

July 10, 2015

Ms. Brenda Edwards, EE–41

Office of Energy Efficiency and Renewable Energy

Energy Conservation Program for Consumer Products

U.S. Department of Energy

1000 Independence Avenue, SW.

Washington, DC 20585–0121

**Re: Pacific Gas and Electric Company comments on the Notice of Proposed Rulemaking on energy conservation standards for residential furnaces**

**Docket Number: EERE-2014-BT-STD-0031**

**RIN: 1904–AD20**

Dear Ms. Edwards:

This letter comprises the comments of the Pacific Gas and Electric Company (PG&E) in response to the Department of Energy (DOE) Standards Notice of Proposed Rule (NOPR) for Residential Gas Furnaces.

Pacific Gas and Electric Company, incorporated in California in 1905, is one of the largest combination natural gas and electric utilities in the United States. Based in San Francisco, the company is a subsidiary of PG&E Corporation. There are approximately 20,000 employees who carry out Pacific Gas and Electric Company's primary business—the transmission and delivery of energy. The company provides [natural gas](http://www.pge.com/myhome/edusafety/systemworks/gas/index.shtml) and [electric service](http://www.pge.com/myhome/edusafety/systemworks/electric/index.shtml) to approximately 15 million people throughout a 70,000-square-mile service area in northern and central California. We understand the potential of appliance efficiency standards to cut costs and reduce consumption while maintaining or increasing consumer utility of the products. We have a responsibility to our customers to advocate for standards that accurately reflect the climate and conditions of our service territory, so as to maximize these positive effects.

We appreciate this opportunity to provide the following comments on this NOPR. We commend DOE for the thorough analysis performed in support of a level of 92 AFUE. We offer these comments in support of the proposed standard and to encourage DOE to go even further and adopt higher efficiency standards that DOE has already found to be cost-effective and technically feasible. The resulting savings of 2.78 Quads makes this one an important DOE appliance standard.

**PG&E supports the standard level proposed by DOE in the NOPR.**

PG&E performed analysis using the DOE LCC model and finds that DOE proposed standard level of 92 AFUE is cost effective, as is the 95 AFUE level. There is apparently widespread misunderstanding of the LCC model but we support its use as the best way to assess impacts across a broad array of alternative scenarios each of which has a probability distribution.

**Improved furnace standards are a key component in meeting state, national, and international climate goals.**

PG&E is directed by the California Public Utilities Commission (CPUC) to implement the Long Term Strategic Plan,[[1]](#footnote-1) and the Codes & Standards program implements the C&S Action Plan.[[2]](#footnote-2) Implementation of the Plans is done, in part, by the Codes & Standards program supporting the effort of the CEC. Given that furnace standards are preempted by DOE we are engaged with CEC in raising the efficiency of gas furnaces.

Induced draft furnaces replaced natural, atmospheric draft units over three decades ago because they provided a boost in efficiency. During the same time period forced draft, condensing furnaces were developed and perfected. They have reached the point of technology maturity required to become the new standard. A similar evolution of technology occurred in automobiles resulting in there being no new vehicles without fuel injection technology. It took regulatory action to cause this change but the benefits to society are numerous. This will be case for furnaces. It has been almost 3 decades since the last furnace standards were promulgated during which public policy and our understanding of carbon and NOx pollution have come to support the retirement of a legacy technology.

**A nationwide 92% AFUE standard is cost-effective and technically feasible and improvements to DOE analysis make a 95% AFUE standard better.**

The Department of Energy (DOE) life cycle cost (LCC) analysis method for residential furnaces, documented in the Notice of Proposed Rulemaking Technical Support Document (NOPR TSD)[[3]](#footnote-3), is based on a Monte Carlo analysis that adequately considers the variability and uncertainty of all input parameters. This approach ensures all input possibilities associated with geographic, application, technical, and economic differences are included in the analysis along with their presentations in the market. Therefore, DOE’s LCC analysis results are well-suited to reflect the energy savings and cost effectiveness of different efficiency levels under consideration.

However, DOE’s analysis includes conservative assumptions for several input parameters, as explained in the following sections. We believe that these conservative assumptions are unnecessary and should be removed to more accurately model the costs and benefits of high efficiency furnaces. We provide LCC results using suggested revisions to the assumptions using the DOE LCC Crystal Ball analysis tool.

We support a national or regional standards based on TSL4 (Efficiency level 3 – AFUE 95%), because the DOE analysis shows that this standard level is cost effective on both national and regional basis. Results are even further cost effective with our modified results. Adopting a standard to dramatically reduce natural gas use is also critical for California to meet its NOx reduction target and US EPA’s smog control mandates.

Fuel switching is controversial in some regions of the country. Recently observed billboard advertisements along freeways in Atlanta advertised incentives of $550 from the local electric utility for switching to a heat pump. This may be a transient situation but does demonstrate that fuel switching analysis must be addressed from a probabilistic perspective as is done in the DOE LCC. In California fuel switching is unlikely given the requirements of the Title 24 Part 6 Building Energy Efficiency Standards. But in case where it occurs it is important to consider that, as shown in the ASAP comment letter, almost all of the manufacturers of furnaces also produce heat pumps. Thus if and when a furnace is replaced with a heat pump the equipment manufacturer does not lose the sale.

Following are our suggestions for improvements to the DOE LCC analysis.

1. **Make less conservative product markup assumptions**

Section 2.7 of the TSD indicates that incremental markups are necessary for “the change in the manufacturer production cost of higher efficiency models to the change in the retailer or distributor sales price.” Section 6.1 states that “Because companies mark up the price at each point in the distribution channel, both baseline and incremental markups are dependent on the distribution channel [.]”

Once the furnace efficiency standard takes effect, manufacturer, wholesaler, and contractor costs for furnaces meeting the new requirements are likely to drop due economies of scales for manufacturers (and thereby wholesalers), and product familiarity for contractors. Yet, the incremental markups are based on current costs-of-good-sold, variant costs, and gross margins related to higher efficiency furnaces. These costs should be reflective of a scenario should that standard be adopted, where the price point of the high efficiency furnace is essentially equivalent to the baseline furnace.

However, tables in Section 6.6.1 show very high incremental markups, as high as 69% in Alaska. These incremental markups are too conservative in a market where manufacturers and contractors are competing to provide the best price for a furnace that meets the federal standard, and should be excluded altogether by treating the new standard as the baseline.

1. **Improve accuracy of market for vent system upgrade for orphaned water heater vents**

We believe that DOE’s assumptions on vent system upgrade for orphaned waters can be improved for replacement, new owner, and new construction installation.

1. **Reduce frequency assumptions for common-vented furnaces and water heaters:** In particular, DOE analysis should include the effect of market penetration of high-efficiency water heaters by 2021, which would make many homes to upgrade their vent for water heaters. For example, the 2009 DOE TSD on Residential Water Heaters, Direct Heating Equipment, and Pool Heaters,[[4]](#footnote-4) Figure 9.3.4, estimated that the market share for gas instantaneous water heaters could reach 28% based on a median projection. The new DOE water heater efficiency standards, which took effect in April 2015 effectively requires gas water heaters with more than 50 gallon storage capacity to be condensing water heaters. The California 2016 Title 24, effective in 2017, includes a prescriptive requirement of tankless (instantaneous) water heater for all new construction homes. To accommodate high-efficiency water heaters, new construction homes and many existing homes (including those with common vents for the furnace and water heater) will need to upgrade water heater vents. DOE’s analysis of vent system upgrade cost for orphaned water heaters was based on market data collected before 2010. By 2021, the number of homes with a common venting system shared by NWGF and a natural vent water heater will be greatly reduced.
2. **Use consultant reported frequencies:** For existing NWGF replacement, DOE analysis relied on a 2010 consultant report[[5]](#footnote-5) to estimate costs of upgrading the vent system for orphaned water heaters. This consultant report was used to support the prior residential gas furnace standard development. However, as shown in the following table, DOE increased the frequencies for applying vent resizing costs without detailed explanation and any supporting data. These frequencies represent the percentages of existing homes where the common vent for the non-condensing furnace and water heater would be too large for the orphaned water heater. As explained above, we expect that increased market adoption of high-efficiency water heaters would further reduce these frequencies from the estimates provided in the consultant report. We recommend that DOE consistently use the results provided in the 2010 consultant report for frequencies to apply resizing orphaned water heater chimney or upgrading metal vent and include further reduction of these frequencies due to increased market adoption of high-efficiency water heaters.

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| --- | --- | --- | --- | --- |
| **Existing Non-Condensing Furnace** | **Replacement Furnace** | **Installation Requirement** | **Frequency of applying requirements** | |
| **Consultant Report Table 8-B.6.5** | **Current Analysis Table 8D.2.19** |
| Natural Draft | Condensing Furnace | Convert Water Heater from single wall to Type B vent Connector | 100% | 100% |
| Natural Draft | Condensing Furnace | Resizing Orphaned Water Heater Chimney or upgrading Metal Vent | 40% | 75% |
| Natural Draft or Fan Assisted | Condensing Furnace | Reline all unlined chimneys for Orphaned Water Heater | 100% | 100% |
| Fan Assisted | Condensing Furnace | Resizing Orphaned Water Heater Chimney or upgrading Metal Vent | 20% | 40% |

1. **Eliminate added costs for new owner installations common-vented with non-condensing water heaters:** For new owner of condensing NWGFs, DOE included a common venting adder of $956 for all new owner installations planned to be commonly vented with non-condensing design option (Table 8D.2.27), which was assumed to represent 45% of the new owners. This adder is unnecessary. Homes in this category do not have a furnace, and therefore do not have an existing common vent for the furnace and water heater. Adding a dedicated vent for the new condensing NWGF does not affect the existing vent for the water heater and, therefore, does not trigger any vent upgrade requirement for the existing water heater. This common venting adder should be removed from the LCC analysis.
2. **Reduce the frequency of common-vented new construction homes:** DOE assumed that 44% of the new construction homes planned to have a common venting system for non-condensing NWGF and water heater as the baseline design option (Table 8D.2.28). As we indicated previously, this assumption does not properly reflect the market trend of increased adoption of high-efficiency water heaters, especially for new construction home. In California, due to the 2016 Title 24 building standards, all new construction homes would have tankless water heater or those with equivalent or better efficiency by 2021. Therefore, this cost adder should not be applicable to California new construction homes. Accordingly, the applicable percentage nationwide would reduce from 44% to 40%, as California represents about 10% of the national NWGF shipment. Assuming other states will reduce the market share of non-condensing storage water heaters by 30%, the applicable nationwide market share for the common venting adder would be 28% (40% \* (1-30%)).
3. **Include learning curve effects on product price trends**

The NOPR TSD section 8A.4 states the product price trends are set to decreasing due to technology learning, which results in a decline in the cost of producing a given product as firms accumulate experience with the technology. However, when using the DOE LCC tool it appears that the learning rate impacting product price was instead set to “No Learning (Constant).” Section 8.2.1 states that a decreasing learning factor of 0.937 was applied to total consumer price, but the spreadsheet settings indicate otherwise. Please provide clarification for the learning factor used.

Concerns have been raised about installation costs in row houses and in the case of various existing conditions. These are addressed by using the “learning” concept. In the case of row houses there are often existing masonry chimneys that go straight up making the installation of the condensing gas furnace and a new water heater venting feasible. New venting technologies have and will be introduced to meet the market demand for low cost venting alternatives.

Revised LCC analysis summary

We ran 40,000 trials using the DOE’s LCC tool with modified assumptions as described above, namely:

1. Setting incremental markups set to equal 1
2. Setting decreasing product price trends to include learning
3. With 1 and 2 combined

LCC analysis was performed for the entire U.S., Northern U.S., Southern U.S., and California.

**Original Results**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NWGF Efficiency Level | U.S. | | Northern U.S. | | Rest of U.S. | | California Only | |
| LCC | LCC Savings | LCC | LCC Savings | LCC | LCC Savings | LCC | LCC Savings |
| 0 - NWGF 80% |  |  |  |  |  |  |  |  |
| 1 - NWGF 90% |  |  |  |  |  |  |  |  |
| 2 - NWGF 92% |  |  |  |  |  |  |  |  |
| 3 - NWGF 95% |  |  |  |  |  |  |  |  |
| 4 - NWGF 98% |  |  |  |  |  |  |  |  |

**Without Incremental Markup**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NWGF Efficiency Level | U.S. | | Northern U.S. | | Rest of U.S. | | California Only | |
| LCC | LCC Savings | LCC | LCC Savings | LCC | LCC Savings | LCC | LCC Savings |
| 0 - NWGF 80% |  |  |  |  |  |  | $8,474 | NA |
| 1 - NWGF 90% |  |  |  |  |  |  | $8,265 | $192 |
| 2 - NWGF 92% |  |  |  |  |  |  | $8,187 | $259 |
| 3 - NWGF 95% |  |  |  |  |  |  | $8,120 | $324 |
| 4 - NWGF 98% |  |  |  |  |  |  | $8,134 | $311 |

**With Learning Curve Effects**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NWGF Efficiency Level | U.S. | | Northern U.S. | | Rest of U.S. | | California Only | |
| LCC | LCC Savings | LCC | LCC Savings | LCC | LCC Savings | LCC | LCC Savings |
| 0 - NWGF 80% |  |  |  |  |  |  |  |  |
| 1 - NWGF 90% |  |  |  |  |  |  |  |  |
| 2 - NWGF 92% |  |  |  |  |  |  |  |  |
| 3 - NWGF 95% |  |  |  |  |  |  |  |  |
| 4 - NWGF 98% |  |  |  |  |  |  |  |  |

**With Both Preceding Assumptions**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NWGF Efficiency Level | U.S. | | Northern U.S. | | Rest of U.S. | | California Only | |
| LCC | LCC Savings | LCC | LCC Savings | LCC | LCC Savings | LCC | LCC Savings |
| 0 - NWGF 80% |  |  |  |  |  |  |  |  |
| 1 - NWGF 90% |  |  |  |  |  |  |  |  |
| 2 - NWGF 92% |  |  |  |  |  |  |  |  |
| 3 - NWGF 95% |  |  |  |  |  |  |  |  |
| 4 - NWGF 98% |  |  |  |  |  |  |  |  |

As seen above, when including all preceding assumptions, the average LCC Savings for 95% AFUE furnaces increases over the original results by $X for the U.S. and $X for California. Please note that these results will be further improved when revising inputs so that the new-owner common-vent installations is 0% and common-vented new construction homes to 28%.

1. **Clarify treatment of constant torque fan motor costs**

The DOE’s treatment of the incremental costs of constant-torque BPM motors is unclear. As stated in the NOPR TSD Section 5.8.1, *“following the 2014 furnace fan rulemaking, in 2019 fan efficiency requirements will be set at a level that will likely essentially require constant-torque BPM blower motors to be used for non-weatherized gas-fired furnaces[.]”*

However, later in the section the Residential Furnaces NOPR TSD states *“Therefore, DOE determined the additional cost of changing from a PSC to a constant-torque BPM blower motor […] in the engineering analysis.”* Please confirm that this statement refers to the engineering analysis of the previous furnace fan rulemaking.

Furthermore, Table 5.8.1 suggests that incremental costs to constant-torque BPM motors are included in overall costs. Please confirm that the only incremental costs included in the analysis are from constant-torque to constant-airflow (e.g., for a 60 kBtuh/h NWGF, the incremental cost is $89.60 - $37.29 = $52.31).

1. **Consider impending air quality regulations that will also increase demand for high-efficiency gas furnaces**

California Air Quality Management Districts have set forth air quality action plans that mandate specific measures to reduce pollutant emissions from various sources and bring concentration levels down to comply with EPA standards. Due to the climate and geography of California, air quality is a significant issue and many districts have experienced difficulty reaching EPA standards for pollutant concentration, especially in the southern part of the state. Of the various pollutants causing air quality concerns, NOx is of significant importance because of its role in forming particulate matter, smog, and ozone, all of which can have harmful effects on people and the environment. The atmospheric warming potential from NOx is 300 times that of the same amount of CO2. Greater adoption and installation of high efficiency furnaces in California will aid in attainment of the EPA’s 24-hour PM2.5 and the 8-hour Ozone targets in Air Pollution Control Districts and Air Quality Management Districts throughout California.

Residential and small commercial furnaces are considered stationary area sources of pollutants, which were responsible for 7% of NOx emissions and 39% of directly emitted particulate matter (2.5 micrometers) (PM2.5) in a 2008 emissions inventory from South Coast Air Quality Management District. Current air quality management plans throughout California require specific NOx emission targets for residential and small commercial furnaces that are less than 175,000 Btu/hr. Many districts have recently reduced the target levels from 40 ng/J of heat output, which is the national standard, to 14 ng/J of heat output for furnaces of this capacity.

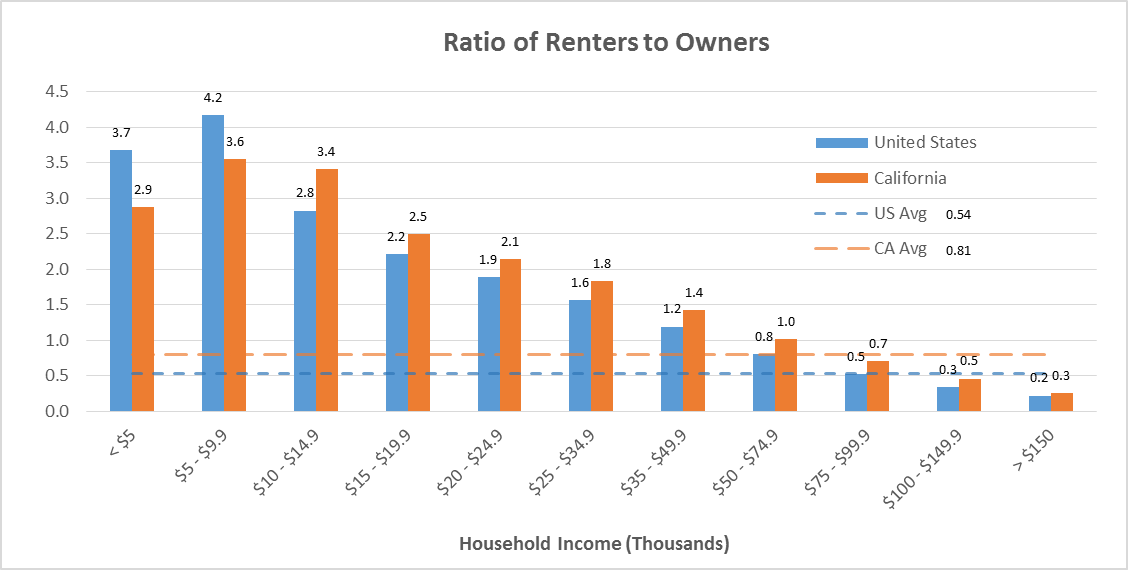
The districts have written the emission targets using a metric that does not specifically promote high efficiency furnace technology; however, due to the fact that high efficiency furnaces require the combustion of less fuel for the same heat output as a standard efficiency furnace, high efficiency furnaces can be designed to meet the lower NOx emissions level more easily than a standard efficiency furnace. A furnace with an annual fuel utilization efficiency (AFUE) of 0.92 is 15% more efficient at producing heat output from the same amount of fuel input as a furnace with a 0.80 AFUE. Therefore, high efficiency, condensing furnaces can result in a 15% reduction in NOx emissions due to less fuel input required for the same heat output. This reduction potential does not consider the additional reductions that could result from low-NOx burners or other furnace technologies.

According to one Air Quality Management District staff member, manufacturers requested that the reduced NOx emission targets go into effect for condensing furnaces prior to other furnace types because it is easier to get these furnace types to meet the limit; whereas further technology developments are required to get standard efficiency furnaces in compliance. Another staff member from a separate Air Quality Management District stated that although the NOx reduction rule does not specify any particular type of furnace technology, high efficiency furnaces would certainly help to meet NOx emission reduction goals.

Moving forward, Air Quality Management District will likely need to implement further measures to reach pollutant emission goals by their target dates. Districts have already implemented the majority of low hanging fruit measures, and, according to previous plans, will begin to look at energy conservation measures as opportunities to further reduce emissions from combustion equipment. It is not clear at this time what measures the Air Quality Management Districts will push forward in their air quality action plans; however, it is clear that condensing furnaces are a readily available technology that can reduce NOx emissions and meet federal standards.

1. **Highly efficient furnaces benefit renters and low-income consumers.**

The DOE analysis does not appear to address use cases of renters and low-income occupants. Census data for the US and CA shows that renters outnumber owners until household incomes are above $50k. In the chart below the data for the US and California are plotted side by side.[[6]](#footnote-6) The California average renter to owner ratio is 0.81, which is 150% of the national average. In California owners have twice the income of renters.



Nationally the trend is for more rentals as noted in an article by Diana Orlick of CBNC.[[7]](#footnote-7)

Even though apartment construction has increased dramatically in the past few years, rents continue to surge, as demand grows, and both are unlikely to abate anytime soon. The drop in the homeownership rate among middle-aged cohorts is a huge driver, as they often prefer larger single-family rentals over less family friendly apartments.

Millennials are also key drivers. In 13 million of the 22 million new households that will form between 2010 and 2030 the occupants will seek to rent, rather than buy, their homes, according to the Urban Institute. Families will likely continue to make up a larger-than-normal share of renters, as they try to repair their credit. Investors are well aware of that.

Rents are set by location and building characteristics such as age and interior amenities. In some areas there is rent control. Replacement of equipment, such as a furnace, is part of normal repair and maintenance of a property and is built into the landlord’s cost structure. Rents do not increase because a furnace is replaced. In California location is the key variable as noted a recent California report:

Rents vary throughout the state as well. The average monthly rent for a two-bedroom apartment in San Francisco ($2,000) was two and a half times greater than the average in Fresno or Bakersfield (both about $800).[[8]](#footnote-8)

When a furnace needs replacing there is little if any financial reason for the landlord to install a more efficient and expensive furnace since the tenant pays the utility bill. This is a classic “split incentive” situation that can only be addressed with minimum appliance efficiency standards.

Utility subsidies are given to low income customers, who are predominately renters, to cover gas and electricity consumption. A condensing furnace will save gas allowing the subsidy to cover a large portion of the heating season gas costs. This is a benefit to all rate payers who are the source of the incentive.

We request that DOE clarify how renters are benefited by the proposed 92 AFUE standard. If this analysis has not been done we recommend that DOE perform the analysis. It is likely that a segment of “losers” at 92 AFUE will diminish since renters do not experience the cost increase of condensing furnace installations.

1. **Furnace Capacity Considerations**

Stakeholders have been exploring compromise solutions that would bridge the gap between condensing and non-condensing furnace efficiency. California is unique in that it has 16 Climate Zones encompassing low, hot, and dry deserts (CZ 15) to high, cold, and dry mountains (CZ 16). The same house built in one climate zone requires a low capacity furnace and when built in another will need a furnace that is twice as large. As shown in the chart below, the distribution of furnace input capacities for California is such that 49% of them are ≤ 60k Btuh. This compares to only 18% in all of the country being ≤60k Btuh.

The ACCA Manual S allows furnaces to be sized to handle the air flow required to meet the air conditioning load. It is not uncommon for a furnace to have twice the heating capacity needed to meet the heating load. Furnace airflow is dependent on the size of the blower and the horse power of the motor connected to the blower. A wider furnace is used so that a larger blower can be installed. The same furnace cabinet can incorporate different number of burners yielding different capacities for the same airflow. If there is a capacity below which 80 AFUE is allowed then manufacturers could produce low capacity units with high airflow for installation in California and other locations with low heating loads and high cooling loads. Thus it is likely that the existing distribution, whether it is as shown above as updated by new data, will change to have more units shipped that are at 80 AFUE.

When these observations are considered the conclusion is that the energy savings from a capacity-based dual standard is uncertain for the nation. For California, especially for new construction, it is difficult to project any significant level of savings.

1. **Use region-specific source energy multipliers and accurately represent renewable generation**

The NOPR TSD references the Energy Information Administration’s (EIA) Annual Energy Outlook (AEO) 2014[[9]](#footnote-9) for the assumption of primary/site conversion factors for electricity, calculated as the heat input (Btu/hr) for each electricity unit produced (kWh) (also known as a “heat rate”). These assumptions impact the benefits summaries in Tables 1.2.1 and 1.2.2 of the NOPR TSD.

Table A17 in AEO 2014 states that *"Consumption at hydroelectric, geothermal, solar, and wind facilities is determined by using the fossil fuel equivalent of 9,716 Btu per kilowatthour*.” A fossil fuel equivalent is an inaccurate representation of the heat rate for renewable energy sources, considering that renewable energy input rate can be treated as ‘zero’ for all practical purposes.

We recommend using region-specific factors that accurately reflect renewable energy sources. California’s heat rate as determined from the California Energy Commission’s Energy Almanac,[[10]](#footnote-10) which includes natural gas, solar, geothermal nuclear, coal, biomass, hydroelectric, and wind plants, is approximately 6,700 Btu/kWh. This is 30% less than the value used in the NOPR TSD. The largest utilities in California are currently serving 23% renewable power, which will increase to 33% in 2020 as per California’s Renewables Portfolio Standard (RPS).[[11]](#footnote-11) Many other states have similar RPS requirements. Increases in renewable energy will drive the heat rate further down. Using region specific heat rates that accurately capture the benefits of renewable sources and potential increases future renewable generation will drastically improve the energy savings and other benefits associated with higher efficiency residential furnaces.

**Conclusion**

PG&E supports DOE adopting a national 92 AFUE and consider the option of moving to 95 AFUE.

Sincerely,

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| Patrick Eilert  Manager, Codes and Standards  Pacific Gas and Electric Company |  |

1. http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/eesp/ [↑](#footnote-ref-1)
2. http://www.cpuc.ca.gov/NR/rdonlyres/33894C3D-BAE7-4051-92A9-E066356FE820/0/CS\_ActionPlan\_20140219.pdf [↑](#footnote-ref-2)
3. U.S. Department of Energy, Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Furnaces. 2015. Available at: <http://www.regulations.gov/#!documentDetail;D=EERE-2014-BT-STD-0031-0027> [↑](#footnote-ref-3)
4. U.S. Department of Energy, Technical Support Document: Energy Efficiency Program for Consumer Products: Residential Water Heaters, Direct Heating Equipment, and Pool Heaters. 2009. Available at: <http://www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0129-0170> [↑](#footnote-ref-4)
5. EER Consulting, L., Appendix 8-B (Section 8-B.5) part of Final Rule Technical Support Document: Energy Efficiency Standards for Consumer Products: Central Air Conditioners, Heat Pumps, and Furnaces. 2010. Dallas, TX. Available at: <http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0011-0012> [↑](#footnote-ref-5)
6. <http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_B25118&prodType=table> [↑](#footnote-ref-6)
7. <http://www.cnbc.com/id/102811764>, accessed July 7, 2015. [↑](#footnote-ref-7)
8. Page 7. <http://www.lao.ca.gov/Publications/Detail/3214> accessed July 7, 2015 [↑](#footnote-ref-8)
9. U.S. Department of Energy: Energy Information Administration, Annual Energy Outlook 2014 with Projections to 2040. 2014. Washington, DC. Available at: [www.eia.gov/forecasts/aeo/](http://www.eia.gov/forecasts/aeo/) [↑](#footnote-ref-9)
10. Available at: <http://energyalmanac.ca.gov/electricity/web_qfer/Heat_Rates.php> [↑](#footnote-ref-10)
11. Available at: <http://www.cpuc.ca.gov/PUC/energy/Renewables/> [↑](#footnote-ref-11)