BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UM 2178

In the Matter of	)	
	)	
OREGON PUBLIC UTILITY COMMISSION STAFF,	)	COMMENTS OF THE OREGON CITIZENS' UTILITY BOARD ON MODELING AND ALTERNATIVE SCENARIOS
	)	
Natural Gas Fact Finding per Executive Order 20-04 PUC Year One Work Plan.	)	
	)	

COMMENTS OF THE

OREGON CITIZENS' UTILITY BOARD

September 24, 2021

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I. INTRODUCTION

CUB appreciates the efforts of the natural gas utilities to model compliance with Oregon DEQ's proposed Climate Protection Program. CUB recognizes that the Oregon DEQ program is not finalized, the utilities had a limited amount of time to model compliance and that the modeling does not contain the depth and complexity that one would see in an Integrated Resource Plan. Despite this, CUB has found this modeling exercise extremely helpful and informative to understanding the costs and risks that decarbonization brings to the gas system.

The three utilities took different approaches, but all three rely on the development of new technology that currently is not commercialized, and the modeling therefore includes uncertain assumptions related to commercialization. In addition, the utilities modeling of energy efficiency as a compliance tool is drastically different between the three utilities. For example, one of the utilities includes some electrification of heating load as an energy efficiency measure. CUB continues to have concerns over the risks that decarbonization presents to natural gas customers, as detailed in our Executive Order 20-04 work plan comments.[1]

[1] Comments of the Oregon Citizens' Utility Board on Oregon Public Utility Commission Executive Order 20-04 Work Plans (Oct. 28, 2020) *available at* https://www.oregon.gov/puc/utilities/Documents/EO20-04-Comments-CUB.pdf.

II. RESPONSE TO UTILITY MODELING

A. *Technology Risk Related to RNG and Hydrogen.*

In their modeling, each of the utilities relies on technologies that are not currently commercialized. It is important to recognize the degree of risk that unproven and un-commercialized technology brings to the gas system. In the 1990s, the electric utility industry expected that geothermal power generation would be a renewable resource on a scale that is similar to wind and solar. However, while geothermal has been, and continues to be, developed, the rate is not near the scale of the old forecasts. The electric grid has fallen short by many gigawatts of the volumes of geothermal electricity that was once forecast. This is the nature of nascent and unproven technology.

The RNG and hydrogen forecasts which all three utilities rely on is technology that is not currently commercialized. With regards to RNG, anaerobic digestion is a technology that is currently commercialized, but the utilities' modeling also relies on thermal gasification, which is not. According to the American Gas Association:

> *There is considerable uncertainty around the costs for thermal gasification of feedstocks, as the technology has only been deployed at pilot scale to date or in the advance states of demonstration at pilot scale.*[2]

Utility scale green hydrogen production requires water, a large utility-scale electrolyzer and a great deal of renewable power.[3] The electrolysis process is currently not cost effective, which means the market for electrolyzers is small. Currently, big electrolyzers are in short supply.[4] While the levelized cost of renewable power sources has decreased, having enough supply of renewable generation at a low enough cost is necessary for hydrogen production. While there is an expectation that renewable overgeneration will supply power at an extremely low cost which may allow green hydrogen to become a cost-effective energy source, there are risks that commercialization will be slower, more difficult, and more costly.

The utilities disagree on the timeline for adding hydrogen. NWN begins adding 589,385 dekatherms of hydrogen in 2030.[5] Avista plans on adding 33,964 dekatherms of hydrogen in 2022 to its system and blend in 2,330,882 dekatherms by 2030.[6] Avista's early hydrogen blending seems to be driven by a need to maximize hydrogen use in the 2030s.[7]

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[2] American Gas Foundation/ICF, Renewable Sources Of Natural Gas: Supply and Emissions Reduction Assessment, December 2019 *available at* https://gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-RNG-Study-Full-Report-FINAL-12-18-19.pdf.

[3] It has been estimated that 1 kg of Hydrogen requires 9 kg of water.

[4] Jason Deign, Greentech Media, So What Exactly Is Green Hydrogen, June 29, 2020

[5] UM 2178, Northwest Natural Workpapers, Base Case.

[6] UM 2178, Avista Utilities Workpapers, Supply Curves, Hydrogen

[7] Avista cites the Fisher-Pry model of technology substitution. This is based on a 1971 article that provided a model for forecasting how a new technology will replace an existing technology. It should be noted that the authors of this model state "the model, by our first assumption, is not to be applied to substitutions prior to their achieving a magnitude of a few percent, at which time a definite growth pattern is established.

Cascade's modeling relies heavily on renewable gas, but its forecast of available RNG is questionable. It assumes the amount that is available is the midpoint between what the American Gas Foundation says is the technical potential and what is the high potential.[8] The share available to Cascade and included in the forecast is based on this assumption. In addition, the largest source of Cascade's RNG is from municipal solid waste through thermal gasification. Due to the lack of commercialization of thermal gasification, CUB is concerned about the assumption that there will be an even greater supply available than the American Gas Foundation's high forecast.

B. *Price Risk Related to RNG and Hydrogen.*

While the utilities forecast future prices for RNG and hydrogen, there is a great deal of uncertainty with these price forecasts. Generally, when forecasting prices of future technology, there will be an attempt to forecast the cost of production and recognize that, as production increases, the cost of production will fall. There are two problems with this: First, there are inherent difficulties in forecasting the cost of production for a commodity that has not been commercialized. The second problem is the role that supply and demand play in establishing prices. The market for RNG and hydrogen will not begin as a mature market. There will be barriers to entry that restrict supplies. Feedstock for RNG is limited.[9] Excess renewable power is limited. Electrolyzers are expensive. There may not be adequate supply of RNG and hydrogen for the market.

The RNG and hydrogen market may be further worsened by excess demand as both electric and gas utilities will be competing for RNG and hydrogen to meet economy-wide decarbonization goals and mandates.[10] Under HB 2021, Oregon is not allowed to build new natural gas power plants. Hydrogen and/or RNG power plants are expected to be used as a potential capacity resource for the electric grid. Even the economy-wide decarbonization studies that assume electrification of buildings still assume that there is robust development of RNG and hydrogen.[11] But those studies see these fuels as being needed for energy uses where electricity is not an alternative: long haul freight, airlines, international shipping, industrial processes and peak electrical generation. There may be more demand than supply, which will increase the price.

C. *Energy Efficiency Assumptions and Risks.*

The three utilities used different approaches to modeling energy efficiency. From the workshop, CUB understands that Avista used the most recent Energy Trust of Oregon (ETO) forecast from

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http://maecourses.ucsd.edu/MAE119/WI_2018/ewExternalFiles/Simple%20Substitution%20Model%20of%20Technological%20Change%20-%20Fischer%20Pry%201971.pdf

[8] UM 2178, Cascade Workpapers, RNG Potential Calculation Worksheet.

[9] Biogas and Renewable Natural Gas Inventory SB 334 (2017) – 2018 Report to the Oregon Legislature, Page ii.

[10] For example in the 2021 PacifiCorp IRP, PacifiCorp's initial optimized power portfolio includes 1,226 MW of Hydrogen resources.

[11] Evolved Energy Research, Oregon Clean Energy Pathways Final Report, June 15, 2021, https://uploads-ssl.webflow.com/5d8aa5c4ff027473b00c1516/60de973658193239da5aec7b_Oregon%20Clean%20Energy%20Pathways%20Analysis%20Final%20Report.pdf

their last IRP. Cascade asked the ETO for an accelerated (high ramp) energy efficiency forecast. Northwest Natural projected its own new energy efficiency supply curve.

While CUB appreciates the detailed work NWN did to create supply curves for new technology, their forecast is problematic for several reasons.

1. **NWN's forecast assumes viability of new technology.**

Much of NW Natural's new energy efficiency forecast is based on the following technologies: dual fuel heat pumps (DFHP), natural gas heat pumps (GHP), and gas heat pump water heaters (GHPWH). While the dual fuel heat pumps are commercially available, the GHP and GHPWH are not.

Gas heat pumps have a challenging road to commercial availability for various reasons:

- Gas heat pumps are "prohibitively complex, large, and costly. In addition to complex system architectures, these systems also tend to have complex control systems that are difficult to implement, which is generally counter to long-term reliability in the field."[12]
- Both electric and dual fuel heat pumps have a head start, are commercially available and generally work well in temperatures above freezing. Therefore, much of the work on further developing GHP technology is focused on cold climates. For example, the first pilot program to test GHPs is with FortisBC, a gas utility serving 1 million customers in Canada. In their materials, FortisBC stresses that the GHP worked when outdoor temperatures dropped to -13C. The pilot involves 5 residential and 5 commercial customers[13] with results expected in Spring, 2022.
- At the same time, cold weather electric heat pumps are now capable of performing well below -10 at twice the efficiency of electric resistance systems and have been tested in a pilot in Minnesota.[14]
- While there are some GHP designs that allow for air conditioning, many of them do not. Because they are being primarily developed and tested for cold climates, air conditioning is not considered essential.
- Due to recent heat events in Oregon, it is expected that air conditioning equipment to be standard in new building moving forward. Currently, EHP and DFHP can provide cooling and heating services to Oregonians.
- HVAC dealers, like most business, sell what they know and do not want to sell their customers unproven technology that could fail. It will take time for HVAC dealers to build confidence in these new products

[12] US Department of Energy, R&D OPPORTUNITIES FOR NATRUAL GAS TECHNOLOGIES IN BUILDING APPLICATIONS, August 2018.
[13] https://www.fortisbc.com/about-us/projects-planning/future-of-energy-efficiency/success-stories
[14] https://rmi.org/heat-pumps-a-practical-solution-for-cold-climates/

- A workforce that is trained to install GHPs will have to be developed. They represent a significant change from high-efficiency furnaces and it will take time to develop a network of trained installers. In addition, GHPs needs to have an established supply chain for repairs and maintenance in order to be widely adopted.
- An HVAC manufacturer is going to take a big risk if they move GHPs into commercial production. They will compete against electric heat pumps which are already present in the marketplace. To the degree that these technologies are developed, they may be targeted at colder climates, where existing electric heat pumps are less efficient (though cold climate heat pumps are changing this).

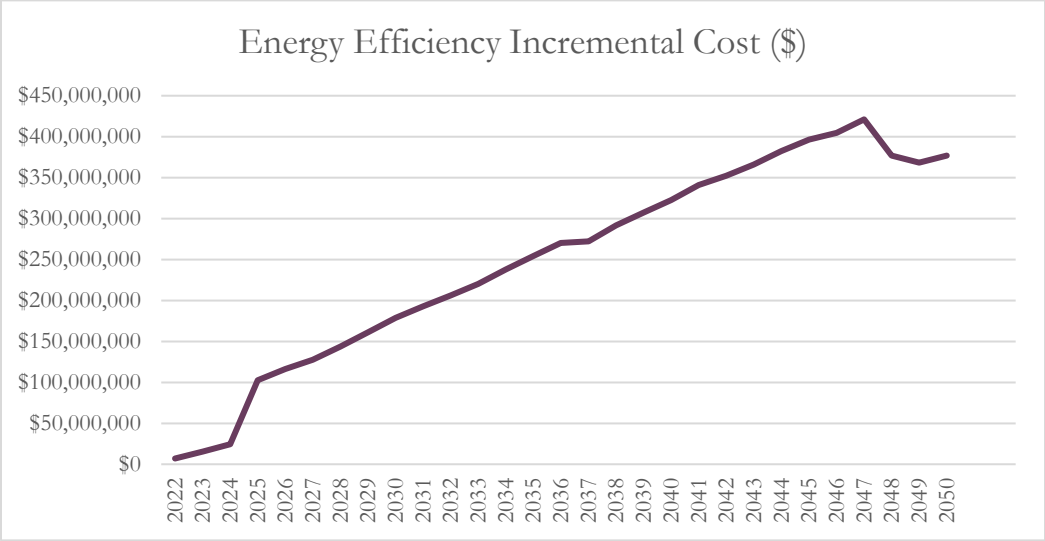
Gas heat pump water heaters are somewhat closer to being commercially available. The Northwest Energy Efficiency Alliance (NEEA) includes GHPWHs in its 2020-2024 Business Plan and is one of a set of partners that is working to field test GHPWH to provide data on performance, savings, costs and installation best practices. The fact that NEEA is involved with a field test is a helpful development but moving from a field test to commercialization usually takes years.

2. Market Transformation Adoption Curve

NW Natural is not only counting on new technology to drive energy efficiency, but it is expecting energy efficiency spending to increase in a significant manner. NWN currently spends about $20-22 million annually on energy efficiency. NWN's total annual utility revenue in Oregon was $669 million in 2020. Its modeling assumes a massive increase in spending to deploy this new technology. Figure 1 below shows NWN's projected incremental spending on energy efficiency. In 2022, NWN will spend about $22 million on energy efficiency. In 2025, it forecasts expenditures of about $124 million.[15] In 2030, it is forecasting around $200 million in energy efficiency and it keeps growing to more than $400 million/year.

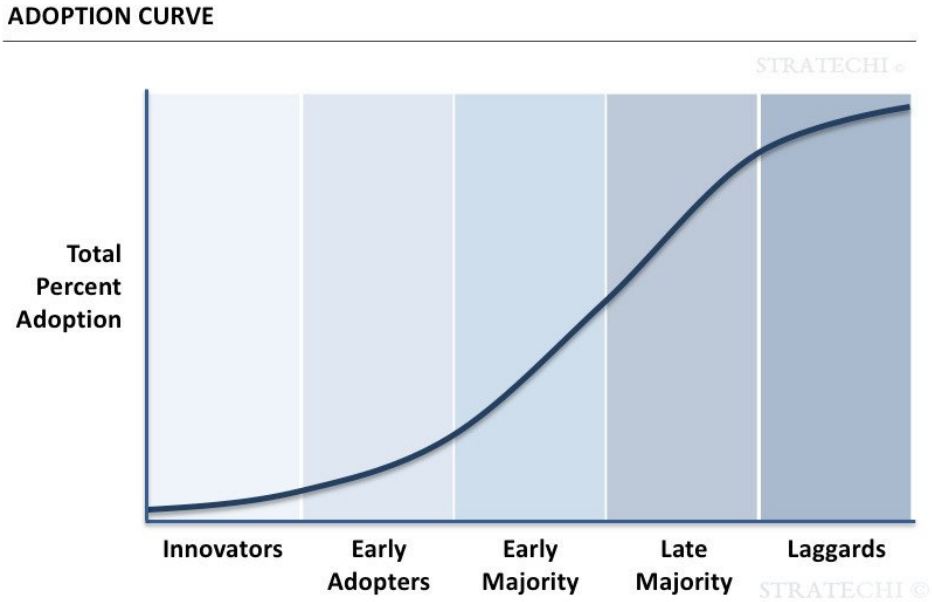
[15] UM 2178, NWN Workpapers, Base Case, shows $102 million in incremental spending above the current programs.

Figure 1



This ramp up in spending is problematic. It is based on unrealistic adoption curves. New technology traditionally follows a S-shaped adoption curve as shown in Figure 2:

Figure 2



NWN's market transformation curves for gas heat pumps (Figures 3, 4 and 5), however, look very different[16]:

Figure 3

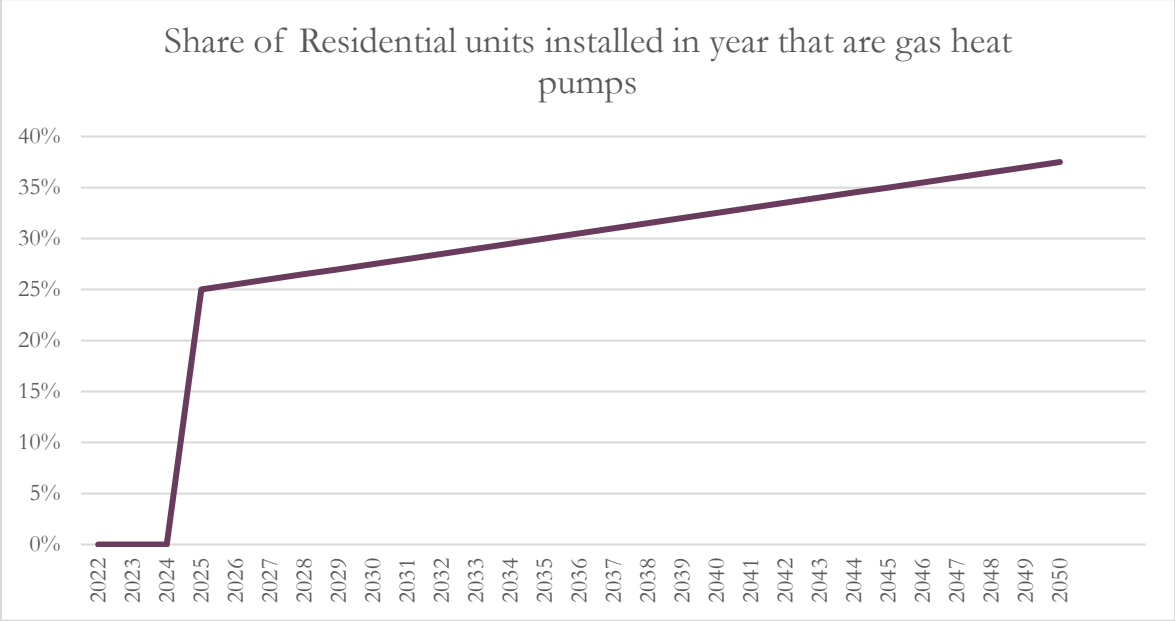
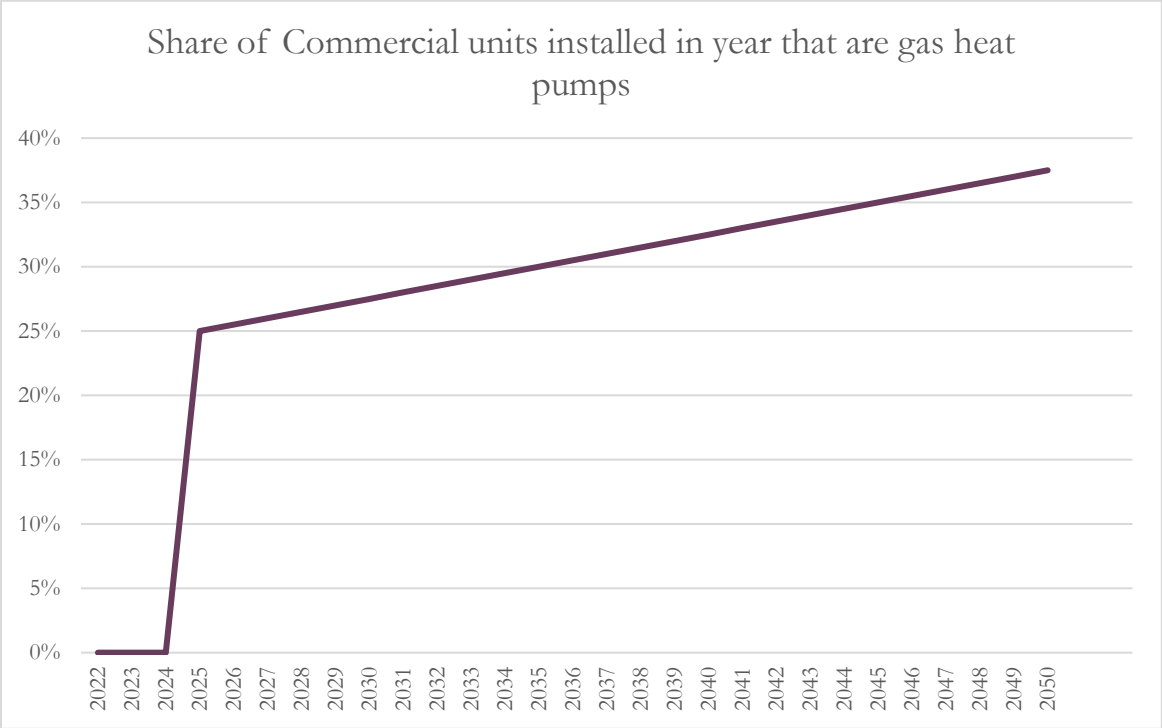
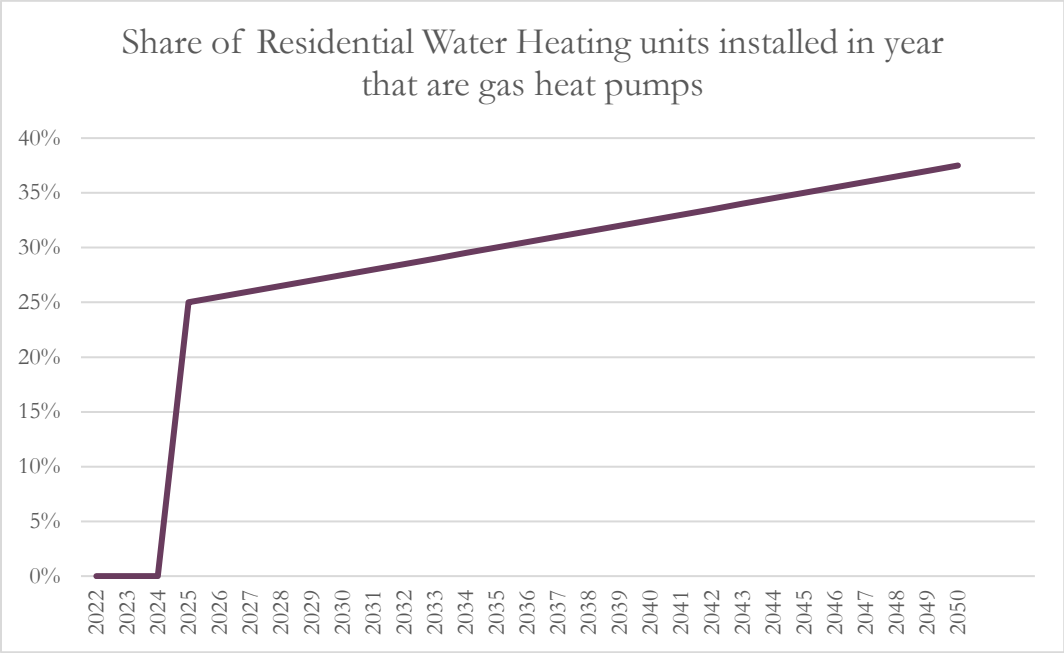


Figure 4



[16] UM 2178, Northwest Natural Workpapers, Base Case

Figure 5

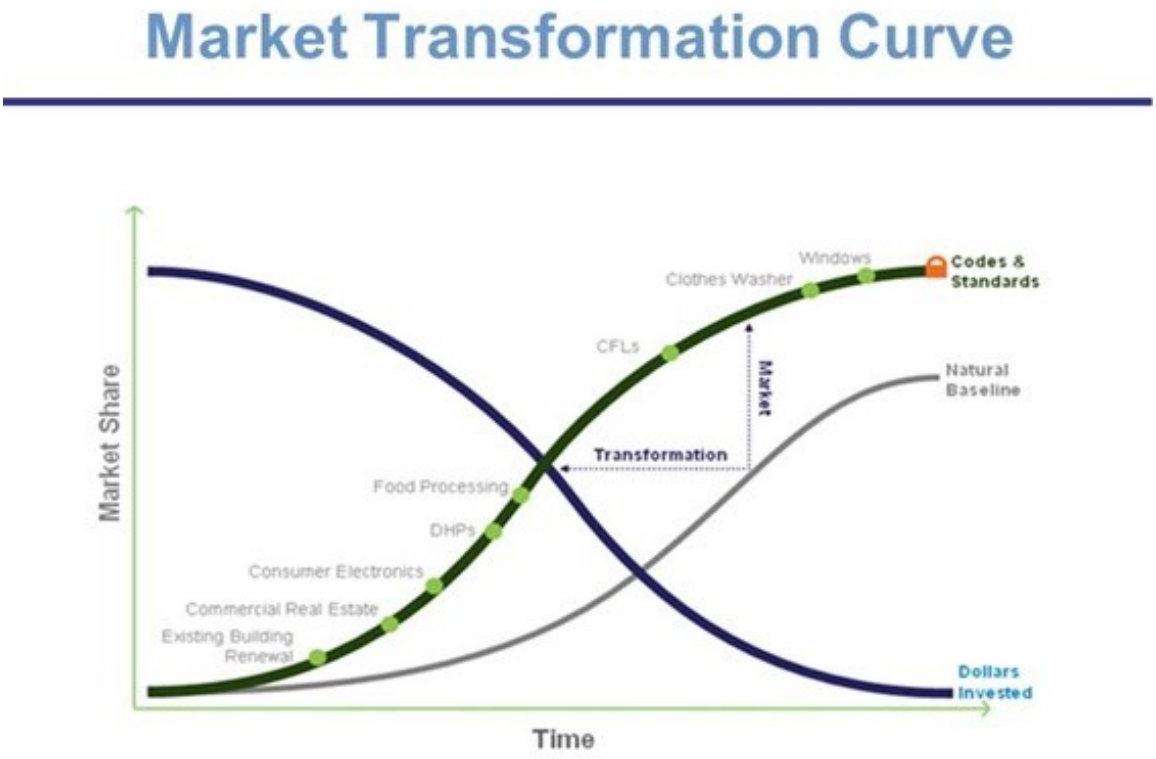


NWN's market transformation curves for gas heat pumps are not realistic. It is unlikely that by 2025 GHPs will have 25% of the market share for residential homes that replace their current gas equipment. For GHP, NWN assumes that the industry can move from a pilot program with 10 units in Canada that will not have results until 2022, to selling more than 9,000 in NWN's service territory in 2025. This is unlikely. While NEEA has looked at these as emerging technology, its Business Plan does not include a current program to move them to commercial availability.[17] No pilots have been planned in the region. Even if they become commercially available, it will take time to train HVAC dealers and installers.

This region has a lot of experience with market transformation, led by NEEA. But market transformation does not change the shape of the S-curve, it changes the timing – it moves the curve along the x axis. Below is an example of NEEA's market transformation curve (Figure 6). It shows that an upfront investment in market transformation can shift the curve causing the measure to be adopted in advance of its natural baseline. The difference between the two curves shows the benefit of the market transformation effort which ultimately produces a market share that is great enough to change the minimum requirements of codes and standards.

[17] Northwest Energy Efficiency Alliance, 2020-2024 Strategic and Business Plan

Figure 6



NWN's energy efficiency modeling has unrealistic adoption curves for residential and commercial dual fuel heat pumps, gas heat pumps, and heat pump water heaters.

D. ***Electrification.***

NWN was the only utility that included some electrification of heating load. CUB appreciates this inclusion, because electrification is a tool to reduce emissions and needs to be included in these discussions. NWN assumes that beginning in 2025, 30% of residential and commercial customers who are purchasing new gas heating equipment will choose dual fuel models and this will continue through 2050. These represent electric heat pumps with a gas furnace. The gas furnace only operates when the temperature is below 40 degrees Fahrenheit (settings vary, but this is the default setting). Within NWN's territory with relatively mild winters, CUB understands that a dual fuel heat pump will electrify approximately 80% of a home's heating load. This means that over time 30% of all NWN residential and commercial customers will electrify 80% of their heating load resulting in 24% of its overall heating load being electrified.

E. ***Role of Electric Heat Pumps.***

Dual fuel heat pumps (DFHP) and electric heat pumps (EHP) are both commercially available. Cold climate heat pumps (CCHP) are also available, but have a much higher cost (some midwestern utilities are currently giving rebates on CCHP). NWN models DFHP. But is it the best use of heat pump technology?

NWN service territory includes coastal communities with mild temperatures. On average, Lincoln City gets below freezing less than 18 nights per year. EHPs that turn to resistance heat in near freezing temperatures might be a better choice in these areas.

Rather than offering a rebate and having DFHPs randomly spread throughout the territory, there may be more bang for the buck by offering home builders even larger incentives to install EHP in new developments where electrification can reduce the need to expand the system. The same thing is true in areas where growth related upgrades are needed. By installing EHPs, new natural gas investment might be avoided. Once we begin incenting electrification, we should be asking ourselves what electrification make sense for Oregon's energy systems.

F. *Rate Design Implications of a Dual Fuel System*

Expanding a dual fuel system to replace some gas in some parts of its service territory would also mean that there will likely be customers who only use gas on the coldest days of the year. How does this customer group share the cost of pipes and gas distribution network? To collect the fixed cost of the distribution network from customers with little usage could require significant increases in customer charges from these customers. DFHP customers may require a separate rate class to minimize cross subsidization within large firm sales classes like Residential or Commercial. But high fixed charges could then incentivize a residential customer to choose an EHP.

G. *Compliance with Oregon expected DEQ regulation.*

CUB believes that the gas utilities have not shown compliance with expected DEQ regulations as their models contain some questionable assumptions. These include Avista's assumptions about hydrogen, Cascade's assumptions about RNG availability, and NWN's assumptions about energy efficiency.

CUB does recognize that DEQ regulations are not final and the utilities have not been able to apply IRP tools to this challenge. These are early attempts to model compliance. But the modeling is extremely helpful in demonstrating how challenging decarbonization is for Oregon's gas utilities and how current tools are not sufficient, and new technologies must be developed. But planning around these new technologies is particularly challenging while we continue to grow the gas system. The gas system is adding thousands of new customers every year who are adding to carbon emissions that we must find a way to eliminate.

The current alternative to growing the gas system is to build all-electric homes. Electrifying new homes might well be the best application of electrification today because it limits the growth of the gas companies' emissions problem.

This does not mean that new technologies will not be developed and offer additional solutions. In Massachusetts gas utilities are investing in a series of pilots to test a concept called

GeoMicroDistrict. The idea is to use their expertise with pipes to build interconnected district heat using ground source heat pump technology.[18]

III. FUTURE MODELING AND ANALYSIS

CUB believes that additional modeling and analysis in the following areas would be helpful.

Energy Efficiency. Energy efficiency normally starts with a conservation potential study that identifies technical potential and then applies analysis to identify an expected adoption curve. But this technical potential is usually based on commercialized technologies. NWN's energy efficiency forecast is based on aggressive application of technology that is not commercialized.

There are some different scenarios that could help demonstrate the risk of relying on an aggressive application of uncommercialized technology:

- Assume gas heat pump water heaters come to market, but gas heat pumps do not.
- Assume no gas heat pumps until after 2030 and assume a more traditional S-adaptation curve.
- Have the ETO or some other organization look at the conservation potential of GHPs and GHPWHs and create realistic adoption curves and require that GHP and GHPWH modeling be limited to these adoption curve.

Hydrogen. Hydrogen is a major resource in these models. We should consider scenarios which test some of these assumptions:

- Hydrogen is unavailable until 2030, except under pilot programs.
- The demand for hydrogen outstrips supply and the cost of hydrogen is twice what current forecasts suggest.

Electrification. NWN's modeling assumes 24% of its residential and commercial heat load be electrified through the offering of incentives to customers to purchase dual fuel heat pumps. There should be some attempt to look at the optimal ways to electrify. One potential way to look at this would be to ask the gas utilities to examine the impact of electrification of a specified percentage of their load when that electrification represents:

- Dual fuel heat pumps randomly through their system
- Electric heat pumps targeted at new growth on system
- Targeted electrification where network upgrades are expected within a few years
- Low-income weatherization programs

[18] https://heet.org/wp-content/uploads/2019/11/HEET-BH-GeoMicroDistrict-Final-Report-v2.pdf https://www.greentechmedia.com/articles/read/can-gas-companies-evolve-to-protect-the-climate-and-save-their-workers

Energy Optimization.
The introduction of dual fuel heat pumps as an energy efficiency measure also shows the need to reimage our approach to energy efficiency. Energy efficiency has been established as a demand side program that offers an alternative to supply side investments. However, with NWN's proposal to offer incentives on DFHP heat pumps, traditional energy efficiency is being augmented by fuel switching. For NWN, DFHPs perform like any other energy efficiency incentive program. But the local electric utilities, DFHPs are new load which increases future electric and capacity needs.

Energy efficiency analysis, therefore, requires an approach that cuts across fuels. Sometimes this is called Energy Optimization.[19] Rather than starting with a particular utility's load/resource balance, energy optimization focuses on buildings and tries to understand the optimal way to serve their energy. It considers energy efficiency, demand response, and fuel switching along with GHG emissions. An Oregon version of energy optimization should also include energy affordability as a key element. This kind of approach considers the implications on both the electric and the gas networks. It would help us identify the best applications of electrification and create a roadmap on how best to serve utility customers. This is not a scenario for gas utilities to consider in additional modeling but is something that is implicated by the introduction of electrification.

[19] https://www.ef.org/2019/08/20/energy-optimization-its-time-to-reimagine-energy-efficiency/

III. CONCLUSION

CUB appreciates the work of the gas utilities to produce these models on short timeline. The modeling demonstrates that RNG and hydrogen are probably not sufficient to decarbonize and that electrification is likely to play a role.

The modeling also shows real risks to gas customers. The modeling points to significant rate increases which could drive some customers – those who can afford it –to electrify their homes, leaving behind the set of customers who cannot afford to electrify.

It also needs to be recognized that this is modeling of a single climate regulation. Oregon has begun to feel the impact of the climate crisis and significant addition impacts are likely to be realized over the coming decade. Local governments may respond by using energy codes, zoning or building emission standards to push for reduced emissions. Elected officials at the state and federal level will want to push policies that respond to climate events by further reducing GHG emissions. DEQ's CPP is not the final decarbonization regulation that Oregon faces, just as this summer's record heat wave is not the last extreme weather event related to climate change that will impact Oregon households.

Dated this 24th day of September, 2021.

Respectfully submitted,

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