October 14, 2022

To: Chair Tony Doan, State Building Code Council
cc: Members of the State Building Code Council

RE: Updated Energy and Cost Benefit Analysis in Support of Heat Pump Proposals 21-GP2-065 and 21-GP2-066

This comment is in response to the Preliminary Cost Benefit Analysis for the 2021 Washington State Energy Code, Residential Provisions, posted on the SBCC website. Thank you for the opportunity to comment and for the hard work that the staff has done in the last 18 months of rulemaking.

During the Energy Code Technical Advisory Group (TAG) process, RMI submitted an updated cost benefit analysis than what is currently referenced for Heat Pump Proposals 21-GP2-065 and 21-GP2-066 in the Preliminary Cost Benefit Analysis. This updated analysis was done based on input from TAG members and SBCC staff on what assumptions should be made in the baseline models, including recommendations for assumptions in the R406 Options Table. A published version of what was submitted to the TAG can be found on the SBCC website.[1]

Since the CR-101 was voted on by the SBCC in June, RMI had done further refining and analysis to update the cost benefit analysis in support of the heat pump proposals, with the results presented in this comment. Overall, the narrative in support for the proposals has not shifted throughout the entire process: all-electric homes built to comply with the Washington State Energy Code will be less expensive than a mixed fuel alternative. All-electric homes also reduce emissions and have lower operating cost than their mixed fuel alternatives.

However, many questions and assumptions have been discussed and brought up during the TAG process and subsequent public comment periods which should be addressed.

First, it is important to discuss what is the baseline from which it is being compared. According to recent data from the Census, 84% of detached single family homes built in Seattle in between 2015-2019 included primary air conditioning in addition to heating.[2] For this reason, the baseline

---

[1] See Energy Code TAG Meeting on June 3, 2022
https://sbcc.wa.gov/sites/default/files/2022-06/Supplemental_Amended%20Analysis_Kocher_060122.pdf
[2]ttps://www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html?s_areas=42660&s_year=2021&s_tablename=TABLE3&s_bygroup1=4&s_bygroup2=3&s_filtergroup1=1&s_filtergroup2=1

mixed fuel building is assumed to have air conditioning. However, alternative analysis was done for both Seattle and Spokane for an alternative that does not include air conditioning.

Second, during the TAG process, it was requested that the models be built to comply with the entirety of the energy code, as is in the 2021 Integrated Draft available on the SBCC website, including the R-406 section, known as the "Additional Energy Efficiency Requirements". This section requires each project built to achieve a required number of options points based on the size of the home. The 2,400 sq ft PNNL Residential Prototype model used to model the energy usage of proposals fell into the medium sized home category, requiring 6 points in R-406 to comply.[3] Per recommendations from members of the TAG, the selected measures for each modeled scenario were chosen based on an Ecotope report that suggested the most cost effective measures.[4] The cost for each of these measures was gathered from a separate NEEA report, also recommended by members of the TAG.[5]

Taking into account these baseline assumptions, the analysis team built models to present the policy. The material cost, labor cost, O&M cost and equipment lifetime assumptions in support of this analysis are attached in Appendix A, along with the data sources for each assumption.[6] Each model was built according to the 2021 Integrated Draft, with the inputs for building characteristics included in Appendix B.[7] BeOpt, developed by the National Renewable Energy Laboratory, was used to model the energy consumption of each scenario. Two cities were chosen to simulate weather conditions, representing the east and west side of the state: Spokane and Seattle. Specific assumptions for efficiency and size of equipment for each scenario, as well as specific measures chosen in the R406 Table, can be found in Appendix C.[8] Three scenarios were run for each city:

- Mixed Fuel home with AC: This was considered the baseline model. This home was built with a code compliant gas furnace, gas water heater, gas stove and an air-conditioner.
- Mixed Fuel home without AC: Same as above, but without an air conditioner
- All-Electric home: This assumes that both proposals are passed, with the additional assumption that builders will choose to install induction stoves rather than pay for the total cost of gas infrastructure to feed a gas stove. This is expanded upon in a section below.

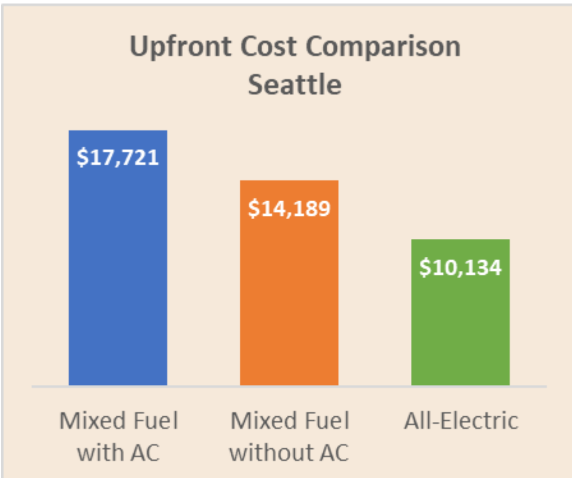
The results of each scenario, shown in Appendix C, were then copied from BeOpt and inputted into the life cycle cost analysis tool created by the SBCC.[9] The results from the life cycle cost analysis tool is shown in Appendix E.[10] Those results show, unequivocally, that the all-electric home has lower upfront costs. In both Spokane and Seattle, an all-electric home costs $7,587

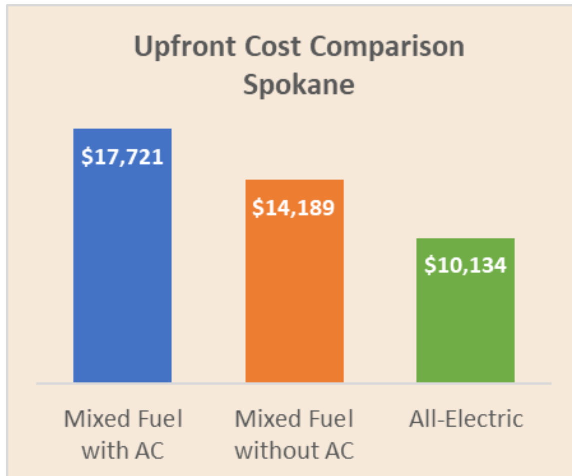
---

3 https://www.energycodes.gov/prototype-building-models#Residential
4 https://sbcc.wa.gov/sites/default/files/2020-03/BaselineStudy_FinalReport_032320.pdf, Table 8
5 https://neea.org/resources/2018-washington-residential-code-energy-savings-analysis
6 Appendix A
7 Appendix B
8 Appendix C
9 Appendix D
10 Appendix E

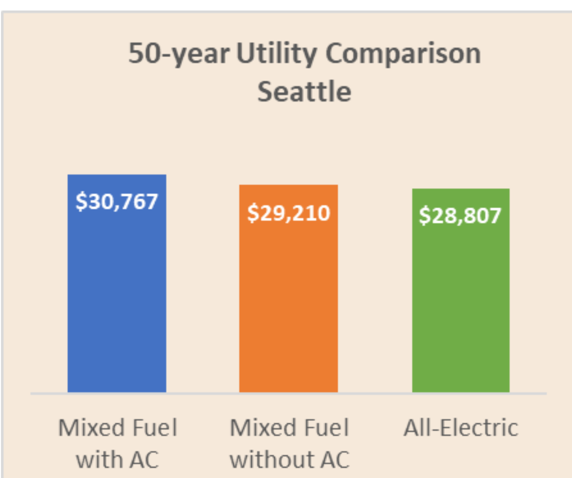
less than the mixed fuel home with an air conditioner. These cost savings are primarily due to three reasons:

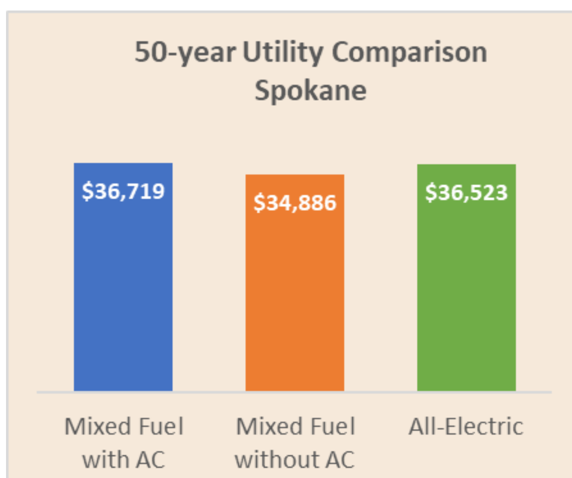
1. The all-electric home needed less expensive R406 measures to comply with that code. This saves thousands of dollars.
2. A heat pump can both heat and cool, reducing the need for two separate devices. This is a relatively minor cost saving measure.
3. An all-electric home doesn't need gas infrastructure, both inside and outside the home. Currently, this saves a moderate amount, but will increase as utilities begin to transition line extension subsidies.



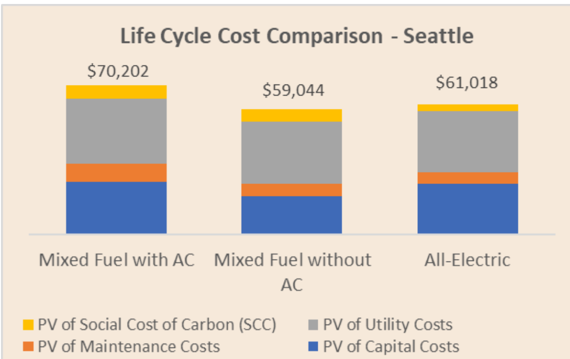


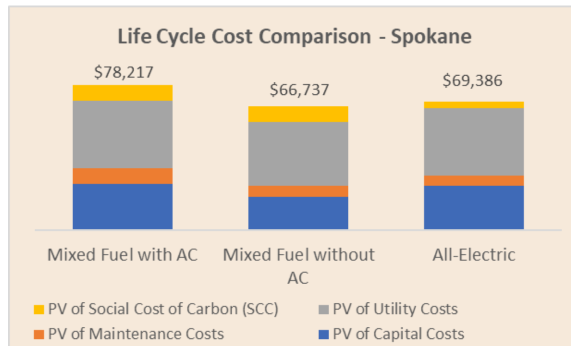
In addition to the upfront cost savings, the analysis found that over the 50 year study period, all-electric homes lowered overall operating costs in both Seattle and Spokane. In fact, in Seattle, an all-electric home even out performed a mixed fuel home without an air conditioner, meaning that the homes there would see a decrease in utility bills even while cooling their home by building with a heat pump.



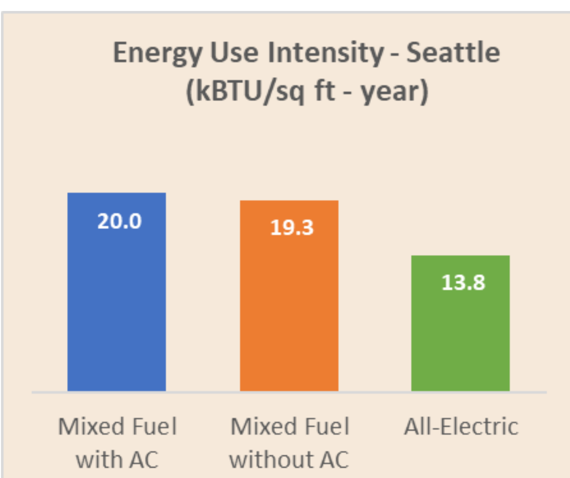


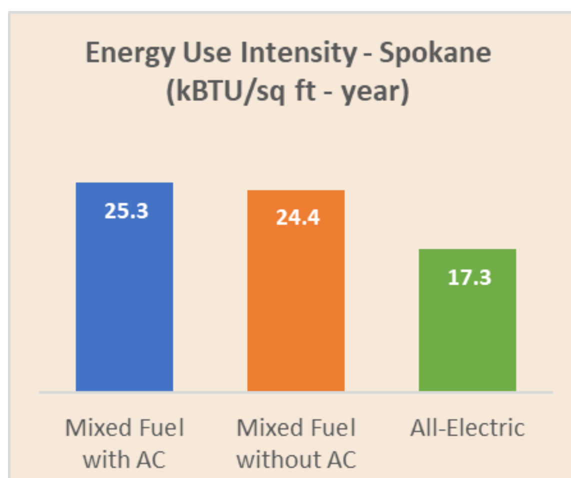
The life cycle cost of an all-electric home in both Spokane and Seattle were less expensive than a mixed fuel home with an air conditioner, especially when accounting for the cost of carbon. It should be noted that the economic and climate benefits of all-electric buildings are expected to only get better. Puget Sound Energy, one of Washington's three largest natural gas utilities, has recently agreed in a rate case settlement to phase out gas line extension allowances starting on Jan 1st 2025. Once these allowances are phased out, this would add approximately $2,000 to the construction cost for each mixed fuel home built. Although this settlement still needs to be reviewed and approved by the Utilities and Transportation Commission, it is expected to be approved by the end of the year.[11] It is likely that other gas utilities will follow suit in similar settlement cases.





In addition to being more economical, all-electric buildings also used significantly less energy than both mixed fuel buildings. An all-electric home uses 31% less energy in Seattle than a mixed fuel home with an air conditioner. In Spokane, an all-electric home uses 32% less energy. This energy savings primarily comes from the high efficiency of heat pump technology, 2-4 times more efficient than a combustion furnace could ever reach.

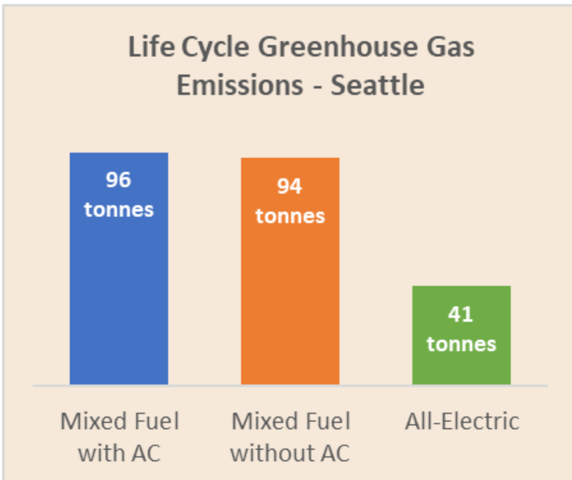


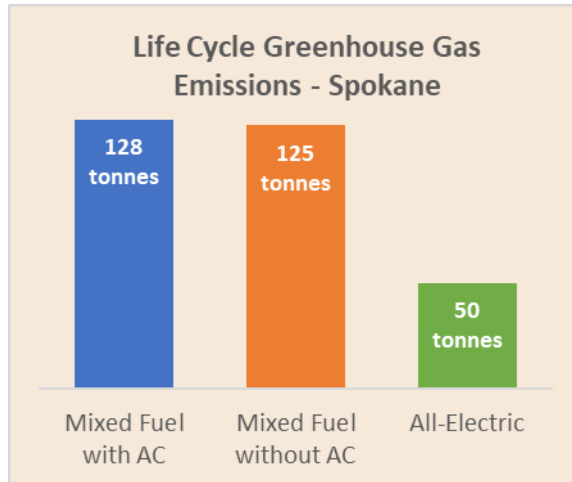


---

[11] Docket UE-220066/UG-220067

Both the high energy efficiency of all-electric homes, paired with the electrical grid that is progressively getting cleaner, means that the life cycle greenhouse gas emissions for an all-electric home is much lower than a mixed fuel home. In Seattle, an all-electric home produces 57% less greenhouse gas emissions than a mixed fuel home. This compares to a 61% emission reduction for an all-electric home in Spokane.





In light of the climate and economic benefits of building electrification, the SBCC should pass Heat Pump Proposals 21-GP2-065 and 21-GP2-066.

Thank you for your consideration.

Jonny Kocher
Senior Associate
RMI

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

Seattle

Executive Report

Project Information	
Project:	
Address:	N/A, N/A, N/A
Company:	RMI
Contact:	Jonny Kocher
Contact Phone:	
Contact Email:	jkocher@rmi.org

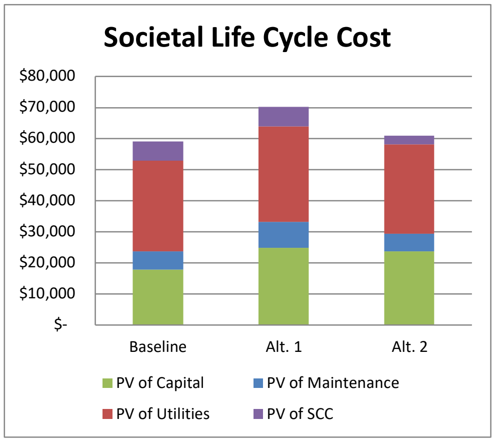
Key Analysis Variables		Building Characteristics	
Study Period (years)	50	Gross (Sq.Ft)	2,400
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	2,400
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

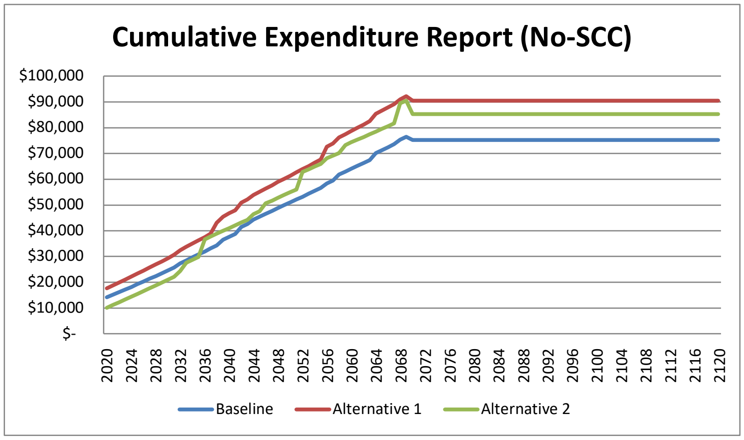
Life Cycle Cost Analysis	BEST		
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	19.3	20.0	13.8
1st Construction Costs	$ 14,189	$ 17,721	$ 10,134
PV of Capital Costs	$ 17,836	$ 24,778	$ 23,704
PV of Maintenance Costs	$ 5,893	$ 8,390	$ 5,635
PV of Utility Costs	$ 29,210	$ 30,767	$ 28,807
Total Life Cycle Cost (LCC)	**$ 52,938**	**$ 63,935**	**$ 58,147**
Net Present Savings (NPS)	**N/A**	**$ (10,997)**	**$ (5,209)**

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	94	96	41
% CO2e Reduction vs. Baseline	N/A	-2%	-
Present Social Cost of Carbon (SCC)	$ 6,107	$ 6,267	$ 2,872
Total LCC with SCC	**$ 59,044**	**$ 70,202**	**$ 61,018**
NPS with SCC	**N/A**	**$ (11,157)**	**$ (1,974)**

Warning: OFM Assigned Variables Not Used





Baseline Short Description
406 Compliant Gas - No Cooling
Alternative 1 Short Description
406 Compliant Gas - Cooling
Alternative 2 Short Description
406 Compliant Electric

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

Spokane

Executive Report

Project Information	
Project:	
Address:	N/A, N/A, N/A
Company:	RMI
Contact:	Jonny Kocher
Contact Phone:	
Contact Email:	jkocher@rmi.org

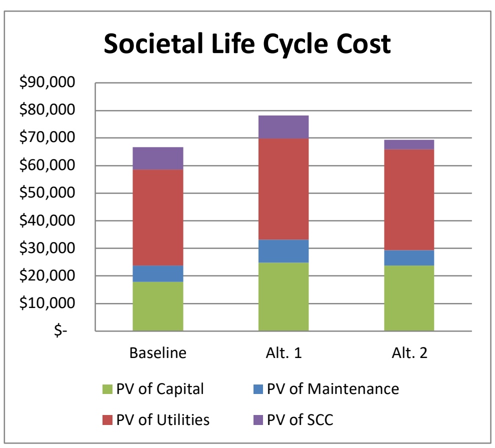
Key Analysis Variables		**Building Characteristics**	
Study Period (years)	50	Gross (Sq.Ft)	2,400
Nominal Discount Rate	5.00%	Useable (Sq.Ft)	2,400
Maintenance Escalation	1.00%	Space Efficiency	100.0%
Zero Year (Current Year)	2020	Project Phase	0
Construction Years	0	Building Type	0

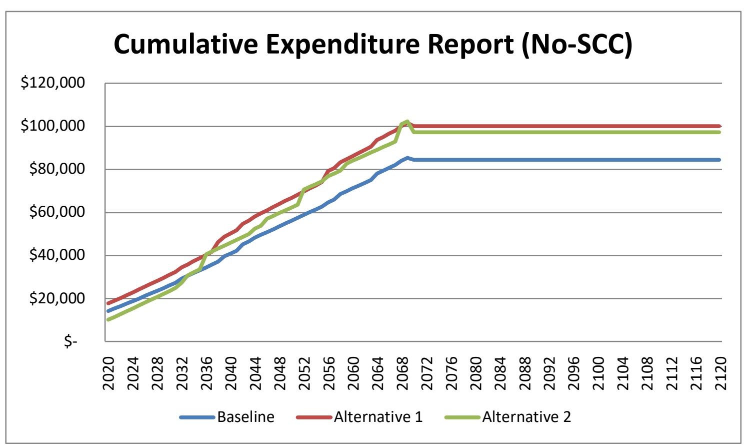
Life Cycle Cost Analysis	**BEST**		
Alternative	Baseline	Alt. 1	Alt. 2
Energy Use Intenstity (kBtu/sq.ft)	24.4	25.3	17.3
1st Construction Costs	$ 14,189	$ 17,721	$ 10,134
PV of Capital Costs	$ 17,836	$ 24,778	$ 23,704
PV of Maintenance Costs	$ 5,893	$ 8,390	$ 5,635
PV of Utility Costs	$ 34,886	$ 36,719	$ 36,523
Total Life Cycle Cost (LCC)	**$ 58,614**	**$ 69,887**	**$ 65,862**
Net Present Savings (NPS)	**N/A**	**$ (11,274)**	**$ (7,249)**

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	125	128	50
% CO2e Reduction vs. Baseline	N/A	-2%	-
Present Social Cost of Carbon (SCC)	$ 8,124	$ 8,330	$ 3,524
Total LCC with SCC	**$ 66,737**	**$ 78,217**	**$ 69,386**
NPS with SCC	**N/A**	**$ (11,480)**	**$ (2,649)**

Warning: OFM Assigned Variables Not Used





Baseline Short Description
406 Compliant Gas - No Cooling
Alternative 1 Short Description
406 Compliant Gas - Cooling
Alternative 2 Short Description
406 Compliant Electric