NORTHWEST GAS ASSOCIATION

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MEMORANDUM

TO: Council Members, Washington State Building Code Council
Mr. Stoyan Bumbalov, Managing Director, Washington SBCC
Mr. Henry Odum, Ecotope

FR: Dan Kirschner, Executive Director
NW Gas Association

DT: April 1, 2022

RE: Follow-up Comments, Analysis & Corrections on the Cost Benefit Analysis "103_Economic_Package", "136_Economic_Package" and "179_Economic_Package"

DELIVERED VIA ELECTRONIC MAIL:
sbcc@des.wa.gov; stoyan.bumbalov@des.wa.gov; henry@ecotope.com

Thank you for the opportunity to review the draft Cost Benefit Analysis at the public hearing on March 16, 2022. While some of the concerns expressed in our March 11, 2022 comment letter were addressed by Ecotope, the draft CBA still failed to address some critical pieces, either adequately or in some cases, at all.

WSEC-C-CR102, 21-GP1-103
Requiring Heat Pumps for Space Heat and Banning Fossil Fuel Heating
Comments on the Cost Benefit Analysis "103_Economic_Package"

GENERAL COMMENTS

- Limited Occupancy Type
  - Only two occupancy types were analyzed – Retail and Office. Space uses with high occupancy loads such as Gyms, Auditoriums, Places of Religious Worship and Classrooms were not included nor analyzed. Both the inclusion and analysis of these spaces is important because of the high corresponding ventilation load in these

occupancy types. Analyzing these space types would show a greater deviation in operating costs between gas and electric heat because tempering outside air in low ambient conditions is likely more expensive when using electric resistance heat.

- <u>Costs of Gas Infrastructure</u>
  - The report references gas infrastructure costs as a “burden” to the building owner, but the owner does not see those costs. Such costs include Plan Review, Meter and Service Extension. According to the Ecotope report, these costs are approximately $18,316. In reality, these costs are incurred by the gas utility provider and should not be included as part of the construction costs paid by the end user.
  - During the Cost Benefit Analysis testimony by Jonny Kocher from RMI, the proposal proponent, he claimed that eventually the rate payer would incur the gas infrastructure expense because the current depreciation schedules used by the gas utility are not aligned with Washington state energy strategy and he assumed, without any foundation or analysis, that the allowances for line extensions will be reduced over time. That is speculation at best and not relevant to this code cycle. That will only become relevant should the Legislature makes the changes that Mr Kocher alludes to, but not before then.

SUMMARY AND RECOMMENDATIONS FOR SPACE HEATING

We would like to emphasize the importance of a thorough, complete and balanced economic study that includes all commercial building types in both predominant Climate Zones of Washington State. The two building types analyzed are arguably the most advantageous for Heat Pumps. Presenting an outdated report from another state does not provide sufficient analysis for the far-reaching economic impacts this proposed code change will have on the commercial building industry.

Additionally, there was no analysis presented concerning the retrofit costs incurred by building owners to convert to heat pumps from gas equipment which may be required by most like-in-kind HVAC system changeouts under section C503.4.5 in the current draft CR102. The absence of any consideration of these costs as a burden to owners represents t best an inaccurate analysis and at worst evidence of a potential bias in the incomplete analysis presented, particularly when the cost of gas infrastructure was inaccurately attributed as a burden to owners.

WSEC-C-CR102, 21-GP1-136
Heat Pump Water Heating
Comments on the Cost Benefit Analysis "136_Economic_Package"

GENERAL COMMENTS

- Limited Occupancy Type
  - Only one occupancy type was analyzed – multifamily housing. For what was supposed to be a complete, not cursory and fragmented analysis, the absence of analysis of the impacts on much higher energy users like hospitals and laboratories is a critical flaw.

- Not Reflective of the Commercial Market
  - The energy saving and carbon impact implications for this single occupancy type appear to be extended to all commercial buildings. Most commercial space – office, retail, etc. – will have much lower domestic hot water demands and will therefore fall under the exceptions in the current version of this proposal. That means under this proposal, most commercial space will be served by electric resistance water heaters, for which the energy and carbon impacts have not been evaluated in any sufficient or reasonable way.

SPECIFIC COMMENTS

- Missing Space Cost Impact
  - No accounting was done for the larger mechanical space required to house the tanks and other appurtenances required for HPWH systems – pumps, more piping, etc. Ecotope asserted, without any particular grounding in research or analysis, that that these mechanical rooms only take up 'waste' space in parking garages. This is contrary to our experience that all space in commercial buildings has a price, whether it consumes available parking spaces or requires additional structure and building materials for a rooftop mechanical penthouse. Ecotope is an experienced expert at designing HPWH systems – they should have exact space requirements for HPWH systems as compared to traditional gas-fired systems, but failed to make that a visible part of their analysis. Please add this cost to the Life Cycle Cost Analysis.
  - For anecdotal reference, we know of a multifamily project under construction with an electric heat pump water heating system. The mechanical room for that project is approximately 1320 square feet – including ventilation shafts required to get air into and out of the space to supply the heat pumps, clearances around heat pumps for airflow and maintenance, etc. We estimate a traditional gas-fired water heater system would occupy 340 square feet. The difference is equivalent to 6 leasable parking spaces – certainly not 'waste' space.

- No OPEX Detail
    - Appendix C of the Ecotope report shows details for capital expenses, but no details for operating expenses. Operating expenses can be significant and impact costs for the life of a building. We ask that this information be shared so that stakeholders are able to assess the completeness of the cost benefit analysis review.

- Life-Cycle Analysis Updates
    - The suggested revisions to water heating operating costs will affect the rest of the cost-benefit and life-cycle analyses. Life Cycle Cost Analyses are typically sensitive to economic inputs. Since operating cost details were not available for public review, the validity of those analyses is in question. This is significant because the Social Life Cycle Cost of the gas-fired and heat pump systems were close – within 5%.

WSEC-C-CR102, 21-GP1-179
Electrical Receptacles
Comments on the Cost Benefit Analysis “179_Economic_Package”. The comments below were not addressed during the March 16, 2022 hearing.

- Estimated Costs Not All-Inclusive
    - The revised cost per receptacle is within reason – for the receptacle itself and wiring to the dwelling unit electrical panel. However, there are many other costs still not accounted for:
        - larger electrical panels in each dwelling unit
        - larger feeders to serve those panels from house panels
        - larger or greater number of house panels
        - larger feeders from main switchgear to those house panels
        - larger switchgear
        - larger feeders from the electrical service to the main switchgear

Also, for a normal project the added cost of utility-side electrical service feeders and transformers will often be borne by the electric utility, but that is not a given. In the case of this proposal, “cost to serve” is more likely since dwelling unit appliance loads will not be online when construction is complete, or anytime soon thereafter.

Please include these additional costs for measure 179 costs into the cost/benefit analysis.

OVERALL SUMMARY AND RECOMMENDATIONS

We strongly encourage the Code Council to require the code change proponents and Ecotope to provide a more thorough economic analysis for these proposed changes before considering putting them into code.

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MEMORANDUM

TO: Council Members, Washington State Building Codes Council (SBCC)
Stoyan Bumbalov, SBCC Managing Director
Henry Odum, Ecotope

FROM: Dan Kirschner, Executive Director

DATE: March 11, 2022

RE: Comments, Analysis and Corrections On Cost Benefit Analyses "103_Economic Package", "136_Economic Package" and "179_Economic Package"

VIA ELECTRONIC MAIL: sbcc@des.wa.gov; stoyan.bumbalov@des.wa.gov; henry@ecotope.com

WSEC-C-CR102, 21-GP1-103
Requiring Heat Pumps for Space Heat and Banning Fossil Fuel Heating
Comments on the Cost Benefit Analysis "103_Economic_Package"

GENERAL COMMENTS

- Not Specific to Washington State
    - The proponent is using source data from a "Reach Code Cost Effectiveness Survey" submitted to the Codes and Standards Program of the State of California. There is no Washington State specific data in this report. It's based on energy studies assuming California Climate Zones and California construction costs.
    - Because the study is based on construction costs in California, it does not account for the more stringent Energy Codes currently in place in Washington State. Therefore, the approximated CAPEX installation costs presented are not an accurate representation of the real, present value build costs in Washington State.
- Not Current
    - The date on the report is 2019. Therefore, construction cost data is at least 3 years old and doesn't reflect present value construction costs, which incurred significant inflation over that time.
- Limited Occupancy Type
    - Only two occupancy types were analyzed – Retail and Office. Space uses with high occupancy loads such as Gyms, Auditoriums, Places of Religious Worship and Classrooms were not included. The analysis of these spaces is important because of the high corresponding ventilation load in these occupancy types. Analyzing these space types would show a greater deviation in operating costs

between gas and electric heat because tempering outside air in low ambient conditions is likely more expensive when using electric resistance heat.

- Irrelevant HVAC System Data
  - One of the two HVAC systems presented for economic analysis is a VAV system with electric resistance heat at VAV zone boxes. However, under Section C403.1.4 of the proposed CR102, electric resistance in VAV terminal units is not allowed. Therefore, half of this analysis is not relevant because the proposed VAV system cannot be legally built in Washington State. Relevant code section language from draft CR102 below…

NEW SECTION WAC 51-11C-40314 Section C403.1.4—HVAC heating equipment. C403.1.4 Use of electric resistance and fossil fuel-fired HVAC heating equipment. HVAC heating energy shall not be provided by electric resistance or fossil fuel combustion appliances. For the purposes of this section, electric resistance HVAC heating appliances include, but are not limited to, electric baseboard, electric resistance fan coil and VAV electric resistance terminal reheat units and electric resistance boilers. For the purposes of this section, fossil fuel combustion HVAC heating appliances include, but are not limited to, appliances burning natural gas, heating oil, propane, or other fossil fuels.

- Irrelevant / Unlabeled Charts and Graphs
  - There are data tables included in this report referencing "Commercial Hot Water Heating" which are not relevant to this code change proposal. There are also graphs without labels and no descriptions to identify what, if any, relevancy they have on the analysis of this report.
- Irrelevant Costs of Gas Infrastructure
  - The report references gas infrastructure costs as a burden to the building owner. Such costs include Plan Review, Meter, and Service Extension. These costs are approximated to be $18,316. In reality, these costs are incurred by the gas utility provider and should not be included as part of the construction costs paid by the end user.

SUMMARY AND RECOMMENDATIONS

The Economic Benefit Analysis provided references one, three-year-old report using data from California. It references only 2 HVAC system types, one of which cannot be legally built in Washington State under current provision of the CR102. It only references two occupancy types, both of which have low to moderate ventilation load which shows an operating cost benefit towards electric heating. This is not a cohesive, standalone document, it contains hyperlinks (some of which are not functional) to other source material that is not pertinent to the supporting data of the analysis in this report.

For the above stated reasons, we are recommending the Economic Benefit Analysis, as submitted, be rejected in its entirety under the grounds that it is insufficient and irrelevant. It does not meet the objective of providing an Economic Analysis for the proposed code measure.

WSEC-C-CR102, 21-GP1-136
Heat Pump Water Heating
Comments on the Cost Benefit Analysis "136_Economic_Package"

GENERAL COMMENTS

- Not Current
  - The submitted cost benefit analysis is based on the initial code change proposal. The analysis has not been revised to reflect the many exceptions now incorporated in the CR102 version.
- Limited Occupancy Type
  - Only one occupancy type was analyzed – multifamily housing. What are the impacts on much higher energy users like hospitals and laboratories?
- Not Reflective of the Commercial Market
  - The energy saving and carbon impact implications for this single occupancy appear to be extended to all commercial buildings. Most commercial space – office, retail, etc. – will have much lower domestic hot water demands and will therefore fall under the exceptions in the current version of this proposal. That means under this proposal, most commercial space will be served by electric resistance water heaters. The energy and carbon impacts of this has not been evaluated.
- Not Locale-Specific
  - Costs for electrical infrastructure upgrades source a CA study, not a prototypical WA construction project.

SPECIFIC COMMENTS

- Missing Space Cost Impact
  - It appears no accounting was done for the larger mechanical space required to house the tanks and other appurtenances required for HPWH systems – pumps, more piping, etc. Based on (4) 2000-gallon tanks, (2) Colmac HP units, (1) recirc heater and associated pumps, we estimate 570 square feet (SF) are needed. A single gas water heater with a recirculation pump could fit in a 70 SF room (or less), a difference of 500 SF. Using an average cost of $225/SF for midrise multifamily housing construction in Washington, that equates to $112,500 additional cost for the HPWH system. Ecotope is an experienced expert at designing HPWH systems – they should have exact space requirements for HPWH systems if our estimate needs refining.
- CAPEX and OPEX Problems
  - Several discrepancies in the system CAPEX and OPEX calculations are identified in the attached. In short, it appears the gas-fired water heater plant is vastly

overpriced while the HWPH plant is underpriced. We expect Ecotope has recent cost data for HPWH plants if the changes proposed need refining. Also, the operating cost of the HPWH plant is understated. Specifically, the *current* code proposal allows resistance heating for recirculation losses, making that the code minimum standard (least cost) – the cost/benefit analysis should match.

- Life-Cycle Analysis Updates
  - The suggested revisions to energy usage, CAPEX and OPEX above will affect the rest of the cost-benefit and life-cycle analyses for multifamily housing. Reworking the proponent's analyses is far beyond the scope of this letter – that work should be performed by the proponent or the economic impact reviewer.

From Page 27 of "136 Economic Package"

AS PROPOSED

RECIRC COP 2.4

SUGGESTED REVISION

RECIRC COP 1

Notes: The final proposal allows electric resistance for recirc heat, therefore that would be "code minimum" - the cheapest and simplest option
The economic analysis should match and use electric resistance, not a heat pump, for recirc heat

AS PROPOSED

HPWH Electic Usage (2.8 COP RCC)	143963	kWh/yr
HPWH Recirc Loss	63145	kWh/yr
HPWH Total Electrical Usage	207108	kWh/yr

SUGGESTED REVISION

HPWH Electic Usage (2.8 COP RCC)	143963	kWh/yr
HPWH Recirc Loss (1.0 COP)	151548	kWh/yr
HPWH Total Electrical Usage	295511	kWh/yr

Notes: Recirc heat is a large fraction (majority) of the total load

AS PROPOSED

Heat Pump Plant	QTY	Unit Price	Install and Markup	Total Costs
Heat Pumps (2) CXA-15 and (1) CXA-10	1	$ 79,000	$ 63,200	$ 142,200
Hot Water Storage (2000 gallons)	4	$ 12,000	$ 9,600	$ 86,400
Controls	1	$ 15,000	$ 20,000	$ 35,000
		$ 106,000	**$ 92,800**	**$ 263,600**

SUGGESTED REVISION

Heat Pump Plant	QTY	Unit Price	Install and Markup	Total Costs
Heat Pumps (2) CXA-15 and (1) CXA-10	1	$ 79,000	$ 63,200	$ 142,200
Hot Water Storage (2000 gallons)	4	$ 40,885	$ 5,942	$ 187,308
Controls	1	$ 15,000	$ 12,000	$ 27,000
		$ 134,885	**$ 81,142**	**$ 356,508**

Source: RS Means, 2022, line# 221223133240, Water heater storage tank, glass lined, 2000 gal
Notes: Storage tanks appear underpriced; Controls install and markup appears overpriced (greater than the 80% Mark Up Cost)
Heat pump plant cost may decrease with electric resistance recirc heater. Does the plant cost include pumps, piping, insulation, etc?

From Page 28 of "136 Economic Package"

AS PROPOSED

Central Gas Boiler	QTY	Unit Price	Install and Markup	Total Costs
Gas Boiler (275,000 BTU/hr)	1	$ 6,200	$ 4,960	$ 11,160
Hot Water Storage (2000 gallons)	4	$ 12,000	$ 9,600	$ 86,400
Controls	1	$ 15,000	$ 20,000	$ 35,000
		$ 33,200	**$ 34,560**	**$ 132,560**

SUGGESTED REVISION

Central Gas Boiler	QTY	Unit Price	Install and Markup	Total Costs
Gas Boiler system (600,000 BTU/hr)	1			$ 40,417
Hot Water Storage (2000 gallons)	0			$ -
Controls	0			$ -
		$ -	$ -	**$ 40,417**

Source: RS Means, 2022, line# D20202502260, gas fired water heater system; line# 221123110510, pump (recirc); plus $2K for flue
Notes: A gas boiler system does not require external storage or controls - they are inherent in the water heater
Gas system sized per AO Smith ProSize online app for 137 unit apartment with in-unit laundry, medium demand profile

AS PROPOSED

Capital Cost	Total Cost
Central Electric HPWH	$ 273,940
Central Gas Boiler	$ 132,560

Operational Cost	Total Cost
Central Electric HPWH	$ 17,728
Central Gas Boiler	$ 14,067

SUGGESTED REVISION

Capital Cost	Total Cost
Central Electric HPWH	$ 356,508
Central Gas Boiler	$ 40,417

Operational Cost	Total Cost
Central Electric HPWH	$ 25,298
Central Gas Boiler	$ 14,067

Notes: Reflecting capital costs and usage changes from above

WSEC-C-CR102, 21-GP1-179
Electrical Receptacles
Comments on the Cost Benefit Analysis “179_Economic_Package”

- <u>Not All-Inclusive</u>
    - The cost per receptacle is within reason – for the receptacle itself and wiring to the dwelling unit electrical panel. However, there are many other costs not accounted for:
        - larger electrical panels in each dwelling unit
        - larger feeders to serve those panels from house panels
        - larger or greater number of house panels
        - larger feeders from main switchgear to those house panels
        - larger switchgear
        - larger feeders from the electrical service to the main switchgear

Also, for a normal project the added cost of utility-side electrical service feeders and transformers will often be borne by the electric utility, but that is not a given. In the case of this proposal, “cost to serve” is more likely since dwelling unit appliance loads will not be online when construction is complete, or anytime soon thereafter.

Please include these costs in the cost/benefit analysis.

###

WASHINGTON PUBLIC UTILITY DISTRICTS ASSOCIATION
WPUDA
YOUR connection

March 8, 2022

Mr. Stoyan Bumbalov
Managing Director
State Building Code Council
Washington State Department of Enterprise Services
1500 Jefferson St SE

Olympia, WA 98501

RE: Proposed Changes to the Washington State Commercial Building Code: Requirement for On-Site Renewable Energy for Commercial Buildings over 10,000 square feet - Section # C411, with carry over to C406, C407

Dear Mr. Bumbalov:

In our letter of September 13, 2021, the Washington Public Utility Districts Association (WPUDA) strongly implored the State Building Code Council (SBCC) to defer action on the proposed code change that would mandate on-site renewable energy for commercial buildings over 10,000 square feet (Section #C411). Our letter demonstrated that the proponent's Initial Cost-Benefit analysis was deeply flawed. As such, the SBCC has no reasonable basis to conclude that the probable benefits of this proposal exceeds its probable costs; or that it would impose the least burden necessary to achieve the general goals and specific objectives of the statute it implements. These are non-discretionary findings that our state legislature requires the SBCC to make for each distinct part of proposed significant legislative rules (see RCW 34.05.328)[1].

[1] The state legislature, when amending the administrative rulemaking procedures in 1995 declared that: "…Washington's regulatory system must not impose excessive, unreasonable, or unnecessary obligations; to do so serves only to discredit government, makes enforcement of essential regulations more difficult, and detrimentally affects the economy of the state and the well-being of our citizens."

While taking no position on the proposed requirement for on-site renewable energy for commercial buildings over 10,000 square feet, WPUDA reminds the SBCC of the seven fundamental flaws in the initial Cost-Benefit analysis identified in our September 13, 2021, letter. We enclosed that letter so that it may be included in the official rulemaking record.

Furthermore, by this letter we add an important eighth item that fundamentally affects the cost-effectiveness of larger on-site generation systems. A super majority of utilities in Washington state purchase wholesale power from BPA under terms specified in Tier I contracts. Those terms impose significant consequences on utilities when their customers install generating resource(s) larger than 200kW in capacity:

- If all or part of a consumer-owned resource reduces the retail load served by the host utility, then that utility's rights to Tier 1 or Tier 2 purchases is decremented.
- BPA requires the host utility submit a small generation interconnection request and a $2,500 application fee.
- The host utility must obtain a transmission interconnection agreement with BPA that meets certain requirements:
    - Compliance with BPA's open access transmission tariff for small generation;
    - Compliance with NEPA standards;
    - Revenue quality metering with hourly values available via telephone dial-up;
    - Protective relaying to prevent islanding when isolated from the grid;
    - Multi-party operations & maintenance agreements among participants in the project; and
    - Participation by local serving utility staff and their active communications with the BPA Dispatcher.

Enclosed is a document from BPA that provides more information about the requirements it places upon utilities should a utility customer seek to interconnect a generating facility larger than 200kW.

WPUDA brings these contract terms to the attention of the SBCC because of the 249kW solar system required for the "Large Office" prototypical building. The proponents' Cost-Benefit analysis included none of the costs associated with the consequences triggered by this larger than 200kW generating system. It is important to note that the proposed code mandating "On-Site Renewable Energy for Commercial Buildings" has no upper limit size of the generation system that must be installed.

In conclusion, WPUDA reminds the SBCC that our request is only that you defer action on the proposed code change **On-Site Renewable Energy for Commercial Buildings Over 10,000 - Section # C411, with carry over to C406, C407**. We make this request so that the Technical Advisory Group may correct the fundamental flaws in the accompanying initial Cost-Benefit analysis. It is WPUDA's firm conviction that the SBCC can neither affirm that the proposal satisfies the standards set by the legislature for significant legislative rules, nor assess whether the proposal is in the public interest without an accurate and sound economic analysis.

Finally, WPUDA stands ready to assist the SBCC in correcting flaws in the Financial Analysis so that it more accurately and fairly reflects the likely financial impacts to citizens of this state.

Sincerely,

Nicolas Garcia, Policy Director
Washington Public Utility Districts Association

enclosures

March 9, 2022

Stoyan Bumbalov, Managing Director
Washington State Building Code Council
PO BOX 41449
1500 Jefferson St SE
Olympia, WA Z98504

sbcc@des.wa.gov

Re: WSEC-2021 Preliminary Cost Benefit Analysis – Public Comment

Dear Mr. Bumbalov,

Please find enclosed our public comments on the Preliminary Cost Benefit Analysis (CBA) pertaining to the major proposed changes in the WSEC-2021 CR-102. We appreciate the opportunity to participate in the code development process. We hope our comments on proposals 103 and 136, based on decades of industry experience, are fully considered for integration into the final Cost Benefit Analysis.

Energy codes are essential tools in decarbonizing the built environment and the construction industry at large. So, the key question before the council is not if, but how to move forward responsibly. Understanding what code proposals do *not* require is just as important as understanding what they intend to accomplish. If I can emphasize two critical points, it is that 1) the proposed heat pump space heating and heat pump water heating proposals (primarily) only impact new construction, and 2) new construction is where these technologies are integrated for little or no cost premium. McKinstry fully supports the heat pump space heating and heat pump water heating proposals because they target the most feasible and cost-effective place to create impact and enable a ramp period for us collectively, industry participants, building owners and manufacturers, to get ready for more sweeping electrification code changes coming in the future.

Please do not hesitate to contact me with any questions or clarifications.

Sincerely,

Michael Frank, P.E. | Vice President, Engineering & Design, McKinstry
206.832.8484 | michaelf@mckinstry.com

WSEC-2021 Preliminary CBA Public Comment

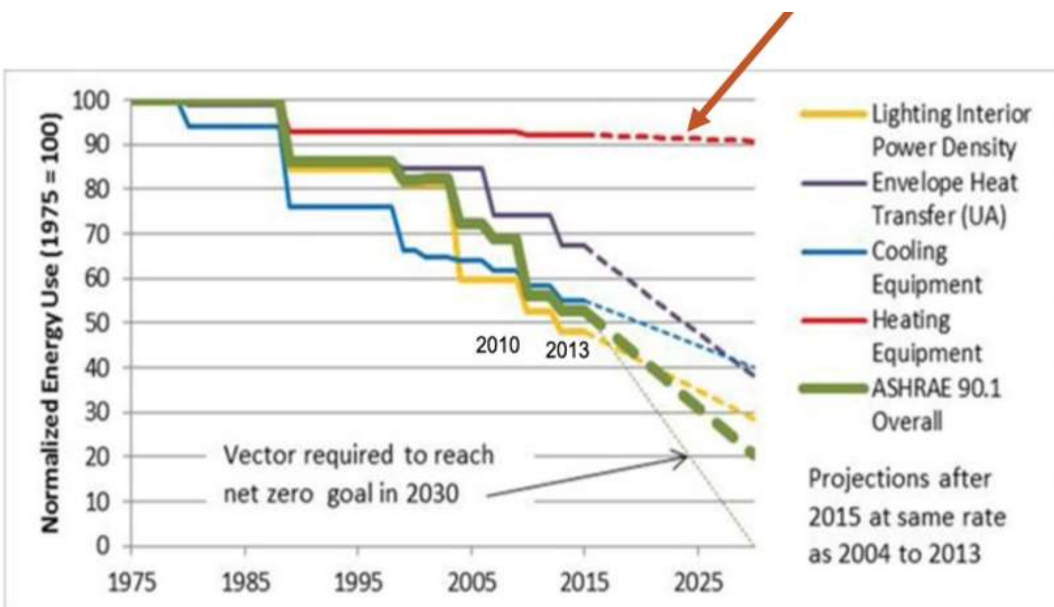
GENERAL COMMENTS: PAGES 1-3

While much of the cost benefit analysis is at the individual building level, it is important to consider community level costs and benefits. Many safety and environmental requirements don't provide a financial return at the individual level. This is part of why the Administrative Procedure Act exists – to ensure Washington State agencies consider statewide and long-term costs and benefits to our collective community. Adding a note to this affect in the first few pages of the CBA would be beneficial.

HEAT PUMP SPACE HEATING AND WATER HEATING, PROPOSALS 21-GP1-103 AND 136

Brief Description: We suggest adding a sentence at the end of the description to clarify the proposal has minimal impact on existing buildings and ***does not require existing building conversions to heat pumps*** except in the case of major renovations. Much discussion of this proposal has focused on challenges with existing building retrofits; it is critical that stakeholders understand the impact of this proposal is 99% on not-yet constructed new commercial buildings. Buildings built today will last for generations – we must ensure they are set up for long-term success, not costly near-term retrofits.

Purpose of Code Change: One element missing from this section is a discussion of the limited progress of the WSEC in terms of heating efficiency. Our national model and state codes have been immensely successful in improving envelope, lighting, and cooling performance; however, we've made little progress in heating efficiency since the 1970's. Without targeted heating efficiency requirements, we are missing important opportunities to meet our seventy percent energy reduction and zero fossil-fuel greenhouse gas emissions buildings targets.



Improvement in ASHRAE Standard 90/90.1 (1975-2013) with Projections to 2030. Courtesy of Pacific Northwest National Laboratory.

Review Process: No comments.

Probable Benefits vs Probable Costs: Our thoughts regarding additional context and content to potentially be included in this section are provided here.

Regarding Probable Costs:

- The submitted LCCA is imperfect in that it does not account for the probable need of near-term retrofits of baseline fossil fuel-fired heating systems. **When that cost is added in year 7 or 10, a heat pump system installed in year 0 will always be more cost effective.** Industry knowledge today suggests electric heat pumps are a less risky solution (in terms of acquiring needed heating emissions reductions) than relying on alternative pathways. It is critical for Washington Stakeholders to understand that we can accrue deep energy and emission savings for little or no upfront cost if heat pumps are incorporated into new buildings now. Retrofitting buildings is a far more challenging hurdle; possible, but more difficult.
- If costs are isolated to individual elements, percent differences amongst mechanical systems or components can be quite high. Evaluation of **total MEP system costs** inclusive of all impacted systems and design and construction costs is more appropriate. Through this lens, the impact of the heat pump space heating proposal on total installed and commissioned MEP system cost is anywhere in the range of -3% to +5%. MEP system cost is in turn only a portion of total project cost, often dominated by land acquisition, architectural, structural, and tenant or occupant needs.
- The first cost premium or savings from a heat pump system is highly dependent on both the selection of the baseline and the proposed system type. While a heat pump VRF system is certainly less costly than a gas boiler and air-cooled chiller hydronic design, an air-to-water heat pump hydronic system compared to an all air-based DX-gas RTU option will certainly show a premium. An owner who may have opted for rooftop DX gas units can now select rooftop heat pumps. An owner who may have selected gas-fired boilers can now select air-to-water heat pumps with electric boilers (or with gas-fired boilers in climate zone 5). That is all to say that there is flexibility in how a building owner can choose to meet the proposed requirements. And with flexibility in approach and design comes flexibility and variation in first cost.
- Code requirements have a history of driving down costs through innovation and economies of scale. Our market has adapted and innovated to react to efficiency stringency changes for chillers, for DOAS, and for controls (as examples). With the adoption of this provision, we would expect new equipment options to only continue expanding, driving down costs and increasing competition.
- Importantly, a growing portion of new commercial construction square footage is already subject to these requirements as Seattle, Shoreline, Bellingham, and others have adopted or are considering adopting these amendments. These early adopters are shouldering learning and training costs that will benefit other Washington communities should these proposals get adopted statewide.
- Lastly, costs and case studies of potential alternatives to electric heat pumps such as gas-engine heat pumps, gas-fired absorption heat pumps, green hydrogen, or renewable natural gas have not been made available for stakeholder consideration.

Regarding Probable Benefits:

- With code-driven changes, suppliers have dependable markets and buyers, designers and engineers have clear direction, building owners have leverage to drive innovation, and everyone moves forward together – ultimately driving down costs and normalizing change. A major benefit of driving the adoption of heat pumps through the energy code is this step-level change, resulting in overall statewide cost savings. This same rate of change is not easily accomplished in new construction through other mechanisms such as utility incentives or tax credits.

- It is likely that an outcome of this requirement will be the installation of cooling in more multi-family housing. While this benefit will increase summer energy use, it will also improve the quality of life for many thousands of Washingtonians.
- Another likely outcome of this code proposal is greater engagement between utility providers and building operators to leverage load management measures to mutual advantage and cost savings. A key benefit of the heat pump water heating proposal is built-in thermal storage. This system storage not only enhances localized building resiliency but is potentially a future cash-flow if utilities incent load shifting.
- In terms of safety and air quality, combustion-free designs exclude use of the Fuel Gas Code and eliminate items such as utility trenching, gas piping, gas meters, gas regulators, combustion ventilation air and exhaust infrastructure, safety sensors for carbon monoxide, safety alarms, and safety shut-off valves.

JOHNSON ECONOMICS

MEMORANDUM

DATE: March 11, 2022

TO: Tamy Linver
NORTHWEST NATURAL GAS

FROM: Jerry Johnson
JOHNSON ECONOMICS LLC

SUBJECT: Review of Proposed Changes to the 2021 Washington State Energy Code, Commercial Provisions

I. INTRODUCTION

The State of Washington adopted a State Energy Code Act (RCW 19.27A), which provides statutory authority and formal goals for the adoption and amendment of the Washington State Energy Code. The primary goal is to construct increasingly energy efficient homes and buildings, with a targeted 70% reduction in annual energy consumption by 2031. Available data through 2018 indicates that the state is well short of meeting its goal, and there is a need for a significant reduction to catch up.

The Washington State Building Code Council (SBCC) is currently considering amendments to the state energy code. This memorandum summarizes our review of the proposed amendments to the commercial provisions, with a focus on three specific proposals (21-GP1-103, 21-GP1-136, and 21-GP1-179).

Our analysis is based on materials made available through the SBCC, including the Preliminary Cost Benefit Analysis for the 2021 Washington State Energy Code, Commercial Provisions as well as proponent's cost benefit analyses. We recognize that additional materials are likely to be generated as consideration of these code amendments proceeds, and we would appreciate the opportunity to review on comment on these when available. Based on our review of materials available at this time, many of the proposals are supported by inadequate analysis and often flawed underlying assumptions. Assuring that the amendments are accurately assessed is critical to informing consideration of these changes.

II. RULE CHANGES AND GENERAL COMMENTS

The following is a brief overview of the three proposed amendments addressed in this memorandum:

Number	Rule Title	Summary of Changes
21-GP1-103	Heat Pump Space Heating	Provide heat pump space heating, rather than fossil fuel or electric space heating, for all buildings. Exceptions are provided to allow electric resistance heating for small loads and as supplementary heat., as well as allowing fossil fuel auxiliary heat in Climate Zone 5 under certain conditions
21-GP1-136	Heat Pump Water Heating	Provide heat pump water heating rather than fossil fuel or electric resistance water heating in commercial buildings. Exceptions are provided to allow electric resistance heating for hand washing facilities.
21-GP1-179	Electric Receptacles at Gas Appliances	Where dwelling unit appliances are served by natural gas, an electrical receptacle or junction box and circuit shall be provided at each gas appliance with sufficient capacity to serve a future electric appliance in the same location. The receptacles and circuits shall be included in the electrical service load calculation. An electric receptacle is not required for a decorative gas fireplace.

The SBCC has stated that proposals should be cost-effective to building owners and tenants. The SBCC has defined cost-effectiveness as a code change that has a net present savings over a 50-year life cycle of a building utilizing the Life Cycle Cost Tool (LCCT) developed by the Office of Financial Management. The tool uses a series of assumptions to calculate the net present savings of each amendment.

A key variable underlying the model and conclusions is the assumed discount rate for cash flows. The current assumption in the model is 3.814%. This discount rate may be appropriate for public sector investments but is well below what would be assumed in the private sector. A discount rate for private investment in commercial real estate would significantly higher, typically in the 4.75% to 7.5% range.

Discount rates are a function of a broad range of variables and expectations, but the most significant is the cost of debt and equity. Public sector projects can get 100% financing at very low interest rates, terms that are not available to the private sector. The current model assumes GO Bond rates at 2.88%, COP rates at 2.98%, and conventional rates at 3.25%. Private sector debt on a commercial real estate project would be available at maybe 3.75% to 5.5% in the current market, and these rates are historically low. In addition, a private development would only be able to obtain debt for 70% to 75% of their project, and the return on equity would be significantly higher. The overall discount rate for a privately owned commercial development is more likely to be in the 5.50% to 7.50% range.

The general methodology is sound, but the assumptions are incorrect for this application. Using a public sector discount rate is highly inappropriate in evaluating a private sector investment. The use of a significantly below market discount rate overvalues savings in later years relative to front end investments. Many of the proposals rely upon significant social benefits in out years, which are overvalued if the discount rate is below market. As a result, any measure of cost effectiveness would need to be assessed again using the appropriate discount rate.

III. Review of Specific Proposed Amendments

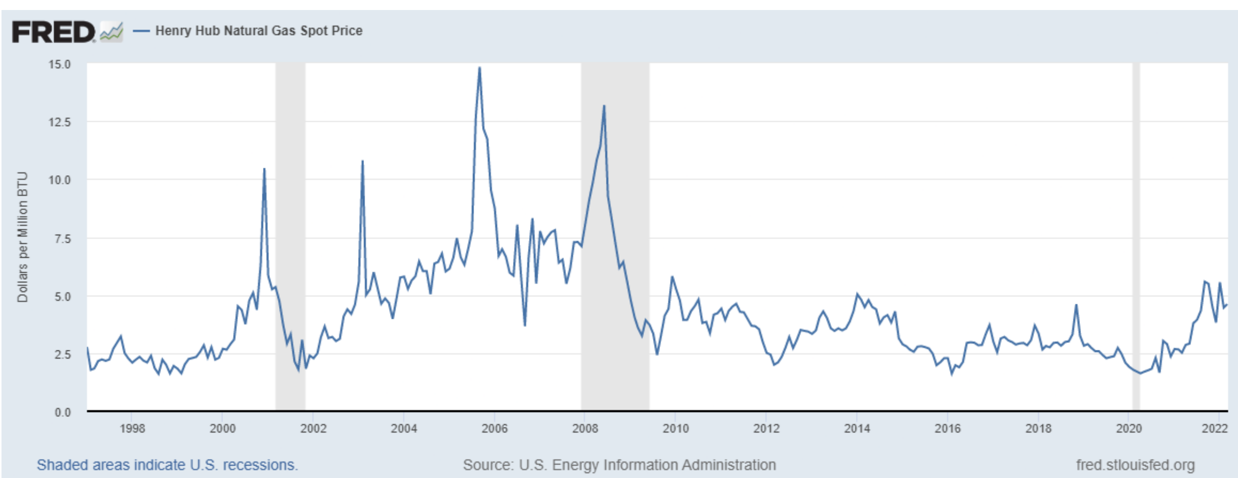
21-GP1-103 – Heat Pump Space Heating

This proposal requires the utilization of heat pump space heating in all buildings. The purpose statement for this proposal states that heat pump space heating is generally two to four times more energy efficient than fossil fuel or electric resistance heating.

The probable benefits vs. probable costs statement notes the following:

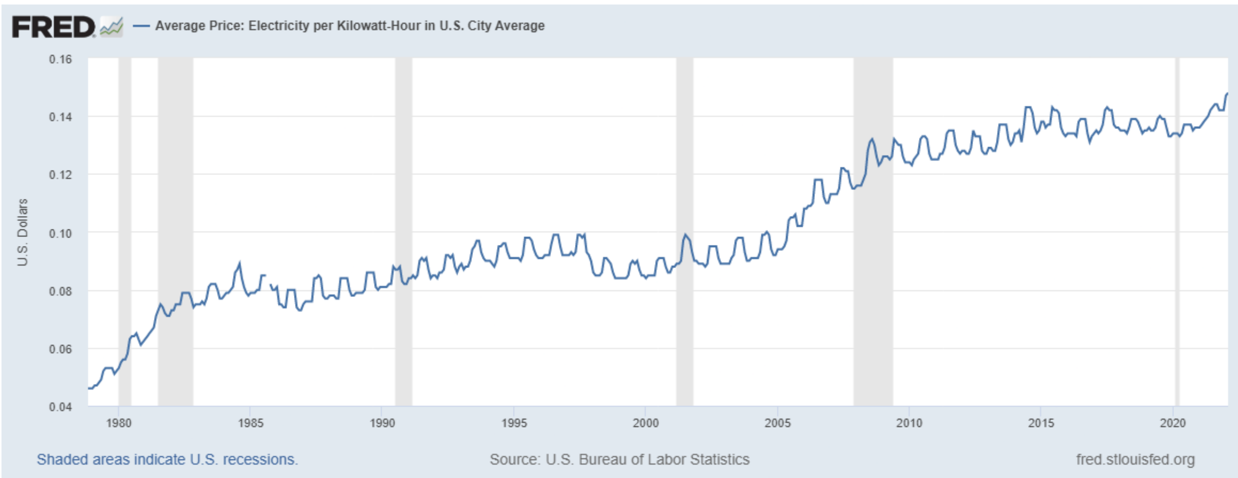
- Construction costs are generally higher
- Annual energy costs same or slightly higher than gas at current rates
    - Cites World Bank long term forecast of 80% increase in natural gas prices over coming decade as mitigating factor
- Including social cost of carbon, heat pump space heating is more cost effective over life cycle.

We have several issues with the statements in the cost benefit analysis. While the proposal includes a citation to a World Bank long term forecast of an 80% increase in natural gas prices, we have been unable to verify this forecast. We were able to find a wide range of alternative forecasts with much different conclusions. If we look at historic natural gas spot prices, the current pricing is largely consistent with historic norms, and there is little historic precedence for a sustained increase of 80%.



The preceding spot prices are in nominal dollars. If adjusted for inflation, the real spot price for natural gas has dropped 32% since 1997. Currently, Natural Gas is trading at $4.61 per MMBtu. Future pricing is extremely difficult to forecast, but natural gas has become easier to acquire thanks to new technologies and mining methods, increasing prospective supply in the market.

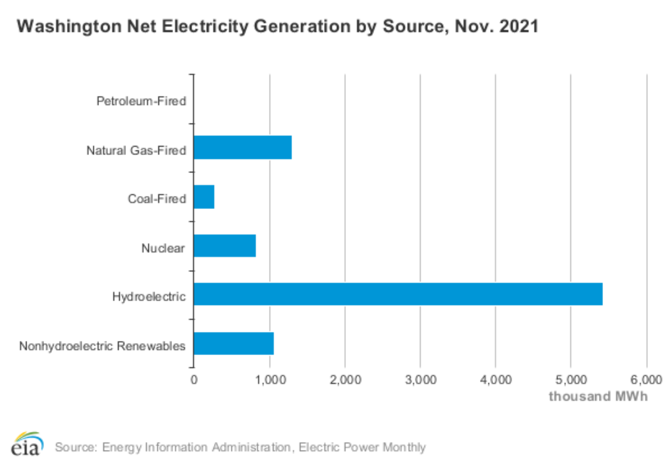
In the context of a cost benefit analysis over the lifetime of a system, the long-term future natural gas and electricity pricing at the market level is most relevant. Natural gas pricing at the consumer level if largely correlated with electrical rates, as the two sources of energy are substitution goods and as such their relative price is linked.



Natural gas is also one of the most significant components of electrical production, further linking pricing. There is little evidence to support a significant long-term variation in pricing trends between electricity and natural gas. The lifecycle cost analysis report submitted with the proposal indicates that any cost saving between the baseline and heat pump alternative are associated with differential energy costs.

If this differential is not assumed, the only advantage indicated for the heat pump alternative is associated with societal costs associated with tons of CO2. The "social cost of carbon" does not reflect a realized cost for a building owner and tenant, and any benefit they accrue represents only a small portion of the assumed reduction in "social cost". The SBCC cites a need for proposals to be cost-effective for the building owner and tenant, and it is important in assessing the impact to these parties that the costs and benefits that accrue to these two parties are kept separate from any broader social accounting.

I am uncertain how emissions related to electricity production are factored into the modelling, but it is important to recognize that fossil fuels remain a significant source of electrical production. Natural gas accounted for 1.3 million MWh of electrical generation in the State of Washington in 2021 and may account for a larger proportion of new marginal production. Coal fired power plants also accounted for 267 thousand MWh of generation. The Clean Energy Transformation Act (CETA) will permit the use of natural gas in generation until 2045.



To the extent the proposal requires existing buildings to be retrofitted to come into compliance with the new code over time, building owners and tenants may realize significant costs to modify their existing HVAC systems to support a heat pump unit.

The marginal benefits provided by this change are negligible, less than 0.16% without including social costs and 2.1% with social costs included. This modest advantage would likely be eroded if space costs were included, and an appropriate discount rate was used in the analysis.

21-GP1-136 – Heat Pump Water Heating

This proposal requires the utilization of heat pump water heating in commercial buildings. The purpose statement for this is similar to that of 21-GP1-103 and focuses on a higher level of assumed energy efficiency and an associated decrease in greenhouse gas emissions. The code allows like-for-like replacement of existing water heaters to mitigate negative impacts on existing buildings.

The probable benefits vs. probable costs statement notes the following:

- The average net present value capital costs would increase roughly $2.47/square foot under this proposal
- The life cycle costs will increase by approximately $2.43/square foot excluding social costs of carbon.
- Including social cost of carbon, heat pump water heating is more cost effective over life cycle, with a $0.38/square foot savings.
- A central gas boiler system had the lowest life cycle costs with and without the inclusion of the social cost of carbon in the initial run.

The cumulative expenditure report provided using the Life Cycle Cost Analysis Tool indicated that a gas boiler system would have total life cycle costs of $796,355, 64% of the estimated costs for a heat pump system. Even with societal life cycle costs incorporated, the central gas boiler has the lower life cycle costs under the baseline assumptions. The heat pump system has a modest advantage in costs if assumed social costs are increased by 3%. As noted previously, the "social cost of carbon" does not reflect a realized cost for a building owner and tenant, and any benefit they accrue represents only a small portion of the assumed reduction in "social cost".

The analysis was only run for multifamily housing and did not consider costs under other land use types. The analysis does not appear to have considered the cost associated with larger space needs for mechanical systems.

As noted in the LCC analysis, the life cycle of a central boiler system is significantly longer than that of a heat pump system. Additional emission impacts associated with manufacturing and transportation of the additional systems does not appear to be accounted for. Increased emissions from electrical generation also does not appear to be incorporated in the analysis.

This proposal clearly does not meet the SBCC mandate under their definition that proposals be cost-effective to building owners and tenants. While assumptions were altered in the LCCT to indicate a modest advantage if elevated social costs were included, this advantage would likely not hold up if an analysis with an appropriate discount rate was used.

21-GP1-179 – Electrical Receptacles at Gas Appliances

This proposal requires an electrical receptacle or junction box be placed at the location of installed gas appliances to enable future "plug and play" installation of electrical appliances. The intent is to reduce the cost of potential future retrofitting to electric appliances.

The probable benefits vs. probable costs statement notes the following:

- There is an estimated cost of $250 per receptacle with no associated energy savings
- Assuming one gas appliance in a 750 square foot apartment, the cost would be $0.33 per square foot.

There was little documentation of the life cycle costs of this improvement, which likely reflects its limited direct costs. The cost estimate appears to exclude additional electrical capacity required, as well as the incremental cost of additional conduit and wiring.

The analysis provided for this proposed amendment is limited and does not appear to be complete.

March 11th, 2022

To: Chair Andrew Klein, WA State Building Code Council
cc: Members of the State Building Code Council

RE: Technical Comment in Support of Heat Pump Proposals 103 and 136 - WSEC-C

The undersigned organizations are writing in support of heat pump proposals 103 and 136 in the 2021 Washington State Energy Code - Commercial Edition (WSEC-C). Below is a summary list of the benefits of the heat pump proposals, linked to more detailed information. We hope this information helps members of the State Building Code Council in understanding why these proposals are the right step forward for Washington in its path to decarbonize the building sector.

- **Efficiency and Decarbonization** — Because heat pumps are 2-3 times more efficient than electric resistance or combustion gas equipment, they can play a significant role in keeping the SBCC on track to meet 70% energy use reduction requirements. In addition, the 2021 Washington State Energy Strategy states that building electrification is "the least-cost strategy" to decarbonize the building sector. The Washington State Energy Strategy also recommends "policies and actions required to implement an electrification strategy in Washington buildings." Waiting until 2030 to implement these changes would emit an additional 4.3 million tonnes of CO_2e from burning natural gas by 2050.
- **Cold Climate Performance** — The Northeast Energy Efficiency Partnerships (NEEP) Cold Climate Air Source Heat Pump database currently contains thousands of heat pumps that can operate in Eastern Washington. These products are tested and rated to provide heating safely and efficiently down to 5 degrees Fahrenheit and below, with minimal impacts to capacity or efficiency.
- **Economic** — Research suggests that when the cost of the gas infrastructure in buildings is included, the total system cost of dual-fueled buildings is often more expensive than all-electric buildings. The Washington 2021 State Energy Strategy concluded that building electrification was the "least-cost strategy to meet the state's greenhouse gas emissions limits for buildings".
- **Health** — An estimated $110 million dollars in health impacts annually can be attributed to burning fossil fuels in commercial buildings in Washington. The proposed code changes move us away from burning fossil fuels in buildings that contribute to hazardous air quality

impacts, and toward cleaner, more efficient sources to heat our buildings.

- **Grid Impact** — The transition to electric buildings won't happen overnight. Over the next three decades, utilities will be taking a lead role and planning for a transition to all-electric buildings.The Northwest Power and Conservation Council notes that regardless of any potentially increased peaks due to building electrification the "council's plan makes sure that NW region has reliable power."
- **Limited Role of "Renewable Natural Gas"** — An investigation of data from an American Gas Foundation study found that after two decades of ramping up supply, RNG will only be able to supply 6 to 13% of the nation's total gas consumption.
- **Manufacturers Readiness** — Manufacturers and distributors such as Nyle Water Heating Systems, Colmac, Small Planet Supply, Mitsubishi, Trane, Johnson Borrow, AirReps, and ARMEC have given either written or oral support for the heat pump proposals.

In light of the benefits of building electrification, the undersigned organizations urge the SBCC to vote to approve proposals 103 and 136.

Thank you for your consideration.

Dylan Plummer
Senior Campaign Representative
Sierra Club

Rachel Koller
Coordinator
Shift Zero

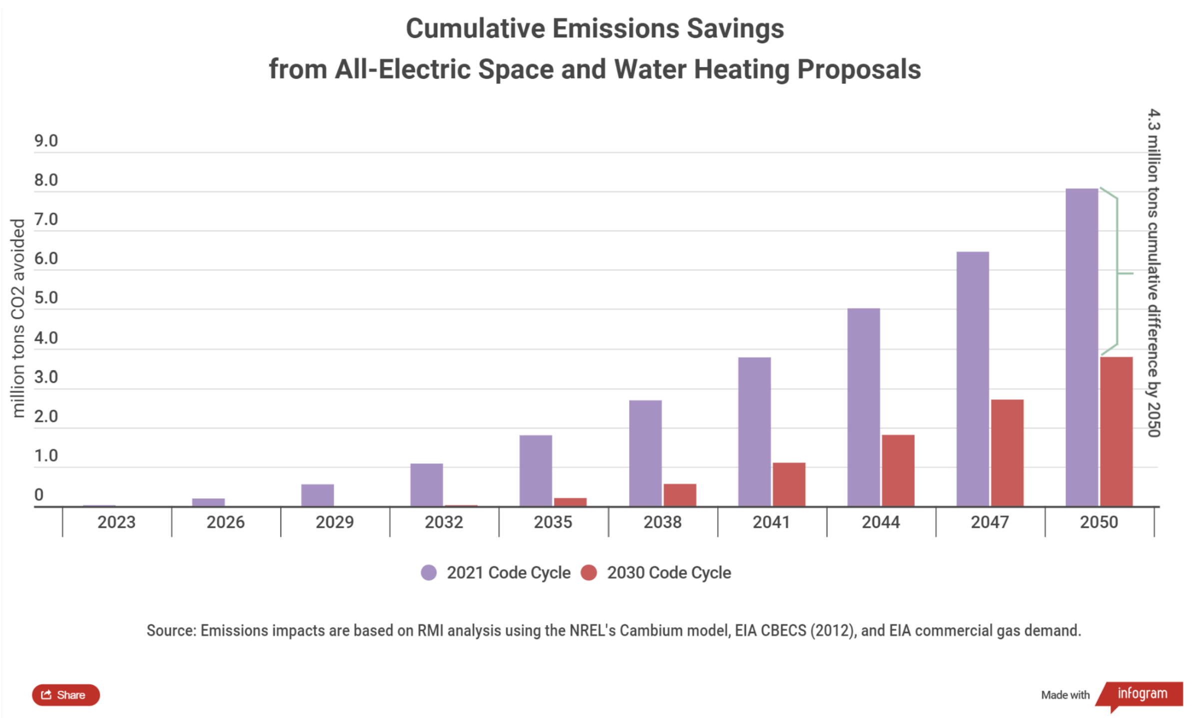
Jonny Kocher
Senior Associate
RMI

Alejandra Mejia Cunningham
Senior Building Decarbonization Advocate
NRDC

Deepa Sivarajan
WA Clean Buildings Policy Manager
Climate Solutions

Efficiency and Decarbonization

By law, the SBCC must achieve a 70% reduction in annual net energy consumption, using the adopted 2006 Washington state energy code as a baseline.[1] Additionally, Washington must reduce 95% of its emissions from a 1990 baseline by 2050.[2] Research by RMI has found that electrifying buildings will significantly reduce emissions in Washington. The New Economics of Electrifying Buildings report showed that a new all-electric home in Seattle would reduce emissions by 93% compared to a new mixed-fuel home.[3] The analysis considered the cumulative emissions over the 15-year lifetime of all-electric appliances installed today, based on a future projection of grid energy sources conducted by the National Renewable Energy Laboratory (NREL). These substantial emission savings arise because heat pumps are 2-4 times more efficient than gas appliances, and the electricity sector in Washington is already over 80% carbon free.[4] Given that Washington's Clean Energy Transformation Act requires the state to have 100% carbon-free electricity generation by 2045, and carbon-neutral generation by 2030, an all-electric building built today will be a carbon-free building in the future.[5] RMI also did an emissions analysis for the two heat pump proposals. The analysis found that by implementing these proposals this code cycle, Washington will reduce 8 million tonnes of CO_2e by 2050 due to avoided natural gas usage.[6] If the SBCC were to wait until 2030 to implement these proposals, the emission reductions by 2050 would be less than half that amount.



[1] https://app.leg.wa.gov/rcw/default.aspx?cite=19.27A.160
[2] https://apps.leg.wa.gov/rcw/default.aspx?cite=70A.45.020
[3] RMI, The New Economics of Electrifying Buildings (2020)
[4] https://www.eia.gov/state/?sid=WA#tabs-4
[5] https://app.leg.wa.gov/RCW/default.aspx?cite=19.405.010
[6] https://rmi.org/washington-state-could-lead-the-nation-on-building-electrification-codes/

Cold Climate Performance

The Northeast Energy Efficiency Partnerships (NEEP) Cold Climate Air Source Heat Pump database currently contains thousands of tested and rated cold-climate commercial and residential air source heat pump products from dozens of manufacturers, available within the United States.[7] These products are tested and rated to provide heating safely and efficiently down to 5 degrees Fahrenheit and below, with minimal impacts to capacity or efficiency that used to occur with older heat pump models. 5 degrees Fahrenheit is the design outdoor air temperature for ASHRAE Climate Zone 5B (Spokane, WA), applicable to the Eastern half of Washington state; cold climate heat pumps will work throughout this state.[8]

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[7] NEEP, ccASHP https://ashp.neep.org/
[8] ASHRAE Climatic Design Conditions, 2017, Spokane International AP, IP, https://bit.ly/3EYdF3i

Economic

The federal government and state governments have consistently shown that building electrification is the least-cost strategy to decarbonize the building sector.[9, 10, 11] According to the Washington 2021 State Energy Strategy, a report directed by the legislature and completed by the Department of Commerce:

> "The deep decarbonization modeling analysis...identified a combination of energy efficiency and electrification as the least-cost strategy to meet the state's greenhouse gas emissions limits for buildings. Consistent with this finding, this chapter recommends policies and actions required to implement an electrification strategy in Washington buildings."[12]

Research shows that when the cost of the gas infrastructure installed to buildings is included, the total system cost of mixed-fueled buildings is often more expensive than all-electric buildings.[13, 14] As an example, these results were found in 2021 research jointly conducted by Arup and NBI, based on work funded by NRDC, that developed cost estimates for electrification of space heating and water heating for a single-family residential and medium office prototype in climate zone 5A.[15] When including the costs of electric and gas infrastructure, the results indicate modest increments and even net savings in some cases:

- For a prototypical medium office, the incremental capital cost of full electrification came to +$42,400 ($0.79/SF), fully burdened and inclusive of the costs associated with more electrical infrastructure and no/removed gas infrastructure.
- For a prototypical single family home, the fully burdened incremental capital cost of full electrification came to -$5,600 (-$1.58/SF), indicating a net capital savings which was primarily associated with no/removed gas infrastructure. Including those costs for an efficient, but dual-fuel gas/electric prototypical single family home, resulted in an incremental capital cost of $2,700 ($0.77/SF).

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[9] *Carbon Neutral Pathways for the United States*, American Geophysical Union, at pg 3 (2020) https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2020AV000284

[10] *Deep Decarbonization Pathways in the United States*, E3, at pg 19 (2014) https://usddpp.org/downloads/2014-technical-report.pdf

[11] *Achieving Carbon Neutrality in California*, E3. at pg. 8 (2020) https://ww2.arb.ca.gov/sites/default/files/2020-08/e3_cn_draft_report_aug2020.pdf

[12] *Washington State Energy Strategy*, at pg. 67 (2021) https://www.commerce.wa.gov/wp-content/uploads/2020/12/Washington-2021-State-Energy-Strategy-December-2020.pdf

[13] RMI, Heat pumps for Hot Water (2020) at 6, https://rmi.org/insight/heat-pump-hot-water-cost/

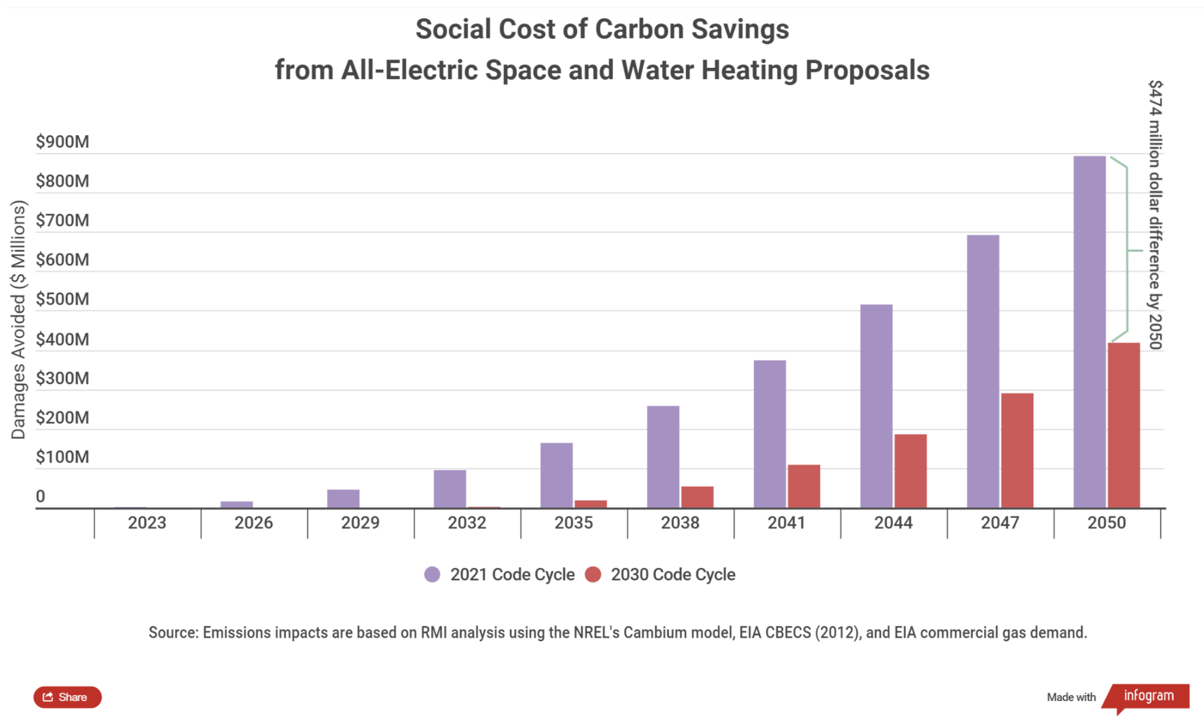
[14] RMI, Economics of Electrifying Buildings at 29 (2018), https://rmi.org/insight/the-economics-of-electrifying-buildings/

[15] Report forthcoming. Please email Jonny Kocher for more information on report (jkocher@rmi.org)

Health

Additionally, it is critical to consider the benefits that the proposed energy code changes would provide for public health in light of the growing body of science demonstrating the massive air quality impacts of gas appliances. According to a Harvard study, burning fossil fuels in commercial buildings caused $110 million in health impacts in Washington state in 2017.[16] This is a conservative estimate because it only includes health impacts from outdoor $PM_{2.5}$ and precursor pollution; it also does not include pollution from upstream extraction. These air quality impacts disproportionately affect low-income and Black, Indigenous and People of Color (BIPOC) communities. The proposed changes to the code would have the benefit of dramatically reducing new contributions to this health, economic and racial justice issue.

When evaluating the cost-benefit analysis for each code proposal, the Washington Office of Financial Management recommends using a social cost of carbon, with a discount rate of 2.5 percent, to account for the societal impacts of greenhouse gas pollution. By that accounting, the 2022 building code proposals will avoid $900 million dollars in damages by 2050.[17]

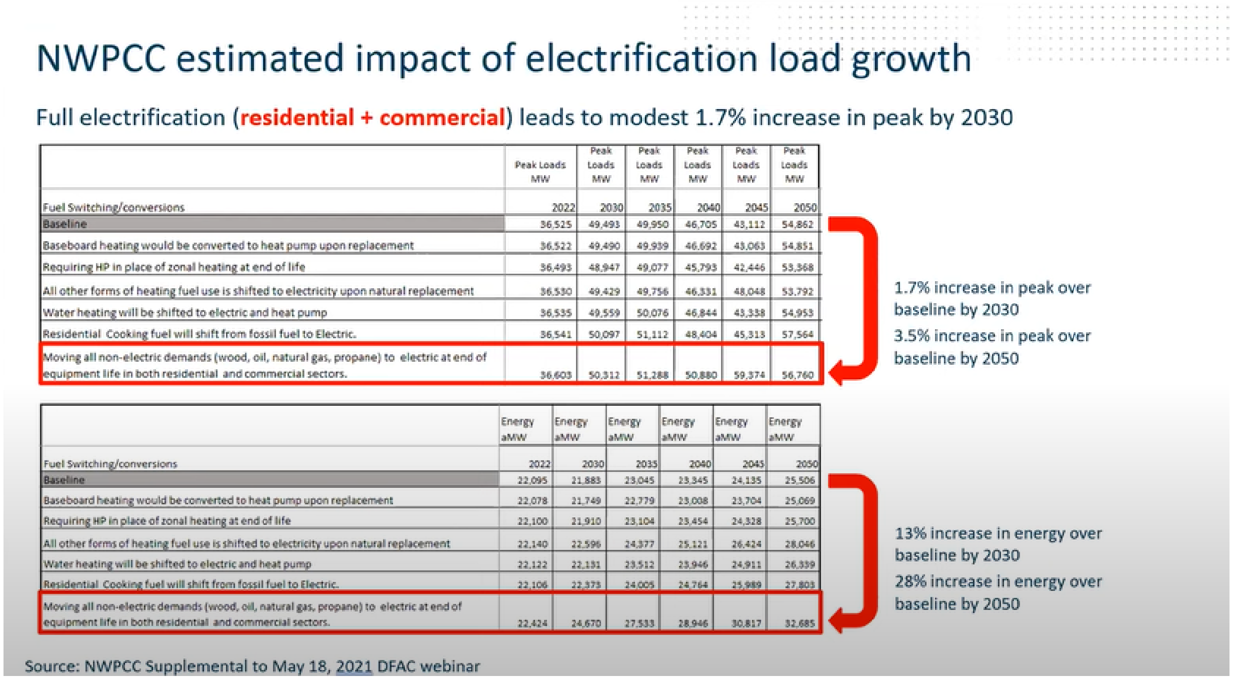


[16] These values are based on additional analysis from Jonathan Buonocore, Sc.D, the study's lead author, RMI used median estimates from the results of 3 reduced complexity models used in: Jonathan J Buonocore (Harvard T.H. Chan School of Public Health) et al, "A decade of the U.S. energy mix transitioning away from coal: historical reconstruction of the reductions in the public health burden of energy", 2021 Environ. Res. Lett. 16 054030, https://doi.org/10.1088/1748-9326/abe74c
[17] https://rmi.org/washington-state-could-lead-the-nation-on-building-electrification-codes/

Grid Impact

Clarification letter from Massoud Jourabchi, NWPCC

This note is to clarify and expand on peak load impacts of fuel switching that were shared by Mr. Stan Price, in the July 16 meeting of TAG, for the proposed commercial building codes.



NWPCC estimated impact of electrification load growth

Full electrification (**residential + commercial**) leads to modest 1.7% increase in peak by 2030

	Peak Loads MW	Peak Loads MW	Peak Loads MW	Peak Loads MW	Peak Loads MW	Peak Loads MW
Fuel Switching/conversions	2022	2030	2035	2040	2045	2050
Baseline	36,525	49,493	49,950	46,705	43,112	54,862
Baseboard heating would be converted to heat pump upon replacement	36,522	49,490	49,939	46,692	43,063	54,851
Requiring HP in place of zonal heating at end of life	36,493	48,947	49,077	45,793	42,446	53,368
All other forms of heating fuel use is shifted to electricity upon natural replacement	36,530	49,429	49,756	46,331	48,048	53,792
Water heating will be shifted to electric and heat pump	36,535	49,559	50,076	46,844	43,338	54,953
Residential Cooking fuel will shift from fossil fuel to Electric.	36,541	50,097	51,112	48,404	45,313	57,564
Moving all non-electric demands (wood, oil, natural gas, propane) to electric at end of equipment life in both residential and commercial sectors.	36,603	50,312	51,288	50,880	59,374	56,760

1.7% increase in peak over baseline by 2030

3.5% increase in peak over baseline by 2050

	Energy aMW	Energy aMW	Energy aMW	Energy aMW	Energy aMW	Energy aMW
Fuel Switching/conversions	2022	2030	2035	2040	2045	2050
Baseline	22,095	21,883	23,045	23,345	24,135	25,506
Baseboard heating would be converted to heat pump upon replacement	22,078	21,749	22,779	23,008	23,704	25,069
Requiring HP in place of zonal heating at end of life	22,100	21,910	23,104	23,454	24,328	25,700
All other forms of heating fuel use is shifted to electricity upon natural replacement	22,140	22,596	24,377	25,121	26,424	28,046
Water heating will be shifted to electric and heat pump	22,122	22,131	23,512	23,946	24,911	26,339
Residential Cooking fuel will shift from fossil fuel to Electric.	22,106	22,373	24,005	24,764	25,989	27,803
Moving all non-electric demands (wood, oil, natural gas, propane) to electric at end of equipment life in both residential and commercial sectors.	22,424	24,670	27,533	28,946	30,817	32,685

13% increase in energy over baseline by 2030

28% increase in energy over baseline by 2050

Source: NWPCC Supplemental to May 18, 2021 DFAC webinar

1) The peak impacts shown in the July 16 meeting table are driven by Monthly temperatures, not hourly. Being calculated at monthly level they can be considered as Weather normalized peaks (Peaks under average trends in temperature).
2) Hourly temperatures present a key driver for determining end-use peak demand for electricity.
3) We use daily temperature forecasts provided by General Circulation Models (GCM) these forecasts are available at decadal basis. This means that forecast of daily min and max temperatures are valid for the decade they occur, not for the year they are expressed for.
4) In general, the future trends in temperatures are downward for Winter. Lowering demand for heating.
5) Peak loads shown are for Regional Residential and Commercial sectors so they should be considered as coincident peaks. Commercial sector peaks for state of Washington would represent a different peak value.
6) For system planning purposes we take monthly energy requirements for the system, shape it to hourly loads and then add to it loads due impact of hourly temperature on loads. The hourly loads are then aggregated to quarterly loads that are used for system planning.
7) The peak graph shows range of system peak used in system planning for Q4 2021-Q2 2041. peak loads used in system planning are subject to wide variations.
8) The second graph shows the difference in draft Base scenario and draft Decarbonization scenario. As they currently stand, the peak loads under decarbonization scenario can be higher by as much as 7000 MW in 2022 Q1 and 25000 MW higher by Q2-2041.

9) Note that these difference in peaks are substantially higher than the monthly weather normalized loads shown in the table.

So, in summary- peak loads shown in the table are monthly/Weather normalized peaks and should not be used for indicating increase in system peak. System peak needs are driven by a wide range of decarbonization strategies. It is more appropriate to use system peaks shown in the graphs, as they are used in system planning work. Note that even with these higher peaks, Council's plan makes sure that NW region has reliable power.

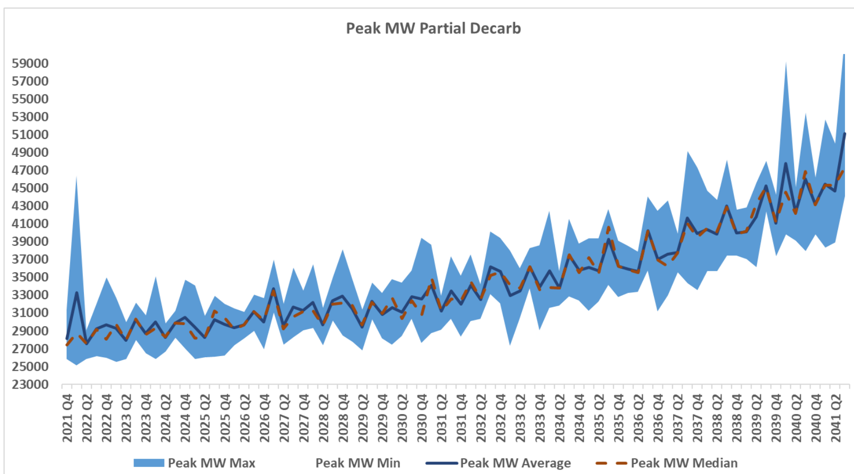
Thanks

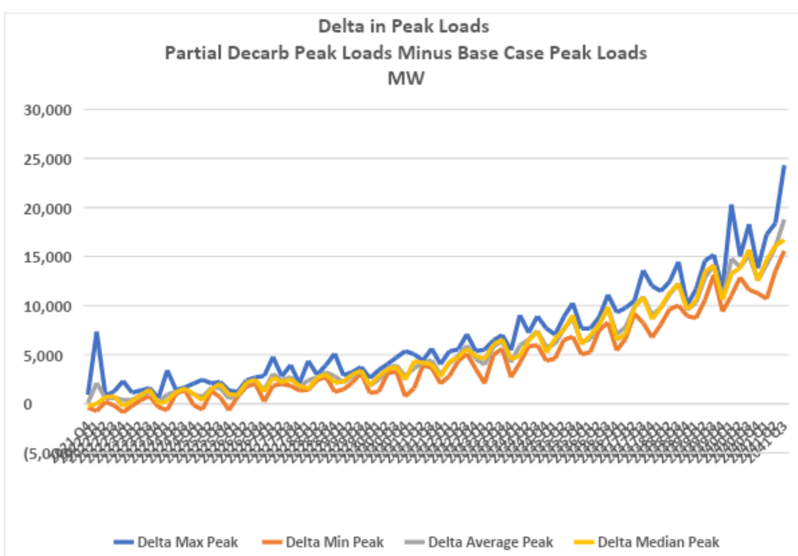
Massoud Jourabchi

Manager, Economic Analysis

Northwest Power and Conservation Council

mjourabchi@nwcouncil.org





Limited Role of "Renewable Natural Gas"

Due to the high climate impact of methane, the natural gas industry has tried to promote the use of renewable natural gas (RNG) as a climate-safe alternative to natural gas derived from fossil fuels. Unfortunately, RNG (which includes both biofuels and power-to-gas fuels) is limited in supply, very expensive and does not lower emissions. Research from NREL suggests there is only enough biomethane feedstock to decarbonize 5% of the nation's natural gas consumption.[18] This means that meeting the 2050 federal climate goals will require the use of power-to-gas technology to create the renewable fuels needed to heat buildings. According to the American Geophysical Union's deep decarbonization study (AGU study), scenarios that delay building electrification in favor of renewable fuels will increase the total cost to reach a net-zero carbon economy by 2050 from 0.4% to 0.6% of total GDP.[19] The AGU study analyzed a renewable fuel scenario and found, counterintuitively, that it had a *higher* electrical usage than the electrification scenario, which will, in turn, drive up carbon emissions.[20] This is due to the high electrical demand needed to create renewable fuels and the low energy efficiency of space heating technologies that combust that gas.

The AGU study is corroborated by research on RNG from Earthjustice and the Sierra Club. Their investigation of data from an American Gas Foundation study found that after two decades of ramping up supply, RNG could supply only 6 to 13% of the nation's total gas consumption.[21] RNG is also expected to cost 8 to 17 times more than the expected price trajectory of natural gas, according to research from the California Energy Commission.[22]

The vast majority of that small RNG supply is not carbon-negative nor even carbon-neutral as industry often claims. The amount of carbon-negative biogas, which comes from capturing unintentionally-created waste methane that would normally be leaked to the atmosphere, is extremely limited and should not be considered as a significant resource.[23] Recent research published in Environmental Research Letters found that less than 1% of the nation's total gas demand can be captured from unintentional waste methane.[24] This indicates that RNG

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[18] *Biogas Potential in the United States*, National Renewable Energy Laboratory, at pg 1 (2013) https://www.nrel.gov/docs/fy14osti/60178.pdf
[19] Williams J.,*Carbon Neutral Pathways for the United States*, American Geophysical Union, at pg 10 (2020)
https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2020AV000284
[20] Ibid at 7
[21] *Rhetoric vs. Reality: The Myth of "Renewable Natural Gas" for Building Decarbonization,* Earth Justice and Sierra Club, at pg 11, 26 (2020)
https://s3.documentcloud.org/documents/6988834/Rhetoric-vs-Reality-The-Myth-of-Renewable.pdf
[22] California Energy Commission, *The Challenge of Retail Gas in California's Low-Carbon Future*, at 8 (2020)
https://ww2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-F.pdf
[23] Grubert E., *At scale, renewable natural gas systems could be climate intensive: the influence of methane feedstock and leakage rates*, Environmental Research Letters, at 5 (2020)
https://iopscience.iop.org/article/10.1088/1748-9326/ab9335/pdf
[24] Ibid at 5

producers would need to intentionally produce methane to meet any sustainable amount of national gas demand. The research also found that:

> "RNG from intentionally produced methane is always GHG-positive unless total system leakage is 0."[25]

This means that only a small fraction of RNG can be used for building decarbonization, while all other RNG will still be contributing to climate change.

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[25] Ibid at 4

Manufacturer Readiness

Oral comments from Colmac, Nyle and Small Planet Supply can be heard at the 9/30/21 SBCC meeting.[26]

July 15, 2021

Kjell Anderson, Chair – Energy TAG
Washington State Building Code Council
1500 Jefferson St SE
Olympia, WA 98501

Dear Mr. Anderson,

We understand that there are two energy code proposals currently under consideration by the Energy Technical Advisory Group for the 2021 edition of the Washington State Energy Code:

- 21-GP1-103: Space Heating Proposal
- 21-GP1-136: Heat Pump Water Heating

As manufacturers and sales representatives of heat pump products for space and water heating in buildings covered by this code, we thought it important to share our knowledge of the performance characteristics of this type of equipment.

Heat pump technology has progressed rapidly over the last few years in both its overall efficiency and in its ability to function in cold climate conditions. Historically, ambient temperatures below freezing often required reliance on auxiliary heating to maintain temperature. Today, and increasingly over the next two to three years, there are readily available and affordable equipment options that will provide reliable and efficient performance in the design temperatures found throughout Washington State.

We hope that this information is helpful to you and others at the State Building Code Council as you continue your deliberation on these proposals.

Respectfully yours,

Rand Conger, Johnson Barrow

Billy Kodosky, AirReps

Daniel Silva, AERMEC

Shaun Vig, Mitsubishi

[26] https://youtu.be/PYZ8FMdMeds

March 10, 2022

Subject: Electrification

Dear State Building Code Council Members,

We are asking for your consideration to OPPOSE energy code proposals 21-GP1-103, 21-GP1-136, & 21-GPA-179 and all WSEC electrification proposals within the 2021 code package.

These proposals go well beyond this State Council's duties per RCW 19.27.020 and directly violates Standard #4 which is to eliminate restrictive, obsolete, conflicting, duplicating and unnecessary regulations and requirements which could unnecessarily increase construction costs or retard the use of new materials and methods of installation or provide unwarranted preferential treatment to types or classes of materials or products or methods of construction.

With the understanding that this Council has been given direction to reduce carbon emissions, the RCW does not provide authority to do so given the massive "electrification costs" and preferential treatment carbon emitting equipment. Providing other than minimum performance standards as per Standard #2 also violates the RCW.

Our country has been dealing with an inflation crisis for the last year that has been affecting our energy resources. Now, we are in the midst of a world-wide crisis and potential war which now has eliminated a portion of our energy resources until decisions are possibly made for our nation to become Energy Independent once again. Do we really want to move forward right now our anytime soon with these proposals that would be detrimental to our current energy sources and simply eliminate another energy option and make us one step closer to a sole reliance on one "preferential" source for some people.

Below are four questions that we submitted last fall and never received answers from the Council, so here are answers from the industry to these two questions;

1. **We are averaging one of the lowest electricity prices in the nation at an estimated $0.08/kWh base rate. What will our estimated rates be in five-year increments given these proposals go in affect next year? And giving economic consideration to the recent passage of the carbon- pricing bill SB 2156, knowing that California is the only other state with a similar program and currently is double in KHw rates.**

   Industry Comments:
   There are some trade-offs which must be considered when answering this question. "Green" energy will almost always reflect in higher energy costs to offset the Capital cost of those technologies. It would then be expected that the costs would come down over time. However, this is not reality. As the deployed goals increase, the Capital costs continue to rise, robbing the customers of enjoying the resulting lower cost energy. Further, as the goals increase, the choices to meet those goals become more expensive, because the "best-value" choices were made previously.

   California is a good market to study in order to answer this question. They have done three things that have escalated the rates that they charge:

1. All Commercial Accounts transitioned to Time of Use (TOU) accounts
2. Requiring all Commercial Clients to pay Demand (kW) charges
3. Tiered electrical rates for Residential customers (the more you use the ***higher*** your rate)

Commercial Rates in California (PGE – their largest Utility Company)

Usage (kWh) = $0.178/kWh Demand
(kW)= $22.50/kW

So as a Comparison (using 1,000 kW for 8 hours):

Spokane cost and similar for other Washington State cities for 1,000 kW for 8 hours would be:
(1,000 kW)x(8 hours)x($0.08/kWh) = $640

For California:
(1,000 kW)x(8 hours)x($0.178/kWh) = $1,424
Plus there would be a monthly Demand charge of (1,000 kW)x($22.50.kWh) = $2,500 The cost

of electricity in California has been increasing at 6.2% per year.

If we assumed that the same would happen here, we could estimate that cities would trend towards California costs over the next 15 years or less, and then continue at 6.2% annually

Year	CA Rate kWh	Spokane Rate kWh
2021	$0.178	$0.10
2026	$0.240	$0.18
2031	$0.325	$0.30
2036	$0.439	$0.40
2041	$0.593	$0.55

2. **What is the estimated cost for all existing commercial building owners that provide millions of square feet to all types of businesses, should they have to retrofit their heat sources into renewables? And do you foresee all of these costs being passed on to the consumer therefore increasing cost for all services?**

Industry Comments:
1. The Washington State Building Code Council estimates a net present value capital cost of $0.24/sq foot.

2. The cost of a 4-ton Heat Pump is ranges from $3,200 (14 SEER) up to $5,200 (18.5 SEER)
The cost of a 4-ton standard AC system (with natural gas heat) is about $1,860
(Neither are installed prices – Installation would add approximately $1,500-$4600.00 in labor costs)
*We must consider these figures most likely as below current prices with the shortage of labor and demand crisis inflating daily

If we use the basis of 50,000 square feet of commercial property, we would estimate 100 tons of installed HVAC.

Replacing an existing AC Unit with a Heat Pump would have a capital cost of:

(100tons)x($1,175/ton) = $117,500

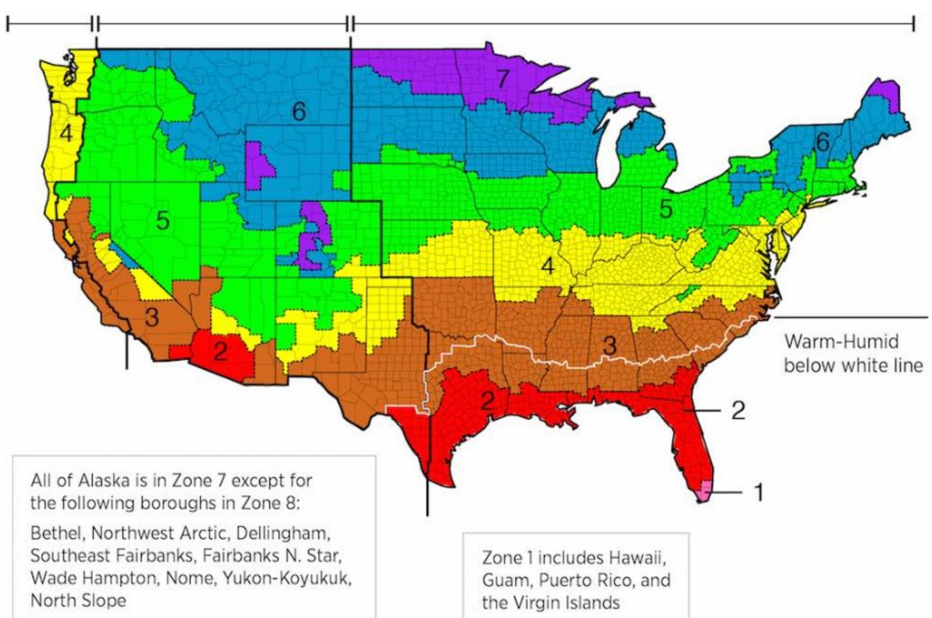
A business owner with a 50,000 square foot property would incur the cost of roughly $117,500.

However, there are other factors to consider. *Additional industry comments considered these rough costs too low after their heat loss calculations and could easily soar upward into the million dollar levels.

The HVAC Industry establishes "Heat Zones" across the USA for selecting technology. From the table below, it's shown that Heat Pumps are good choices for Climate Zones 1-4 and Gas Furnaces are good choices for Climate Zones 4-7.

System	Heats with(1)	AC(2)	Cost/BTUs(3)	Climate Zones(4)	Ave Cost Installed
Heat Pump	1, 3 (optional)	Yes	$7-$10	1 to 4	$6,700
Gas Furnace	2	No	$11-$14	4 to 7	$3,175
Electric Furnace	3	No	$31-$34	1 & 2	$2,350
Dual Fuel	1, 2, 3 (optional)	Yes	$8-$12	6 & 7	$7,200

Washington State is covered by Climate Zones 4, 5, and 6. Spokane is in Climate Zone 5. Since Heat Pumps are primarily recommended for Climate Zones 1-4, they are not necessarily a good technology selection for Washington State, and certainly not for eastern Washington.



A better alternative to banning Natural Gas would be to convert to Bio-Natural Gas, often called RNG (Renewable Natural Gas). This would eliminate the required capital expenditure, and greatly reduce the GHG emissions. And as a "Renewable" RNG, it is NOT a fossil fuel.

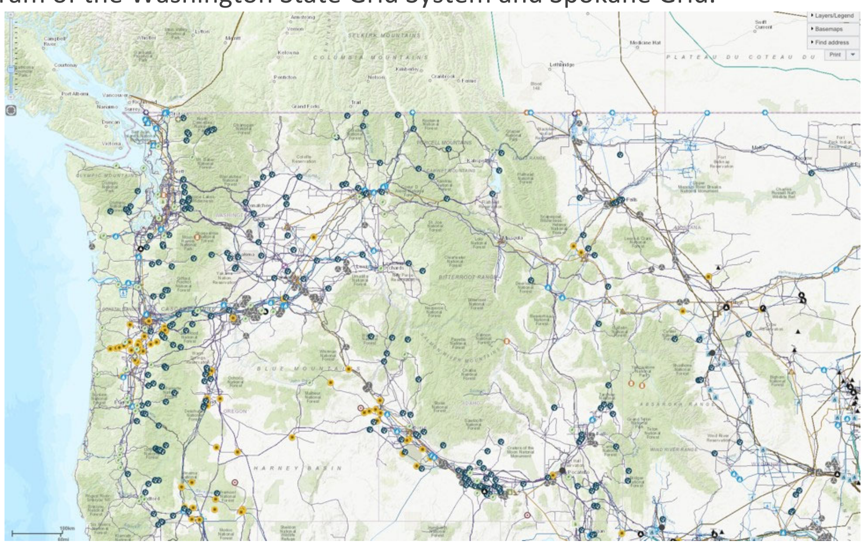
If the Commercial Property Owners were required to move to Heat Pumps. It would be reasonable to assume that Commercial Property Owners would pass those costs on to their customers and clients.

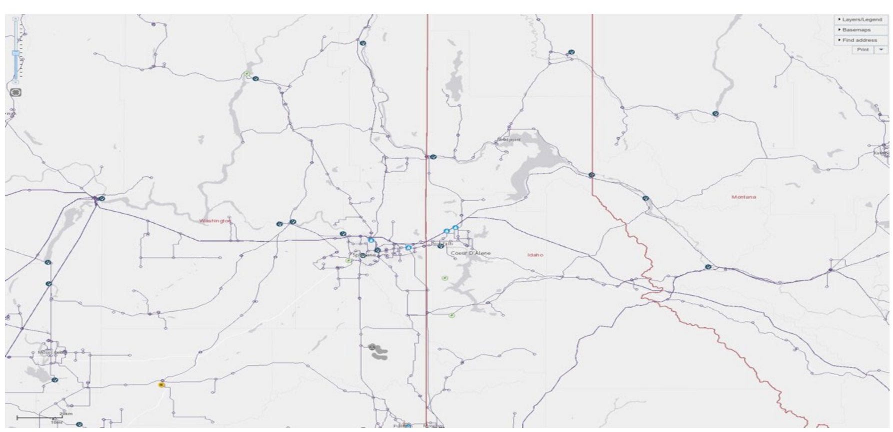
3. **Is there enough electricity on the grid, and given current CETA mandates, to fully remove natural gas appliances from Washington State and not forecast ongoing outages?**

<u>Industry Comments:</u>
The Washington Electrical Grid should have the capacity to deliver the additional electricity throughout the state. However, the State would likely need to import out-of-state power to cover that need. As a result, if no other changes are made, the power make-up will actually become "less green," as the imported power will not be from zero emission sources. So the imported power would "dilute" the green benefit from such things as Hydro power.

The sustainability goals would need to be reconciled with the importation of dirtier electricity.

Disruptions in power could become a concern based on the source of the generated power. As more utilities and municipalities move towards cleaner solutions like Wind and Solar, there will be a risk of supply stability. The Grid stability will rely heavily on the State's ability to store power generated from daytime solar for use in the evening and night hours.
Natural Gas, RNG, and Gasification technologies have much fewer interruptions that renewable electricity. Below is a diagram of the Washington State Grid System and Spokane Grid.





4. **If there is not enough foreseeable electricity without natural gas usage, will scheduled outages become the daily norm, and will these schedules adhere to less outages for regions that incur drastic hot and cold temperatures when compared to other milder regions where an outage will not as much affect their life-safety needs?**

Industry Comments:
While the infrastructure of the grid can handle more electricity, the generation of power which is sent onto that grid is a separate question.

If natural gas was reduced or eliminated too quickly, and replaced with electricity, it is very likely that there would be electrical service impacts if the strategy was to continue to feed the grid with zero emission power. In order to increase electrical power quickly to offset the use of natural gas without service interruptions, ironically, there would likely need to be additional electrical production from Natural Gas powered Gen-Sets outside of the State.

In order to prevent the service outages, there would need to be several factors that come into play:

1. The rate of new renewable power generation (Solar, Wind, Gasification) would need to be at the same (or faster) pace than the decreased use of natural gas.
2. Significant Power Storage would need to be installed into the grid to offset the previous natural gas power that would be used in the evenings and nights. There would essentially need to be a network of storage ("electrical flywheels") that would allow the daytime production of power to be used during the non-sunlight hours.
3. RNG (Renewable Natural Gas) production would need to be increased dramatically in order to replace natural gas, or to support the transition from natural gas.

The data suggests that natural gas is a more stable source of energy than electricity. If there is truly the need to eliminate the GHG impact from fossil-fuel natural gas, then an agricultural RNG Bio-gas (non-fossil fuel) should be utilized into the existing gas infrastructure.

Please do not take action on the 2021 WSEC Proposals. We need to preserve any and all of our energy resources in this horrifying humanitarian and economic time for our state, nation, and world allies. We do not know what tomorrow or even next year will bring.

Tena Risley

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