7,048.35				-530	-78
	X9020	HVAC									
	X902001	3.1a - Furnace	1	1	18	$251.59		$ 252		-55	-51
	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,387.73					
	X902003	3.3a - GSHP	1.5		20	$10,900.00					
	X902004	3.4 - DHP	1.5		18	$1,529.78					
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78					
	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58					
	X902007	4.1 - Deeply buried	1		50						
	X902008	4.2 - HVAC inside	1.5	1	50	$327.81		$ 328		-781	-38
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5	1	50	$437.08		$ 437		55	-33
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32				-3	-34
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56				-12	-48
	X903004	5.4 - Tier III HPWH	2	1	15	$955.02		$ 955		1167	-153
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45				1099	-156
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040.00					
	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-625	
	X9050	2018 Compliant Building Cost			55	$8,340.00					
	X9060	Added Cost		1	55	$2,561.00		$ 2,561			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Medium Gas Home – ALT 2

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 961	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 809	$ 153
Annual Utility Consumption Not Entered Below		-	8,903	481
Sum of Annual Utility Consumption Below		-	81	(336)
Total Annual Utility Consumption		-	8,984	145
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ 1.05

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Analy		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14							$ 13,316			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5		50	$1,789.84				-292	-5
	X901002	1.2 - U-.20 Glaze	1		50	$2,625.10				-369	-18
	X901003	1.3 - 5% UA reduc	0.5		50	$1,270.23				70	2
	X901004	1.4 - 15% UA reduc	1		50	$3,255.06				-288	-28
	X901005	1.5 - 22.5% UA reduc	2	1	50	$4,849.92		$ 4,850		-577	-41
	X901006	1.6 - 30% UA reduc	3		50	$12,094.52				-887	-69
	X901007	2.1 - 2 ACH, HRV	1	1	50	$2,283.74		$ 2,284		271	-19
	X901008	2.2 - 1.5 ACH, HRV	1.5		50	$5,456.94				-87	-67
	X901009	2.3 - 0.6 ACH, HRV	2		50	$7,048.35				-530	-78
	X9020	HVAC									
	X902001	3.1a - Furnace	1	1	18	$251.59		$ 252		-55	-51
	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,387.73					
	X902003	3.3a - GSHP	1.5		20	$10,900.00					
	X902004	3.4 - DHP	1.5		18	$1,529.78					
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78					
	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58					
	X902007	4.1 - Deeply buried	1		50						
	X902008	4.2 - HVAC inside	1.5	1	50	$327.81		$ 328		-781	-38
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5	1	50	$437.08		$ 437		55	-33
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32				-3	-34
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56				-12	-48
	X903004	5.4 - Tier III HPWH	2	1	15	$955.02		$ 955		1167	-153
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45				1099	-156
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040.00					
	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-625.255731	
	X9050	2018 Compliant Building Cost			55	$8,340.00					
	X9060	Added Cost		2200	55	$0.75		$ 1,650			
	X906001	3ACH, continuous ins		1	55	$2,561.00		$ 2,561			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Medium Gas Home – Expenditure Report

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	$ 8,340	$ 11,666	$ 13,316	$ 8,340	$ 11,666	$ 13,316
2021	$ 9,417	$ 12,636	$ 14,286	$ 1,077	$ 970	$ 970
2022	$ 10,494	$ 13,605	$ 15,255	$ 1,077	$ 970	$ 970
2023	$ 11,582	$ 14,585	$ 16,235	$ 1,088	$ 980	$ 980
2024	$ 12,676	$ 15,567	$ 17,217	$ 1,093	$ 983	$ 983
2025	$ 13,794	$ 16,571	$ 18,221	$ 1,118	$ 1,004	$ 1,004
2026	$ 14,933	$ 17,595	$ 19,245	$ 1,140	$ 1,024	$ 1,024
2027	$ 16,079	$ 18,622	$ 20,272	$ 1,145	$ 1,027	$ 1,027
2028	$ 17,226	$ 19,650	$ 21,300	$ 1,148	$ 1,028	$ 1,028
2029	$ 18,377	$ 20,680	$ 22,330	$ 1,150	$ 1,030	$ 1,030
2030	$ 19,555	$ 21,727	$ 23,377	$ 1,179	$ 1,046	$ 1,046
2031	$ 20,751	$ 22,786	$ 24,436	$ 1,195	$ 1,059	$ 1,059
2032	$ 21,937	$ 23,837	$ 25,487	$ 1,187	$ 1,051	$ 1,051
2033	$ 23,129	$ 24,891	$ 26,541	$ 1,192	$ 1,054	$ 1,054
2034	$ 24,326	$ 25,948	$ 27,598	$ 1,197	$ 1,057	$ 1,057
2035	$ 25,523	$ 27,960	$ 29,610	$ 1,197	$ 2,012	$ 2,012
2036	$ 26,715	$ 29,010	$ 30,660	$ 1,191	$ 1,050	$ 1,050
2037	$ 27,906	$ 30,060	$ 31,710	$ 1,191	$ 1,050	$ 1,050
2038	$ 29,091	$ 31,355	$ 33,005	$ 1,185	$ 1,295	$ 1,295
2039	$ 30,279	$ 32,400	$ 34,050	$ 1,188	$ 1,045	$ 1,045
2040	$ 31,459	$ 33,436	$ 35,086	$ 1,180	$ 1,036	$ 1,036
2041	$ 32,641	$ 34,474	$ 36,124	$ 1,182	$ 1,038	$ 1,038
2042	$ 33,815	$ 35,503	$ 37,153	$ 1,174	$ 1,029	$ 1,029
2043	$ 34,992	$ 36,534	$ 38,184	$ 1,176	$ 1,031	$ 1,031
2044	$ 36,160	$ 37,557	$ 39,207	$ 1,168	$ 1,022	$ 1,022
2045	$ 37,330	$ 38,581	$ 40,231	$ 1,171	$ 1,024	$ 1,024
2046	$ 38,504	$ 39,606	$ 41,256	$ 1,173	$ 1,026	$ 1,026
2047	$ 39,680	$ 40,633	$ 42,283	$ 1,176	$ 1,027	$ 1,027
2048	$ 40,847	$ 41,652	$ 43,302	$ 1,167	$ 1,019	$ 1,019
2049	$ 42,017	$ 42,672	$ 44,322	$ 1,170	$ 1,020	$ 1,020
2050	$ 43,181	$ 44,640	$ 46,290	$ 1,164	$ 1,968	$ 1,968
2051	$ 44,346	$ 45,653	$ 47,303	$ 1,165	$ 1,013	$ 1,013
2052	$ 45,511	$ 46,665	$ 48,315	$ 1,165	$ 1,012	$ 1,012
2053	$ 46,677	$ 47,677	$ 49,327	$ 1,165	$ 1,012	$ 1,012
2054	$ 47,843	$ 48,688	$ 50,338	$ 1,166	$ 1,011	$ 1,011
2055	$ 49,009	$ 49,699	$ 51,349	$ 1,166	$ 1,011	$ 1,011
2056	$ 50,176	$ 50,961	$ 52,611	$ 1,167	$ 1,262	$ 1,262
2057	$ 51,343	$ 51,971	$ 53,621	$ 1,167	$ 1,010	$ 1,010
2058	$ 52,510	$ 52,980	$ 54,630	$ 1,167	$ 1,009	$ 1,009
2059	$ 53,678	$ 53,989	$ 55,639	$ 1,168	$ 1,009	$ 1,009
2060	$ 54,846	$ 54,998	$ 56,648	$ 1,168	$ 1,008	$ 1,008
2061	$ 56,015	$ 56,006	$ 57,656	$ 1,169	$ 1,008	$ 1,008
2062	$ 57,184	$ 57,013	$ 58,663	$ 1,169	$ 1,007	$ 1,007
2063	$ 58,354	$ 58,020	$ 59,670	$ 1,169	$ 1,007	$ 1,007
2064	$ 59,523	$ 59,027	$ 60,677	$ 1,170	$ 1,007	$ 1,007
2065	$ 60,694	$ 60,988	$ 62,638	$ 1,170	$ 1,961	$ 1,961
2066	$ 61,864	$ 61,993	$ 63,643	$ 1,171	$ 1,006	$ 1,006
2067	$ 63,035	$ 62,998	$ 64,648	$ 1,171	$ 1,005	$ 1,005
2068	$ 64,207	$ 64,003	$ 65,653	$ 1,171	$ 1,005	$ 1,005
2069	$ 65,379	$ 65,007	$ 66,657	$ 1,172	$ 1,004	$ 1,004
2070	$ 65,793	$ 65,085	$ 66,585	$ 414	$ 78	$ (72)

LCCA Results

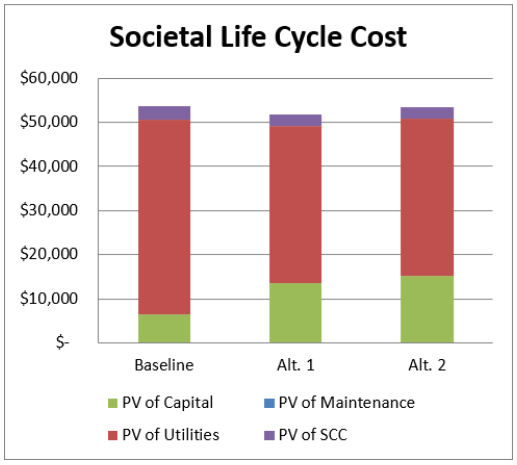
Medium Heat Pump Home – Executive Report

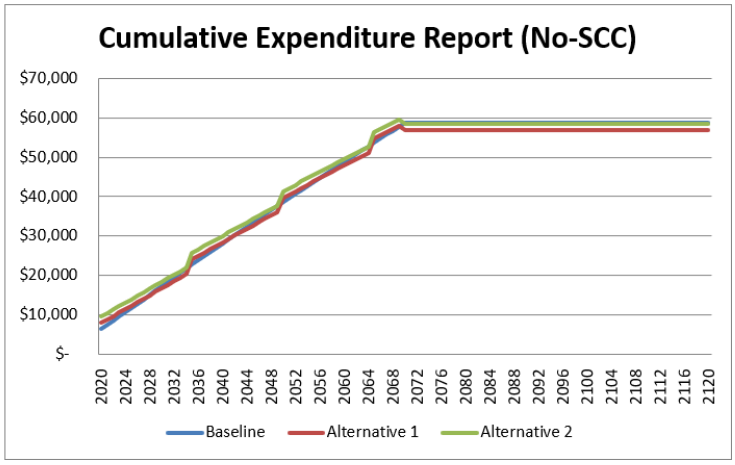
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	2,200
Nominal Discount Rate	3.14%	Useable (Sq.Ft)	2,200
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	17.9	14.4	14.4
1st Construction Costs	$ 6,416	$ 7,963	$ 9,613
PV of Capital Costs	$ 6,416	$ 13,579	$ 15,123
PV of Maintenance Costs	$ -	$ -	$ -
PV of Utility Costs	$ 44,098	$ 35,652	$ 35,652
Total Life Cycle Cost (LCC)	**$ 50,515**	**$ 49,231**	**$ 50,775**
Net Present Savings (NPS)	**N/A**	**$ 1,283**	**$ (261)**

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	43	35	35
% CO2e Reduction vs. Baseline	N/A	19%	24%
Present Social Cost of Carbon (SCC)	$ 3,240	$ 2,619	$ 2,619
Total LCC with SCC	**$ 53,755**	**$ 51,851**	**$ 53,395**
NPS with SCC	**N/A**	**$ 1,904**	**$ 360**





LCCA Results

Medium Heat Pump Home – Baseline Input

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
Life Cycle Cost Analysis Tool

Baseline Input Page

Open Primary Filter and Click OK to Re-filter

☑ Show All Entered Units (Requires Re-Filter)

Total Building Annual Utility Analysis	$ 1,036	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 1,036	$ -
Annual Utility Consumption Not Entered Below			11,513	
Sum of Annual Utility Consumption Below		-	-	-
Total Annual Utility Consumption		-	11,513	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							$ 6,558	Entries Below for Component Specific Utility Analy		
	A	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
x	X9010	Building Envelope									
x	X901001	1.1 - U-.24 Glaze	0.5		50	$1,789.84				-302	
x	X901002	1.2 - U-.20 Glaze	1		50	$2,625.10				-492	
x	X901003	1.3 - 5% UA reduc	0.5		50	$1,270.23				-59	
x	X901004	1.4 - 15% UA reduc	1		50	$3,255.06				-528	
x	X901005	1.5 - 22.5% UA reduc	1.5		50	$4,849.92				-817	
x	X901006	1.6 - 30% UA reduc	2.5		50	$12,094.52				-1,158	
x	X901007	2.1 - 2 ACH, HRV	0.5		50	$2,283.74				-105	
x	X901008	2.2 - 1.5 ACH, HRV	1		50	$5,456.94				-504	
x	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$7,048.35				-762	
x	X9020	HVAC									
x	X902001	3.1a - Furnace	1		18	$251.59					
x	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,387.73				-328	
x	X902003	3.3a - GSHP	1.5		20	$10,900.00					
x	X902004	3.4 - DHP	1.5		18	$1,529.78					
x	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78				-980	
x	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58					
x	X902007	4.1 - Deeply buried	0.5		50	$0.00					
x	X902008	4.2 - HVAC inside	1		50	$327.81				-666	
x	X9030	Hot Water									
x	X903001	5.1 - DWR	0.5		50	$437.08				-282	
x	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32					
x	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56					
x	X903004	5.4 - Tier III HPWH	2		15	$955.02				-1,761	
x	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45				-1,916	
x	X9040	Other									
x	X904001	6.1 - Solar pV	1		25	$5,040.00					
x	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-750	
x	X9050	2018 Compliant Building Cost		1	50	$6,558.39		$ 6,558			
x	X9060	Added Cost			55	$0.75					
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Medium Heat Pump Home – ALT 1

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 896	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 896	
Annual Utility Consumption Not Entered Below			13,396	
Sum of Annual Utility Consumption Below		-	(3,443)	-
Total Annual Utility Consumption		-	9,953	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Analy		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14							$ 7,181			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5	1	50	$1,789.84		$ 1,790		-301.5926795	
	X901002	1.2 - U-.20 Glaze	1		50	$2,625.10				-492.3861265	
	X901003	1.3 - 5% UA reduc	0.5		50	$1,270.23				-59.11484922	
	X901004	1.4 - 15% UA reduc	1		50	$3,255.06				-528.041402	
	X901005	1.5 - 22.5% UA reduc	2		50	$4,849.92				-817.1943594	
	X901006	1.6 - 30% UA reduc	3		50	$12,094.52				-1157.67213	
	X901007	2.1 - 2 ACH, HRV	1	1	50	$2,283.74		$ 2,284		-104.5804845	
	X901008	2.2 - 1.5 ACH, HRV	1.5		50	$5,456.94				-504.2060427	
	X901009	2.3 - 0.6 ACH, HRV	2		50	$7,048.35				-761.9789856	
	X9020	HVAC									
	X902001	3.1a - Furnace	1		18	$251.59					
	X902002	3.2a - 9.5 HSPF HP	0.5	1	15	$1,387.73		$ 1,388		-328.0623131	
	X902003	3.3a - GSHP	1.5		20	$10,900.00					
	X902004	3.4 - DHP	1.5		18	$1,529.78					
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78				-979.6948553	
	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58					
	X902007	4.1 - Deeply buried	1		50						
	X902008	4.2 - HVAC inside	1.5	1	50	$327.81		$ 328		-665.8185187	
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5	1	50	$437.08		$ 437		-281.5676614	
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32					
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56					
	X903004	5.4 - Tier III HPWH	2	1	15	$955.02		$ 955		-1760.941903	
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45				-1916.158669	
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040.00					
	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-750.0634586	
	X9050	2018 Compliant Building Cost			50	$6,558.39					
	X9060	Added Cost			55	$0.75					
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Medium Heat Pump Home – ALT 2

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 896	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 896	$ -
Annual Utility Consumption Not Entered Below		-	13,396	-
Sum of Annual Utility Consumption Below		-	(3,443)	-
Total Annual Utility Consumption		-	9,953	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Ana		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14							$ 8,831			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5	1	50	$1,790		$ 1,790		-302	
	X901002	1.2 - U-.20 Glaze	1		50	$2,625				-492	
	X901003	1.3 - 5% UA reduc	0.5		50	$1,270				-59	
	X901004	1.4 - 15% UA reduc	1		50	$3,255				-528	
	X901005	1.5 - 22.5% UA reduc	1.5		50	$4,850				-817	
	X901006	1.6 - 30% UA reduc	2.5		50	$12,095				-1158	
	X901007	2.1 - 2 ACH, HRV	0.5	1	50	$2,284		$ 2,284		-105	
	X901008	2.2 - 1.5 ACH, HRV	1		50	$5,457				-504	
	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$7,048				-762	
	X9020	HVAC									
	X902001	3.1a - Furnace	1		18	$252					
	X902002	3.2a - 9.5 HSPF HP	0.5	1	15	$1,388		$ 1,388		-328	
	X902003	3.3a - GSHP	1.5		20	$10,900					
	X902004	3.4 - DHP	1.5		18	$1,530					
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,530				-980	
	X902006	3.6a - DHP (15% elec)	2		18	$5,901					
	X902007	4.1 - Deeply buried	0.5		50						
	X902008	4.2 - HVAC inside	1	1	50	$328		$ 328		-666	
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5	1	50	$437		$ 437		-282	
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640					
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,009					
	X903004	5.4 - Tier III HPWH	2	1	15	$955		$ 955		-1761	
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824				-1916	
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040					
	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$505				-750	
	X9050	2018 Compliant Building Cost			50	$6,558					
	X9060	Added Cost		2200	55	$1		$ 1,650			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Medium Heat Pump Home – Expenditure Report

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	$ 6,558	$ 7,181	$ 8,831	$ 6,558	$ 7,181	$ 8,831
2021	$ 7,605	$ 8,086	$ 9,736	$ 1,047	$ 905	$ 905
2022	$ 8,652	$ 8,992	$ 10,642	$ 1,047	$ 905	$ 905
2023	$ 9,710	$ 9,906	$ 11,556	$ 1,058	$ 914	$ 914
2024	$ 10,768	$ 10,820	$ 12,470	$ 1,058	$ 914	$ 914
2025	$ 11,847	$ 11,754	$ 13,404	$ 1,079	$ 933	$ 933
2026	$ 12,948	$ 12,705	$ 14,355	$ 1,101	$ 952	$ 952
2027	$ 14,049	$ 13,657	$ 15,307	$ 1,101	$ 952	$ 952
2028	$ 15,150	$ 14,609	$ 16,259	$ 1,101	$ 952	$ 952
2029	$ 16,251	$ 15,561	$ 17,211	$ 1,101	$ 952	$ 952
2030	$ 17,352	$ 16,513	$ 18,163	$ 1,101	$ 952	$ 952
2031	$ 18,464	$ 17,474	$ 19,124	$ 1,112	$ 961	$ 961
2032	$ 19,564	$ 18,425	$ 20,075	$ 1,101	$ 952	$ 952
2033	$ 20,665	$ 19,377	$ 21,027	$ 1,101	$ 952	$ 952
2034	$ 21,766	$ 20,329	$ 21,979	$ 1,101	$ 952	$ 952
2035	$ 22,867	$ 23,624	$ 25,274	$ 1,101	$ 3,295	$ 3,295
2036	$ 23,957	$ 24,566	$ 26,216	$ 1,090	$ 942	$ 942
2037	$ 25,048	$ 25,509	$ 27,159	$ 1,090	$ 942	$ 942
2038	$ 26,127	$ 26,442	$ 28,092	$ 1,079	$ 933	$ 933
2039	$ 27,206	$ 27,375	$ 29,025	$ 1,079	$ 933	$ 933
2040	$ 28,275	$ 28,299	$ 29,949	$ 1,069	$ 924	$ 924
2041	$ 29,343	$ 29,222	$ 30,872	$ 1,069	$ 924	$ 924
2042	$ 30,401	$ 30,137	$ 31,787	$ 1,058	$ 914	$ 914
2043	$ 31,459	$ 31,051	$ 32,701	$ 1,058	$ 914	$ 914
2044	$ 32,506	$ 31,957	$ 33,607	$ 1,047	$ 905	$ 905
2045	$ 33,553	$ 32,862	$ 34,512	$ 1,047	$ 905	$ 905
2046	$ 34,600	$ 33,767	$ 35,417	$ 1,047	$ 905	$ 905
2047	$ 35,647	$ 34,672	$ 36,322	$ 1,047	$ 905	$ 905
2048	$ 36,683	$ 35,568	$ 37,218	$ 1,036	$ 896	$ 896
2049	$ 37,719	$ 36,464	$ 38,114	$ 1,036	$ 896	$ 896
2050	$ 38,744	$ 39,693	$ 41,343	$ 1,025	$ 3,229	$ 3,229
2051	$ 39,768	$ 40,577	$ 42,227	$ 1,023	$ 885	$ 885
2052	$ 40,789	$ 41,460	$ 43,110	$ 1,021	$ 883	$ 883
2053	$ 41,808	$ 42,341	$ 43,991	$ 1,019	$ 881	$ 881
2054	$ 42,824	$ 43,220	$ 44,870	$ 1,017	$ 879	$ 879
2055	$ 43,839	$ 44,097	$ 45,747	$ 1,015	$ 877	$ 877
2056	$ 44,851	$ 44,972	$ 46,622	$ 1,012	$ 875	$ 875
2057	$ 45,862	$ 45,846	$ 47,496	$ 1,010	$ 873	$ 873
2058	$ 46,870	$ 46,717	$ 48,367	$ 1,008	$ 872	$ 872
2059	$ 47,876	$ 47,587	$ 49,237	$ 1,006	$ 870	$ 870
2060	$ 48,879	$ 48,455	$ 50,105	$ 1,004	$ 868	$ 868
2061	$ 49,881	$ 49,321	$ 50,971	$ 1,002	$ 866	$ 866
2062	$ 50,881	$ 50,185	$ 51,835	$ 999	$ 864	$ 864
2063	$ 51,878	$ 51,047	$ 52,697	$ 997	$ 862	$ 862
2064	$ 52,873	$ 51,908	$ 53,558	$ 995	$ 860	$ 860
2065	$ 53,866	$ 55,109	$ 56,759	$ 993	$ 3,201	$ 3,201
2066	$ 54,857	$ 55,965	$ 57,615	$ 991	$ 857	$ 857
2067	$ 55,846	$ 56,820	$ 58,470	$ 989	$ 855	$ 855
2068	$ 56,832	$ 57,673	$ 59,323	$ 987	$ 853	$ 853
2069	$ 57,816	$ 58,524	$ 60,174	$ 984	$ 851	$ 851
2070	$ 58,799	$ 57,811	$ 59,311	$ 982	$ (713)	$ (863)

LCCA Results

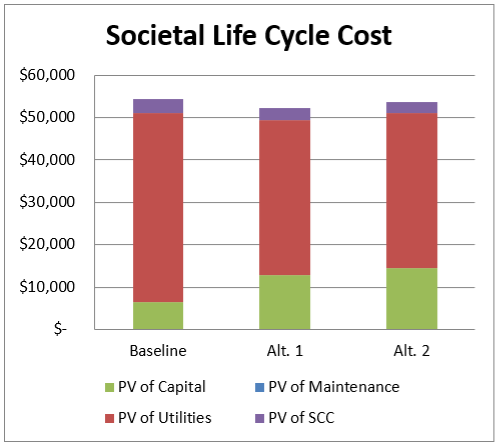
Medium Zonal Electric Home – Executive Report

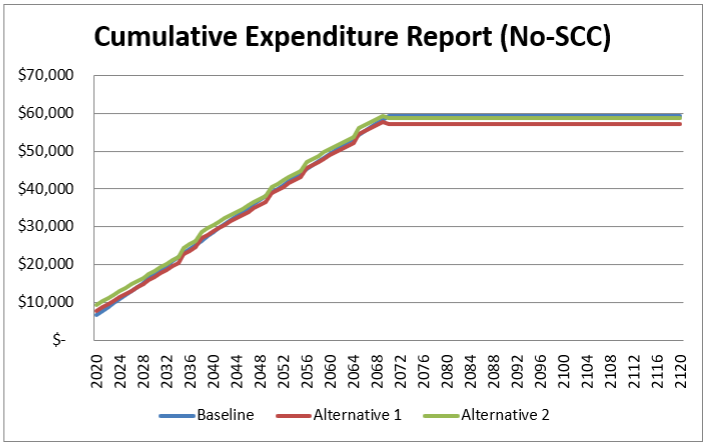
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	2,200
Nominal Discount Rate	3.14%	Useable (Sq.Ft)	2,200
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	18.0	14.8	14.8
1st Construction Costs	$ 6,558	$ 7,778	$ 9,428
PV of Capital Costs	$ 6,558	$ 12,956	$ 14,500
PV of Maintenance Costs	$ -	$ -	$ -
PV of Utility Costs	$ 44,513	$ 36,544	$ 36,544
Total Life Cycle Cost (LCC)	**$ 51,072**	**$ 49,500**	**$ 51,044**
Net Present Savings (NPS)	**N/A**	**$ 1,572**	**$ 27**

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	43	35	35
% CO2e Reduction vs. Baseline	N/A	18%	22%
Present Social Cost of Carbon (SCC)	$ 3,271	$ 2,685	$ 2,685
Total LCC with SCC	**$ 54,342**	**$ 52,185**	**$ 53,729**
NPS with SCC	**N/A**	**$ 2,157**	**$ 613**





LCCA Results

Medium Zonal Electric Home – Baseline Input

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
Life Cycle Cost Analysis Tool

Baseline Input Page

Open Primary Filter and Click OK to Re-filter

☑ Show All Entered Units (Requires Re-Filter)

Total Building Annual Utility Analysis	$ 1,046	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 1,046	$ -
Annual Utility Consumption Not Entered Below			11,621	
Sum of Annual Utility Consumption Below		-	-	-
Total Annual Utility Consumption		-	11,621	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							$ 6,558	Entries Below for Component Specific Utility Analy		
	A	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
x	X9010	Building Envelope									
x	X901001	1.1 - U-.24 Glaze	0.5		50	$1,789.84				-348	
x	X901002	1.2 - U-.20 Glaze	1		50	$2,625.10				-597	
x	X901003	1.3 - 5% UA reduc	0.5		50	$1,270.23				-122	
x	X901004	1.4 - 15% UA reduc	1		50	$3,255.06				-648	
x	X901005	1.5 - 22.5% UA reduc	1.5		50	$4,849.92				-1,015	
x	X901006	1.6 - 30% UA reduc	2.5		50	$12,094.52				-1,456	
x	X901007	2.1 - 2 ACH, HRV	0.5		50	$2,283.74				-111	
x	X901008	2.2 - 1.5 ACH, HRV	1		50	$5,456.94				-664	
x	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$7,048.35				-997	
x	X9020	HVAC									
x	X902001	3.1a - Furnace	1		18	$251.59					
x	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,387.73					
x	X902003	3.3a - GSHP	1.5		20	$10,900.00					
x	X902004	3.4 - DHP	1.5		18	$1,529.78				-1,129	
x	X902005	3.5a - 11.0 HSPF HP	1		15	$1,529.78					
x	X902006	3.6a - DHP (15% elec)	2		18	$5,900.58				-2,185	
x	X902007	4.1 - Deeply buried	0.5		50	$0.00					
x	X902008	4.2 - HVAC inside	1		50	$327.81					
x	X9030	Hot Water									
x	X903001	5.1 - DWR	0.5		50	$437.08				-318	
x	X903002	5.2 - 0.80 gas DHW	0.5		15	$640.32					
x	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,008.56					
x	X903004	5.4 - Tier III HPWH	2		15	$955.02				-1,790	
x	X903005	5.5 - CO2 HPWH	2.5		15	$3,824.45				-1,941	
x	X9040	Other									
x	X904001	6.1 - Solar pV	1		25	$5,040.00					
x	X904002	7.1 - ES Appl+ventless Dryer	0.5		15	$504.83				-776	
x	X9050	2018 Compliant Building Cost		1	50	$6,558.39		$ 6,558			
x	X9060	Added Cost			55	$0.75					
x	X9070	3ACH & Continuous Insulation			50	$2,561.00					
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Medium Zonal Electric Home – ALT 1

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 859	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 859	
Annual Utility Consumption Not Entered Below			13,901	
Sum of Annual Utility Consumption Below		-	(4,360)	-
Total Annual Utility Consumption		-	9,541	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2								Entries Below for Component Specific Utility Analy		
	Match Baseline: Filter to Select All & Drag Copy O14:S14 & U14:AG14							$ 7,778			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5	1	50	$1,790		$ 1,790		-348	
	X901002	1.2 - U-.20 Glaze	1		50	$2,625				-597	
	X901003	1.3 - 5% UA reduc	0.5		50	$1,270				-122	
	X901004	1.4 - 15% UA reduc	1		50	$3,255				-648	
	X901005	1.5 - 22.5% UA reduc	2		50	$4,850				-1015	
	X901006	1.6 - 30% UA reduc	3		50	$12,095				-1456	
	X901007	2.1 - 2 ACH, HRV	1		50	$2,284				-111	
	X901008	2.2 - 1.5 ACH, HRV	1.5		50	$5,457				-664	
	X901009	2.3 - 0.6 ACH, HRV	2		50	$7,048				-997	
	X9020	HVAC									
	X902001	3.1a - Furnace	1		18	$252					
	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,388					
	X902003	3.3a - GSHP	1.5		20	$10,900					
	X902004	3.4 - DHP	1.5	1	18	$1,530		$ 1,530		-1129	
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,530					
	X902006	3.6a - DHP (15% elec)	2		18	$5,901				-2185	
	X902007	4.1 - Deeply buried	1		50						
	X902008	4.2 - HVAC inside	1.5		50	$328					
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5	1	50	$437		$ 437		-318	
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640					
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,009					
	X903004	5.4 - Tier III HPWH	2	1	15	$955		$ 955		-1790	
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824				-1941	
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040					
	X904002	7.1 - ES Appl+ventless Dryer	0.5	1	15	$505		$ 505		-776	
	X9050	2018 Compliant Building Cost			50	$6,558					
	X9060	Added Cost			55	$0.75					
	X9070	3ACH & Continuous Insulation		1	50	$2,561		$ 2,561			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Medium Zonal Electric Home – ALT 2

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 859	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 859	
Annual Utility Consumption Not Entered Below		-	13,901	
Sum of Annual Utility Consumption Below		-	(4,360)	-
Total Annual Utility Consumption		-	9,541	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	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							$ 9,428			
.	**A**	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5	1	50	$1,790		$ 1,790		-348	
	X901002	1.2 - U-.20 Glaze	1		50	$2,625				-597	
	X901003	1.3 - 5% UA reduc	0.5		50	$1,270				-122	
	X901004	1.4 - 15% UA reduc	1		50	$3,255				-648	
	X901005	1.5 - 22.5% UA reduc	1.5		50	$4,850				-1015	
	X901006	1.6 - 30% UA reduc	2.5		50	$12,095				-1456	
	X901007	2.1 - 2 ACH, HRV	0.5		50	$2,284				-111	
	X901008	2.2 - 1.5 ACH, HRV	1		50	$5,457				-664	
	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$7,048				-997	
	X9020	HVAC									
	X902001	3.1a - Furnace	1		18	$252					
	X902002	3.2a - 9.5 HSPF HP	0.5		15	$1,388					
	X902003	3.3a - GSHP	1.5		20	$10,900					
	X902004	3.4 - DHP	1.5	1	18	$1,530		$ 1,530		-1129	
	X902005	3.5a - 11.0 HSPF HP	1		15	$1,530					
	X902006	3.6a - DHP (15% elec)	2		18	$5,901				-2185	
	X902007	4.1 - Deeply buried	0.5		50						
	X902008	4.2 - HVAC inside	1		50	$328					
	X9030	Hot Water									
	X903001	5.1 - DWR	0.5	1	50	$437		$ 437		-318	
	X903002	5.2 - 0.80 gas DHW	0.5		15	$640					
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$1,009					
	X903004	5.4 - Tier III HPWH	2	1	15	$955		$ 955		-1790	
	X903005	5.5 - CO2 HPWH	2.5		15	$3,824				-1941	
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040					
	X904002	7.1 - ES Appl+ventless Dryer	0.5	1	15	$505		$ 505		-776	
	X9050	2018 Compliant Building Cost			50	$6,558					
	X9060	Added Cost		2200	55	$0.75		$ 1,650			
	X9070	3ACH & Continuous Insulation		1	50	$2,561		$ 2,561			
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Medium Zonal Electric Home– Expenditure Report

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	$ 6,558	$ 7,778	$ 9,428	$ 6,558	$ 7,778	$ 9,428
2021	$ 7,615	$ 8,645	$ 10,295	$ 1,057	$ 868	$ 868
2022	$ 8,672	$ 9,513	$ 11,163	$ 1,057	$ 868	$ 868
2023	$ 9,740	$ 10,389	$ 12,039	$ 1,068	$ 877	$ 877
2024	$ 10,807	$ 11,266	$ 12,916	$ 1,068	$ 877	$ 877
2025	$ 11,897	$ 12,160	$ 13,810	$ 1,090	$ 894	$ 894
2026	$ 13,008	$ 13,073	$ 14,723	$ 1,111	$ 912	$ 912
2027	$ 14,120	$ 13,985	$ 15,635	$ 1,111	$ 912	$ 912
2028	$ 15,231	$ 14,897	$ 16,547	$ 1,111	$ 912	$ 912
2029	$ 16,342	$ 15,810	$ 17,460	$ 1,111	$ 912	$ 912
2030	$ 17,453	$ 16,722	$ 18,372	$ 1,111	$ 912	$ 912
2031	$ 18,576	$ 17,643	$ 19,293	$ 1,122	$ 921	$ 921
2032	$ 19,687	$ 18,556	$ 20,206	$ 1,111	$ 912	$ 912
2033	$ 20,798	$ 19,468	$ 21,118	$ 1,111	$ 912	$ 912
2034	$ 21,909	$ 20,380	$ 22,030	$ 1,111	$ 912	$ 912
2035	$ 23,021	$ 22,753	$ 24,403	$ 1,111	$ 2,372	$ 2,372
2036	$ 24,121	$ 23,656	$ 25,306	$ 1,100	$ 903	$ 903
2037	$ 25,222	$ 24,559	$ 26,209	$ 1,100	$ 903	$ 903
2038	$ 26,311	$ 26,984	$ 28,634	$ 1,090	$ 2,424	$ 2,424
2039	$ 27,401	$ 27,878	$ 29,528	$ 1,090	$ 894	$ 894
2040	$ 28,479	$ 28,764	$ 30,414	$ 1,079	$ 886	$ 886
2041	$ 29,558	$ 29,649	$ 31,299	$ 1,079	$ 886	$ 886
2042	$ 30,625	$ 30,526	$ 32,176	$ 1,068	$ 877	$ 877
2043	$ 31,693	$ 31,402	$ 33,052	$ 1,068	$ 877	$ 877
2044	$ 32,750	$ 32,270	$ 33,920	$ 1,057	$ 868	$ 868
2045	$ 33,807	$ 33,137	$ 34,787	$ 1,057	$ 868	$ 868
2046	$ 34,864	$ 34,005	$ 35,655	$ 1,057	$ 868	$ 868
2047	$ 35,920	$ 34,873	$ 36,523	$ 1,057	$ 868	$ 868
2048	$ 36,966	$ 35,731	$ 37,381	$ 1,046	$ 859	$ 859
2049	$ 38,012	$ 36,590	$ 38,240	$ 1,046	$ 859	$ 859
2050	$ 39,047	$ 38,900	$ 40,550	$ 1,035	$ 2,310	$ 2,310
2051	$ 40,080	$ 39,747	$ 41,397	$ 1,033	$ 848	$ 848
2052	$ 41,111	$ 40,594	$ 42,244	$ 1,031	$ 846	$ 846
2053	$ 42,139	$ 41,438	$ 43,088	$ 1,028	$ 844	$ 844
2054	$ 43,166	$ 42,281	$ 43,931	$ 1,026	$ 843	$ 843
2055	$ 44,190	$ 43,121	$ 44,771	$ 1,024	$ 841	$ 841
2056	$ 45,212	$ 45,490	$ 47,140	$ 1,022	$ 2,369	$ 2,369
2057	$ 46,231	$ 46,327	$ 47,977	$ 1,020	$ 837	$ 837
2058	$ 47,249	$ 47,163	$ 48,813	$ 1,018	$ 835	$ 835
2059	$ 48,264	$ 47,996	$ 49,646	$ 1,015	$ 834	$ 834
2060	$ 49,278	$ 48,828	$ 50,478	$ 1,013	$ 832	$ 832
2061	$ 50,289	$ 49,658	$ 51,308	$ 1,011	$ 830	$ 830
2062	$ 51,298	$ 50,486	$ 52,136	$ 1,009	$ 828	$ 828
2063	$ 52,304	$ 51,313	$ 52,963	$ 1,007	$ 826	$ 826
2064	$ 53,309	$ 52,138	$ 53,788	$ 1,005	$ 825	$ 825
2065	$ 54,311	$ 54,420	$ 56,070	$ 1,002	$ 2,283	$ 2,283
2066	$ 55,311	$ 55,241	$ 56,891	$ 1,000	$ 821	$ 821
2067	$ 56,309	$ 56,061	$ 57,711	$ 998	$ 819	$ 819
2068	$ 57,305	$ 56,878	$ 58,528	$ 996	$ 818	$ 818
2069	$ 58,299	$ 57,694	$ 59,344	$ 994	$ 816	$ 816
2070	$ 59,290	$ 57,195	$ 58,695	$ 991	$ (499)	$ (649)

LCCA Results

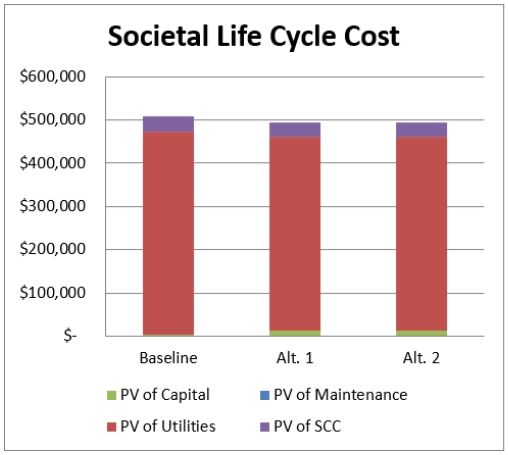
Multifamily Zonal Electric Home – Executive Report

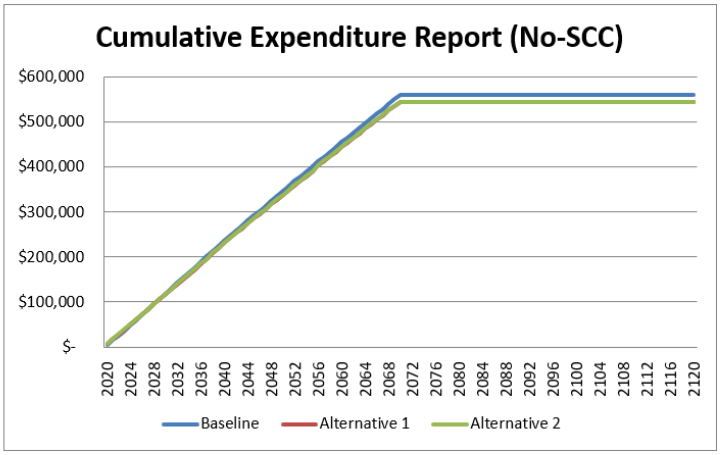
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	820
Nominal Discount Rate	3.14%	Useable (Sq.Ft)	820
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

Life Cycle Cost Analysis		BEST	
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	510.6	487.2	487.2
1st Construction Costs	$ 3,911	$ 7,224	$ 7,839
PV of Capital Costs	$ 3,911	$ 12,450	$ 13,026
PV of Maintenance Costs	$ -	$ -	$ -
PV of Utility Costs	$ 469,980	$ 448,485	$ 448,485
Total Life Cycle Cost (LCC)	**$ 473,890**	**$ 460,935**	**$ 461,511**
Net Present Savings (NPS)	**N/A**	**$ 12,955**	**$ 12,379**

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	455	434	434
% CO2e Reduction vs. Baseline	N/A	5%	5%
Present Social Cost of Carbon (SCC)	$ 34,531	$ 32,951	$ 32,951
Total LCC with SCC	**$ 508,421**	**$ 493,887**	**$ 494,462**
NPS with SCC	**N/A**	**$ 14,534**	**$ 13,959**





LCCA Results

Multifamily Zonal Electric Home – Baseline Input

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
Life Cycle Cost Analysis Tool

Baseline Input Page

Open Primary Filter and Click OK to Re-filter

☑ Show All Entered Units (Requires Re-Filter)

Total Building Annual Utility Analysis	$ 11,043	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 11,043	$ -
Annual Utility Consumption Not Entered Below			122,700	
Sum of Annual Utility Consumption Below		-	-	-
Total Annual Utility Consumption		-	122,700	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	Primary Entries Below: # of Units must be > 0 to be counted; Useful Life must be >= 2							$ 3,911	Entries Below for Component Specific Utility Analy		
	A	**Substructure**									
	B	**Shell**									
	C	**Interiors**									
	D	**Services**									
	E	**Equipment & Furnishings**									
	F	**Special Construction & Demolition**									
	G	**Building Sitework**									
x	X9010	Building Envelope									
x	X901001	1.1 - U-.24 Glaze	0.5		50	$0.00				-132	
x	X901002	1.2 - U-.20 Glaze	1		50	$887.05				-263	
x	X901003	1.3 - 5% UA reduc	---		50	$173.23				34	
x	X901004	1.4 - 15% UA reduc	1		50	$946.79				-223	
x	X901005	1.5 - 22.5% UA reduc	1.5		50	$1,382.85				-420	
x	X901006	1.6 - 30% UA reduc	2		50	$3,779.14				-555	
x	X901007	2.1 - 2 ACH, HRV	0.5		50	$851.21				-329	
x	X901008	2.2 - 1.5 ACH, HRV	1		50	$2,033.95				-642	
x	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$2,627.11				-934	
x	X9020	HVAC									
x	X902001	3.1a - Furnace	1		18	$251.59					
x	X902002	3.2a - 9.5 HSPF HP	---		15	$0.00					
x	X902003	3.3a - GSHP	1		20	$0.00					
x	X902004	3.4 - DHP	2		18	$3,059.56				41	
x	X902005	3.5a - 11.0 HSPF HP	---		15	$0.00					
x	X902006	3.6a - DHP (15% elec)	3		18	$5,244.96				-740	
x	X902007	4.1 - Deeply buried	0.5		50	$0.00					
x	X902008	4.2 - HVAC inside	---		50	$0.00					
x	X9030	Hot Water									
x	X903001	5.1 - DWR	---		50	$504.83				-182	
x	X903002	5.2 - 0.80 gas DHW	0.5		15	$0.00					
x	X903003	5.3 - 0.91 gas DHW, GSHP	1		15	$0.00					
x	X903004	5.4 - Tier III HPWH	2.5		15	$318.34				-973	
x	X903005	5.5 - CO2 HPWH	3		15	$1,274.82				-1,055	
x	X9040	Other									
x	X904001	6.1 - Solar pV	1		25	$5,040.00					
x	X904002	7.1 - ES Appl+ventless Dryer	1.5		15	$504.83				-629	
x	X9050	2018 Compliant Building Cost		1	50	$3,910.77		$ 3,911			
x	X9060	Added Cost			55	$0.75					
x	X9070	3ACH & Continuous Insulation			50	$865.00					
	Z	**Other Project Costs**									
	Z10	**One Time - Upfront Costs**		1	50						
	Z30	**Re-Occurring Annual Cost (Track Inflation)**		1	1						

LCCA Results

Multifamily Zonal Electric Home – ALT 1

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 10,538	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 10,538	
Annual Utility Consumption Not Entered Below			118,885	
Sum of Annual Utility Consumption Below		-	(1,797)	-
Total Annual Utility Consumption		-	117,088	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	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							$ 7,224			
.	A	Substructure									
	B	Shell									
	C	Interiors									
	D	Services									
	E	Equipment & Furnishings									
	F	Special Construction & Demolition									
	G	Building Sitework									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5		50					-132	
	X901002	1.2 - U-.20 Glaze	1		50	$887.05				-263	
	X901003	1.3 - 5% UA reduc	---		50	$173.23				34	
	X901004	1.4 - 15% UA reduc	1	1	50	$946.79		$ 947		-223	
	X901005	1.5 - 22.5% UA reduc	1.5		50	$1,382.85				-420	
	X901006	1.6 - 30% UA reduc	2		50	$3,779.14				-555	
	X901007	2.1 - 2 ACH, HRV	0.5		50	$851.21				-329	
	X901008	2.2 - 1.5 ACH, HRV	1	1	50	$2,033.95		$ 2,034		-642	
	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$2,627.11				-934	
	X9020	HVAC									
	X902001	3.1a - Furnace	1		18	$251.59					
	X902002	3.2a - 9.5 HSPF HP	---		15						
	X902003	3.3a - GSHP	1		20						
	X902004	3.4 - DHP	2	1	18	$3,059.56		$ 3,060		41	
	X902005	3.5a - 11.0 HSPF HP	---		15						
	X902006	3.6a - DHP (15% elec)	3		18	$5,244.96				-740	
	X902007	4.1 - Deeply buried	0.5		50						
	X902008	4.2 - HVAC inside	---		50						
	X9030	Hot Water									
	X903001	5.1 - DWR	---		50	$504.83				-182	
	X903002	5.2 - 0.80 gas DHW	0.5		15						
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15						
	X903004	5.4 - Tier III HPWH	2.5	1	15	$318.34		$ 318		-973	
	X903005	5.5 - CO2 HPWH	3		15	$1,274.82				-1055	
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040.00					
	X904002	7.1 - ES Appl+ventless Dryer	1.5		15	$504.83				-629	
	X9050	2018 Compliant Building Cost			50	$3,910.77					
	X9060	Added Cost			55	$0.75					
	X9070	3ACH & Continuous Insulation		1	50	$865.00		$ 865			
	Z	Other Project Costs									
	Z10	One Time - Upfront Costs		1	50						
	Z30	Re-Occurring Annual Cost (Track Inflation)		1	1						

LCCA Results

Multifamily Zonal Electric Home – ALT 2

<- Primary Filter (Requires Level 1)

Office of Financial Management
Olympia, Washington - Version: 2020-A
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	$ 10,538	Water (CCF)	Electricity (KWH)	Natural Gas (Therms)
Annual Utility Bill [$]			$ 10,538	
Annual Utility Consumption Not Entered Below		-	118,885	
Sum of Annual Utility Consumption Below		-	(1,797)	-
Total Annual Utility Consumption		-	117,088	-
Annual Utility Bill ÷ Total Utility Consumption		$ -	$ 0.09	$ -

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)
	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							$ 7,839			
.	A	Substructure									
	B	Shell									
	C	Interiors									
	D	Services									
	E	Equipment & Furnishings									
	F	Special Construction & Demolition									
	G	Building Sitework									
	X9010	Building Envelope									
	X901001	1.1 - U-.24 Glaze	0.5		50					-132	
	X901002	1.2 - U-.20 Glaze	1		50	$887.05				-263	
	X901003	1.3 - 5% UA reduc	---		50	$173.23				34	
	X901004	1.4 - 15% UA reduc	1	1	50	$946.79		$ 947		-223	
	X901005	1.5 - 22.5% UA reduc	1.5		50	$1,382.85				-420	
	X901006	1.6 - 30% UA reduc	2		50	$3,779.14				-555	
	X901007	2.1 - 2 ACH, HRV	0.5		50	$851.21				-329	
	X901008	2.2 - 1.5 ACH, HRV	1	1	50	$2,033.95		$ 2,034		-642	
	X901009	2.3 - 0.6 ACH, HRV	1.5		50	$2,627.11				-934	
	X9020	HVAC									
	X902001	3.1a - Furnace	1		18	$251.59					
	X902002	3.2a - 9.5 HSPF HP	---		15						
	X902003	3.3a - GSHP	1		20						
	X902004	3.4 - DHP	2	1	18	$3,059.56		$ 3,060		41	
	X902005	3.5a - 11.0 HSPF HP	---		15						
	X902006	3.6a - DHP (15% elec)	3		18	$5,244.96				-740	
	X902007	4.1 - Deeply buried	0.5		50						
	X902008	4.2 - HVAC inside	---		50						
	X9030	Hot Water									
	X903001	5.1 - DWR	---		50	$504.83				-182	
	X903002	5.2 - 0.80 gas DHW	0.5		15						
	X903003	5.3 - 0.91 gas DHW, GSHP	1		15						
	X903004	5.4 - Tier III HPWH	2.5	1	15	$318.34		$ 318		-973	
	X903005	5.5 - CO2 HPWH	3		15	$1,274.82				-1055	
	X9040	Other									
	X904001	6.1 - Solar pV	1		25	$5,040.00					
	X904002	7.1 - ES Appl+ventless Dryer	1.5		15	$504.83				-629	
	X9050	2018 Compliant Building Cost			50	$3,910.77					
	X9060	Added Cost		820	55	$0.75		$ 615			
	X9070	3ACH & Continuous Insulation		1	50	$865.00		$ 865			
	Z	Other Project Costs									
	Z10	One Time - Upfront Costs		1	50						
	Z30	Re-Occurring Annual Cost (Track Inflation)		1	1						

LCCA Results

Multifamily Zonal Electric Home– Expenditure Report

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	$ 3,911	$ 7,224	$ 7,839	$ 3,911	$ 7,224	$ 7,839
2021	$ 15,069	$ 17,871	$ 18,486	$ 11,158	$ 10,648	$ 10,648
2022	$ 26,227	$ 28,519	$ 29,134	$ 11,158	$ 10,648	$ 10,648
2023	$ 37,500	$ 39,277	$ 39,892	$ 11,273	$ 10,757	$ 10,757
2024	$ 48,773	$ 50,034	$ 50,649	$ 11,273	$ 10,757	$ 10,757
2025	$ 60,276	$ 61,011	$ 61,626	$ 11,503	$ 10,977	$ 10,977
2026	$ 72,009	$ 72,208	$ 72,823	$ 11,733	$ 11,197	$ 11,197
2027	$ 83,742	$ 83,404	$ 84,019	$ 11,733	$ 11,197	$ 11,197
2028	$ 95,476	$ 94,601	$ 95,216	$ 11,733	$ 11,197	$ 11,197
2029	$ 107,209	$ 105,797	$ 106,412	$ 11,733	$ 11,197	$ 11,197
2030	$ 118,942	$ 116,994	$ 117,609	$ 11,733	$ 11,197	$ 11,197
2031	$ 130,790	$ 128,300	$ 128,915	$ 11,848	$ 11,306	$ 11,306
2032	$ 142,523	$ 139,497	$ 140,112	$ 11,733	$ 11,197	$ 11,197
2033	$ 154,257	$ 150,693	$ 151,308	$ 11,733	$ 11,197	$ 11,197
2034	$ 165,990	$ 161,890	$ 162,505	$ 11,733	$ 11,197	$ 11,197
2035	$ 177,723	$ 173,405	$ 174,020	$ 11,733	$ 11,515	$ 11,515
2036	$ 189,341	$ 184,492	$ 185,107	$ 11,618	$ 11,087	$ 11,087
2037	$ 200,959	$ 195,579	$ 196,194	$ 11,618	$ 11,087	$ 11,087
2038	$ 212,462	$ 209,615	$ 210,230	$ 11,503	$ 14,037	$ 14,037
2039	$ 223,966	$ 220,592	$ 221,207	$ 11,503	$ 10,977	$ 10,977
2040	$ 235,354	$ 231,459	$ 232,074	$ 11,388	$ 10,867	$ 10,867
2041	$ 246,742	$ 242,327	$ 242,942	$ 11,388	$ 10,867	$ 10,867
2042	$ 258,015	$ 253,084	$ 253,699	$ 11,273	$ 10,757	$ 10,757
2043	$ 269,288	$ 263,842	$ 264,457	$ 11,273	$ 10,757	$ 10,757
2044	$ 280,446	$ 274,489	$ 275,104	$ 11,158	$ 10,648	$ 10,648
2045	$ 291,604	$ 285,137	$ 285,752	$ 11,158	$ 10,648	$ 10,648
2046	$ 302,762	$ 295,785	$ 296,400	$ 11,158	$ 10,648	$ 10,648
2047	$ 313,920	$ 306,433	$ 307,048	$ 11,158	$ 10,648	$ 10,648
2048	$ 324,963	$ 316,970	$ 317,585	$ 11,043	$ 10,538	$ 10,538
2049	$ 336,006	$ 327,508	$ 328,123	$ 11,043	$ 10,538	$ 10,538
2050	$ 346,934	$ 338,255	$ 338,870	$ 10,928	$ 10,747	$ 10,747
2051	$ 357,839	$ 348,661	$ 349,276	$ 10,905	$ 10,406	$ 10,406
2052	$ 368,721	$ 359,045	$ 359,660	$ 10,882	$ 10,384	$ 10,384
2053	$ 379,580	$ 369,408	$ 370,023	$ 10,859	$ 10,362	$ 10,362
2054	$ 390,416	$ 379,748	$ 380,363	$ 10,836	$ 10,340	$ 10,340
2055	$ 401,229	$ 390,067	$ 390,682	$ 10,813	$ 10,318	$ 10,318
2056	$ 412,019	$ 403,423	$ 404,038	$ 10,790	$ 13,356	$ 13,356
2057	$ 422,786	$ 413,697	$ 414,312	$ 10,767	$ 10,275	$ 10,275
2058	$ 433,529	$ 423,950	$ 424,565	$ 10,744	$ 10,253	$ 10,253
2059	$ 444,250	$ 434,180	$ 434,795	$ 10,721	$ 10,231	$ 10,231
2060	$ 454,948	$ 444,389	$ 445,004	$ 10,698	$ 10,209	$ 10,209
2061	$ 465,623	$ 454,575	$ 455,190	$ 10,675	$ 10,187	$ 10,187
2062	$ 476,275	$ 464,740	$ 465,355	$ 10,652	$ 10,165	$ 10,165
2063	$ 486,904	$ 474,883	$ 475,498	$ 10,629	$ 10,143	$ 10,143
2064	$ 497,510	$ 485,004	$ 485,619	$ 10,606	$ 10,121	$ 10,121
2065	$ 508,093	$ 495,421	$ 496,036	$ 10,583	$ 10,417	$ 10,417
2066	$ 518,653	$ 505,498	$ 506,113	$ 10,560	$ 10,077	$ 10,077
2067	$ 529,189	$ 515,553	$ 516,168	$ 10,537	$ 10,055	$ 10,055
2068	$ 539,703	$ 525,586	$ 526,201	$ 10,514	$ 10,033	$ 10,033
2069	$ 550,194	$ 535,597	$ 536,212	$ 10,491	$ 10,011	$ 10,011
2070	$ 560,662	$ 544,694	$ 545,253	$ 10,468	$ 9,097	$ 9,041