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

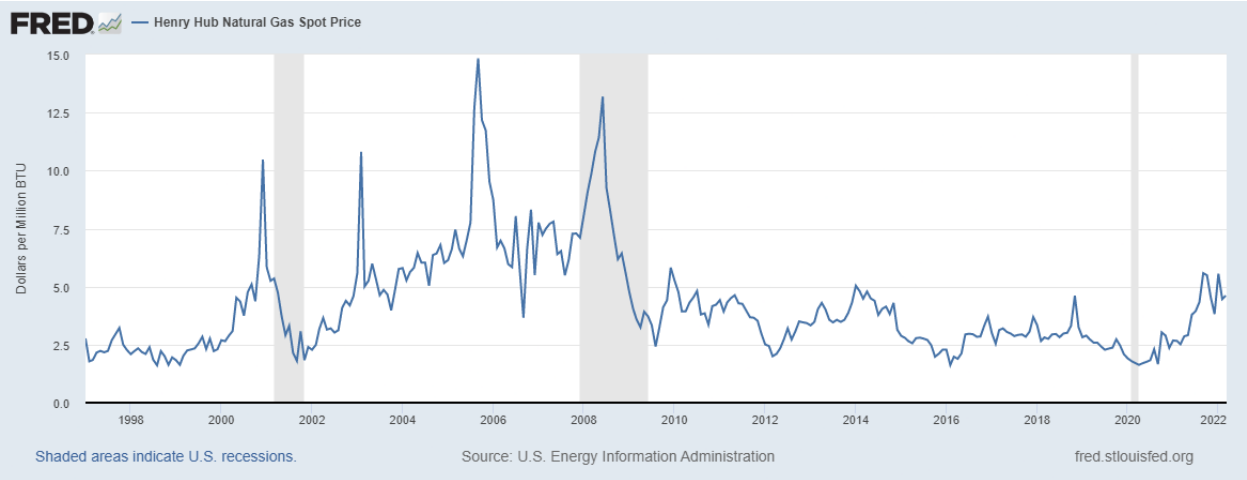
21-GP1-103 – Heat Pump Space Heating

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:

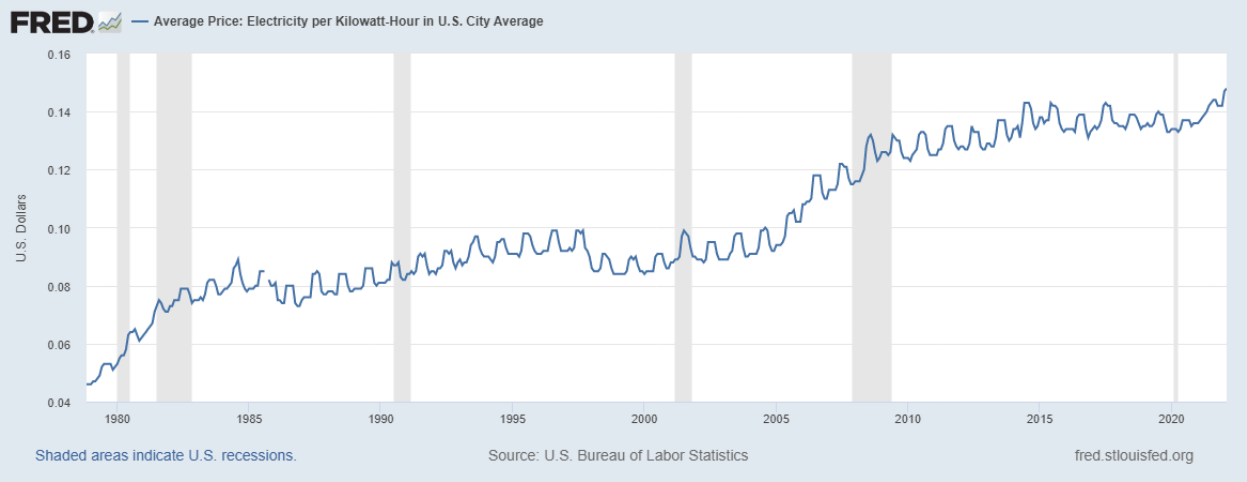
- Construction costs are generally higher
- Annual energy costs same or slightly higher than gas at current rates
    - Cites World Bank long term forecast of 80% increase in natural gas prices over coming decade as mitigating factor
- Including social cost of carbon, heat pump space heating is more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

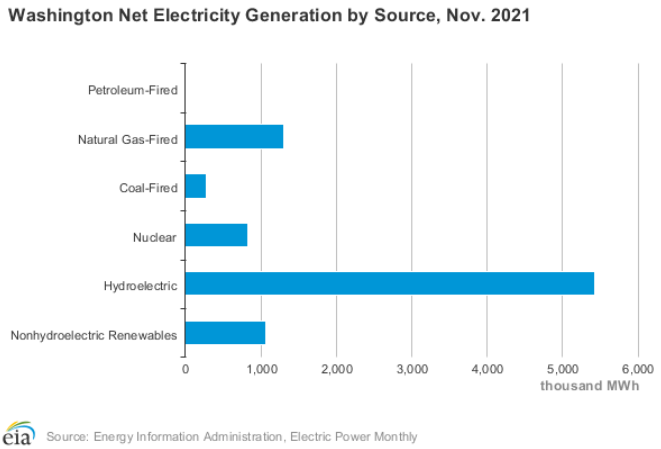
In the context of a cost benefit analysis over the lifetime of a system, the long-term future natural gas and electricity pricing at the market level is most relevant. Natural gas pricing at the consumer level if largely correlated with electrical rates, as the two sources of energy are substitution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