October 10, 2014

Maziar Shirakh
Project Manager, Building Energy Efficiency Standards
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

Subject: Comments of the American Gas Association (AGA) on the California Codes and Standards Enhancement (CASE) Initiative analysis, "Residential Instantaneous Water Heaters," Measure Number 2016-RES-DHW1-F, Revised August 27, 2014.

Dear Mr. Shirakh:

The American Gas Association, founded in 1918, represents more than 200 local energy companies that deliver clean natural gas throughout the United States. There are more than 71 million residential, commercial and industrial natural gas customers in the U.S., of which 94 percent — over 68 million customers — receive their gas from AGA members. AGA is an advocate for natural gas utility companies and their customers and provides a broad range of programs and services for member natural gas pipelines, marketers, gatherers, international natural gas companies and industry associates. Today, natural gas meets more than one-fourth of the United States' energy needs.

The following issues with the subject analysis report and accompanying Microsoft Excel™ spreadsheet followed a review initiated by AGA on August 29, 2014 and shared with Sempra Utilities and Southwest Gas Company, both of which are AGA member companies operating in the State of California. Issues identified are accompanied with brief recommendations for further action for the consideration of CASE study stakeholders:

- The spreadsheet contains logical errors that, at this point in time, are not identified. CASE staff is reported to have distributed a "modified" spreadsheet, but Sempra staff have reported errors in that spreadsheet as well. AGA reviewed the spreadsheet, "Cost Benefit Analysis IWH T24 27Aug," and found the following Microsoft Excel™ warning:

  "Careful, we found one or more circular references in your workbook that might cause your formulas to calculate incorrectly. FYI, a circular reference can be a formula that refers to its own cell value, or refers to a cell dependent on its own cell value."

AGA has not pursued finding spreadsheet error(s) since other modified spreadsheets have not been made available for AGA review, and additional modified versions may become available.

Recommendation: Given this situation, it is clear that the spreadsheet analysis is not complete and has not been debugged for stakeholder review. CASE study staff should provide a final spreadsheet analysis and provide sufficient additional time for a comprehensive public review.

- Even taking the available spreadsheet numbers at face value (which is not appropriate given the issue discussed above), the difference in net present value (NPV) for instantaneous gas water heaters compared to storage water heaters shown on the spreadsheet is less than three percent of total present value baseline costs ($201/$7,787). This extremely small cost advantage is less than the cost of one basic service procedure over the life of a water heater and points to the potentially high sensitivity of the cost analysis to basic assumptions of various cost assumptions, including frequency and magnitude of service cost procedures. This points to the need for simple sensitivity analysis of the cost advantages relative to variation and uncertainty of component costs over the water heater life. The value of sensitivity analysis is clear, regardless of version of spreadsheet ultimately arising from the CASE work.

  Recommendation: The final spreadsheet analysis should include sensitivity analysis based on variation and uncertainty of component costs.

- Critical study assumptions may not be fully or directly reflected in the final spreadsheet analysis. Issues associated with these assumptions, documented in the CASE report text, are discussed in the remainder of these comments. Once a final spreadsheet analysis is provided, the full implementation of these assumptions in the spreadsheet analysis can be evaluated for validity and completeness.

  Recommendation: The CASE report should identify spreadsheet inputs discussed in the report text, so that the potential impact of specific assumptions can be reviewed. To that end, the study group should consider assigning spreadsheet inputs by variable names and including those variable names within the appropriate report text.

- The 20 year lifetime assumed for instantaneous gas water heaters is unjustified. As the CASE report points out, field experience of residential instantaneous gas water heaters is very limited to draw conclusions regarding appliance lifetime. In contrast, storage water heaters have decades of field experience across millions of installed units. Their estimated average lifetime of 13 years is justifiable based on a variety of sources and professional and consumer experience. The CASE report presents a variety of speculative reasons for extending estimates of average lifetime for instantaneous water heaters to 20 years, but these reasons do not supplant the value of field experience. Deficiencies in the CASE report justifications of this lifetime are discussed below. However, it is notable from Table 10 of the report that the “anchor” value of 20 years is at odds with the estimates of water heater manufacturers and other direct stakeholders involved with instantaneous water heaters. Furthermore, and upon review of the sources cited, it appears obvious that the U. S. Department of Energy (DOE) estimated average lifetime of 20 years is the principal source of that estimate. In its final rule covering minimum efficiency of residential water heaters, DOE cited the following as its

reason for utilizing the 20 year average lifetime (presented in its entirety from the final rule as published in the Federal Register):[1]

> *"For the December 2009 NOPR analysis, DOE used an average lifetime of 20 years for gas-fired instantaneous water heaters. A.O. Smith stated that a 20 year lifetime for gas-fired instantaneous water heaters is too long, and is largely based on manufacturers' literature or advertising claims. It referred to its experience with commercial water heating equipment that uses a similar copper-tube type heat exchanger as gas-fired instantaneous water heaters and similar input combustion systems of around 200,000 Btu/h, and the commenter concluded that the same service life (i.e., 13 years) as a tank-type heater should be used for gas-fired instantaneous water heaters. (A.O. Smith, No. 76 at pp. 4-5)*
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> *DOE acknowledges that, given that long-term field experience with gas-fired instantaneous water heaters is relatively limited, there is uncertainty regarding the lifetime of these products. Furthermore, the lifetime is influenced by maintenance practices. The 20-year mean lifetime used by DOE is primarily based on the value reported in the National Association of Home Builders/Bank of America Home Equity Study of Life Expectancy of Home Components, which is 20+ years.*
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> *Regarding the analogy between gas-fired instantaneous water heaters and commercial water heating equipment mentioned by A.O. Smith, DOE notes that the usage patterns in residential applications are different (e.g., less hot water use), and these patterns have a significant impact on the lifetime. Given the available data, DOE decided to retain the mean lifetime of 20 years for the final rule analysis."*

This justification is an insufficient proxy for field experience and, in the absence of field experience, complete rationale for establish an average lifetime estimate for instantaneous water heaters in excess of the more established lifetime for storage water heaters. The common source cited by DOE and the CASE report for the instantaneous water heater 20 year lifetime (National Association of Home Builders/Bank of America Home Equity Study of Life Expectancy of Home Components) does not provide a traceable source for its "20+" year estimate and, as such, is not reviewable for validity. Qualitatively, the CASE report attributes the economic justification for the instantaneous water heater requirement to the "IWH's longer lifespans."[2]

Recommendation: For the purpose of analysis and in the absence of appropriate field experience and validated assumptions for extending lifetime estimates, the CASE study should use 13 years as the average lifetime for instantaneous water heaters. Use of this average lifetime should be the first sensitivity case for spreadsheet analysis as called for above. That sensitivity case should be carried through to the calculation of benefit-to-cost (B-C) ratios shown in Table 3a and 3b of the report, which currently show very low B-C ratio scores. Some critical assumptions used by the CASE study group to justify the average lifetime differentials between storage and instantaneous water heaters are discussed below.

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[1] Federal Register, Energy Conservation Program: Energy Conservation Standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters, Final Rule, Docket Number: EE–2006–BT-STD–0129] RIN 1904–AA90, April 16, 2010, p. 20144.

[2] California Utilities Statewide Codes and Standards Team, Codes and Standards Enhancement Initiative (CASE), "Residential Instantaneous Water Heaters," Measure Number 2016-RES-DHW1-F, Revised August 27, 2014, page x, "Market Analysis and Regulatory Impact Assessment."

- Maintenance assumptions and associated costs for storage water heaters and instantaneous water heaters are inconsistently applied. The 13-year average lifetime of storage water heaters provided in the literature is based up on actual operational experience, with and without periodic maintenance. It is not valid for the CASE study to incorporate recommended maintenance procedures and costs for all storage water heaters in its cost comparison since the lifetime impacts of not performing recommended maintenance is already accounted for in the 13-year average lifetime. Going forward, CASE cannot justify using this lifetime limitation and, at the same time, assuming all water heaters receive the recommended maintenance and incur the associated maintenance costs. In contrast, justification of the CASE study 20-year average lifetime for instantaneous water heaters is dependent upon full execution of recommended maintenance procedures. No adjustment of average lifetime of instantaneous water heaters is provided under situations where recommended maintenance is not performed. While this CASE study assumption adds maintenance costs, insufficient evidence is available to determine how inadequate maintenance across some fraction of the installed instantaneous water heaters would reduce lifetime or how infrequently recommended maintenance is performed.

- A review of manufacturer installation instructions and warrantee information suggest that the potential for voiding water heater warrantees due to failure to perform maintenance is a higher risk for purchasers of instantaneous water heaters than for storage water heaters. As such, the warrantee risk is generally higher for owners of instantaneous water heater. The reason for this should be clear. Failure modes for storage water heaters due to water quality issues and failure to drain the storage tank is a longer term issue than for instantaneous water heaters, which tend to fail at elevated temperatures associated with the heat exchanger system. These are failures much more likely to occur within the warrantee period and should incentivize higher compliance with recommended maintenance procedures among owners of instantaneous gas water heaters. The associated differential in maintenance costs is not estimated with the CASE study analysis.

- The CASE study inappropriately downplays the costs of failure of heat exchangers in instantaneous water heaters. Suggesting that "repair to the damaged part"[3] instead of water heater replacement (as would be required for storage water heater) masks the costs of such failures. It is agreed that water heater replacement is called for in major failures of storage water heaters due to liming, but replacement of a heat exchange in an instantaneous water heater will be more expensive in parts and labor than a storage water heater replacement. Precise and reliable data on heat exchanger replacement needs to be gathered to shed full light on this differential.

- Anecdotal information that "without routine maintenance, storage water heaters typically fail between 5 and 10 years"[4] is at odds with industry and consumer experience generally, and provides no information useful to the analysis other

[3] *Ibid*., Section 3.3.2, "Maintenance," page 15.
[4] *Ibid*., Section 3.3.2, "Maintenance," page 15.

than to justify the differential treatment of storage and instantaneous water heaters. This unverified comment has no place in the CASE study report.

- Energy impacts may be based upon Federal test procedures that are now being made obsolete. On July 11, 2014, DOE promulgated the Water Heater Universal Efficiency Descriptor Test Procedure, which changed the energy descriptor calculations and test procedures that will apply to instantaneous water heaters effective July 13, 2015.[5] One objective of this change in the test procedures, promulgated under a change in Federal law, was to revise the energy factor (EF) energy descriptor across products to enhance comparability of storage and instantaneous water heaters while retaining continuity with prior EF ratings through a calculation adjustment procedure. However, stakeholders including the trade association representing the manufacturers of residential water heaters, the Air-Conditioning, Heating and Refrigeration Institute (AHRI), have maintained that the energy rating and, as a result the effective Federal minimum efficiency standards, have changed. Material changes in the test procedures that may affect the energy impacts calculations within the CASE study report include changes in the water heater draw pattern (including simulated use patterns) and outlet water temperature requirements. Detailed review of the potential impacts of these changes on the CASE study report energy consumption calculations could not be completed with the report review time allotted.

  Recommendation: The CASE study team should review its energy impacts analysis for potential changes caused by the change in Federal test procedures and the energy descriptor for both storage water heaters and instantaneous water heaters.

This concludes the comments of AGA on the subject draft of the CASE study report and its supporting spreadsheet analysis. Since it is AGA's understanding is that the CASE study is not complete at this time, AGA has deferred commenting on other issues that may be resolved in future published versions of the report and spreadsheet. AGA looks forward to working on the CASE study review through the engagement of its State of California members.

Sincerely,

James A. Ranfone
Managing Director,
Codes & Standards

cc: Commissioner Andrew McAllister

[5] "Energy Conservation Program for Consumer Products and Certain Commercial and Industrial Equipment: Test Procedures for Residential and Commercial Water Heaters, Office of Energy Efficiency and Renewable Energy, Department of Energy, Final Rule," Federal Register, Vol. 79, No. 133, July 11, 2014, pp. 40542-40588,