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
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RMI

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NRDC

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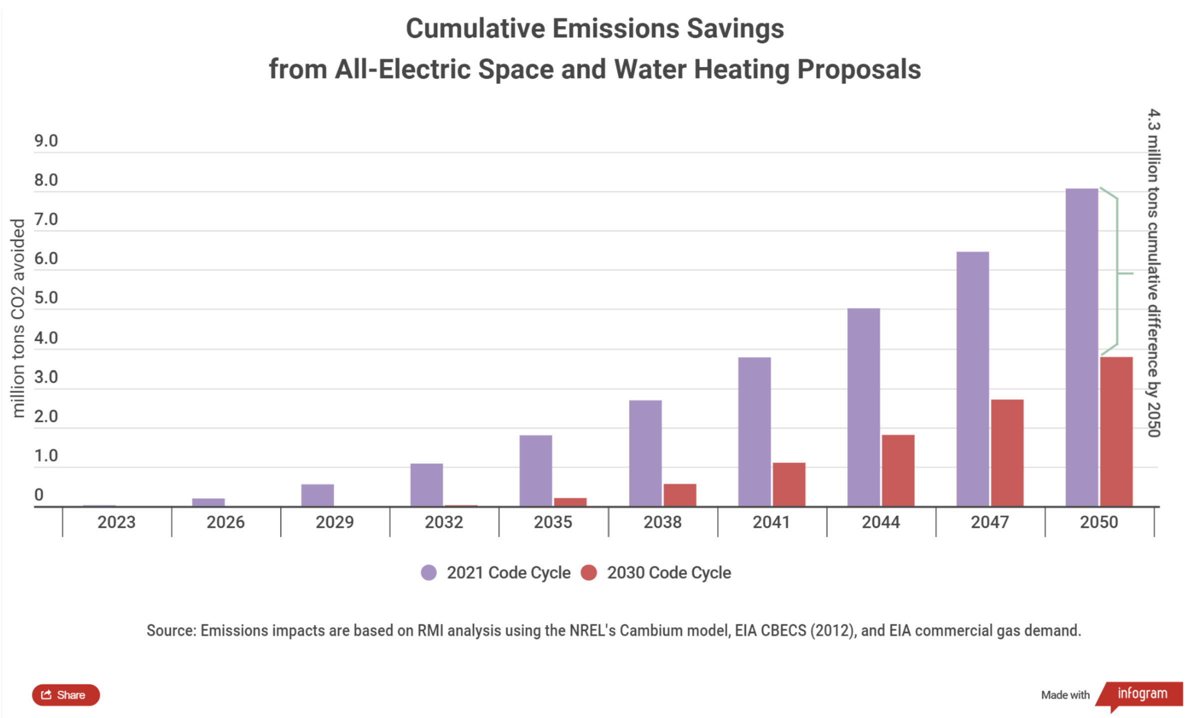
Climate Solutions

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/

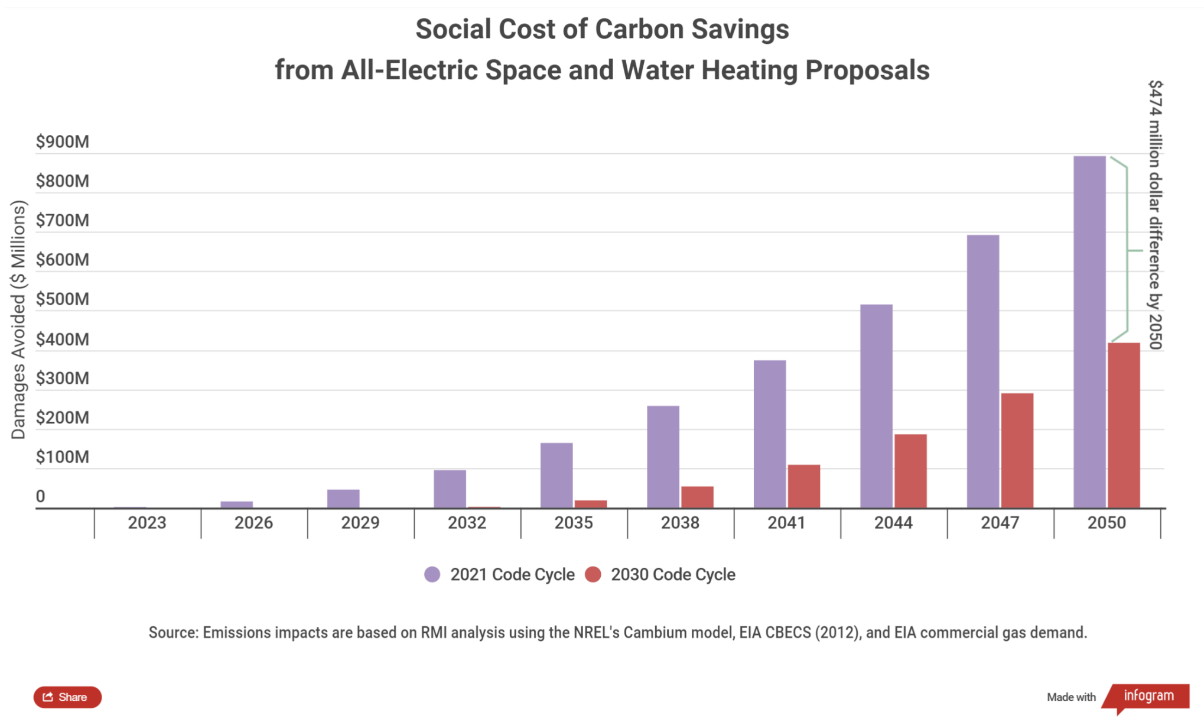
[14] RMI, Economics of Electrifying Buildings at 29 (2018), https://rmi.org/insight/the-economics-of-electrifying-buildings/

[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.

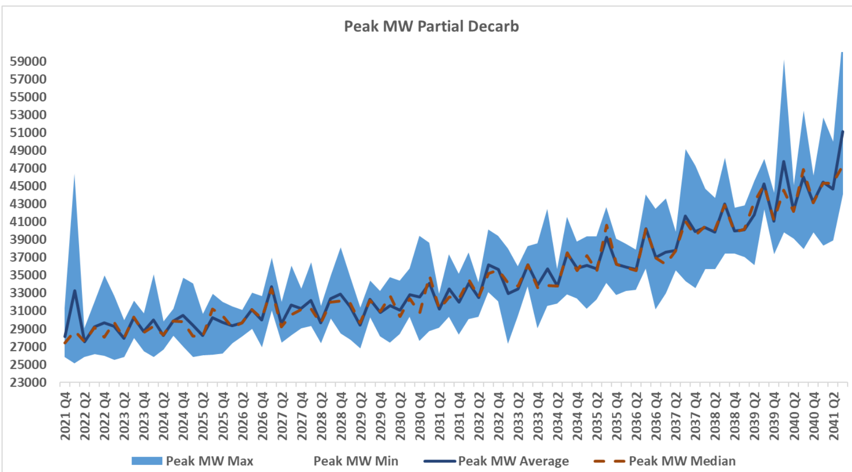
Thanks

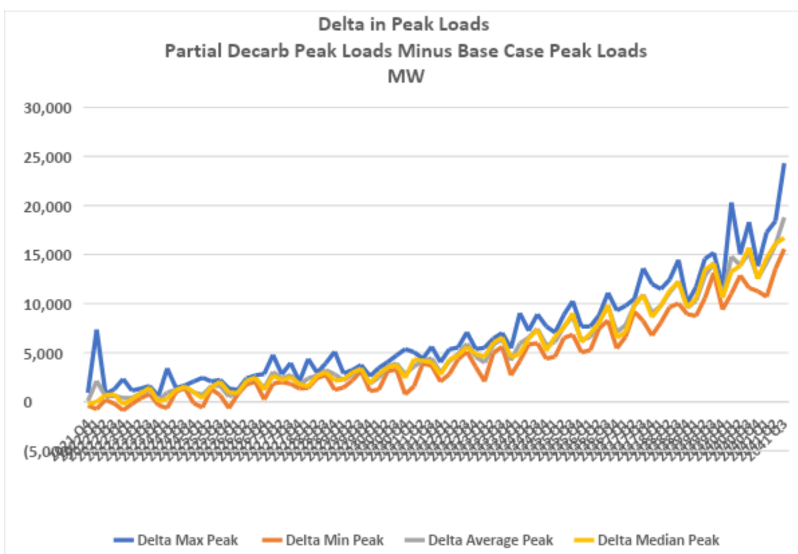
Massoud Jourabchi

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.

[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