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SoCalGas Comments on CEC Heat Pump Workshop

Additional submitted attachment is included below.

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February 11, 2021

California Energy Commission
Docket Unit, MS-4
Docket No. 19-BSTD-03
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: Comments on the Proposed Changes for Low-Rise Residential Heat Pump Baselines for the 2022 Energy Code

Dear Payam Bozorgchami:

Southern California Gas Company (SoCalGas) appreciates the opportunity to provide comments on the proposed updates to the 2022 the Building Energy Efficiency Standards (Energy Code), specifically on heat pump baselines for low-rise residential buildings, presented at the January 26, 2021 California Energy Commission (CEC) workshop. SoCalGas supports energy efficiency measures for furnaces and water heaters as a pathway to building decarbonization. In response to the discussion and materials presented on January 26, we respectfully ask CEC Staff to consider our technical comments on three topic areas:

1. Efficiency considerations in colder climate zones: The overall energy efficiency of heat pump water heaters (HPWHs) is impacted by cold weather, thereby impacting the installation costs for homeowners. SoCalGas requests that CEC evaluate the change in HVAC energy resulting from use of HPWHs when performing the energy savings calculations because colder climate zones can significantly reduce the energy efficiency of HPWHs.

2. Installation costs of HPWHs: Efficient operation of HPHWs requires effective installation and costs associated with certain upgrades including ducting and space requirements. These costs should be assessed and incorporated into the requisite analysis.

3. Global warming potential of HPWHs: The environmental impact of widespread installation of HPWHs with high global warming potential (GWP) refrigerants should be evaluated.

Impacts on Energy Efficiency in Colder Climate Zones

A HPHW takes in ambient air and removes the heat and humidity from the air, resulting in exhaust air which is less humid and cooler. Overall a HPWH has a cooling and dehumidifying effect on the space it is in and the overall efficiency (COP) of a heat pump is typically higher when the unit is placed in a conditioned space (temperature controlled space) versus an unconditioned space because of the smaller range in ambient air temperature. However, the energy efficiency within a few climate areas of California can change significantly. According to a 2013 National Laboratory of Renewable Energy (NREL) study, cool-climate homes using inefficient heating systems in the form of electric resistance "can take up to three times as much energy for the electric heating equipment to meet the space heating load imposed by the HPWH on the conditioned space." For instance, homes in cooler climate zones with a HPWH placed in a conditioned area can consume more energy because the heating system is trying to replace the heat used by the heat pump. The NREL study highlights that the Pacific Northwest is particularly susceptible to higher energy impacts resulting from a HPWH in a conditioned space. This is because of the region's marine climate causes a small heating load to occur for much of the year. As such, a HPWH can contribute to this net heating load year around when it is located in a conditioned space. In fact, a study by the Bonneville Power Administration found that between 52-57% of the water heater energy savings is diminished by an increased demand on the electric resistance furnace when a HPWH is installed in a conditioned space.[1]

Accordingly, a heat pump may not be the most efficient option for those colder climate zones that tend to rely on backup (inefficient/about 50% more heating energy[2]) electric resistance heating for several months of the year when outside temperatures fall below 45°F.[3] In fact, NREL designates an ambient air temperature requirement of 45°F to 110°F year-round for the efficient operation of HPWHs and space heaters. When temperatures fall below 45°F, the unit could go into electric resistance-based heating, resulting in a loss in efficiency through the operation of the less than efficient heating source. Several climate zones, such as 2, 11, 12, 13, 14, and 16, could fall out of this range during the winter season.[4] Of particular concern are climate zones 11, 12, and parts of

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[1] *See* Bonneville Power Administration, *Residential Heat Pump Water Heater Evaluation: Lab Testing & Energy Use Estimates*, 9 November 2011. Available at: https://www.bpa.gov/EE/Technology/EE-emerging-technologies/Projects-Reports-Archives/Documents/HPWH_Lab_Evaluation_Final_Report_20111109.pdf.

[2] U.S. Department of Energy, *Webpage on Heat & Cool: Home Heating Systems: Electric Resistance Heating.* Available at: https://www.energy.gov/energysaver/home-heating-systems/electric-resistance-heating#:~:text=Electric%20resistance%20heating%20is%20100,energy%20is%20converted%20to%20heat.&text=If%20electricity%20is%20the%20only,compared%20with%20electric%20resistance%20heating.

[3] *See* Pacific Gas and Electric, *California Climate Zone 11: Red Bluff*, 2021. Available at: https://www.pge.com/includes/docs/pdfs/about/edusafety/training/pec/toolbox/arch/climate/california_climate_zone_11.pdf.

[4] *See* Pacific Gas and Electric, *The Pacific Energy Center's Guide To: California Climate Zones and Bioclimatic Design,* October 2006. Available at:

16 because these are some of the most populated zones in the State, which represents approximately 10% of the population.[5] These residents could be most impacted by the energy efficiency loss that can be experienced due to the colder temperatures. Due to this loss of efficiency, residents may pay more in their energy bill than modeled.

Additionally, according to NREL, effective use of HPWHs should be in climate zones where the ambient temperature would realistically be several degrees above the stated minimum temperature due to the cooling effect the HPWH has on the surrounding space.[6] These winter periods of higher energy use due to electric resistance back-up heating would also coincide with the period of the year when solar panels output is decreased due to weather and shorter daylight hours. This inverse relationship may result in an increase in non-renewable electricity to power the appliance.[7] Given the impacts a climate zone can have on the energy efficiency of a HPWH, SoCalGas requests that CEC Staff evaluate the change in HVAC energy resulting from the HPWH when performing the energy savings calculations for HPWHs.

Installation Costs to Properly Upgrade Ducting Systems

There are several installation requirements necessary for efficient operation of a HPWH which were not discussed in the CEC workshop. First, HPWH systems require 700-1,000 square feet of unoccupied space for adequate air circulation based on various manufacturer installation requirements. If the minimum space requirement is not met, the intake must be ducted to bring in more warm air. The Pacific Northwest National Laboratory (PNNL) found that fully ducting the exhaust and intake of a HPWH mitigates the additional heating energy impact of the HPWH on a home's HVAC system. If a system is not fully ducted, the PNNL report found that there are significant annual expenses associated with the additional space heating and cooling required.[8]

In addition to space, HPWHs should be placed in an insulated space to maximize efficiency, not outside or in an un-insulated garage for instance. However, placing the units inside a dwelling can create a noise issue. Due to the ambient air requirements, the ideal installation location for a HPWH is in a conditioned space, however the unit's fan and compressor will make noise while

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https://www.pge.com/includes/docs/pdfs/about/edusafety/training/pec/toolbox/arch/climate/california_climate_zones_01-16.pdf.

[5] *See* California Census 2020. Available at: https://census.ca.gov/htc-map/.

[6] U.S. Department of Energy, *Measure Guideline: Heat Pump Water Heaters in New and Existing Homes*, February 2012. Available at: https://www.nrel.gov/docs/fy12osti/53184.pdf.

[7] The result is the effective COP of the HPWH is 1.5 in very cold climates versus 2.0 in hot-humid climates. For comparison, the COP of electric resistance is 1. *See* U.S. Department of Energy, *Impact of Ducting on Heat Pump Water Heater Space Conditioning Energy Use and Comfort*, July 2014. Available at: https://labhomes.pnnl.gov/documents/HPWH_SpaceConditioning_Report_PNNL_23526_FINAL.pdf.

[8] U.S. Department of Energy, *Impact of Ducting on Heat Pump Water Heater Space Conditioning Energy Use and Comfort*, July 2014. Available at: https://labhomes.pnnl.gov/documents/HPWH_SpaceConditioning_Report_PNNL_23526_FINAL.pdf.

operating, within the range of 40-60 decibels.[9] For this reason, it is recommended not to install the unit in the immediate living space. As such this would require possible ducting requirements discussed above or sound mitigation, and the associated design and installation costs.

Additionally, HPWHs produce condensed water that must be drained by either gravity or through a condensate pump. It is unclear whether the cost associated with this was included in the cost estimates presented at the workshop. Further, heat pumps are typically taller than a traditional water heater tank and require additional clearance. Due to the additional heat pump components, the units are also heavier than a traditional heater and may require two or more people to move and install the unit.[10] SoCalGas respectfully asks that CEC Staff consider the additional cost estimates to homeowners for ducting materials, duct insulation, and/or installation that may be necessary for homes in these colder climates when conducting the required cost analysis.

Global Warming Potential of the Refrigerants used for Heat Pump Water Heaters

Older models of heat pumps use refrigerant R-22, which have been phased out due to the high ozone depletion potential. As such, R-410A has become the refrigerant of choice to replace R-22. While R-410A does not directly impact ozone, it is a greenhouse gas and belongs to the group of refrigerants known as hydrofluorocarbons (HFCs).[11] HFCs have a high GWP and are found in some HPWHs. According to WSP (a sustainable engineering firm), the GWP of R-410A is 2,088 times that of carbon dioxide.[12] However, some of the HPWHs on the market today, Rheem, AO Smith for example, use R-134a, which is another type of HFC and has a similarly high GWP. In addition, heat pumps, especially spilt systems, can have operating and maintenance problems with incorrect refrigerant charge, reducing system operational efficiency in practice. The CEC may want to consider putting in place a system to minimize the risk of this happening. SoCalGas asks that CEC Staff to factor into the cost/benefit calculations the environmental impacts of refrigerants used in space heating and HPWHs as net GHG reduction does not consider refrigerant losses. The CEC may consider working with the California Air Resources Board on how they will account for high GWP refrigerants in the upcoming Scoping Plan.

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[9] *See* U.S. Department of Energy, *Webpage on Heat Pump Water Heaters – Code Compliance Brief.* Available at: https://basc.pnnl.gov/code-compliance/heat-pump-water-heaters-code-compliance-brief#_ftn2.

[10] U.S. Department of Energy, *Measure Guideline: Heat Pump Water Heaters in New and Existing Homes*, February 2012. Available at: https://www.nrel.gov/docs/fy12osti/53184.pdf.

[11] Noah Kaufman, David Sandalow, Clotilde Rossi Di Schio, and Jake Higdon, *Decarbonizing Space Heating With Air Source Heat Pumps*, December 2019. Available at: https://www.eenews.net/assets/2019/12/18/document_cw_01.pdf.

[12] *See* WSP, *Webpage on the Importance of refrigerants in heat pump selection*, 28 March 2018. Available at: https://www.wsp.com/en-GB/insights/the-importance-of-refrigerants-in-heat-pump-selection.

SoCalGas appreciates this opportunity to provide input on this important workshop. If you would like to schedule a meeting to discuss the research presented in this comment letter, please do not hesitate to contact me at 916-492-4248 or at TCarmichael@semprautilities.com.

Sincerely,

/s/ Tim Carmichael

Tim Carmichael
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