APPENDIX A

MEASUREMENT TERMS AND DEFINITIONS

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Billing Data	Metered data obtained from the electric or gas meter used to bill the customer for energy used in a particular billing period. Such meters typically conform to regulatory standards established for each customer class.
Comparison Group	A group of customers who did not participate during the program year and who share as many characteristics as possible with the participant group.
Designated Units(s) of Measurement	The metric(s) used for expressing load impacts for a particular program as a function of customer characteristics (e.g., kWh per square foot). The metric is used to compare load impacts of different customers or customer groups (participants, comparison group samples, future participants).
Earnings Claim Year	The calendar year in which a utility claim for earnings is filed in an AEAP. The first claim year is the year after the program year.
Earnings Recovery Period	The number of years between the first and last year in which earnings are recovered in rates for a specific program year.
Earnings Recovery Year	The calendar year in which a utility recovers AEAP-adopted earnings from prior year program activities. The earnings recovery year is the year after the earnings claim year.
Effective Useful Life	An estimate of the median number of years that the measures installed under the program are still in place and operable.
End-Use Consumption and Load Impact Model	A model that is used to analyze data to estimate gross or net load impacts. These models include engineering, conditional demand, and calibrated engineering models, as follows:

(a) Engineering Models

(1) Simplified Engineering Models: Engineering equations used to calculate energy usage and/or savings. These models are usually based on a quantitative description of physical processes that describe the transformation of delivered energy into useful work such as heat, lighting or motor drive. In practice, these models may be reduced to simple equations that calculate energy usage or savings as a function of measurable attributes of customers, facilities or equipment (e.g., lighting use = watts X hours of use). These models do not incorporate billing data and do not produce estimates of energy savings to which tests of statistical validity can be applied.

(2) Engineering Simulation Models: Computer models based on physical engineering principals and/or standards used to estimate energy usage and/or savings. These models do not make use of billing or metered data, but usually incorporate site-specific data on customers and physical systems. Building Simulation Models usually require such site-specific data as square footage, weather, surface orientations, elevations, space volumes, construction materials, equipment use, lighting and building occupancy. Building simulation models can usually account for interactive effects between end uses (e.g., lighting and HVAC), part-load efficiencies, and changes in external and internal heat gains/losses. Examples of building simulation models include ADM2, BLAST, and DOE2.

(b) Load Impact Regression Model (LIRM)

The most general definition of a LIRM is a statistical model that produces estimates of the load impacts of energy conservation programs. Depending on the particular approach and the statistical issues encountered, it may involve more than one regression model and technique:

(1) The load impact estimation model typically is a linear or non-linear regression model that uses billing data that estimates gross and/or net load impacts. Data from program nonparticipants, in addition to participant data, can be used to derive net impacts directly or to affect other statistical control.

(2) The participant/decision model typically is a discrete choice model used in conjunction with the load impact estimation model to isolate free ridership effects, generate self-selection correction terms, and/or net-to-gross ratios as needed. When this model is used to estimate a net-to-gross ratio, the resulting estimate is multiplied by an estimate of gross load impact to yield an estimate of net load impact.

1. Estimation of Gross Energy Impacts: The LIRMs used to estimate gross energy savings should have the following characteristics:

a) The model is an econometric or statistical model, embodying accepted or thoroughly defensible empirical techniques for measuring impacts of policies, programs and measures.

b) The models employ billing and weather data, pooled by customer, for multiple time periods, as well as customer-specific attributes, and/or other measured or observed data to estimate energy impacts.

c) The model produces diagnostics and test statistics that allow others to assess the robustness of its estimates and/or simulations.

d) The model specification is developed in consideration of the issues identified in the Protocols in Section D.5 of Table 7. That is, the model specification should follow from an accurate conceptualization of the energy consumption process, and should use compatible econometric and statistical techniques.

The estimates of energy impacts should flow from a statistical model rather than a deterministic engineering model, while perhaps relying to some extent on engineering information. For example, an SAE model exhibits an acceptable blend of statistical and engineering models.

Confounding effects on energy consumption should be controlled for. The use of a comparison group and the inclusion of social, political, and economic changes, are acceptable methods.

2. Estimation of Net Energy Impacts: The estimation of net energy impacts can also involve the use of a statistical model that does not use energy consumption as the dependent variable but rather uses the observed decisions of customers to participate in DSM programs and to install efficient equipment as the dependent variables. The purpose of these models is to control for freeridership or to derive a net-to-gross savings adjustment. The models may also be used to estimate an adjustment factor to control for self-selection bias.

The LIRMs used to estimate net energy savings should have the following characteristics:

a) The model is an econometric or statistical model, embodying accepted or thoroughly defensible empirical techniques for measuring impacts of policies, programs and measures.

b) The model utilizes comparisons between participants and nonparticipant behavior in a discrete choice, difference-of-differences, or other statistical modeling context to isolate net from gross load impacts.

c) The model produces diagnostics and test statistics that allow others to assess the robustness of its estimates and/or simulations.

d) The model specification is developed in consideration of the issues identified in the Protocols in section D.5 of Table 7. That is, the model specification should follow from an accurate conceptualization of the customer decision process, and should use compatible econometric and statistical techniques.

The use of a comparison group is required for estimating net load impacts. One can compare participants and nonparticipants with respect to energy consumption or with respect to the decisions they make regarding program participation and installation of efficient equipment.

(c) Calibrated Engineering Models

Calibrated Engineering (CE) Models: A complex modeling approach that combines elements of engineering and statistical analysis in a framework that estimates energy consumption using engineering equations. These models incorporate site-specific data on customers and physical systems, as well as billing or metered data, for statistically representative samples of customers. These models produce estimates of energy use and/or savings to which tests of statistical validity can be applied.

Energy Efficiency Improvement

Reduced energy use for a comparable level of service, resulting from the installation of an energy efficiency measure or the adoption of an energy efficiency practice. Level of service may be expressed in such ways as the volume of a refrigerator, temperature levels, production output of a manufacturing facility, or lighting level per square foot.

Energy Efficiency of a Measure

A measure of the energy used to provide a specific service or to accomplish a specific amount of work (e.g., kWh per cubic foot of a refrigerator, therms per gallon of hot water).

Energy Efficiency of Equipment

The percentage of gross energy input that is realized as useful energy output of a piece of equipment.

Energy Efficient Investments

An investment that produces a reduction in energy use for a comparable level of service, compared to a specified base case. The following are key distinctions in the types of energy efficiency investment that need to be made for the purposes of establishing the base usage for impact estimation. These investments may or may not be covered by state and/or federal energy efficiency standards or codes:

(a) Retrofit Investments

Any investment made in an existing building or facility. These may in turn be either replacement or add-on investments:

(1) Equipment Replacement: Investments in energy-using equipment that replace older equipment that serves the same end use. Discretionary replacement refers to investments that replace existing equipment made prior to the end of the engineering useful life. Normal replacement refers to investments that occur at or near the end of the engineering useful life of the equipment.

(2) Equipment add-ons: Investments that do not replace existing equipment, that is investments in equipment that serves an end use not previously available in the building or facility (e.g., air conditioning), or that increases the amount of equipment providing an end use (e.g., a second refrigerator or a second room air conditioner.

(3) Shell and equipment improvements refers to materials and products that reduce energy use in existing equipment (e.g., insulation, gas flue damper).

(b) New Construction Investment

Any investment that occurs prior to occupancy in any type of new building. This includes all energy efficiency investments in the new building, whether covered by state building standards (Title 24) or not. For measurement purposes, new construction also includes expansion of plant facilities (new floor space); and remodeling investments in an existing building that are subject to state building standards (Title 24).

(c) Remodeling Investments

A change in all or a substantial portion of a building or facility that substantially changes the type or level of service provided by the energy-using systems. For the purpose of establishing base usage, some remodeling investments may be considered new construction if they are subject to state building standards (Title 24).

Engineering Useful Life	An engineering estimate of the number of years that a piece of equipment will operate if properly maintained.
Free Driver	A nonparticipant who adopted a particular efficiency measure or practice as a result of a utility program. See "Spillover Effects" for aggregate impacts.
Free Rider	A program participant (see definition) who would have implemented the program measure or practice in the absence of the program.
Gross Load Impact	The change in energy consumption and/or demand that results directly from program-related actions taken by participants in the DSM program, regardless of why they participated.
Impact Year	Depending on the context, impact year means either (a) the twelve months subsequent to participation used to represent program costs or load impacts occurring in that year, or (b) any calendar year after the program year in which load impacts may occur.
Level of Service	The utility received by a customer from energy using equipment. Level of service may be expressed as the volume of a refrigerator, an indoor temperature level, the production output of a manufacturing facility, lighting levels per square foot, etc.
Load Impact	Changes in electric energy use, electric peak demand, or natural gas use.
Load Shape	The time-of-use pattern of customer or equipment energy use. This pattern can be over 24 hours or over a year (8760 hours).
Load Shape Impacts	Changes in load shape induced by a program.
Measure (or Energy Efficiency Measure)	A product whose installation and operation at a customer's premises results in a reduction in the customer's on-site energy use, compared to what would have happened otherwise.

Measure Retention Study An assessment of (a) the length of time the measure(s) installed during the program year are maintained in operating condition; and (b) the extent to which there has been a significant reduction in the effectiveness of the measure(s).

Measured Data Data collected from participants in a utility efficiency program after their participation.

Measurement Period The number of years between the program year and the year in which the results of the last required impact study are presented in an AEAP.

Metered Data Data collected at a customer's premises over time through a meter for a specific end use, or energy-using system (e.g., lighting and HVAC), or location (e.g., floors of a building or a whole premise). Metered data may be collected over a variety of time intervals.

Metering The collection of energy consumption data over time at a customer's premises through the use of meters. These meters may collect information about kWh, kW or therms, with respect to an end-use, a circuit, a piece or equipment or a whole building (or facility). Short-term metering generally refers to data collection for no more than a few weeks. End-use metering refers specifically to separate data collection for one or more end uses in a building, such as lighting, air conditioning or refrigeration. What is called "spot metering" is not metering in this sense, but is instantaneous measurement (rather than over time) of volts, amps, watts or power factor to determine equipment size and/or power draw.

Monitoring The collection of data other than energy consumption at a customer's premises over a period of time through the use of meters or other devices that record temperature, humidity, air flow, duty cycle, hours of operation, etc.

Natural Change	The change in base usage over time. Natural change represents the effects of energy-related decisions that would have been made in the absence of the utility programs by both program participants and nonparticipants.
Net Load Impact	The total change in load that is attributable to the utility DSM program. This change in load may include, implicitly or explicitly, the effects of free drivers, free riders, state or federal energy efficiency standards, changes in the level of energy service, and natural change effects.
Net-to-Gross Ratio	A factor representing net program load impacts divided by gross program load impacts that is applied to gross program load impacts to convert them into net program load impacts. This factor is also sometimes used to convert gross measure costs to net measure costs.
Nonparticipant	Any customer who was eligible but did not participate in the utility program under consideration in a given program year.
Participant	An individual, household, business, or other utility customer that received the service or financial assistance offered through a particular utility DSM program, set of utility programs, or particular aspect of a utility program in a given program year. Participation is determined in the same way as reported by a utility in its Annual DSM Summary.
Persistence Study	A study to assess changes in net program load impacts over time.
Practice (or Energy Efficiency Practice)	A change in a customer's behavior or procedures that reduces energy use (e.g., thermostat settings, maintenance procedures).
Practice Retention Study	An assessment of the length of time a customer continues the energy conservation behavioral changes after adoption of these changes.

Program Year	The calendar year in which program participation occurs. For energy efficiency incentive programs, this means the year in which financial assistance is provided or the date on which a program participant takes an action associated with assistance provided by the utility. For energy management services programs, utility program administration costs will be allocated to the year in which they are recorded. Program participation, incremental measure costs, and lifecycle energy savings will be attributed to the year in which the utility provided the final step of its program service to the customer.
Rebound Effect	A change in energy using behavior that yields an increased level of service and that occurs as a result of taking an energy efficiency action.
Technical Degradation Factor	A multiplier used to account for time-and-use-related change in the energy savings of a high efficiency measure or practice relative to a standard efficiency measure or practice.
Spillover Effects	Reductions in energy consumption and/or demand in a utility's service area caused by the presence of the DSM program, beyond program-related gross savings of participants. These effects could result from: (a) additional energy efficiency actions that program participants take outside the program as a result of having participated; (b) changes in the array of energy-using equipment that manufacturers, dealers, and contractors offer all customers as a result of program availability; and (c) changes in the energy use of nonparticipants as a result of utility programs, whether direct (e.g., utility program advertising) or indirect (e.g., stocking practices such as (b) above, or changes in consumer buying habits).

The definitions in this Appendix were developed specifically for these California measurement protocols. The authors have consulted a number of sources for comparable definitions used elsewhere, including:

"An Energy Efficiency Blueprint for California, Appendix A, Measurement Protocols for DSM Programs Eligible for Shareholder Incentives," January 1990.

Hirst, E. and Reed, J., eds., "Handbook of Evaluation of Utility DSM Programs," Oak Ridge National Laboratory, December 1991.

Hirst, E. and Sabo, C., "Electric Utility DSM Programs: Terminology and Reporting Formats," Oak Ridge National Laboratory (prepared for the U.S. Department of Energy and the Electric Power Research Institute), June 1992.

RCG / Hagler, Bailly, Inc., "Impact Evaluation of Demand-Side Management Programs," (prepared for the Electric Power Research Institute), February 1991.