



DATE: *October 1, 2009*

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California Department of Toxic Substance Control*

FROM: *Mark Tibbetts, Executive Director
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SUBJECT: *Research Plan for Mercury Thermostat Inventory/Flow Analysis Validation*

Basic Project Objective:

The project research plan, involving a web survey¹ on presence and removal of mercury-containing thermostats and the associated statistical analysis, is designed to support estimates of:

- The total number of mercury-containing thermostats currently in place in residential and commercial buildings in the State of California, and
- The annual "flow" of mercury-containing thermostats out of residential and commercial buildings in the state.

Error Potential in Self-Assessment of Facility and Project Safeguards Addressing the Concerns:

The analytical methodology is state-of-the-art and fully appropriate. However, some are concerned that the web survey approach leaves room for some error in the reporting of mercury-containing thermostats. Skumatz Economic Research Associates (SERA) has incorporated strategies to minimize the potential for this error.

- 1) The survey instrument design – including pictures and descriptions – will provide the key indicators necessary to identify whether the equipment contains mercury, including how to visibly inspect the thermostat to distinguish between electronic and electromechanical thermostats and subsequently determine if the electromechanical thermostat contains mercury.²
- 2) Respondents are people with direct visual access to the thermostat – persons in the building itself (not distant property managers, etc.).
- 3) Information is being requested about equipment that is unique and visible. SERA has previously conducted residential validation studies, comparing self-reported answers on energy-related equipment to on-site verification, and we found minimal error rates.³ People are able to answer certain kinds of equipment-related questions via a survey over the phone (or presumably web). The key factors in that project were that the items were fairly easily identified (e.g., it might not work for insulation, but would work for a water heater or, in this case, presence of a thermostat).

¹ With phone alternative for respondents preferring phone or for respondents without internet access.

² Electronic thermostats do not contain mercury and are easily distinguishable from electromechanical thermostats.

³ The analysis, which we performed for an analysis of PG&E's Comfort Home Program, examined the accuracy of reports on new equipment for 4 measures that were fairly clearly-identified. There were zero or nearly zero "wrong" responses compared to an on-site inspection, which gave us confidence in the phone responses.

Why Pure On-Site Survey Methods Aren't Suitable:

These reported data are critical to the success of the project. One possible strategy is to use on-site auditors to gather these data. This will not meet the project's needs for two reasons:

- First, our study requires information that cannot be observed by the trained auditors (removals) and requires responses from building occupants. Thus, the survey needs to involve another group, which may or may not be convenient to the timing of the on-site contractor.
- Second, it is prohibitively expensive. The only study that used this approach relied on salaried staff and confined the on-site visits to one densely populated county. A statewide study, designed to provide statistical representation of the State using trained staff, would be very expensive – perhaps 20 times the cost of the current study.

Recommendations for a Validation Add-On Task:

The study's mandate is to develop a methodology for estimating the desired information. The method proposed is credible and defensible. Thus, the proposed study meets the statutory requirements of providing statistically valid data on the number of thermostats that become waste annually in California.

However, TRC will expand the scope of the study and include a "real-time" validation analysis to eliminate potential criticisms of the study.

- **Proposed Data Collection:** SERA will use contractor or experienced engineering consultant staff that are very familiar with mercury thermostats to visit a sample of homes and businesses that responded to the questionnaire (survey respondents will have given a phone or contact number and/or address to register for the prize). SERA will select geographically clustered responses, with variety of situations (single and multi-family and business). The on-site auditor will bring the responses they gave, and inspect, on-site, the validity of their responses on whether or not the equipment is mercury-containing, and attempt to confirm the number of thermostats (of both types) on site. After verifying the accuracy of the response, the on-site auditors will then also ask the person on-site what procedures they used to determine whether it contained mercury, how helpful were the photos and instructions on the survey, and what would have been more helpful.⁴ We will also repeat the questions on removals and timing to check the consistency of their responses on these topics.⁵
- **Proposed Analysis Method - Inventory:** There are several possible outcomes for any one thermostat. Respondents may be 100% correct in their reporting of mercury thermostats, or they may potentially misreport mercury thermostats as non-mercury-containing; or they may report non-mercury thermostats as mercury-containing. They may report the correct numbers (total or by type) or they may not. If there are any differences between the survey reports and on-site observed presence of mercury-containing thermostats will be used to compute "correction factors" to be applied to the estimates of the total number of mercury-containing thermostats in place in California buildings to provide an improved (less biased) estimator of the inventory. Factors based on the commercial building inspections will be applied to commercial estimates, and those from residential inspections will be applied to residential estimates.
- **Proposed Number of Site Visits:** SERA projected 30⁶ completed site visits are necessary to achieve a +/-15% at 90% confidence or +/- 18% at 95% confidence. This accuracy is for combined residential and commercial.
- **Proposed Analysis Method – Thermostat Flows:** Revisions in the number of thermostats or the number of mercury containing thermostats will not directly affect our "flow model" estimation work. This portion of the analysis simply derives the percent of thermostats that are in place that can be expected to be removed from the buildings each year. However, if the analysis finds patterns of deviations in the comparisons of removal dates, we will create a "range" for the reported values and estimate the flow models using the high and low ends of the

⁴ This will be used to guide improvements for future studies.

⁵ We cannot validate these dates by inspection easily (although we may have auditors ask to inspect any easily-accessed records), but the approach can confirm the *consistency* of the responses compared to those provided on the survey.

⁶ 30 is a number that is commonly considered the point at which the "law of large numbers" starts to kick in.

removal date ranges. This will provide a range for the flows per year, which will be applied to the mercury thermostat inventory estimates.⁷

⁷ The original estimates, or if corrections are applied, the corrected values will be used as the starting point for the derivation of the annual flow of number of mercury-containing thermostats.