COMPILATION AND ANALYSIS OF CURRENTLY AVAILABLE BASELINE DATA ON CALIFORNIA ENERGY-EFFICIENCY MARKETS

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EXECUTIVE SUMMARY

This report presents results from the *Compilation and Analysis of Currently Available Baseline Data on the California Energy Efficiency Markets Study (the "CABD Study"),* which was conducted for San Diego Gas & Electric (SDG&E), on behalf of the California Board for Energy Efficiency (CBEE). This report presents complete study results, findings, and recommendations. It updates and supplements the information presented in the study Interim Report, submitted in October 1998.

E.1 PROJECT OBJECTIVES

The primary project objectives of this study are:

1) To summarize, in a systematic fashion, the available baseline market information from a wide variety of data *sources*.

2) To assess individual studies identified in Objective 1 above with respect to the ability to reuse the collected data ***to support future evaluations*** of market transformation activities, as well as market assessments intended to support these activities.

3) To assess gaps (i.e., areas where no information is available) in the inventory of identified studies with respect to markets, market actors, and market events.

4) To make recommendations regarding further collection of baseline data ***to facilitate future evaluations*** of the market effects of CBEE-sponsored programs.

E.2 PROJECT APPROACH

To accomplish the objectives of this study within the budget and time available, we implemented the following steps:

- An extensive search was carried out to identify a population of *sources*.
- A framework was developed for defining and categorizing the types of relevant information sought in these sources and for assessing the information content.
- A database was developed for tracking sources and documenting relevant market baseline information content and quality.
- The selected sources were reviewed, assessed, and documented in the database.
- A second review was conducted of those sources that had the most useful information for each market.
- Findings were synthesized from the second review and gaps documented for each market.

- Recommendations were developed for research that could be conducted to fill key baseline market information gaps.

E.3 PROJECT FRAMEWORK

The first analytic step conducted in this study was to define the appropriate framework to structure our review and assessment of selected information sources. The two key dimensions of the framework are energy-efficiency markets and market baseline characteristics.

E.3.1 Energy-Efficiency Market Definition

The two main guidelines used to define the energy-efficiency markets are:

- That the baseline market characteristics (see Section E.3.2) were substantially different across individual markets, but consistent within them; and
- That the markets developed were reasonably consistent with the program categories included in the CBEE's October 15, 1998, Advice Filing to the California Public Utilities Commission (CPUC).

The primary determinant of a market used here is the sector and vintage of the building or facility. The three primary market categories are: existing residential buildings, existing non-residential buildings and facilities, and new construction of all types. Within these primary categories, other determinants are used to define markets that are likely to have similar characteristics. Table E-1 shows these secondary determinants within each primary market determinant category.

Table E-1
Energy-Efficiency Markets

	Primary Determinants		
	Existing Residential	Existing Non-Residential	New Construction
Secondary Determinants	• HVAC • Lighting • Appliances • Building shell • Renovation	• HVAC • Lighting • Motors • Refrigeration • Office equipment • Compressed air • Building shell • Process • Comprehensive retrofit • Remodeling/renovation	• Residential • Commercial • Industrial • Agricultural

E.3.2 Market Baseline Characteristics

We organized the baseline characteristics developed for this study into the following three categories:

- how the market is structured and how it functions,
- energy-efficient products and services, and
- market actors.

A summary of all of the types of information that are assessed is presented in Table E-2. Each of these groupings and their elements are described in the body of this report (see Section 2).

Table E-2
Types of Information Assessed

	Characteristics Categories		
	Market Structure and Functioning	Products and Services	Market Actors
Specific Baseline Characteristics	• Market participants - end users • Market participants - non-end users • Distribution channels • Information channels • Causal linkages and leverage points • Market barriers • Market size	• Energy efficiency • Other features • Cost • Sales and market shares	• Demographics/ firmographics • Psychographics • Energy use • Behaviors
Ease of Use for Market Change Assessment	• Structure and functioning change indicators	• Products/services change indicators	• Market actor change indicators

E.4 DATA SOURCE SCORING & ASSESSMENT

The market baseline characteristics data were assessed by assigning a value to the information in each data source that reflected the "quality" of that information with respect to the characteristic. The level of quality was determined by reviewing the information presented about each baseline characteristic and assessing how useful the information would be for defining current baseline conditions. Factors taken into account included the following:

1. Timeliness. *How recently was the information produced? Is the market characteristic likely to have changed substantially since then?*
2. Relevance to California market. *Was the information collected in the California market? If not, is the market characteristic likely to vary much between California and where it was collected?*
3. Reliability and validity of data. *Were data collection instruments tested for reliability? Did the instrument or test used measure what it was supposed to measure? Were there systematic biases in the measurements used to assess the characteristic? Were sample sizes adequate and representative of the right populations?*

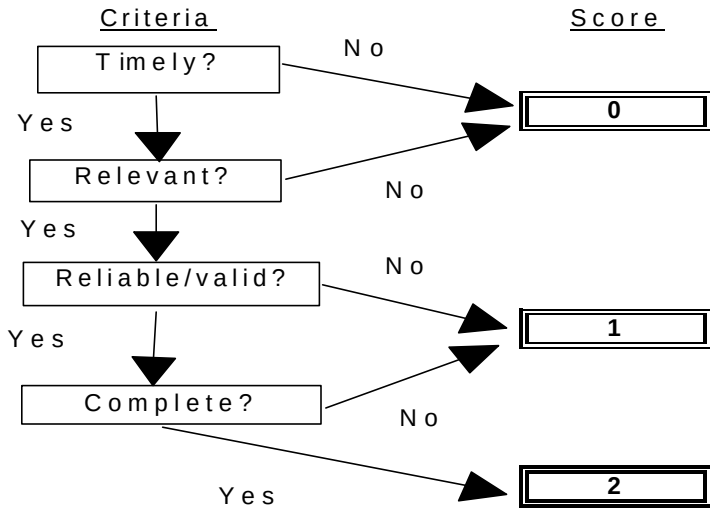
4. Completeness. Did the information cover all or most of the components of the baseline characteristic?

A value for each market characteristic was entered into the database based on how well the baseline information satisfied all the criteria above combined.

- The default value for all these entries is "0." This value indicates that a data source contains little or no useful information on a given market characteristic or the information that it does contain is outdated (Criterion 1) or is not relevant to California (Criterion 2).
- A value of "1" is entered if the data source provides moderately useful baseline information on the market characteristic. "Moderately useful" means that the information is timely (Criterion 1) and is relevant to California (Criterion 2), but either the reliability and validity of the data (Criterion 3) are questionable or unknown or the completeness (Criterion 4) is questionable or unknown.
- A value of "2" is entered if the data source provides very useful baseline information on the market characteristic. "Very useful" means that the information is timely (Criterion 1) and is relevant to California (Criterion 2), and both the reliability and validity of the data (Criterion 3) and the completeness (Criterion 4) are acceptable.

The scoring process summarized in the flowchart shown in Figure E-1.

Figure E-1
Scoring Process



E.5 GENERAL CHARACTERISTICS OF SOURCES ASSESSED

During the information gap review, we assessed 92 data sources collected for this study. For each data source, we documented the characteristics of the source including the type of source or study,

the time period covered, the geographic area covered, and whether the source was recommended for review during the second round. Of the 92 sources initially reviewed, 50 were recommended for inclusion in our second-level review.

E.5.1 General Summary of Sources

The general characteristics of the 92 data sources include the following:

- About half were evaluation studies and 28% were market effects studies;
- About 70% were sponsored by the three California investor-owned utilities (IOUs), and 12% were sponsored by the California Energy Commission (CEC) (and were usually statewide studies);
- 56% covered the period 1995 and later; 21% covered more than two years and several covered periods that were ill-defined; and
- Sources were fairly evenly split between northern and southern California.

Major differences for the subset that was recommended for further study included the following:

- Only 20% were classified as impact evaluations;
- Almost all of the sources classified as market effects studies were recommended for further review;
- Recommended sources were more likely to be multi-year studies; and
- Recommended sources were almost twice as likely to provide out-of-state or national information.

We rated just over half (50) of the data sources as "recommended for further review." Table E-3 compares the market coverage of all the data sources with the coverage by the subset recommended for further review. Both the entire set and the recommended subset covered the existing non-residential market more adequately than they did the other two primary markets. For the entire set of sources, 53 sources addressed at least one type of existing non-residential market. Over 40 covered either non-residential lighting or non-residential HVAC markets alone. Thirty-seven addressed at least one of the existing residential markets. Twenty-six sources addressed at least one of the new construction markets.

Table E-3
Coverage of Broad Market Categories

	Complete Set Total Sources=92		Set of Sources Recommended for Further Review Sources=50	
Primary market	Number	% of total	Number	% of subset
Residential existing	37	40%	24	48%
Non-residential existing	53	58%	32	64%
New construction	26	28%	9	18%
Note: Some sources cover multiple markets so percentage totals exceed 100.				

E.5.2 Examples of Scoring Results

In this section we provide a few examples of the scoring results developed for this study and how they were utilized to identify gaps in existing baseline sources. We only present examples in this Executive Summary section because there are far too many tables summarizing the scoring results to include here. These tables are presented in Section 3 of this report.

General Baseline Characteristics Coverage

One example of the extent of coverage provided by existing sources based on the 92 sources reviewed is provided in Table E-4. The table presented shows frequencies of the number of sources that received the highest of the three possible scores (i.e., a "2" on a three-point scale including 0 and 1, as described in Section 2) by the number of characteristics for which the high scores were attained. One way to look at the distribution of baseline characteristics covered by the sources reviewed is to break them down according to the primary baseline characteristics categories.

The information in Table E-4 indicates that large fractions of the sources reviewed do not cover any of the characteristics of interest within the three principal market characteristics groups. The table also shows, however, that the Market Actor category was more consistently covered than the Market Structure and Function and Product/Services categories, even for the studies that were not baseline or market effects studies. Examination of the specific non-baseline/non-market effects sources that scored well for the Market Actor category indicated that these sources were split fairly evenly between impact evaluations and saturation studies. This is consistent with the fact that the Market Actor category captured demographic, firmographic, psychographic, energy use, and behavioral information. These traditional studies tended to cover the demographic, firmographic, and energy use characteristics well, but did not do so for psychographic and behavioral information.

Table E-4
Number of Unique Studies Scoring "2" by Characteristic Category and Study Type

	All Sources							
	Number of Characteristics for which Unique Studies Score "2"							
Baseline Category[1]	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Market Structure and Function	60	16	3	2	3	2	5	1
Market Actor	56	12	11	11	2	--	--	--
Products / Services	63	20	4	5	0	--	--	--

	Market Effects & Baseline Studies (30 total)							
	Number of Characteristics for which Unique Studies Score "2"							
Baseline Category	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Market Structure and Function	10	7	3	2	1	1	5	1
Market Actor	17	2	3	6	2	--	--	--
Products / Services	20	5	3	2	0	--	--	--

	Evaluation, Saturation, etc. (62 total)							
	Number of Characteristics for which Unique Studies Score "2"							
Baseline Category	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Market Structure and Function	50	9	0	0	2	1	0	0
Market Actor	39	10	8	5	0	--	--	--
Products / Services	43	15	1	3	0	--	--	--

[1] Note that for the Market Actor and Products/Services categories, the maximum number of characteristics is 4.

Market-Specific Characteristics Coverage

Another example of the type of summaries developed in this study is shown in Table E-5. In the example shown, we display results based on identification of the number of sources that received a rating of "2" for each Market Actor characteristic by each specific energy-efficiency market. Parallel tables were developed for the other primary market characteristics. The number of data sources with good quality information on the market and market characteristic appears in each of the cells. The total shown in the far right column is the total number of sources that presented good baseline information about at least one of the specific characteristics within the group covered by the table. This type of table indicates how many studies had useful information about a specific market structure/functioning characteristic for a given market regardless of whether they presented other useful baseline information.

Table E-5
Number of Sources Rated "2" on Market Actor Information by Market

Energy-Efficiency Market	Market Actor Characteristic					
	Demographics/ Firmographics	Psychographics	Usage	Behavior	Market Actor Indicators	Total
Res—HVAC	10	3	5	4	6	10
Res—Lighting	8	2	6	5	6	10
Res—Appliances	10	5	8	7	7	14
Res—Shell	9	4	4	5	6	10
Res—Renovation	3	2	1	2	2	4
Non-res—HVAC	6	0	3	4	2	7
Non-res—Lighting	7	3	5	7	4	10
Non-res—Motors	7	1	4	5	2	8
Non-res—Refrig.	5	0	3	3	1	5
Non-res—Off. Equip.	3	0	1	3	1	3
Non-res—Comp. Air	4	0	2	4	1	5
Non-res—Shell	4	0	2	3	1	4
Non-res—Process	1	1	2	2	1	4
Non-res—Retrofit	3	0	1	3	1	3
Non-res—Remodel	4	0	2	3	2	4
New Residential	2	2	4	3	2	6
New Commercial	3	2	3	3	2	4
New Industrial	1	0	1	0	1	1
New Agricultural	1	0	1	1	1	2
Averages	4.8	1.3	3.1	3.5	2.6	6.0

Note: "Total" indicates the total number of sources that contain information on at least one market characteristic for the specified market.

E.6 SUMMARY OF RECOMMENDATION RESULTS

Lastly, we present a summary that prioritizes our recommendations for further baseline research in support of California's energy efficiency program efforts. The recommendations themselves are provided in Section 4 of this report and are too detailed and numerous to summarize in this Executive Summary. Instead, Table E-6 is provided as summary documentation of the relative priority of the recommendations made in each major topical area. The first two columns of the table summarize our assessment of the adequacy of current baseline sources. The assessment in the first column is based on our review of studies completed before the end of 1998. The assessment in the second column is a preliminary and rough estimate of the extent to which we think gaps would remain after completion of the CBEE's five 1998 statewide MA&E studies and its 11 first-round MA&E studies slated for 1999. This is obviously only a rough estimate because the scopes of work for the second round of 11 studies have not yet been completed. The third column summarizes, on a simple relative basis, the statewide funding levels for PY99 in terms of

the percent of total statewide funding associated with each efficiency market. We utilized "N/A" (not available) for budget levels for the efficiency markets for which statewide funding levels are not available. The final column in the table provides our assessment of the overall priority of each research area. This overall priority combines the extent to which baseline gaps exist with the relative importance of the area (using PY99 funding as the importance proxy).

Finally, note the following context for the draft recommendations provided in Section 4:

- ***Although we have screened and consolidated recommendations as much as possible, we have not restricted the total number of recommendations based on any a priori constraints***. At the same time, we recognize that such constraints clearly exist and are critically important. For this reason, we prioritized our recommendations.
- ***To address the fact that a number of recommendations are being made, we provide a summary table in which we prioritize our recommendations by major topic area into three levels: High, Medium, and Low***. The approach used to develop the overall priority rankings is discussed in Section 4.
- ***The recommendations made here are not intended to be project proposals***. Our objective is to recommend what would be necessary to collect to fill the gaps identified in Section 3, not to specify the specific projects in which the work should be done. The *market-specific* recommendations made here could be organized or aggregated in a variety of ways. At the time of this writing, a system of long-term assignments for state-level MA&E activities is being developed. As part of this MA&E process, we recommend that MA&E project managers identify synergies among the research recommendations made in this report, the MA&E projects for which they are responsible, and the research activities to be conducted as part of the Efficiency Market Share Tracking studies. As part of this process, MA&E managers should also solicit the input of those who implement and plan efficiency programs to determine whether there are any closely related research needs of these parties that can be met while collecting baseline data for evaluation purposes.
- ***Some of the needs for which recommendations have been made will be filled by studies that are just being completed or for which scopes of work are now being specified as part of the CBEE's first- and second-round MA&E studies, including the Residential and Non-Residential Efficiency Market Share Studies***. Although we provide some explicit cross references to the Market Share Studies in our recommendations, the scope of this project does not include a comprehensive integration of recommendations between the two studies. We again recommend that these coordination and integration tasks be carried out by MA&E project managers under the emerging system of long-term assignments for state-level MA&E activities mentioned above.
- ***Recommendations for further research are presented in two broad groups:*** *those that* ***cut across energy-efficiency markets*** *and those that are* ***specific to efficiency markets***.

Table E-6
Overall Recommendation Summary

Area	Topic/Market	Extent of Gaps in Baseline Information		Relative PY99 Funding Levels[3]	Overall Priority of New Baseline Research[4]
		Current Assessment[1]	After Current and Currently Planned MA&E Projects[2]		
Residential	HVAC	Med.	Low	Low (4%)	Low
	Lighting	Med.	Low	Med. (5%)	Low
	Appliances	Med.	Med.	High (13%)	Med.
	Shell	Med.	Med.	N/A - *Low*	Low
	Renovation	High	High	High (14%)	**High**
Non-Residential	HVAC	Med.	Med.	Med. (7%)	Med.
	Lighting	Low	Low	N/A - *High*	Med.
	Motors	Med.	Med.	Low. (2%)	Low
	Refrigeration	Med.	Med.	N/A - *Low.*	Low
	Office Equipment	High	High	N/A - *Low*	Low
	Compressed Air	High	High	N/A - *Med*	Med.
	Shell	Med.	Med.	N/A - *Low*	Low
	Process	High	High	Med. (6%)	**High**
	Retrofit	High	Low	High (31%)	Med.
	Remodel/Renovation	High	Med.	Med. (5%)	Med.
New Construction	Residential	Med.	Low	Med. (6%)	Low
	Commercial	Med.	Med.	Med. (6%)	Med.
	Industrial	High	High	Low (1%)	Low
	Agricultural	High	High	Low (<1%)	Low
Cross-Cutting	Supply Side	N/A	N/A	N/A	**High**
	End User	N/A	N/A	N/A	**High**
	Assess Potential	High	High	N/A	Med.
	Measure Costs	Med.	Med.	N/A	Med.
	Integrate Existing Sources	N/A	N/A	N/A	Med.

[1] This assessment is based on our review of studies completed before the end of 1998.

[2] This assessment is a an estimate of the extent to which gaps will remain after completion of the CBEE's first five 1998 statewide MA&E studies and its 11 second-round MA&E studies slated for 1999.

[3] This assessment is based on the statewide funding levels for PY99. The percent of total PY99 associated with each market is shown in parentheses. For markets that are not broken out in available statewide figures, we denote "N/A" and have estimated the importance level based on our judgment of expenditures from past program years. These estimated importance levels are shown in italics.

[4] This assessment of the overall priority of each research area takes into account the extent to which gaps remain after current and currently planned MA&E studies and the relative importance (in terms of funding) of each area.

1 INTRODUCTION AND OVERVIEW

This report presents results from the *Compilation and Analysis of Currently Available Baseline Data on the California Energy Efficiency Markets Study (the "CABD Study"),* which was conducted for San Diego Gas & Electric (SDG&E), on behalf of the California Board for Energy Efficiency (CBEE). This report presents complete study results, findings, and recommendations. It updates and supplements the information presented in the study Interim Report, submitted in October 1998. This section provides a general introduction, background information, and objectives of the project.

1.1 PROJECT BACKGROUND

The CBEE's advisory role includes responsibility for overseeing data collection and analysis activities, such as market assessment and program evaluation, that are needed to support program planning and implementation efforts. To effectively meet its responsibilities for overseeing these analysis activities, the CBEE has sought to develop a systematic analysis plan. However, development of such a plan has been impeded by, among other factors, the lack of any detailed or centralized information regarding existing energy-efficiency markets baseline data that are already available from California utilities, state agencies, or other entities. In the absence of systematic information regarding what data are already available, it is difficult to make plans regarding what new data should be collected.

The CABD Study is intended to help overcome this problem by:

1. Reviewing a wide range of potential sources of relevant baseline data on energy-efficiency markets in California;
2. Summarizing in a single report what types of baseline data are available and gaps in the available data; and
3. Based on the results of these activities, presenting recommendations regarding baseline data collection and analysis activities that are needed to facilitate evaluation of market effects resulting from California energy-efficiency programs.

This project is one of two intended to inform the development of a systematic CBEE data collection and analysis plan. The other project, which has been carried out for the CBEE under the contract management of PG&E, is being conducted by Regional Economic Research (RER), and involves the development of a set of recommended projects to track the market share of various specific energy-efficiency measures and services in California (the *Efficiency Market Share Needs Assessment and Feasibility Scoping Study*). The CBEE has initiated the development of a systematic CBEE analysis plan, covering Market Assessment and Evaluation (MA&E) needs for 1999, utilizing the interim and final results of these two scoping projects. The

results of this project and the second scoping project have been two significant inputs into the development of the systematic analysis plan.

All of the CBEE's analysis activities, including market assessment, market characterization, strategic planning, and program evaluation, need to rely extensively on analyses of the baseline characteristics of energy-efficiency markets in California. Many such analyses have already been conducted, either by individual California utilities, by the California Energy Commission (CEC), or under the auspices of the California Demand-Side Management Advisory Committee ("CADMAC") Market Effects Subcommittee.[1] The available data needed to be compiled and assessed before systematic planning of new analysis activities could proceed.

1.2 PROJECT OBJECTIVES

Although the types of baseline data with which we are concerned in this project can be used to support both program planning and program evaluation activities, *the objective of this study is to assess the usefulness of existing data with respect to the extent to which it can help to meet program evaluation needs*.[2] Program evaluation needs are at the center of our assessment of existing baseline data in this study. This is not to say that the results of this study cannot also be used to aid program planners; we believe the results are also extremely useful to those seeking to identify program planning needs. We want to emphasize, however, that the specific objective of this report is to assess the extent to which existing baseline sources can be used to support future evaluations and to make recommendations for new data collection efforts that are necessary to fill *the most important* gaps in baseline data within this same evaluation context. Baseline data is critical to the evaluation of program market effects because market effects are, by definition, *changes* in the marketplace. According to the CPUC's Policy Rules and Definitions for Energy Efficiency Activities, a market effect is defined as:

> *A change in the structure or functioning of a market or the behavior of participants in a market that is reflective of an increase in the adoption of energy-efficient products, services, or practices and is causally related to Market Interventions.*

Identifying and measuring market effects is not easy in practice. The robustness of evaluation results increases dramatically, however, when the right baseline data are available for the period prior to any program intervention. Although successful market effects studies have been conducted using methodologies that rely on retrospective analyses, the availability of baseline data allows for more powerful longitudinal measurements of market effects indicators. Of course, collecting baseline data obviously comes at a cost. It is for this reason that this study identifies and documents existing sources that can be used as part of future evaluation efforts and prioritizes

[1] The CADMAC Market Effects Subcommittee consists of the utilities, Pacific Gas & Electric, San Diego Gas & Electric, Southern California Gas Co. and Southern California Edison, California Energy Commission, Office of the Ratepayers Advocate, and other stakeholders. The objective of this committee is to primarily oversee the Market Effects studies conducted for utility DSM programs.

[2] This was the objective as stated in the Request for Proposals for this project.

recommendations for new research. The specific primary project objectives of this study are as follows:

1. To summarize in a systematic fashion, the available baseline market information from each of the following types of data *sources*:
   a) published/available utility market effects studies, and utility market baseline studies,
   b) utility load impact evaluations,
   c) relevant CEC-sponsored studies and databases,
   d) utility saturation surveys and other relevant utility studies,
   e) relevant databases maintained by federal agencies such as the Department of Energy (DOE), and
   f) other data sources, either in California or elsewhere, that may provide relevant energy-efficiency market indicators.
2. To assess individual studies identified in objective 1 above with respect to the ability to reuse the collected data **to support future evaluations** of market transformation activities, as well as market assessments intended to support these activities.
3. To assess gaps (i.e., areas where no information is available) in the inventory of identified studies with respect to markets, market actors, and market events.
4. To make recommendations regarding further collection of baseline data **to facilitate future evaluations** of the market effects of CBEE-sponsored programs.

1.3 PROJECT SCOPE AND APPROACH

As with any study, there are a number of ways in which the project objectives can be met, which vary considerably with the amount of project resources and time that would be required. We developed an initial approach to meet the study's original objectives. We then modified our approach as required to meet interim objectives that arose during the project and to take into account better information on the content of sources as we reviewed them. To accomplish the objectives of this study within the budget and time available, we implemented the following steps:[3]

1. An extensive search was carried out to identify a population of *sources* (as defined under objective 1 above) that might provide useful baseline information for future MA&E assessments of energy-efficiency programs in California.

[3] The original plan called for a "shallow" review of the information sources, followed by an in-depth review of about half the most productive sources. When we started reviewing the sources, we found that it was more constructive to review all the selected sources in more depth than planned for the first review phase. One outcome of this change in approach is that when we conducted the second review we were able to use it to make a stronger case for the research recommendations that we developed. Another positive outcome of this approach is that the database is a more useful and more internally consistent resource for other possible applications.

2. This population of sources was screened based on the knowledge of the project team and interviews with sponsors and reviewers of the sources identified, to select and obtain a subset of the most promising sources (approximately 100) to be reviewed with respect to the specific objectives of this project.
3. A framework was developed for defining and categorizing the types of relevant information sought in these sources and for assessing the information content of the sources. The framework specifies taxonomies of markets and market baseline characteristics to be used in assessing the usefulness of the information sources.
4. A database was developed for tracking the information sources and documenting the sources' relevant market baseline information content and quality.[4]
5. The selected sources were reviewed, assessed, and documented in the database.
6. After completing an initial review of the documents, we prepared an Interim Report summarizing findings about what types of baseline market information were readily available and what gaps existed.
7. A second review of the information sources was then conducted, structured around specific markets. We identified and reviewed, in more depth, those sources that had the most useful information for each market.
8. Findings were synthesized from the second review and gaps documented for each market. We also identified, for each market, baseline characteristics for which adequate information exists or could be compiled based on existing sources.
9. Recommendations were developed for research that could be conducted to fill key baseline market information gaps for the purpose of supporting future evaluation needs. These recommendations were developed in the context of programs and interventions likely to be pursued in both the short (first six months of 1999) and medium (next two years) terms.

1.4 GUIDE TO THIS REPORT

In addition to this introduction, this report consists of the following sections and appendices:

- *Section 2: Framework and Methods*
- *Section 3: Information Gap Analysis Findings*
- *Section 4: Research Recommendations*
- *Appendix A: Sources Reviewed*
- *Appendix B: End-Use Market Assessments*
- *Appendix C: Memo on Draft Recommendations and CBEE's First 11, High-Priority MA&E Projects*

[4] The database was intended to be *research* grade, and was not developed for commercial or public use.

2 FRAMEWORK AND METHODS

The first analytic step taken in this study was to define the energy-efficiency markets and specific baseline characteristics that would structure our review of available information sources and assessment of baseline-related gaps in those sources. The market and characteristic dimensions discussed in this section underpin the framework used to score each of the studies reviewed with respect to how well they met the baseline information needs identified. The specific topics covered include:

- Study Framework
- Scoring and Assessment Procedure and Identification of Gaps
- Process for Developing Research Recommendations
- Sources Considered and Reviewed

2.1 STUDY FRAMEWORK

The first component of the framework described in this section consists of a taxonomy of markets. Section 2.1.1 discusses the approach used to define these markets. The second component of the framework is the set of market characteristics for which baseline information is needed to meet Market Assessment and Evaluation (MA&E) requirements, particularly for future market effects studies. Section 2.1.2 describes the market characteristics included in this review and assessment.

2.1.1 Market Definition

As introduced above, the first step in developing the framework was to define the markets that would be addressed.[1] The two main guidelines used to define markets were:

- That the baseline market characteristics (see Section 2.1.2) were substantially different across individual markets, but consistent within them; and
- That the markets developed were reasonably consistent with the program categories included in the CBEE's October 15, 1998, Advice Filing to the California Public Utilities Commission (CPUC).

There were two principal reasons that markets in our framework were defined to be largely parallel to the CBEE's PY99 program categories:

[1] Note that the market and critical market characteristics taxonomies were developed jointly between the consultant team and the Study Director and Project Manager under a short timeline while initial phases of the study were being conducted. This accelerated process helped maximize the relevance of the study's findings and recommendations to the CBEE's MA&E planning process.

- First, because the CBEE's PY99 program planning process explicitly attempted to link program structure more closely to actual markets, the CBEE's resulting 14 program categories represented a good indication of what the CBEE regarded as a high-level typology of energy-efficiency markets.[2]
- Second, at a more pragmatic level, PY99 programs were likely to be organized and reported by the CBEE program categories, so it was likely that stakeholders would find our results most useful if they were presented in relatively consistent categories.[3]

The *primary* determinant of a market used here is the sector and vintage of the building or facility. The three primary market categories are:

- existing residential buildings,
- existing non-residential buildings and facilities, and
- new construction of all types.

Residential buildings are defined in accordance with California building codes and include here both single-family and multi-family residential buildings. Non-residential buildings include all other buildings classified into the commercial, industrial, agricultural, and government categories. The new construction category includes all building types.

Within these primary categories, other secondary determinants are used to define markets that are likely to have similar characteristics. Table 2-1 shows these secondary determinants within each primary market determinant category. In general, the secondary characteristics tended to follow end uses. This is because end use is a powerful discriminator of energy markets; particularly with respect to the organization of supply-side markets and of energy-efficiency measures themselves. In addition to end use, what are sometimes referred to as market events or decision types (such as new construction, remodeling/renovation, retrofit, replacement-upon-burnout, and emergency replacement) were also considered in developing the secondary determinants. As shown in Table

[2] The CBEE's 14 program categories in the October 15th, 1998 Advice Filing were as follows: Residential Heating & Cooling, Residential Lighting, Residential Appliances, Residential Retrofit and Renovation; Non-Residential HVAC Turnover, Large Non-Residential Comprehensive Retrofit, Small Non-Residential Comprehensive Retrofit, Non-Residential Motor Turnover, Non-Residential Process Overhaul, Commercial Remodeling/Renovation; Residential New Construction, Commercial New Construction, Industrial and Agricultural New Construction, and New Construction Codes and Standards Support and Local Government Initiatives.

[3] However, this parallelism between the typology of markets used in this project and the structure adopted by the CBEE for 1999 programs was not perfect. In a few cases we found that a program category in the CBEE's PY99 system did not lend itself easily to a review of existing sources. This was usually because the sources were not focused on precisely the same market; for example, information relevant to residential retrofit was likely to be contained in sources targeting specific end uses rather than retrofit as a specific market. In addition, it was necessary to finalize the framework for this project before the CBEE's framework was adopted because of our project's schedule and, in particular, the need to begin reviewing a large number of sources according to a fairly complex set of review and scoring criteria (as is defined in more detail in the remainder of this section).

2-1, these decision types are partially incorporated into our framework but not completely. The categories that were generally excluded from the primary and secondary level of the market definitions used for this study were replacement-on-burnout and emergency replacement. This was because the market actors and decision-making processes associated with these events vary significantly across end use. Therefore, rather than significantly increase the number of markets (by having, for example, three markets—retrofit, replacement-on-burnout, and emergency replacement—for many of the end uses shown in Table 2-1), we decided that these decision types would be covered under each of the more general end use categories. Conversely, comprehensive retrofit and remodeling/renovation are included as markets because these decision types affect *multiple* end uses. This decision was also made knowing a priori that few sources were available that would provide detailed baseline data for these sub-markets within most end uses. None of this is to say that these decision type sub-markets are not important; on the contrary, their importance grew in the PY99 planning process as evidenced by the emergence of program categories such as Non-residential HVAC Turnover and Non-residential Motor Turnover. Nonetheless, we believe the markets we have defined were most appropriate for this CABD Study at this time. If the framework and baseline cataloging processes developed for this study are continued in the future, it may be important to expand the market definitions we have used to include these and other decision-type markets as well.

Table 2-1
Energy-Efficiency Markets

	Primary Determinants		
	Existing Residential	Existing Non-Residential	New Construction
Secondary Determinants	• HVAC • Lighting • Appliances • Building shell • Renovation	• HVAC • Lighting • Motors • Refrigeration • Office equipment • Compressed air • Building shell • Process • Comprehensive retrofit • Remodeling/renovation	• Residential • Commercial • Industrial • Agricultural

2.1.2 Market Baseline Characteristics

The most critical step in this framework is the process for organizing baseline market characteristics information in the data sources. Through an iterative process with the Study Director and Project Manager, we organized the baseline characteristics into the following three categories:

- how the market is structured and how it functions,
- energy-efficient products and services, and

- market actors.

A summary of all of the types of information that are assessed is presented in Table 2-2. They include both market baseline characteristics and market change indicator information by major characteristics category. Each of these groupings and their elements are described in the following subsections.

Table 2-2
Types of Information Assessed

	Characteristics Categories		
	Market Structure and Functioning	Products and Services	Market Actors
Specific Baseline Characteristics	• Market participants - end users • Market participants - non-end users • Distribution channels • Information channels • Causal linkages and leverage points • Market barriers • Market size	• Energy efficiency • Other features • Cost • Sales and market shares	• Demographics/ firmographics • Psychographics • Energy use • Behaviors
Ease of Use for Market Change Assessment	• Structure and functioning change indicators	• Products/services change indicators	• Market actor change indicators

Market Structure and Functioning

Baseline market characteristics in this category describe how the market functions and how it is organized. Many of these characteristics capture the dynamic and causal relationships *between* market actors. The baseline characteristics in this category are defined as follows:

- *Market participants. This characteristic captures identification of the market actors who are instrumental in the market for a product or service:* Major participants can include the buyer, manufacturer, wholesaler, installer or retailer, and designer. Lenders are instrumental in some markets by providing the capital required to purchase a product or service. Government can be instrumental through policies or regulations that affect energy efficiency. For documentation purposes we disaggregated market participants into two major groups—end users and all others.

- *Distribution channels. This characteristic captures the channels that bring products and services to the consumer:* Distribution channels link the manufacturer or provider to the buyer and ultimate end user. Distribution channels are the paths that products and services follow. Analysis of distribution channels is important to market characterization.

- *Information channels. Information channels are used to transmit and obtain information about products and services between market actors:* Information channels are used by manufacturers, retailers, and other actors on the supply side to communicate information about their product or service. These channels can include advertising, mailings, press releases, and other venues. Information channels are also accessed by actors on the demand side. Consumers may seek information on products and services through consumer product publications, government publications, contractors, etc.
- *Causal linkages and leverage points. This characteristic captures the extent to which the causal relationships in energy markets are well-identified and analyzed:* Market outcomes are determined by how the market actors interact and how various forces affect the market. Causal linkages reflect the influences in the market. For example, a consumer's decision to purchase a high-efficiency appliance is influenced by what efficiency levels are available in the market (the result in part of efficiency standards), what the dealer tells the consumer, what financing is available, etc. The causal linkages paint a picture of the influences in the market and cause-and-effect relationships. Points frequently exist in the market at which energy-efficiency choices can be influenced relatively easily. Such leverage points can be good places to focus interventions to transform a market and are important to monitor as part of market effects studies.
- *Market barriers. These barriers, by definition, impede the purchase, introduction, or delivery of energy-efficient products and services:* An extensive taxonomy of potential barriers in markets for energy efficiency has been developed and utilized on a number of market effects studies in California. The barriers are usually associated with information, risk, or incentives. For example, several barriers involve information gaps or costs to acquire information. Overcoming one or more of these market barriers is generally a primary objective of a market transformation intervention.
- *Market size:* This characteristic is meant to capture the magnitude of the entire baseline market for a given product or service, not just the energy-efficient portion of the market.

Energy-Efficient Products and Services

The purpose of this category is to capture detailed information on key market characteristics associated with energy-efficient products and services such as energy-efficient measure saturation and cost data. This category also includes other product and service features and characteristics that may be related to issues of energy efficiency, such as reliability. The baseline characteristics included in this category are defined as follows:

- *Energy efficiency:* The range of efficiency levels in a particular market and the distribution of those levels are important baseline characteristics.
- *Other product/service features:* Other features of specific products and services may be affected by energy-efficiency levels. For example, the durability of a product or its reliability may be positively or negatively affected by energy-efficiency improvements. The baseline for such features provides a starting point for assessing the overall costs and benefits of efficiency improvements and their marketability.

- *Cost:* The effect of energy efficiency on first cost, incremental costs, and life-cycle cost is a key baseline characteristic. Life-cycle cost takes into account the effects of efficiency on energy-use costs. Cost data for products and services should be combined with information about other features affected by energy efficiency to adequately assess the impacts of efficiency improvements.
- *Sales and market shares:* Baseline sales and market shares data for energy-efficiency products and services provide an essential starting point for measuring market changes.

Market Actors

The purpose of this category is to capture detailed information about key market actors that is related to their behavior in the market for energy efficiency. The baseline characteristics included in this category are defined as follows:

- *Demographics/firmographics data that are relevant to energy-efficiency choices or future baseline analyses:* Important baseline demographics data for individuals include standard statistics on characteristics that might be related to energy-efficiency decisions. Such information also might be useful for identifying market segments. Examples include breakdowns of owner versus renter segments, number and types of end users by energy consumption or revenue groupings, etc. This is also the place to highlight sources that could be useful in developing sample frames for future baseline studies. Important baseline data for firms or organizations include the number and market power of firms in each group. For example, there may be anywhere from one to hundreds of producers of a specific product. The number of producers, in part, will determine the most effective intervention type and the costs of intervening.
- *Psychographics:* Important baseline data include attitudes, beliefs, awareness, and understanding about energy efficiency. These data from consumers are critical to assess demand-side behavior. Similar data from individuals representing different components of the supply side can be useful to characterize the supply side, including the views of key actors on energy efficiency relative to the products and services delivered. Many of these data tracked over time can be useful indicators of market changes.
- *Energy use:* Baseline energy consumption for a specific end use or end uses is a key market characteristic. Different types of consumption data may be presented, including the average or typical consumption for an end use, the distribution of consumption levels, or aggregate consumption for a region.
- *Behaviors:* Behavioral information related to energy efficiency is crucial for understanding and tracking market changes. Consumer product and services efficiency choices ultimately determine end-use energy consumption. Similarly, behaviors on the supply side determine what choices of products and services are available and promoted to consumers.

Market Change Indicator Information

In addition to assessing the baseline market characteristic discussed in the preceding sections, this framework includes an approach for reviewing and appraising the usefulness of information presented on market transformation indicators. Although the focus of this study is on assessing the status of baseline market characteristics data, a few of the existing data sources (and probably a growing number of future studies) are expected to provide useful insights into metrics, or indicators, of market changes and how to use them to assess market transformation. Our framework includes assessment of each data source in terms of the quality of this type of information in the three primary market characteristics categories. In each of the categories, we judge how clearly and comprehensively the information is organized and communicated so that it could be used to identify and track pertinent market changes. This can be thought of as an overall indicator of how well a study or source *does the work* for a market analyst and avoids the need for combing through the source to assemble disparate information.

2.2 SCORING AND ASSESSMENT PROCEDURE AND IDENTIFICATION OF GAPS

The market baseline characteristics data were assessed by assigning a value to the information in each data source that reflected the "quality" of that information with respect to the characteristic. The level of quality was determined by reviewing the information presented about each baseline characteristic and assessing how useful the information would be for defining current baseline conditions and supporting future market effects evaluations. The key factors used for the scoring process developed were as follows:

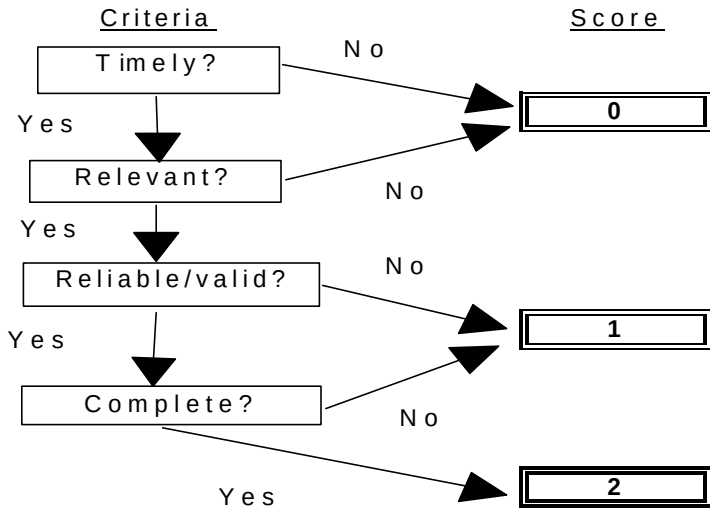
1. Timeliness. *How recently was the information produced? Is the market characteristic likely to have changed substantially since then?* For example, the fraction of leased versus owned office space may not change significantly over five years, but building operators' awareness of energy-efficient HVAC equipment may change significantly from year to year.
2. Relevance to California market. *Was the information collected in the California market? If not, is the market characteristic likely to vary much between California and where it was collected?* While a study of consumer attitudes in Chicago may not be very transferable to California, a national data source of residential refrigerator efficiency levels may be transferable because of its value as a cross-sectional comparison point for the California market.
3. Reliability and validity of data. *Were data collection instruments tested for reliability? Did the instrument or test used measure what it was supposed to measure? Were there systematic biases in the measurements used to assess the characteristic? Were sample sizes adequate and representative of the right populations?* For example, measurements of baseline consumer awareness about energy efficiency in a restricted area where an intensive pilot program promotion campaign had been underway would not provide a valid baseline measurement of the market as a whole.
4. Completeness. *Did the information cover all or most of the components of the baseline characteristic?* For example, information about most of the market actors is more useful than information about just a single market actor.

A value for each market characteristic was entered into the database based on how well the baseline information satisfied all the criteria above combined.

- The default value for all these entries is "0." This value indicates that a data source contains little or no useful information on a given market characteristic or the information that it does contain is outdated (Criterion 1) or is not relevant to California (Criterion 2).
- A value of "1" is entered if the data source provides moderately useful baseline information on the market characteristic. "Moderately useful" means that the information is timely (Criterion 1) and is relevant to California (Criterion 2), but either the reliability and validity of the data (Criterion 3) are questionable or unknown or the completeness (Criterion 4) is questionable or unknown.
- A value of "2" is entered if the data source provides very useful baseline information on the market characteristic. "Very useful" means that the information is timely (Criterion 1) and is relevant to California (Criterion 2), and both the reliability and validity of the data (Criterion 3) and the completeness (Criterion 4) are acceptable.

The scoring process can be described with the flowchart shown in Figure 2-1.

Figure 2-1
Scoring Process



Information summarizing why the values were assigned is included in the comments field of the database for each baseline characteristic. This is especially important for cases where a value of "1" is assigned.

Within each baseline characteristics category, a value also is entered into the database indicating the quality of information presented that is related to using market indicators to assess market transformation. A three-point scale is used here also. The quality of the information is based on

whether the data source addresses the concept of indicators and whether it offers potential indicators. Once again:

- A value of "0" is entered if the source does not provide any useful information on or a discussion of indicators or similar concepts.
- A value of "1" is entered if the source provides some useful information but does not clearly or explicitly present this information in the context of market indicators.
- A value of "2" is entered if the source *provides useful information* and *explicitly identifies and recommends* the use of specific indicators for particular purposes.

We used the database that was developed for this project to conduct a preliminary quantitative assessment of gaps in existing sources of market baseline characteristics data. This assessment relied on tabulations of the scores in the database, which are presented in Section 3 of this report. The first step in the process was to summarize general information about the sources. For this purpose, we tabulated the number of sources according to the:

- information source or study type,
- sponsor,
- period covered by source or study, and
- geographic area covered by source.

The second step was to summarize how comprehensive the sources were in their coverage of the market characteristics. To do so, we tabulated how many sources received a rating of "2" for their coverage of zero, one, two, three, etc. baseline market characteristics.

The next step was to focus on how well the sources covered each baseline market characteristic. To do this, we counted the number of sources that received a rating of "2" for their coverage of individual market baseline characteristics. These results showed which characteristics were covered well by existing sources and which ones were not. These results were the core of our analysis to identify where gaps occur in the existing sources, as well our assessment of which market baseline characteristics were covered adequately by existing sources.

2.3 PROCESS FOR DEVELOPING RESEARCH RECOMMENDATIONS

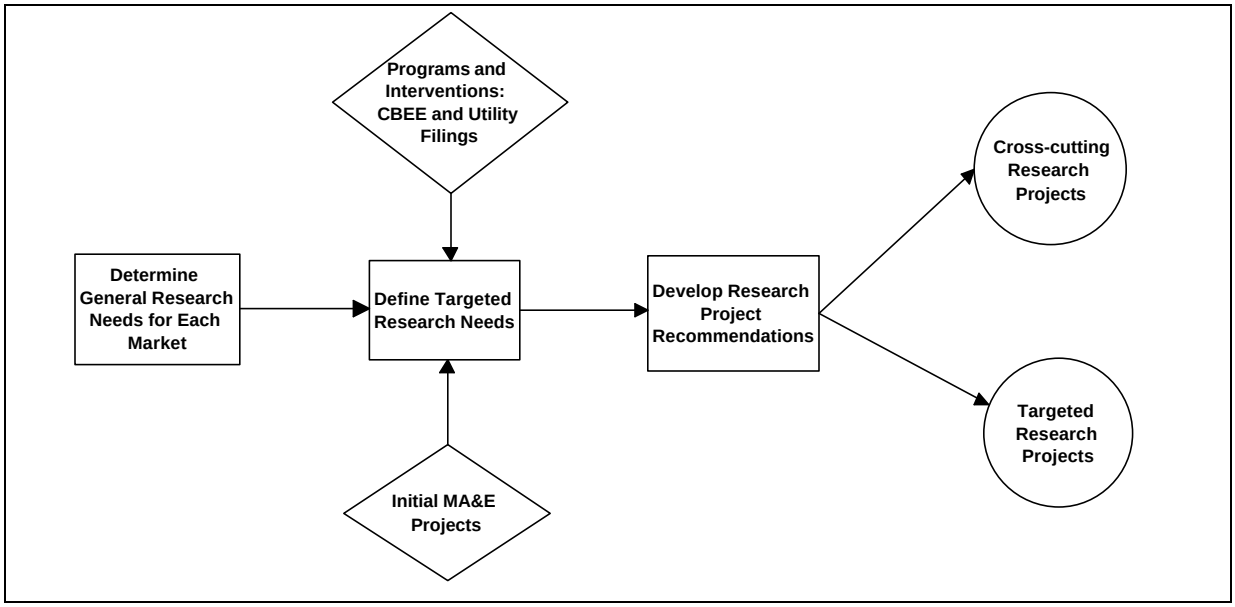
As noted earlier, this study was structured to address 19 specific energy-efficiency products and services markets. These markets were defined in conjunction with the CBEE Study Director and Project Manager to reflect the organization of the CBEE's program areas. We used these 19 products and services markets to structure a focused review of the baseline market characteristics data available in the information sources assessed for this study. For each market, this review documented the extent of usable baseline market characteristics information, the most useful sources of this information, and the nature of the gaps in this information. The most useful

information sources were identified by tabulating the number of "2's" received by category of market characteristic, the total number of "2's" received, and the total score each source received (adding up all scores assigned to the source).

We then identified generic research that would be required to fill the information gaps in each market. Next, we synthesized these research needs to produce a list of key research project recommendations, taking into account the following:

- planned programs and interventions as delineated in CBEE documents and utility 1999 filings,
- the initial 1999 menu of approved MA&E research projects,
- potential overlaps and synergies among the research projects that emerged from our assessment, and
- possible cross-cutting research needs. These research recommendations are presented in Section 4 of this report. The steps in this process are shown conceptually in Figure 2-2.

Figure 2-2
Development of Research Project Recommendations



2.4 SOURCES CONSIDERED AND REVIEWED

We identified 182 unique sources that we considered in our review process for this CABD Study. A source is defined as either a study, a database, or an information source. For example, the Dun & Bradstreet Marketplace product appears as a single record, or source, in the database. In a few cases, a source is a firm, for example, E-Source, that may offer a number of reports. Of the

sources collected and identified, 92 were systematically reviewed and scored with respect to the quality of baseline information provided. The distribution of sources reviewed is shown by type of source in Section 3. Even the collection of the 182 sources involved some screening. This screening was designed to minimize collection of sources that were highly unlikely to meet the minimum criteria for sources described previously (i.e., that they be timely, relevant to the California market, have reliable and valid data, be complete with respect to at least a few of the baseline characteristics defined in our framework, and not be redundant with other sources being reviewed).

Perhaps the most important criteria that we used to screen out large numbers of sources were the timeliness and redundancy criteria. These criteria were used to identify a subset of DSM impact evaluation studies conducted under the California measurement protocols since the early 1990s. Since there are several hundred such studies in and of themselves,[4] and because many of these studies apply the same methods and data collection instruments to particular evaluations year after year, we decided to begin by including only *the most recent* impact evaluation studies conducted for each energy-efficiency market. Based on our review of these most recent studies, we then determined whether there was any value to going back further and reviewing older studies for the same markets. In general, we found that impact evaluations provided very little baseline information of use for evaluations oriented around market effects. Therefore, we did not find it necessary to collect and review impact evaluations from the early 1990s.

In the end, impact evaluation studies represented slightly less than half of the sources reviewed in this study (see Table 3-1 in Section 3). We believe that this provides a reasonable balance between the goal of systematically assessing previous studies to maximize their value for meeting future research objectives, and ensuring the inclusion of a diverse set of sources beyond the well-known pool of California impact evaluations.

Sources within the database were categorized according to the following groups:

- ***Impact Evaluations.*** The database includes the *most recent* impact evaluations for every end use and vintage as required by the California Public Utilities Commission's impact evaluation protocols for the three major California electric utilities.
- ***Market Effects Studies.*** The database includes the majority of the market effect studies recently overseen by CADMAC, several non-California studies, and current CBEE studies that have been started but not completed.
- ***Baseline Studies.*** The database includes a small number of *self-described* baseline studies. The term "baseline" is restricted in our definition to refer to baseline information relevant to measurement of market change indicators related to energy efficiency.
- ***Private Marketing Databases.*** The database includes the documentation of private databases including Dun & Bradstreet, F.W. Dodge, Metromail, and others.

[4] See Appendix D for the California Energy Commission's list of over 400 California evaluation studies.

- ***Saturation Studies.*** The database includes the three electric utilities' residential appliance saturation survey (RASS) and commercial end-use survey (CEUS) studies and a recent Southern California Edison (SCE) industrial survey.
- ***Government Sources.*** The database includes documentation on selected government sources, including the CEC, DOE, Energy Information Administration (EIA) (RECS, CBECS, MECS), and OSTI.
- ***Other.*** The database includes documentation of other sources that fall outside of the categories above.

Specific titles of sources reviewed are included in Appendix A.

Efforts also were made to find studies produced outside of California that would have value as baseline sources for California. The organizations we contacted are listed below:

- Consortium for Energy Efficiency
- Northeast Energy Efficiency Partnerships
- Lawrence Berkeley National Laboratory
- Oak Ridge National Laboratory
- Energy Center of Wisconsin
- Northwest Energy Efficiency Alliance
- U.S. Environmental Protection Agency
- U.S. Department of Energy

3 GAP ANALYSIS

This section provides findings from our analysis of baseline information gaps. Most of these results were reported in the Interim Report for this project, but they have been updated for this final report to reflect the complete collection of information sources. The framework and scoring approach that underlie this analysis are described in Section 2.

This section first provides an introduction and a few caveats that the reader should keep in mind. It then summarizes the information sources in terms of their baseline-related characteristics and coverage. The next subsection presents a summary of the types of sources included in this study. The last three subsections present different analyses of the extent to which the existing sources provide the types of baseline data that facilitate the evaluation of market effects.

3.1 INTRODUCTION AND CAVEATS

This section presents findings from our first-stage assessment of the reviewed data sources. Our objective in compiling these findings is to provide a structured analysis of gaps in existing sources of baseline information. While the primary objective was to identify gaps in the data sources, the findings presented here also provide a broader view of the information and data sources, focusing on "what's there" as well as "what's not."

As with any study of this nature, there are a few important contextual points that the reader should keep while reviewing this section:

- Most of the results presented in this section were developed from the first stage of our review process. The first-stage analyses rely on the scores developed for each market characteristic for each of the sources reviewed. This first-stage analysis is complemented by the second-stage review, which was more qualitative and focused on a subset of the total set of sources reviewed. The detailed results of the second-stage review are presented in Appendix B. These second-stage results are likely to be of more specific use to those interested our assessment of individual sources of baseline information for particular efficiency markets.
- The judgments and scoring should not be interpreted to convey any information about the general quality of the data sources with respect to their own original objectives. Our assessments are made strictly with respect to the usefulness of the sources in providing the baseline market data described in Section 2. We have not assessed the data sources from any perspective other than their contribution to the pool of baseline market characteristics data, which, again, was generally not the original purpose for the majority of sources.
- The database tabulations presented in this section should be looked at as very general guides to extant baseline data, not as analytic ends in themselves. By definition, some extremely complex studies were summarized at a highly aggregated level.

- The preliminary findings in this section were intended to identify the markets and market characteristics for which baseline information appeared to be inadequate and those cases where potentially useful information was available. Subsequent assessments (summarized in Appendix B) also led to the recommendations presented in Section 4.
- Part of our initial gap assessment was a preliminary recommendation for each source indicating whether it should be included during the second-round review. These recommendations reflected a combined judgment about the usefulness of the baseline information in the source and the value likely to be added by an in-depth review. The data sources that were not recommended for further review were typically those that had little baseline market data or presented few insights into how baseline information could be constructed. Nonetheless, the fact that a source was recommended for further review was more an artifact of this study's design (a way to efficiently allocate our project's resources) than it was a declaration that the recommended sources mitigated gaps in baseline characteristics data.

3.2 GENERAL CHARACTERISTICS OF SOURCES ASSESSED

During the information gap review, we assessed 92 data sources collected for this study. For each data source, we documented the characteristics of the source including the type of source or study, the time period covered, the geographic area covered, and whether the source was recommended for review during the second round. This subsection summarizes these general characteristics.

3.2.1 General Summary of Sources

Table 3-1 presents summary information on the data sources. The general characteristics of the 92 data sources include the following:

- About half were evaluation studies and 28% were market effects studies;
- About 70% were sponsored by the three California investor-owned utilities (IOUs), and 12% were sponsored by the California Energy Commission (CEC) (and were usually statewide studies);
- 56% covered the period 1995 and later; 21% covered more than two years, and several covered periods that were ill-defined; and
- Sources were fairly evenly split between northern and southern California.
- We rated just over half (50) of the data sources as "recommended for further review."

Major differences for the subset that was recommended for further study included the following:

- Only 20% were classified as impact evaluations;[1]
- Almost all of the sources classified as market effects studies were recommended for further review;
- Recommended sources were more likely to be multi-year studies; and
- Recommended sources were almost twice as likely to provide out-of-state or national information.[2]

Because future California market transformation initiatives increasingly will be statewide, baseline market information will be most directly useful if it covers all regions of the state. We note that one criterion used in our assessment during this study phase was relevance of the information to the California market (see Section 2), so sources receiving a score of "2" were judged to be very relevant to this market. However, it was useful to categorize the sources further based on whether or not they included data for the state as a whole, specific regions of the state, or regions outside of the state. Those that were based on statewide information (or information for multiple areas covering most of the state) were likely to be most useful and require the least amount of work for use in future California evaluation studies.

Table 3-2 breaks down the sources by the geographic region covered and shows how many provided good baseline information on different quantities of market characteristics. In all three of the major market characteristics categories, only about one-fourth of the sources provided statewide information; the rest were based on either only one geographic region of California or on areas outside of the state. For the market structure/functioning characteristics, five of the statewide sources provided good information on at least four of the seven characteristics. Five statewide sources provided good information on at least half of the market actor characteristics. Only three statewide sources provided good information on at least half of the products/services characteristics.

[1] This result should be expected given the dominant role of measuring gross and net savings in studies conducted under impact evaluation protocols designed for adjudicating utility shareholder earnings that were tied to ex post measurements.

[2] This is partly because only sources with a high *a priori* probability of being good baseline sources were included in our target of out-of-state sources to review.

Table 3-1
Summary Information on Data Sources

Category	Complete Set (Total=92)		Set Recommended for Further Review (Total=50)	
Study Type	Number	%	Number	%
-Baseline	4	4%	3	6%
-Market effects	26	28%	23	46%
-Evaluation	45	49%	10	20%
-Government source	4	4%	4	8%
-Saturation	7	8%	7	14%
-Other	6	7%	3	6%
Sponsor[1]				
-CADMAC-Only[2]	5	5%	1	2%
-CEC	11	12%	5	10%
-Federal	5	5%	5	10%
-PG&E	34	37%	19	38%
-SCE	18	20%	10	20%
-SDG&E	11	13%	6	12%
-Other (including CBEE)	14	15%	7	14%
Period Covered				
-1997+	16	17%	13	26%
-1995-96	36	39%	11	22%
-1992-94	7	8%	3	6%
-Longer than 2 years	19	21%	14	28%
-Unclear	14	15%	9	18%
Geographic Region[1]				
-California[3]	20	22%	9	18%
-Northern California	30	33%	16	32%
-Southern California	29	32%	15	30%
-National, Outside California	13	14%	10	20%

[1] Some sources cover more than one category.

[2] Note that this category does not cover CADMAC-overseen studies that were carried out by one or two utility sponsors for their service-territories. These studies are counted under each utility. The CADMAC-only category captures a handful of CADMAC studies that were either conducted on a statewide basis or whose objectives were not limited to a particular territory. Note also that under *Study Type* many of the 26 market effects studies were overseen by the CADMAC Market Effects subcommittee over the past two years, though, again, these are tracked under *Sponsor* by utility not by CADMAC.

[3] Only a handful of these studies are truly "statewide" studies that contain *primary data collection*, the rest include studies jointly sponsored by both a northern and southern utility and more general research projects (e.g., an energy-efficiency potential study) that do not include primary data collection.

Table 3-2
Number of Unique Sources Scoring "2" by
Primary Baseline Characteristics and Geographic Region

Geographic Region	Number of Characteristics for which Unique Sources Score "2"														
	Market Structure/Functioning Characteristics							Market Actor Characteristics				Products / Services Characteristics			
	1	2	3	4	5	6	7	1	2	3	4	1	2	3	4
California	2	0	0	1	1	2	1	1	2	4	1	4	0	4	0
Northern California	6	1	0	1	0	1	0	6	2	1	0	6	1	1	0
Southern California	8	1	0	0	0	2	0	4	7	4	0	6	3	0	0
Outside California	0	1	2	1	1	0	1	1	1	2	2	4	0	2	0

3.2.2 Summary of Sources by Primary Markets

Tables 3-3 and 3-4 compare the market coverage of all the data sources with the coverage by those recommended for further review. Market coverage is defined for these tables by the inclusion in a data source of at least one specific energy efficiency market (e.g., existing residential lighting) within the primary market. Note that although we have tried to minimize the categorization of the number of primary markets that each study addressed to only those markets that were clearly the focus of the source, there were a number of gray areas in which a source covered multiple primary markets, even if unequally.[3]

Both the entire set and the recommended subset covered the non-residential existing market more adequately than they did the other two primary markets. For the entire set of sources, 53 sources addressed at least one type of energy efficiency market in the non-residential existing market. Over 40 covered either non-residential lighting or non-residential HVAC markets alone. Thirty-seven addressed at least one of the energy efficiency markets in the residential existing market. Twenty-six sources addressed at least one of the new construction markets.

[3] For example, a study might have two primary markets checked in our documentation database even though the relative focus of the study was unequally weighted between the markets. Although difficult to standardize exactly, reviewers were instructed to minimize categorization of sources under multiple markets as much as reasonably possible. Under more extreme cases in which a source had, say, a 90-10 focus split between two markets, the market with the 10 percent focus would not be selected for the source in the tracking system.

Table 3-3
Coverage of Broad Market Categories

	Complete Set Total Sources=92		Set of Sources Recommended for Further Review Sources=50	
Primary market	Number	% of total	Number	% of subset
Residential existing	37	40%	24	48%
Non-residential existing	53	58%	32	64%
New construction	26	28%	9	18%
Note: Some sources cover multiple markets so percentage totals exceed 100.				

Table 3-4
Coverage of Sources by Energy Efficiency Market

Energy Efficiency Market	Total Observations	Recommended for Further Review	Percent Recommended for Further Review
Res—HVAC	20	14	70%
Res—Lighting	24	14	58%
Res—Appliances	25	17	68%
Res—Shell	19	12	63%
Res—Renovation	8	7	88%
Non-res—HVAC	34	18	53%
Non-res—Lighting	40	24	60%
Non-res—Motors	24	17	71%
Non-res—Refrig.	18	11	61%
Non-res—Off. Equip.	7	5	71%
Non-res—Comp. Air	16	10	63%
Non-res—Shell	11	9	82%
Non-res—Process	19	8	42%
Non-res—Retro.	6	5	83%
Non-res—Remodel	7	6	86%
New Residential	15	5	33%
New Non-Residential*	16	6	38%

*Includes New Commercial, New Industrial, and New Agricultural combined.

3.3 OVERVIEW OF BASELINE CHARACTERISTIC COVERAGE

In this subsection we present some high-level tabulations of findings based on the 92 sources reviewed. The tables presented show frequencies of the number of sources that received the highest of the three possible scores (i.e., a "2" on a three-point scale including 0 and 1, as described in Section 2) by the number of baseline characteristics for which the high scores were attained. For example, in the first table, Table 3-5, we present a distribution of the number of

sources that scored a "2" by the number of baseline characteristics for which the "2" was received.

Note that, as described in Section 2, there is a maximum of 15 baseline characteristics across the three primary market categories.[4] Table 3-5 shows that almost half of the sources reviewed (43 of 92) did not score a "2" for any of the baseline characteristics of interest, and 88% of the sources scored a "2" on only 5 or less of the 15 possible baseline characteristics. At the opposite end of the spectrum, only seven of the sources scored a "2" for 10 or more of the baseline characteristics. The number of characteristics for which a particular study scored well was a measure of how comprehensively the source addressed important baseline characteristics. Not surprisingly, sources categorized as either market effects studies or baseline studies received scores that indicated they provided more comprehensive coverage of baseline market characteristics.

Table 3-5
Number of Unique Studies Scoring "2" Across All Characteristics by Study Type

	Number of Sources Rated "2"		
Number of Baseline Characteristics	Market Effects & Baseline Studies (30 total)	Evaluation, Saturation, etc. (62 total)	Total
0	10	33	43
1	4	6	10
2	2	8	10
3	1	6	7
4	2	5	7
5	3	1	4
6	0	0	0
7	0	2	2
8	2	0	2
9	0	0	0
10	4	1	5
11	0	0	0
12	1	0	1
13	0	0	0
14	1	0	1
15	0	0	0

Another way to look at the distribution of baseline characteristics covered by the sources reviewed is to break them down according to the primary baseline categories. These breakdowns are shown in Table 3-6. The information in this table indicated that even larger fractions of the

[4] We are not including the "market change indicators" fields in the tables presenting the number of baseline characteristics covered since these are summary ratings that involve assessment across specific characteristics.

sources reviewed did not cover any of the characteristics of interest within the three primary baseline categories. The table also shows, however, that the Market Actor category was more consistently covered than the Market Structure and Function and Product/Services categories, even for the studies that were not baseline or market effects studies.

Examination of the specific non-baseline/non-market effects sources scoring well for the Market Actor category indicated that these sources were split fairly evenly between impact evaluations and saturation studies. This is consistent with the fact that the Market Actor category captured demographic, firmographic, psychographic, energy use, and behavioral information. These traditional studies tended to cover the demographic, firmographic, and energy use characteristics well, but did not cover psychographic and behavioral information well.

Table 3-6
Number of Unique Studies Scoring "2" by Characteristic Category and Study Type

	All Sources							
	Number of Characteristics for which Unique Studies Score "2"							
Primary Baseline Category[1]	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Market Structure and Function	60	16	3	2	3	2	5	1
Market Actor	56	12	11	11	2	--	--	--
Products / Services	63	20	4	5	0	--	--	--

	Market Effects Studies & Baseline Studies (30 total)							
	Number of Characteristics for which Unique Studies Score "2"							
Primary Baseline Category	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Market Structure and Function	10	7	3	2	1	1	5	1
Market Actor	17	2	3	6	2	--	--	--
Products / Services	20	5	3	2	0	--	--	--

	Evaluation Studies, Saturation Studies, etc. (62 total)							
	Number of Characteristics for which Unique Studies Score "2"							
Primary Baseline Category	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Market Structure and Function	50	9	0	0	2	1	0	0
Market Actor	39	10	8	5	0	--	--	--
Products / Services	43	15	1	3	0	--	--	--

[1] Note that for the Market Actor and Products/Services categories, the maximum number of characteristics is 4.

3.4 INFORMATION AVAILABILITY AND GAPS BY MARKET CHARACTERISTICS

This assessment of the data sources reflects the coverage of information on each of the 15 baseline characteristics for each of the 19 market types. To identify gaps in this information it was

necessary to examine each specific market and the extent of information available on each baseline characteristic in that market.

We analyzed and rated the coverage of each baseline characteristic for all data sources containing information on a specific market. We then counted the number of sources that covered a characteristic well, i.e., received a rating of "2". Both the distribution and total number of sources receiving a "2" were calculated. The results are presented in the following subsections for each of the major baseline characteristic categories.

In each subsection, we first display the number of sources that received a rating of "2" by each specific energy efficiency market and baseline characteristic. The total shown in the far right column is the total number of sources that presented good baseline information about at least one of the specific characteristics within the group covered by the table. These tables indicate how many studies had useful information about a specific market structure/functioning characteristic for a given market regardless of whether they presented other useful baseline information.

The second table presented in each subsection shows the distribution of sources by how many scored a "2" *across multiple indicators*.[5] These tables provide an indication of whether there were very many studies that *comprehensively* addressed the baseline characteristics of interest, or whether it was more likely that one would have to look across several studies to obtain all of the pieces of information needed for a complete picture.

3.4.1 Market Structure and Functioning Characteristics

As seen in Table 3-7, there were a large number of gaps under several of the market structure/functioning characteristics, as defined by cells with zeros or small numbers of sources, particularly for distribution channels, information channels, linkages, end users, participants other than end users, and market structure indicators. There were no more than five sources with good information on any of these characteristics, and the coverage was restricted further because it was limited primarily to existing residential markets (other than renovation) and the non-residential lighting, HVAC, and motors markets.

Table 3-7 also shows that market size was the most readily available baseline market structure information. A number of sources appeared to provide good market size information for the existing residential and non-residential markets: four or more relatively high rated sources were available across most of these markets.

The baseline market barrier information appeared to be relatively well covered for several markets (residential HVAC, lighting, and appliances; non-residential HVAC, lighting, and motors), but poorly covered for others (e.g., residential renovation; non-residential refrigeration compressed air, remodeling, etc.; and new construction industrial and agricultural). These results

[5] Note that we have combined the results for all new construction non-residential building markets (commercial, agricultural, and industrial) in the second table that appears in each of the following subsections.

were consistent with what one would expect given the markets targeted by the 15 CADMAC market effects studies conducted over the past two years.

Turning now to Table 3-8, one gets another perspective on the nature of coverage for the market structure/functioning characteristics. This table shows that the vast majority of sources did not cover more than one characteristic well. In fact, only a handful of studies comprehensively addressed the market structure/functioning characteristics comprehensively as evidenced by scoring "2's" across half or more of the individual elements (i.e., 4 or more of the 7 characteristics).

Table 3-7
Number of Sources Rated "2" on Market Structure/Functioning Information by Energy Efficiency Market

Energy-Efficiency Market	Market Structure/Functioning Characteristic								
	Dist. Channels	Info. Channels	Barriers	Linkages	Size	End Users	Other Part.	Structure Indicators	Total
Res—HVAC	3	3	4	2	5	1	2	2	11
Res—Lighting	3	2	4	3	7	1	2	3	8
Res—Appliances	3	3	6	5	6	2	4	3	13
Res—Shell	4	3	4	3	5	2	3	3	9
Res—Renovation	2	1	2	2	3	1	2	2	4
Non-res—HVAC	2	2	5	1	4	1	3	2	10
Non-res—Lighting	2	3	6	2	6	1	3	2	11
Non-res—Motors	2	1	6	1	5	2	3	2	10
Non-res—Refrig.	0	0	1	0	4	0	0	0	5
Non-res—Off. Equip.	0	0	0	0	4	0	0	0	4
Non-res—Comp. Air	1	1	3	1	4	0	1	1	7
Non-res—Shell	0	0	2	0	4	0	1	0	6
Non-res—Process	2	2	3	2	1	1	2	2	4
Non-res—Retro.	0	0	0	0	3	0	0	0	3
Non-res—Remodel	1	1	1	0	4	0	0	1	4
New Residential	2	2	4	2	0	2	2	2	4
New Commercial	2	2	4	1	2	1	2	2	4
New Industrial	1	1	2	0	1	0	0	1	2
New Agricultural	1	1	1	0	1	0	0	0	1
Averages	1.6	1.5	3.1	1.3	3.6	0.8	1.6	1.5	6.3

Note: "Total" indicates the total number of sources that contain information on at least one market characteristic for the specified market.

Table 3-8
Number of Unique Sources Scoring "2" Across Multiple Characteristics Under the Market Structure/Functioning Category

	Number of Characteristics for which Unique Sources Score "2"

Energy-Efficiency Market	0	1	2	3	4	5	6	7	Totals
Res—HVAC	10	7	1	0	0	1	1	0	20
Res—Lighting	16	5	0	0	0	1	2	0	24
Res—Appliances	12	7	2	1	1	1	1	0	25
Res—Shell	10	5	1	0	0	1	2	0	19
Res—Renovation	4	2	0	0	0	1	1	0	8
Non-res—HVAC	24	7	1	0	1	1	0	0	34
Non-res—Lighting	29	8	1	0	0	0	1	1	40
Non-res—Motors	14	6	1	1	1	1	0	0	24
Non-res—Refrig.	13	5	0	0	0	0	0	0	18
Non-res—Off. Equip.	3	4	0	0	0	0	0	0	7
Non-res—Comp. Air	9	6	0	0	0	1	0	0	16
Non-res—Shell	5	5	1	0	0	0	0	0	11
Non-res—Process	15	2	0	0	0	1	1	0	19
Non-res—Retro.	3	3	0	0	0	0	0	0	6
Non-res—Remodel	3	3	0	0	1	0	0	0	7
New Residential	11	2	0	0	0	0	2	0	15
New Non-Residential	12	1	1	0	1	0	0	1	16

Several preliminary findings can be drawn about gaps in this category of market baseline characteristics.

- *Looking across the market rows in Table 3-8 it is clear that very few sources presented good information comprehensively across the different market structure and functioning characteristics.* This suggested that several sources would be required to address all of the baseline characteristics within any single market. Experience shows that the more one has to combine information across disparate sources, the less likely one is to have a consistent and systematic analysis that can serve as a baseline for future measurement activities. At the same time, there were a few markets, as indicated in the same table, that have been the subject of a small number of productive studies that covered five or more of the seven baseline structure/functioning characteristics.
- *Table 3-8 shows that about 70% of the structure/functioning characteristics within individual markets were addressed well by only two or fewer sources (of the 92) within our database.* About one-fourth were not addressed by any of the sources.
- *Highly rated market baseline structure/functioning information for end-user characteristics was available from only a small number of studies*. In many markets, none of the sources in our database provided good baseline information on end users with respect to market structure or function characteristics. (Note that many studies did provide end-user baseline characteristic information such as demographics and energy usage.)
- *Baseline structure/functioning characteristics for other market participants were also rarely available in these data sources.*

- *The markets where there were the fewest sources on baseline structure/functioning information included the following: all new construction; existing non-residential remodeling, retrofit, process, shells, compressed air, office equipment, refrigeration; and existing residential renovation.*

3.4.2 Market Actor Characteristics

Table 3-9 and Table 3-10 present the same type of results for market actor baseline information. Overall, market actor information was more common in these sources than information on market structure and functioning. Demographics and firmographics data were the most commonly available market actor baseline information: for six markets there were seven or more sources available that scored well on at least one of the individual characteristics. However, as shown in Table 3-10, only a few sources covered three or four of the market actor characteristics well, primarily in the existing residential markets. Several information sources were available for information on energy usage, behavior, and market indicators related to market actors, but primarily in the existing residential and non-residential lighting and motors markets.

These tables suggested several findings about gaps in the market actor baseline characteristics category.

- *Comparing the number of sources with good demographics/firmographics information with the total number of sources containing some market actor information in Table 3-9, it appeared that sources that had any good market actor information were likely to have good demographics/firmographics baseline information.*
- *However, psychographics (e.g., attitudes, beliefs, awareness, and understanding about energy efficiency), which are arguably critical to measuring market effects, was an area that was covered only slightly in all but a few markets (the well-covered markets being some of the same ones mentioned previously such as residential existing [non-renovation] and non-residential lighting).* Psychographics data were the least available type of market actor baseline information across all markets. There were no sources of this information for nearly half the specific markets.
- *In about 42% of the cells in Table 3-9, only two or fewer good baseline information sources were available within our database. About 13% were not addressed by any of the sources.*
- *The markets where sources of market actor baseline information were least available included the following: new agricultural construction; new industrial construction; and existing non-residential remodeling, retrofit, process, and office equipment.*

Table 3-9
Number of Sources Rated "2" on Market Actor Information by Market

	Market Actor Characteristic					
Energy-Efficiency	Demographics/	Psychographics	Usage	Behavior	Market Actor	Total

Market	Firmographics				Indicators	
Res—HVAC	10	3	5	4	6	10
Res—Lighting	8	2	6	5	6	10
Res—Appliances	10	5	8	7	7	14
Res—Shell	9	4	4	5	6	10
Res—Renovation	3	2	1	2	2	4
Non-res—HVAC	6	0	3	4	2	7
Non-res—Lighting	7	3	5	7	4	10
Non-res—Motors	7	1	4	5	2	8
Non-res—Refrig.	5	0	3	3	1	5
Non-res—Off. Equip.	3	0	1	3	1	3
Non-res—Comp. Air	4	0	2	4	1	5
Non-res—Shell	4	0	2	3	1	4
Non-res—Process	1	1	2	2	1	4
Non-res—Retro.	3	0	1	3	1	3
Non-res—Remodel	4	0	2	3	2	4
New Residential	2	2	4	3	2	6
New Commercial	3	2	3	3	2	4
New Industrial	1	0	1	0	1	1
New Agricultural	1	0	1	1	1	2
Averages	4.8	1.3	3.1	3.5	2.6	6.0
Note: "Total" indicates the total number of sources that contain information on at least one market characteristic for the specified market.						

Table 3-10
Number of Unique Sources Scoring "2" Across Multiple Characteristics Under the Market Actor Category

Energy-Efficiency Market	Number of Characteristics for which Unique Sources Score "2"				
	0	1	2	3	4
Res—HVAC	10	3	2	5	0
Res—Lighting	14	4	1	5	0
Res—Appliances	11	5	2	7	0
Res—Shell	9	3	2	5	0
Res—Renovation	4	1	2	1	0
Non-res—HVAC	27	2	4	1	0
Non-res—Lighting	30	2	5	2	1
Non-res—Motors	16	2	4	1	1
Non-res—Refrig.	13	0	4	1	0
Non-res—Off. Equip.	4	0	2	1	0
Non-res—Comp. Air	11	1	3	1	0
Non-res—Shell	7	0	3	1	0
Non-res—Process	15	2	2	0	0
Non-res—Retro.	3	0	2	1	0
Non-res—Remodel	3	0	3	1	0
New Residential	9	3	1	2	0
New Non-Residential	11	1	2	1	1

3.4.3 Products/Services Characteristics

In Table 3-11 and Table 3-12 we present results regarding the number of good sources of baseline market information in the products and services category. A different pattern emerges in the results than that seen in either the market structure/functioning or market actor results. The only type of information that is readily available in the data sources is for the energy efficiency characteristic (defined as the range of efficiency levels in a particular market and the distribution of those levels). There are three or more sources available for efficiency information in almost every market. The remaining market characteristics are rarely covered by more than two data sources. For most markets, the bulk of the sources do not address any of these product/service features well, as shown in Table 3-12.

The findings on gaps in this category of market baseline characteristics include the following:

- *Overall, there are few sources of good information on any products/services baseline characteristic other than efficiency.* For about 70% of the cells in Table 3-11 only two or fewer sources addressed the specific market and characteristic. About 21% were not addressed by any of the sources.

- *Comparing the number of sources rated as having good efficiency information with the total number of sources with some products/services baseline information, it appeared that there were few sources that provided any good products/services baseline information if they did not also provide energy-efficiency information.*
- *Market baseline products/services information was almost nonexistent in the data sources we reviewed for cost, sales/market shares, other product features, and products/services market indicator baseline information.*

Table 3-11
Number of Sources Rated "2" on Products/Services Information by Market

Energy-Efficiency Market	Products/Services Characteristic					
	Efficiency	Cost	Sales/ Market Shares	Other Features	Product/ Services Indicators	Total
Res—HVAC	8	2	1	1	1	8
Res—Lighting	11	2	3	2	2	11
Res—Appliances	10	4	3	3	3	12
Res—Shell	7	2	1	1	2	8
Res—Renovation	3	2	2	0	1	4
Non-res—HVAC	7	2	1	1	1	7
Non-res—Lighting	7	4	2	3	3	9
Non-res—Motors	7	2	1	1	1	7
Non-res—Refrig.	5	2	1	1	1	5
Non-res—Off. Equip.	3	0	0	0	0	3
Non-res—Comp. Air	5	1	0	1	1	5
Non-res—Shell	4	1	0	1	1	4
Non-res—Process	3	1	1	1	2	3
Non-res—Retro.	3	0	0	0	0	3
Non-res—Remodel	4	0	0	0	0	4
New Residential	6	2	1	1	2	7
New Commercial	2	2	1	2	2	3
New Industrial	2	1	0	1	1	2
New Agricultural	1	0	0	0	0	1
Averages	5.2	1.6	0.9	1.1	1.3	5.6

Note: "Total" indicates the total number of sources that contain information on at least one market characteristic for the specified market.

Table 3-12
Number of Unique Sources Scoring "2" Across Multiple Characteristics Under the Products/Services Category

Energy-Efficiency Market	Number of Characteristics for which Unique Sources Score "2"				
	0	1	2	3	4
Res—HVAC	12	6	0	2	0
Res—Lighting	13	7	1	3	0
Res—Appliances	13	8	0	4	0
Res—Shell	11	6	1	1	0
Res—Renovation	4	2	1	1	0
Non-res—HVAC	27	5	0	2	0
Non-res—Lighting	31	5	1	3	0
Non-res—Motors	17	5	0	2	0
Non-res—Refrig.	13	3	0	2	0
Non-res—Off. Equip.	4	3	0	0	0
Non-res—Comp. Air	11	4	0	1	0
Non-res—Shell	7	3	0	1	0
Non-res—Process	16	1	1	1	0
Non-res—Retro.	3	3	0	0	0
Non-res—Remodel	3	4	0	0	0
New Residential	8	5	1	1	0
New Non-Residential	13	1	0	2	0

3.5 INFORMATION STRENGTHS, WEAKNESSES, AND GAPS BY MARKET

In this subsection we present summary information on strengths, weaknesses, and gaps for each of the 19 markets rather than by the types of market baseline characteristics. It presents summary information in tables for each market. Under strengths, the tables provide an indication in some cases of how many sources provide good information. Where the tables say a "few" sources were available it means that only one or two sources were identified; "several" indicates that three to five were identified; and "many" indicates that six or more were identified.

Section 4 summarizes these findings in the context of research recommendations. The strengths, weaknesses, and gaps underlie our research the Section 4 recommendations. Appendix B provides more extensive information on each of these markets and is the source from which the following material was drawn.

3.5.1 Residential

The following five tables, Table 3-13 through Table 3-17, summarize the strengths and weaknesses/gaps in the available sources of existing residential market information.

Table 3-13
Existing Residential HVAC Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several good sources of market size information are available • Baseline information on distribution channels and market structure for gas heat equipment is fairly complete • Residential SPC evaluation might provide current statewide market barriers, actors, and decision-making information	• Few good sources are available for distribution channel, information channel, barriers, linkages, leverage points, market participants, and indicators information • Little statewide information is available
Market Actors	• Many good sources of demographics/firmographics information are available • Several good sources of usage, behavior, and indicators information are available • Some consumer behavioral and decision-making information is available for gas heat	• Few good sources are available for psychographics information • Little statewide information is available • There is little or no information on consolidators and retailers who sell directly to consumers • There is little information on either consumers' or supply-side actors' awareness, knowledge, or decision-making
Products/Services	• Many good sources (including RASS studies) of efficiency and saturation data are available and usually apply statewide • Gas heating system data are good for SCG service area	• Few good sources are available for cost, sales/market shares, and other features information • Little statewide information is available

Notes:
SCG - Southern California Gas
RASS - residential appliance saturation survey

Table 3-14
Existing Residential Lighting Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Many good sources of market size information are available • 2 recent studies provide good baseline information on most structure/functioning characteristics	• A limited number of good sources are available for distribution channel, information channel, barriers, linkages, market participants, and indicators information • Much of the information is limited to CFLs • Most information is utility-specific
Market Actors	• Many good sources are available for demographics/ firmographics information • Many good sources are available for usage, behavior, and indicators information • 2 recent studies provide good information on consumers	• Few good sources are available for psychographics information and end-user decision-making • Much of the information is limited to CFLs • Most information is utility-specific • There is little information on supply-side actors
Products/Services	• Many good sources (including RASS studies) are available for efficiency and saturation data • CFL information is fairly complete	• Few good sources are available for cost, sales/market shares, and other features information • Much of the information is limited to CFLs • Saturation data are incomplete and dated • Little statewide information is available

Notes:

CFL - compact fluorescent lighting

Table 3-15
Existing Residential Appliances Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Many good sources are available for market size and barriers information (primarily for refrigerators) • Several studies provide partial baseline information on structure/functioning characteristics • Good information is available for refrigerator market	• Available information is scattered across several disparate sources • Comprehensive information is lacking for appliances other than refrigerators • Little statewide information is available
Market Actors	• Many good sources are available for demographics/ firmographics information • Many good sources are available for psychographics, usage, behavior, and indicators information	• Most of the information is limited to refrigerators • Available information is scattered across several disparate sources • There is little information on supply-side actors • Little statewide information is available
Products/Services	• Many good sources (including RASS studies) are available for efficiency and saturation data • Refrigerator information is fairly complete	• Few good sources are available for cost, sales/market shares, and other features information • Much of the information is limited to refrigerators • Little statewide information is available

Table 3-16
Existing Residential Shell Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several good sources are available for market size information • 1 good source is available on windows market	• No comprehensive sources of information are available • Comprehensive information is lacking for measures other than windows • Little statewide information is available
Market Actors	• Many good sources are available for demographics/firmographics information • Many good sources are available for market indicators information • 1 good source is available for comprehensive information	• Most of the information is limited to windows • Little statewide information is available
Products/Services	• Many good sources are available for efficiency data and saturations • Windows information is fairly complete	• No comprehensive sources of information are available • Few good sources are available for cost, sales/market shares, and other features info. • Much of the information is limited to windows • Little statewide information is available

Table 3-17
Existing Residential Renovation Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several good sources are available for market size information	• No comprehensive sources of information are available • Little information is available
Market Actors	• Several good sources are available for demographics/ firmographics information • A few good sources are available for windows information	• No comprehensive sources of information are available • Little information is available for either end users or supply side
Products/Services	• Several good sources are available for efficiency data and saturations	• No comprehensive sources of information are available • Little information is available

3.5.2 Non-Residential

The following tables, Table 3-18 through Table 3-27, provide summaries of the information available on the existing non-residential markets.

Table 3-18
Existing Non-Residential HVAC Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several good sources of market size information are available • 1 source provides good information on barriers, distribution channels, and information channels for schools, universities, hospitals, and offices • Information on end-users and market channels is probably appropriate to all of California • PG&E market effects study provides good information on barriers, distribution channels, and information channels	• No comprehensive sources of information are available • Little information is available for markets other than schools, universities, hospitals, and offices • Market structure/functioning characteristics information is especially limited regarding causal links, leverage points, and market size • Little statewide information is available • Little supply-side information is available
Market Actors	• Many good sources of demographics/firmographics information are available • CEUS studies provide good end-user firmographics and energy use data • CEUS data are based on reasonably large samples and PG&E market effects study uses reliable and valid sampling approaches • Recent SPC evaluation provides end-user behavior, attitudes, etc.	• No comprehensive sources of information are available • CEUS data are from different years • Little statewide information is available • There is little information on supply-side actors • There is little information on actors' awareness, knowledge, or decision-making
Products/Services	• Many good sources of efficiency data are available • Good information is available on packaged A/C	• Only one study provides comprehensive information • Few good sources are available for cost, sales/market shares, and other features information • Little statewide information is available • Little information is available on technologies other than packaged A/C

Table 3-19
Existing Non-Residential Lighting Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Many good sources are available for market size and barriers information • CEUS studies provide good information on market size • 1 good market effects study is available	• Little information is available on distribution channels, linkages, and end users • Little information is available on industrial lighting • Little information is available on renovation/remodeling
Market Actors	• Many sources are available for demographics/firmographics and behavior information • Good information is available on supply-side actors • CEUS studies provide good information on actor characteristics and usage • 1 good market effects study is available • Recent SPC evaluation provides end-user behavior, attitudes, etc.	• Little information is available on codes and local government role • Little information is available on psychographics
Products/Services	• Many sources are available for efficiency data • CEUS studies provide good information on products • Several studies provide information on several characteristics • 1 good market effects study is available	• Little information is available on occupancy sensors, HID, exit signs, T-5s, lighting controls, LED traffic signals, outdoor lighting, and daylighting • Limited data are available on costs • Little information is available on industrial sector, integrated design, and installation

Notes:

CEUS - commercial end-user survey
HID - high intensity discharge
LED - light emitting diode
SPC - standard performance contract

Table 3-20
Existing Non-Residential Motors Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several sources are available for market size and barriers information • CEUS studies provide market size data • Market effects study provides good barriers information • Good national market size information is available that could be applied to California	• No comprehensive sources of information are available • Little information is available on distribution channels, information channels, linkages, and market actors • CEUS data are utility-specific
Market Actors	• Many sources are available for demographics/firmographics information • CEUS studies provide demographics and usage data • 1 study provides good decision-making information • Recent SPC evaluation provides end-user behavior, attitudes, etc. • Good energy usage data are available	• Only one study provides comprehensive information • Little information is available on psychographics, behavior, and decision-making • CEUS data are utility-specific • Little information is available on motor turnover • Little information is available on supply-side firmographics
Products/Services	• Many sources are available for efficiency information • Good national stock information is available that could be applied to California • CEUS studies provide good data on motor stock	• Only one study provides comprehensive information • Little information is available on cost, market shares, and other features • Little statewide information is available • Cost and availability data are limited for high efficiency motors

Table 3-21
Existing Non-Residential Refrigeration Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several sources are available for market size information • 1 market effects study provides good information for supermarkets and is probably relevant to state	• No comprehensive sources of information are available • Limited information is available on structure/ functioning characteristics other than market size • Information is not available for markets other than supermarkets
Market Actors	• Several sources are available for demographics/firmographics information • 1 market effects study provides good information and is probably relevant to state • CEUS studies provide energy usage data and efficiency measures	• No comprehensive sources of information are available • CEUS studies were conducted in different years • Little information is available for markets other than supermarkets • Little statewide information is available
Products/Services	• Several sources are available for efficiency data • 1 market effects study provides good information and is probably relevant to state • CEUS studies provide stock data	• Only one study provides comprehensive information • Almost no information is available on products/services characteristics other than efficiency • CEUS studies were conducted in different years • Stock data are available only at a summary level

Table 3-22
Existing Non-Residential Office Equipment Market:
Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several sources (primarily CEUS studies) are available for market size data • CEUS studies provide some information channel information	• No comprehensive sources of information are available • Little relevant information is available • Information is especially weak on distribution channels, market barriers, and linkages
Market Actors	• CEUS studies provide end-user firmographics data • CEUS studies provide some attitudes and practices information	• No comprehensive sources of information are available • Little relevant information is available • Information is especially weak on supply side firmographics and all market actors' behavior
Products/Services	• Forthcoming EPA study may provide market shares information	• No comprehensive sources of information are available • Little information is available on energy-efficient products

Table 3-23
Existing Non-Residential Compressed Air Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several sources (primarily CEUS studies) are available for market size data • A market strategy report outlines structure/functioning, with supply side emphasis • Strategy report defines market barriers, linkages, and market transformation options • 1 source provides vendor barriers, behaviors, and leverage points information	• Little California information is available • The only comprehensive study available is a few years old • CEUS studies were not all performed in the same year
Market Actors	• Several studies are available for demographics/firmographics data • Some good energy usage information is available • Some information is available on vendors	• No comprehensive sources of information are available • Little relevant information is available • Information is especially weak for end-users
Products/Services	• Several sources provide efficiency information	• Little relevant information is available

Table 3-24
Existing Non-Residential Shell Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several sources (primarily CEUS studies) are available for market size data • CEUS studies include some data on information channels	• No comprehensive sources of information are available • Little statewide information is available • Little information is available on distribution channels and linkages • Some CEUS data are dated
Market Actors	• Several sources (primarily CEUS studies) are available for firmographics/demographics and energy usage data • CEUS studies provide some attitudes and practices information	• No comprehensive sources of information are available • Little information is available on end-user decision-making • Little information is available on supply side, especially stocking practices and sales • Some CEUS data are dated
Products/Services	• Several sources (primarily CEUS studies) are available for efficiency data and measures information • One study provides end-use data on window film and roof spray measures	• Little information is available on products/services availability • No comprehensive sources of information are available • Little information is available on efficiency improvements • Some CEUS data are dated

Table 3-25
Existing Non-Residential Process Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Some information is available on barriers in water supply pumping market • Some information is available on barriers and linkages for process pumping (petroleum, paper/pulp, and chemical) and fans/blowers	• Little relevant information is available • No comprehensive sources of information are available • Information is available on only a few markets • No statewide information is available
Market Actors	• Some information is available on end-user awareness and decision-making for water pumping • Some supply-side information is available process pumping (petroleum, paper/pulp, and chemical) and fans/blowers	• Little relevant information is available • No comprehensive sources of information are available • Information is available on only a few markets
Products/Services	• Industrial saturation data are available for SCE area	• Little relevant information is available • No comprehensive sources of information are available

Table 3-26
Existing Non-Residential Retrofit Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several sources are available for market size information • CEUS studies provide some information on information channels	• No statewide information is available • No comprehensive sources of information are available • Little information is available on distribution channels, information channels, barriers, and linkages • Some CEUS data are dated
Market Actors	• Several sources are available for demographics/firmographics and behavior information • CEUS studies provide some energy usage information	• No statewide information is available • No comprehensive sources of information are available • Supply-side information (especially behaviors and stocking practices) is lacking • Little information is available on end-user behavior and decision-making • Some CEUS data are dated
Products/Services	• Several sources are available for efficiency information • CEUS studies provide some equipment age and saturation information	• No statewide information is available • No comprehensive sources of information are available • Some CEUS data are dated • Information is lacking on integrated design, system optimization, costs, and sales

Table 3-27
Existing Non-Residential Remodeling Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several sources (CEUS studies) are available for market size information • Current CBEE study will provide information on barriers and information channels for California	• Little statewide information is available • No comprehensive sources of information are available • The CBEE data focus on new construction/renovation markets rather than remodeling • Information is lacking on distribution channels, barriers, and linkages • No statewide information is available on market size • Some CEUS data are dated
Market Actors	• CEUS studies provide information on end-user demographics/firmographics and usage patterns • Current CBEE study will provide information on supply side and energy usage for California	• Little statewide information is available • No comprehensive sources of information are available • The CBEE data focus on new construction/renovation markets rather than remodeling • Little information is available on supply side • Little information is available on end-user decision-making • Little information is available on code enforcement and local government roles
Products/Services	• CEUS studies provide information on equipment saturations and efficiencies	• Little statewide information is available • No comprehensive sources of information are available • Little information is available on cost, availability, integrated design, system optimization, promotional practices, and sales

3.5.3 New Construction

The following tables, Table 3-28 through Table 3-31, present summaries for the new construction markets.

Table 3-28
New Residential Construction Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several sources are available for barriers information • Good information is available on windows market • Good information is available on gas space and water heating markets	• Little statewide information is available; windows and gas equipment information is for limited geographic regions • Little comprehensive information is available • Little information is available on products other than windows and gas equipment • No information is available on manufactured housing market structure/functioning
Market Actors	• Several sources are available for energy usage information • Good information is available on windows market • Good information is available on gas space and water heating markets	• Little statewide information is available; windows and gas equipment information is for limited geographic regions • No comprehensive sources of information are available • Little information is available on supply-side market actors and consumers • There is little information on code compliance • No information is available on manufactured housing market actors
Products/Services	• Many sources are available for efficiency data • Good information is available on windows market • Good information is available on gas space and water heating markets • Some information is available on duct systems	• No comprehensive sources of information are available • Little statewide information is available; window and gas equipment information is for limited geographic regions • No information is available on manufactured housing market products/services

Table 3-29
New Commercial Construction Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• Several sources are available for barriers information • Recent CBEE study provides good comprehensive statewide information • 1 source provides good information on market leverage points • Good information is available on lighting market	• Little statewide information is available on sectors other than offices, retail, schools, and public assembly • No comprehensive sources of information are available • No information is available on relocatable classroom market • Some geographic gaps exist in CBEE statewide study data • Some information is available only for one area (e.g., leverage points)
Market Actors	• Several sources are available for demographics/firmographics, energy usage, and behavior information • Recent CBEE study provides good comprehensive statewide information • Good information is available on lighting market	• Few sources of information are available • No comprehensive sources of information are available • Some geographic gaps exist in CBEE statewide study data
Products/Services	• Recent CBEE study provides good comprehensive statewide information • Good information is available on lighting market	• Few sources of information are available • No comprehensive sources of information are available • Some geographic gaps exist in CBEE statewide study data • Baseline conditions may change due to expected building code modification

Table 3-30
New Industrial Construction Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• None	• No relevant information is available
Market Actors	• None	• No relevant information is available
Products/Services	• A few sources are available for efficiency information	• Very little relevant information is available

Table 3-31
New Agricultural Construction Market: Information Strengths and Weaknesses

General Market Characteristics Category	Strengths	Weaknesses and Gaps
Structure and Functioning	• None	• No relevant information is available
Market Actors	• None	• No relevant information is available
Products/Services	• None	• No relevant information is available

4 RESEARCH RECOMMENDATIONS

4.1 OVERVIEW AND SUMMARY

In this section we present our recommendations for further baseline research in support of California's energy efficiency program efforts. While Section 3 of this report provided the direct results of our review and assessment of *existing* baseline data sources, principally in the form a identification of strengths, weaknesses, and gaps; this section provides recommendations for addressing those gaps and weaknesses. These recommendations are made in the following context:

- ***Although we have screened and consolidated recommendations as much as possible, we have not restricted the total number of recommendations based on any a priori constraints***. At the same time, we recognize that such constraints clearly exist and are critically important. For this reason, we prioritized our recommendations as discussed below.
- ***To address the fact that a number of recommendations are being made, we provide a summary table in which we prioritize our recommendations by major topic area into three levels: High, Medium, and Low***. The approach used to develop the overall priority rankings is discussed below. Again, as stated in Section 1 of this report, although the types of baseline data with which we are concerned in this project can be used to support both program planning and program evaluation activities, the objective of this study is to make recommendations for improving baseline data to facilitate *the evaluation* of market effects resulting from California energy-efficiency programs.
- ***The recommendations made here are not intended to be project proposals***. Our objective is to recommend what would be necessary to collect to fill the gaps identified in Section 3, not to specify the specific projects in which the work should be done. The reason for this is that the baseline needs that we identify could be met through a variety of research project structures ranging from baseline-only studies, to broad multi-objective program-specific evaluations, to topically-oriented studies, studies organized by end use, or studies organized by market actor, to name a few possible approaches. The *market-specific* recommendations made here could be organized or aggregated in a variety of ways. At the time of this writing, a system of long-term assignments for state-level MA&E activities is being developed.[1] As part of this MA&E process, we recommend that MA&E project managers identify synergies among the research recommendations made in this report, the MA&E projects for which they are responsible, and the research activities to be conducted as part of the Efficiency Market Share Tracking studies. As part of this process,

[1] Proposed System of Long-Term Assignments for State-Level MA&E Activities in Third Round and Beyond. Memorandum to the California Board for Energy Efficiency from Ralph Prahl and Jeff Schlegel, Technical Services Consultants to the CBEE. April 5, 1999.

MA&E managers should also solicit the input of those who implement and plan efficiency programs to determine whether there are any closely-related research need of these parties that can be met while collecting baseline data for evaluation purposes.

- ***Some of the needs for which recommendations have been made will be filled by studies that are just being completed or for which scopes of work are now being specified as part of the CBEE's first- and second-round MA&E studies, including the Residential and Non-Residential Efficiency Market Share Studies***. Although we provide some explicit cross references to the Market Share Studies in our recommendations, the scope of this project does not include a comprehensive integration of recommendations between the two studies. Determining the extent to which the Market Share Studies can help to meet some of the baseline needs identified in this study is a detailed project development and specification function that is outside of the scope of this report. We again recommend that these coordination and integration tasks be carried out by MA&E project managers under the emerging system of long-term assignments for state-level MA&E activities mentioned above.
- ***Recommendations for further research are presented in two broad groups: those that cut across energy-efficiency markets and those that are specific to energy-efficiency markets***. The market-specific recommendations are presented first, followed by the recommendations that cut across market areas.

In Table 4-1, we present an overall summary of the relative priority of each baseline research needs for each topical area. The first two columns of the table summarize our assessment of the adequacy of current baseline sources. The assessment in the first column is based on our review of studies completed before the end of 1998. The assessment in the second column is a preliminary and rough estimate of the extent to which we think gaps would remain after completion of the CBEE's first five 1998 statewide MA&E studies and its 11 second-round MA&E studies slated for 1999. This is obviously only a rough estimate because the scopes of work for the second round of 11 studies have not yet been completed. The third column summarizes, on a simple relative basis, the statewide funding levels for PY99 in terms of the percent of total statewide funding associated with each efficiency market. We utilized "N/A" (not available) for budget levels for the efficiency markets for which statewide funding levels are not available. The final column in the table provides our assessment of the overall priority of each research area. This overall priority combines the extent to which baseline gaps exist with the relative importance of the area (using PY99 funding as the importance proxy).

Judgmental assessments were required for the *Extent of Gaps in Baseline Information* and *Overall Priority* columns of Table 4-1. The judgments on the *Extent of Gaps in Baseline Information* column are based on the results of the gap analysis documented in Section 3. The gap analysis was structured around whether or not existing sources would adequately meet the baseline data needs that we *anticipated* future market effects evaluation studies would require to comprehensively assess whether changes in each market had occurred as a result of efficiency program interventions. Within the context of the current study, we could only anticipate these future evaluation needs because during the course of this study the PY99 efficiency programs

Table 4-1
Overall Recommendation Summary

Area	Topic/Market	Extent of Gaps in Baseline Information		Relative PY99 Funding Levels[3]	Overall Priority of New Baseline Research[4]
		Current Assessment[1]	After Current and Currently Planned MA&E Projects[2]		
Residential	HVAC	Med.	Low	Low (4%)	Low
	Lighting	Med.	Low	Med. (5%)	Low
	Appliances	Med.	Med.	High (13%)	Med.
	Shell	Med.	Med.	N/A - *Low*	Low
	Renovation	High	High	High (14%)	**High**
Non-Residential	HVAC	Med.	Med.	Med. (7%)	Med.
	Lighting	Low	Low	N/A - *High*	Med.
	Motors	Med.	Med.	Low. (2%)	Low
	Refrigeration	Med.	Med.	N/A - *Low.*	Low
	Office Equipment	High	High	N/A - *Low*	Low
	Compressed Air	High	High	N/A - *Med*	Med.
	Shell	Med.	Med.	N/A - *Low*	Low
	Process	High	High	Med. (6%)	**High**
	Retrofit	High	Low	High (31%)	Med.
	Remodel/Renovation	High	Med.	Med. (5%)	Med.
New Construction	Residential	Med.	Low	Med. (6%)	Low
	Commercial	Med.	Med.	Med. (6%)	Med.
	Industrial	High	High	Low (1%)	Low
	Agricultural	High	High	Low (<1%)	Low
Cross-Cutting	Supply Side	N/A	N/A	N/A	**High**
	End User	N/A	N/A	N/A	**High**
	Assess Potential	High	High	N/A	Med.
	Measure Costs	Med.	Med.	N/A	Med.
	Integrate Existing Sources	N/A	N/A	N/A	Med.

[1] This assessment is based on our review of studies completed before the end of 1998.

[2] This assessment is a an estimate of the extent to which gaps will remain after completion of the CBEE's first five 1998 statewide MA&E studies and its 11 second-round MA&E studies slated for 1999.

[3] This assessment is based on the statewide funding levels for PY99. The percent of total PY99 associated with each market is shown in parentheses. For markets that are not broken out in available statewide figures, we denote "N/A" and have estimated the importance level based on our judgment of expenditures from past program years. These estimated importance levels are shown in italics.

[4] This assessment of the overall priority of each research area takes into account the extent to which gaps remain after current and currently planned MA&E studies and the relative importance (in terms of funding) of each area.

were not fully developed. In addition, to have made our assessment at the level of detail required for actual market effects studies of each program in the portfolio, or each efficiency market affected, would have required several times the resources that were allocated to this study. As

mentioned above, the assessments in the Overall Priority column are based on combining the extent to which baseline gaps exist (based on the *After Current and Currently Planned MA&E Projects* sub column) with the relative importance of the area (based on PY99 funding).

The following sections summarize the research recommendations for the 19 markets identified in Sections 2 and 3 of this report. Our recommendations were developed by focusing on the specific baseline data requirements of each market independently. We then identified overlaps between the individual market recommendations and, as appropriate, eliminated this duplication through project recommendations presented under the Cross-Cutting Research Needs section (Section 4.5). A critical step in the process of identifying research needs was to analyze the strengths and weaknesses of the existing sources. These strengths and weaknesses are summarized in Section 3 of this report and in the detailed market-by-market assessments provided in Appendix B.

4.2 RESIDENTIAL BASELINE RESEARCH NEEDS

Baseline data research recommendations for the residential sector are discussed in detail for the five efficiency markets in the subsections that follow.

4.2.1 Residential HVAC

Useful information is available on the gas furnace markets. However, this information is available primarily from a new construction perspective and is utility specific. There currently is no comprehensive source of statewide baseline data on the residential HVAC market. Baseline data on market functioning is particularly limited on market barriers, market linkages, and leverage points. Additionally, there is little information in the retrofit market for HVAC contractors and retailers or on products and services. Market actor data on end-user and supplier awareness, knowledge, and decision making also is limited. Note that a portion of the needs addressed by the recommendations made below may be met by the *Residential Contractor Initiatives* evaluation study included in the CBEE's second round of MA&E studies for 1999.

Research Project Recommendations:

1. Conduct statewide study of the market for residential HVAC equipment and heating and cooling distribution systems. Develop explicit market indicators for measuring effects over time and ensure that comprehensive first-year measurement occurs.

   a) Characterize consumer attitudes, awareness levels, knowledge, barriers, and decision-making processes and criteria. Expand gas heating market information for areas other than SCG and SDG&E. Emphasize information collection for product retrofits including air conditioning, furnaces, and duct services.

   b) Conduct analysis of HVAC and envelope weatherization contractor market. Target certification, specifically contractor interest, consumer perceptions/attitudes, and consumer equipment decision-making process. Focus on service provider receptivity to training and certification and potential market impacts. For comparative purposes, identify, characterize, and assess the penetration and role of non-energy certification services, both

public and private (e.g., ValueStar). Quantify key market structure and functioning characteristics such as supply-side product flows and information channels. Contractor samples should be large enough to draw reliable statistical inferences.

2. Develop thorough baseline market information on HVAC and other residential contractors emphasizing all categories of baseline market characteristics (structure/functioning, products/services, and actor characteristics).

3. Monitor research activities in support of the national residential HVAC standards upgrade program and the Energy Star program and investigate benefits and costs of coordinating baseline market research efforts with these national efforts.

4.2.2 Residential Lighting

The residential lighting end-use program area comprises 14% of the statewide residential budget in 1999. Baseline data on residential lighting is particularly strong for CFLs. Most data sources on CFLs are relatively recent (1997-1998). A weakness in this baseline data is that the data sources are not statewide. Additionally, data on market characterization is inadequate for both the demand and supply sides. There is little information on consumer decision-making, attitudes and behavior at a statewide level (though information is available for the PG&E and SDG&E service territories). With the exception of data on CFLs, baseline saturation data is limited. Note that a portion of the needs addressed by the recommendations made below may be met by the *Statewide Residential Lighting and Appliance Programs* evaluation study included in the CBEE's second round of MA&E studies for 1999.

Research Project Recommendations:

1. Further develop equipment saturation, energy consumption, and supply-side baselines. Address upstream supply-side market actor issues for a wide variety of lighting technologies (CFLs, torchieres, hard-wired fixtures, etc.).

   a) Also (or as part of a separate study), conduct more in-depth, statewide research in the area of retail market dynamics (earlier studies did not go far enough in this area and were not conducted on a statewide basis). For example, more information is needed on a statewide/regional basis on why certain market barriers still exist for high efficiency lighting (e.g., why aren't CFLs sold in drug stores?) and on how the programs should intervene to reduce these retail-level market barriers in a way that is consistent with the objectives of market transformation.

   b) Continue working with manufacturers and major suppliers to further assess attribution issues and to monitor changes in production and sales trends. Coordinate with EPA's evaluation of the Energy Star program; complete assessment of Energy Star in California.

4.2.3 Residential Appliances

The residential appliance end-use market program area currently comprises approximately 36% of the statewide residential budget. Statewide baseline data on refrigerators includes market

structure/functioning and supply-side information. Clothes washer market structure/functioning and supply-side information is available, but from studies conducted in other regions (primarily in the Northwest). Market characterizations are inadequate for appliances other than refrigerators on both the demand and supply sides. The baseline saturation data from the RASS studies includes data on refrigerators, second refrigerators, freezers, dishwashers, clothes washers and room air conditioners but does not adequately characterize efficiency levels. In addition, this data is limited in that it is consistently current and is not statewide. Once again, a portion of the needs addressed by the recommendations made below may be met by the *Statewide Residential Lighting and Appliance Programs* evaluation study included in the CBEE's second round of MA&E studies for 1999.

Research Project Recommendations:

1. Conduct statewide study of supply side and consumer baseline market characteristics for appliances *other than refrigerators*. Focus on developing baseline data on attitudes, awareness, knowledge, behavior, market barriers, distribution channels, and product and services. Develop baseline data on manufacturers, distributors and dealers including data on the number of supply side firms offering efficient options, equipment stocking and ordering practices, and marketing and advertising strategies. Beyond documenting how the current market is characterized and organized, it is critical to also explore how best to go about leveraging program dollars to initiate and sustain desired market effects.

   a) Coordinate efforts as appropriate with national/regional Energy Star market studies.

   b) Build upon the information developed in the refrigerator market evaluation studies and expand information on market characteristics for other appliances that are included in the program initiatives (e.g., clothes washers).

2. Consider market baseline, characterization study of fuel switching applications (e.g., electric versus gas clothes dryers, stoves ,and water heaters).

4.2.4 Residential Building Shell

Existing data on the residential building shell end-use market is strong for the windows market in the PG&E service territory and for building shell measures in the new construction market statewide. Market characterization of the retrofit building shell market is more limited for both the demand and supply sides, particularly for windows. Data sources are inconsistent statewide.

Research Project Recommendations:

Note that some or all of the following recommendations could be coordinated or integrated with those under the Residential HVAC market and may be addressed by the *Residential Contractor Initiatives* evaluation study included in the CBEE's second round of MA&E studies for 1999.

1. Collect information on building shell market characteristics (i.e., structure/functioning, products/services, actor characteristics).

a) Develop baseline data on consumer information channels, decision-making, attitudes, and awareness about energy efficiency as it specifically relates to building shell measures.

b) Develop baseline efficiency data on building shell measures, including but perhaps not limited to major insulation upgrades (ceiling, wall, floor), windows, and minor insulation and seal-up measures (weatherstripping, caulking). *[This need is likely to be met under the Residential Efficient Market Share Tracking Project.]*

c) Expand building shell market information for areas other than windows in the PG&E territory, new construction generally, and southern California.

d) Characterize residential retrofit/renovation issues and processes. Coordinate with renovation market studies.

4.2.5 Residential Renovation

The lack of baseline data in this program area appears to be a large weakness given the relative importance of the residential renovation market in the statewide budget. There currently is no source of statewide baseline data on the residential renovation market. Data strengths include information on the windows market in the PG&E service territory. Gaps exist in data which characterize the residential renovation market—both from the demand and supply-side perspectives. With the exception of baseline data on windows, there are no penetration data on other energy-efficiency measures in renovation projects.

Research Project Recommendations:

Renovation research can be addressed via independent studies or integrated with other residential research efforts. If integrated within other studies, care must be take to ensure that the unique issues, opportunities, and barriers associated with renovation and remodeling are adequately addressed via sample stratification or other means that result in the ability to make reliable statistical inferences associated with this critical market event.

1. Conduct one study or a coordinated group of studies of the residential retrofit/renovation market for relevant energy efficiency products and services (e.g., HVAC equipment, heating and cooling distribution systems, and building shell upgrades).

   a) Develop thorough baseline information on renovation market characteristics (i.e., structure/functioning, products/services, actor characteristics). Quantify volume and type of remodeling activities generally. Identify and quantify key customer and supply-side segments.

   b) Develop baseline information on consumer information channels, decision making, attitudes, and awareness about energy efficiency as it applies to renovation projects.

   c) Characterize renovation issues and processes (by market segment).

   d) Characterize consumer attitudes, awareness, barriers, and decision-making (by market segment).

e) Characterize supply-side actors' characteristics, attitudes, awareness, barriers, and marketing strategies.

4.3 NON-RESIDENTIAL BASELINE RESEARCH NEEDS

Baseline data research recommendations for the non-residential sector are discussed in detail for the ten efficiency markets in the subsections that follow.

4.3.1 Non-Residential HVAC

The non-residential HVAC market represents 13% of the statewide non-residential budget. The most complete source of information is for PG&E's territory and covers packaged air conditioners only. This study has comprehensive data on schools, universities, hospitals, and offices. It includes data on market barriers, distribution channels, and information channels. However, comprehensive statewide baseline data is extremely limited for the non-residential HVAC market.

Research Project Recommendations:

1. Conduct statewide study of supply side baseline market characteristics for products and services. Target filling in information pertaining to poorly covered areas such as decision making associated with emergency replacement, turnover, remodeling, and renovation.
   a) Focus on expanding the information available on supply-side actors statewide.
   b) Characterize turnover event issues and process.
   c) Characterize remodeling/renovation issues and process.
2. Develop thorough baseline market information on HVAC distributors, contractors, and designers emphasizing all categories of baseline market characteristics (structure/functioning, products/services, actor characteristics).

4.3.2 Non-Residential Lighting

Lighting is a major component of several non-residential programs planned for 1999 and beyond. Baseline data on market structure and functioning, particularly on market barriers, linkages and distribution channels, is strong. Information on products and services is also strong and includes data on penetration of high-efficiency lighting technologies. Gaps exist for data on lighting in the industrial sector and on integrated design and installation practices. Additionally, data on the following specific lighting technologies is lacking: occupancy sensors, HID, exit signs, T-5 fluorescent technology, LED traffic signals, outdoor lighting, and daylighting.

Research Project Recommendations:

1. Fill out existing end user baseline data in the following areas:.
   a) Integrate existing sources of CEUS data.
   b) Expand upon industrial lighting baseline data.

c) Focus on and continue monitoring baseline indicators in the small non-residential market.

d) Develop indicators on selected non-T8/electronic ballast technologies and integrated design practices.

e) Consider expanding current baseline indicators on T8s and electronic ballasts to include the SCE territory.

f) Track market penetration of different lighting technologies (especially in the small C&I market). *[This need is likely to be met under the Nonresidential Efficient Market Share Tracking Project.]*

2. Characterize the supply side of the non-T8/electronic ballast lighting markets. Expand the information available on supply-side actors including data on design criteria and practices. Include data on number of firms promoting energy efficiency design as component of services and number of owners/developers offering energy efficiency warranties to tenants.

4.3.3 Non-Residential Motors

The Non-Residential Motor Turnover Program represents approximately 4% of the statewide budget in 1999. The objective of the program is to transform the replacement market for existing motors. It targets intervention strategies at manufacturers, distributors, vendors and end-users to stimulate demand and supply for premium efficiency motors, pumps, fans, high-efficiency motor controls and optimal motor sizing and application. Some baseline data on energy efficiency levels, energy usage, and efficiency of replacement equipment is available. Several sources provide information on market structure and functioning. The major gaps and weaknesses are a lack of a consolidated statewide database regarding the motors market and limited understanding of how to reduce barriers. There is limited data on turnover of high efficiency pumps and fans.

Research Project Recommendations:

1. Consolidate baseline data from existing sources. Leverage and build off data from Sources 930 and 1210 and explore statewide integration of the CEUS data. High priority motor baseline issues include:

   a) better understanding of market leverage points and mechanisms for reducing barriers and increasing penetration;

   b) awareness and attitudes of market participants toward premium efficiency equipment;

   c) level of penetration of premium efficiency equipment, ASD controls, sizing and installation practices; supplemental controls or compliance with sizing/installation protocols;

   d) unsettled aspects of premium efficiency products (above EPACT), especially pricing of motors and product line (manufacturers are juggling product lines and prices, one influential manufacturer currently maintains a much higher than industry average price differential for premium motor line);

   e) end users' self-reports of policies to use high-efficiency motors may be overstated, so focus on better corroboration of such policies;

f) number of engineers, vendors, and contractors offering optimal sizing and installation services in their scope of services; and

g) supply-side stocking policies and marketing strategies.

2. Characterize motor turnover events and practices focusing on the following three opportunity segments: 1) premium efficiency motors, 2) efficient pumps and fans, and 3) optimized motor system sizing and design.

3. Develop baseline data on linkage and promotion of DOE, CEE, NEEP, EPA, and other product labeling and certification programs including DOE's Motor Challenge Program. Specifically, leverage and expand upon DOE's Motor Challenge on-site data collection methods and efforts.

4.3.4 Non-Residential Refrigeration

Existing baseline data on the non-residential refrigeration end-use market is comprehensive for the supermarket industry. Baseline information on this sector includes data on market penetration of high efficiency refrigeration equipment, market barriers, distribution channels and information channels. However, this data is limited in that it is not statewide. Other data gaps and weaknesses include a lack of data on the supply-side of the refrigeration market in industries other than supermarkets. Good supermarket refrigeration data are available on measure penetration, market barriers, distribution channels, information channels, and market actors; but only for one utility. Industrial baseline data is only available for SCE's territory. The CEUS and industrial data on refrigeration is limited.

Research Project Recommendations:

1. Determine the structure, market actors, and product offerings for refrigeration modifications in businesses beyond supermarkets (such as convenience stores or warehouses). Emphasize baseline information for small commercial end-users and collect information needed to refine small commercial programs.

2. Leverage existing CEUS data to develop a statewide inventory of refrigeration equipment and efficiency baselines. Current data is limited to equipment inventories. Expand coverage to incorporate market actor information and customer behaviors.

4.3.5 Non-Residential Office Equipment

Non-residential office equipment is not broken out as a component of program funding in 1999. With the exception of limited data from the CEUS sources, very little baseline data exist on office equipment. There is no source which compiles information specifically on office equipment with the exception of a pending EPA study ,which is national in scope. Supply-side characterization and baseline data is lacking, particularly data on firmographics, availability and characterization of high efficiency products, stocking practices, and sales. There is a significant gap in baseline data regarding end-user and supply side actor behavior and decision making criteria pertaining to the office equipment market; specifically data on market barriers, distribution channels and linkages is lacking.

Research Project Recommendations:

None.

4.3.6 Non-Residential Compressed Air

The best source of information on the non-residential compressed air end-use market is national in scope and is somewhat dated. It provides data on market structure, function ,and products and services. The data is particularly strong for distribution channels, market barriers, linkages, end-user and supplier behavior and energy efficiency opportunities. Data is available on energy usage of air compressors by size, type, market and segment. Additionally, this source provides data on sales volume and marketing information for a range of equipment types and sizes. A mini-study on air compressor vendors and their service offerings provides useful baseline data on vendor barriers, behaviors, and leverage points. However, this study is limited in that it provides data only for PG&E's territory. The main weakness is that there is very little baseline data to support a market characterization study of the compressed air market in California. The CEUS and IEUS data is not statewide and provides limited inventory data on compressed air equipment.

Research Project Recommendations:

1. Conduct a statewide study of baseline market characteristics for compressed air.
   a) Develop more information on industrial decision making processes and barriers to compressed air system optimization.
   b) Determine the structure, market actors, and product offerings for compressed air system maintenance, modification, and replacement.
   c) Quantify the penetration of efficiently optimized systems.
   d) Supplement existing saturation information with broad studies in other geographic areas.

4.3.7 Non-Residential Building Shell

The main source of baseline data for the non-residential building shell market is the CEUS data. CEUS data includes information on building specifications of exterior walls, roof/ceiling types, floor types, and glazing types. Baseline data is available on roof insulation, ceiling insulation, wall insulation, window treatment and weather stripping. Data weaknesses include information on market structure and functioning, market actors, and products and services. Supply-side characterization and baseline data is lacking, particularly data on products and services, distribution channels, linkages, and leverages.

Research Project Recommendations:

None.

4.3.8 Non-Residential Process

There are only two comprehensive market transformation-related studies in the process end-use market that are focused on agricultural and water supply pumping and on process pumping. Although limited in scope, these studies provide useful data on market actors, barriers, consumer awareness, and decision making. Industrial impact evaluations provide detailed case studies of gross and net impacts for a variety of process measures. The process pumping study provides national data on process equipment in the petroleum, chemical, and pulp and paper industries. It also covers non-HVAC fan blower systems. The IEUS data provides a generalized inventory of process equipment in SCE's territory. Therefore, statewide baseline data on the process market is quite limited and could be supplemented by additional research in this area.

Research Project Recommendations:

1. Develop better understanding of industrial decision making processes and barriers to process optimization. Characterize role of energy efficiency with end users process-related decision making structure.
2. Identify a limited set of high-potential process efficiency improvements upon which to focus. Explore opportunities that leverage or complement non-energy process benefits such as production expansion and environmental compliance.
3. Quantify naturally-occurring rates of process efficiency improvements.
4. Supplement existing SCE industrial saturation information with broad studies in other geographic areas. Current data is limited to equipment inventories. Expand coverage to incorporate market actor information, end user behavior and turnover event issues. Focus on determining energy usage and efficiency levels as well as actor behavior with respect to process improvements.

4.3.9 Non-Residential Comprehensive Retrofit

The Non-Residential Comprehensive Retrofit Program accounts for 61% of the statewide non-residential budget. This budget is relatively evenly split between the large and small non-residential programs. Given the importance of this program area, baseline tracking activities should be focused on providing adequate tracking of all key market indicators in this market. To date, there has been no market characterization study of the non-residential comprehensive retrofit market. There is a significant amount of overlap between this program and the other identified non-residential end-use markets. Therefore, baseline data on related end-uses will be very useful in characterizing this market. Nonetheless, there are significant gaps in baseline data which characterize the comprehensive retrofit market. Most notable are gaps in data regarding integrated design practices. Data on distribution channels, market barriers, linkages and leverages specifically pertaining to comprehensive retrofits is lacking. Data on optimal sizing of equipment and installation practices is also lacking. There are gaps in supply side data as previously identified, behavior and products and services. CEUS data from the pre-program period (pre-1998) could be valuable as an on-site based measure penetration baseline with which future surveys can be compared. The Nonresidential Market Share Tracking Study should provide

needed ongoing efficient market share data. The recommendations below may be addressed by two CBEE MA&E studies planned for 1999: the *Follow-Up Evaluation of Large SPC* and the *Support of Marketing Efforts Targeting Small C&I Customers*.

Research Project Recommendations:

1. Continue statewide studies to characterize the non-residential comprehensive retrofit market. Research efforts for the non-residential comprehensive retrofit program should be carefully coordinated with research efforts targeted to specific end-uses.
   a) Target information supporting the Small NSPC program.
   b) Build upon the information developed in the NSPC evaluation.
   c) Include data on planned retirement of equipment or planned overhauls.
   d) Characterize turnover issues and processes.
2. The 1998 NSPC Evaluation did not include supply-side actors other than energy-efficiency service providers (which were mostly ESCOs in the 1998 program). A more comprehensive supply-side baseline is needed for this and all non-residential programs. These needs may be best addressed through the cross-cutting supply-side research discussed in Section 4.5.
3. If statewide supply-side baselines are not conducted, integrate relevant baseline data from existing studies, e.g.,
   a) Build upon available motors and compressed air market information from national studies.
   b) Build upon available single-territory HVAC market characterization.
   c) Build upon available single-territory supermarket refrigeration study information.
   d) Build upon extensive available lighting market information developed for PG&E/SDG&E. Fill out technology gaps (e.g., CFLs, T5s, HID, controls).

4.3.10 Non-Residential Remodeling/Renovation

The major gaps and weaknesses are a shortage of information on the market characteristics of the non-residential remodeling/renovation market. There are gaps in data regarding consumer decision making criteria related to decisions to remodel/renovate. Additionally, there are gaps in data regarding supply side actor behavior and products and services. The recommendations below may be addressed by the *Support of Non-Residential Remodeling and Renovation Program* evaluation study included in the CBEE's second round of MA&E studies for 1999.

Research Project Recommendations:

1. Fully characterize the non-residential remodeling/renovation market, identify indicators for evaluating market effects and implement baseline measurements. Build upon existing end-use sources and characterize, at a minimum, the following:
   a) Renovation and remodeling (R&R) rates by segment

b) Key decision-making steps in the R&R process

c) Relative role and importance of energy efficiency in R&R decision-making processes

d) Roles of different market actors in the design and decision-making processes

e) Energy-efficiency penetration rates in R&R activities

f) Unique barriers and opportunities associated with R&R

g) Integrated lighting design practices

4.4 BASELINE RESEARCH NEEDS FOR NEW CONSTRUCTION

Baseline data research recommendations for new construction are discussed in detail for the four efficiency markets in the subsections that follow.

4.4.1 Residential New Construction

The baseline data on the residential new construction market is strong relative to other end-use markets. Baseline efficiency data are fairly complete. Baseline data on gas heating and water heating is particularly strong. Data on duct characteristics is also fairly complete. Baseline data on products, market structure/functioning and market actors are fairly complete for windows in one service territory. Additionally, the data on construction and equipment characteristics for new homes are good in some geographic areas. However, the data sources are for specific geographic areas so statewide information is not complete. Comprehensive information is only available for certain products such as windows and gas heating equipment. Market actor information is limited for both the demand and supply sides. There is very little baseline information in compiled studies on codes and standards (i.e. data on code enforcement and compliance is lacking). In addition, there is no information on the California manufactured housing market. The recommendations below may be addressed by the *Support of Codes and Standards and Local Government Initiatives Program* and *Support of Residential and Non-Residential New Construction Programs* evaluation studies included in the CBEE's second round of MA&E studies for 1999.

Research Project Recommendations:

1. Conduct statewide baseline study of role of local government in code implementation and enforcement. Identify and review past energy code program evaluations for California and other states having strict energy codes. Build upon available information in these studies on local code official practices, enforcement barriers, and motivations. Include consumer, builder, and product and equipment supplier perspectives on role of codes in new home energy efficiency.
2. Conduct limited study of northern California market of both demand- and supply-side baseline market characteristics for new residential construction to supplement Source 170 for southern California new homes market (note that a closely related study has just been started by PG&E).
   a) Enhance information on market structure and functioning, market actors and for products and components of new residential buildings.

b) Develop baseline data on consumer attitudes, awareness, and decision-making regarding energy efficiency in new homes. The consumer role currently is relatively small in the new homes market.

c) Further assess completeness of available residential baseline information on gas space and water heating and build upon information for these technologies. Emphasize additional baseline data collection on products other than gas space and water heating.

2. Conduct baseline study of manufactured housing market in California including home buyers, home manufacturers, product suppliers, and role of codes and government. Review and extract relevant information from Pacific Northwest studies.

3. Collect baseline information on building starts, enforcement practices and barriers, compliance verification, code awareness, and attitudes. Focus on code officials and local government administrators. Identify and target representative local jurisdiction "market segment."

4.4.2 Commercial New Construction

The current CBEE baseline study is consolidating existing data sources to provide statewide data. This study covers major commercial building types and will provide market structure, barriers, actor and product information. The lighting market in new buildings is well defined by an existing market effects study. Additionally, data on leverage points in the commercial new construction market is provided in the PG&E Energy Center study. However, the current baseline study is limited in that it does not include several commercial building types and some of the data are dated (e.g., 1994-96 vintage). Additionally, there is no data available on relocatable classrooms. Similar to the residential sector, there is very little baseline data on codes and standards. The recommendations below may be addressed by the *Support of Codes and Standards and Local Government Initiatives Program* and *Support of Residential and Non-Residential New Construction Programs* evaluation studies included in the CBEE's second round of MA&E studies for 1999.

Research Project Recommendations:

1. Continue focus on current baseline study being sure to adequately deal with geographic gaps that have been identified. Additionally, assess the importance of all commercial business types to determine if additional areas should be covered in conjunction with the ongoing baseline study that has targeted offices, retail, schools, and public assembly.

2. Conduct a small study on relocatable classrooms to determine the market actors, structure, products and leverage points for transforming the market. Include baseline information on code issues and local government involvement.

3. Conduct a state-wide assessment of the role local governments play in supporting Title 24. Gather data on the market actors and structure to determine how codes are enforced from the planning phase of a project through actual completion. Collect baseline attitudinal, market barrier, and decision-making information on non-residential building sector actors and code officials to help predict response to new code.

4. Collect baseline information on building starts, enforcement practices and barriers, compliance verification, code awareness, and attitudes. Focus on code officials and local government administrators.

4.4.3 Industrial New Construction

There is no apparent baseline data on the industrial new construction market. Additionally, there is very little baseline information in compiled studies on codes and standards.

Research Project Recommendations:

1. Conduct a state-wide study of industrial new construction to define the actors, market structure, functioning, leverage points and products. Review information provided by recent CADMAC market effects studies on non-residential new construction and utilize relevant information.

4.4.4 Agricultural New Construction

There is no baseline data on the agricultural new construction market. Additionally, there is very little baseline information in compiled studies on codes and standards.

Research Project Recommendations:

1. If justifiable, conduct a state-wide study of agricultural new construction to define the actors, market structure, functioning, leverage points and products.

4.5 CROSS-CUTTING BASELINE RESEARCH NEEDS

Having presented the recommended baseline research recommendations for the 19 efficiency markets, we now discuss some of the important baseline needs that cut across them. These recommendations result from underlying gaps and weaknesses in baseline data that cut across multiple energy-efficiency markets. There are several criteria that we considered with respect to determining whether an activity is discussed under this cross-cutting category. These criteria are that activity would produce data that would meet identified needs in multiple markets, that conducting the activity across markets would result in substantial economies of scale, or that conducting the activity would reduce over-surveying of small populations of targeted respondents. Based on these criteria, there are several important baseline research needs that we believe apply to multiple markets. The cross-cutting research needs we have identified fall into the following principal areas, which are discussed in turn:

- Supply-Side Needs
- End-User Needs
- Assessment and Tracking of Market Transformation Potential
- Measure Costs

- Integration of Existing Sources

4.5.1 Supply-Side Needs

Our review of existing sources indicates that current processes of developing comprehensive, statistically reliable supply-side data are generally weak. There are several problems with the way in which supply-side data have been collected to date, including the following:

- ***Supply-side population frames are problematic at best, and commonly are not utilized at all***. Existing sources of supply-side data, such as D&B's MarketPlace database are very inaccurate at the 6- and 8-digit SIC levels, which are usually the levels required to identify the specific market actors of interest (for example, SIC 5603-04 *is supposed to be* Electrical apparatus and equipment - lighting fixtures*;* SIC 8711-9906 *is supposed to be* Energy conservation engineering).
- ***Most of the studies conducted to date have used relatively small sample sizes of supply-side interviews***. This has resulted in limited or nonexistent statistical precision.
- ***Partly because of inadequate samples, most studies have not attempted to segment supply-side actors*** based on the end-use markets that they serve (e.g., small versus large customers) or their types of business (niche local players versus national vertically integrated organizations).
- ***A number of currently planned studies must address multiple end-use markets; however, experience shows that studies of moderate scope that cover multiple end-use markets typically result in too much dilution*** in the number and type of supply-side data collected. The result is often *broad but shallow* results inadequate for quantitative baseline development, market characterization, and the drawing of statistical inferences.
- ***Finally, many supply-side markets are characterized by small populations of interest, which can lead to increased non-response if actors are over-surveyed***. For example, three manufacturers dominate the fluorescent tube market, less than 50 distributors handle the bulk of the California packaged HVAC market, and the entire ESCO industry is only on the order of several dozen firms. Thus, as surveying of supply-side actors continues to increase, there is a significant risk of individual actors being besieged by surveyors acting independently across multiple projects. Such a trend can lead to increases in survey non-response, which can potentially bias results.

There are two recommendations that we believe arise from the observations above:

1. ***Conduct a scoping study of supply-side data collection issues focused on determining the optimal approach to developing more homogenous and statistically reliable sample frames***. Such a study should compare existing sources, such as D&B, utility SIC codes, industry-specific membership lists, etc., and determine their relative level of adequacy. The study should also investigate whether any new approaches to creating supply-side sample frames should be implemented expressly for the purpose of meeting the statewide MA&E needs for measuring supply-side market indicators over time.

2. ***Consider organizing baseline data collection by supply-side, end-use market***. The current problem is that if supply-side data collection is diffused across multiple projects that have competing research priorities, it is unlikely that adequate baselines will be developed for any key end-use markets. If each project attempts to collect supply-side baseline and market characterization data across multiple end-use markets, the result is likely to be a set of studies with anecdotally interesting results, but no comprehensive supply-side baseline data sets. Note that within the CADMAC market effects studies there were some excellent examples of what could be done in projects organized around high-priority efficiency markets such as lighting and HVAC.

   Obviously, a challenge to organizing supply-side baseline data collection around end-use markets is that such projects would require close coordination between a number of MA&E project managers and program implementation managers to ensure that the information collected can be used for multiple program evaluations. The advantage of scoping some baseline projects in this way is that it is much more likely that the major supply-side markets of interest will be comprehensively characterized with a level of rigor commensurate with what is expected on the demand side. Any such studies should be carried out statewide to parallel current statewide end-user surveys.

4.5.2 End-User Needs

Extensive surveying of end users has been conducted in California over the past decade as part of impact evaluations, traditional RASS and CEUS studies, and, more recently, baseline and market effects studies. In addition, the last two years have seen an increase in energy-related surveys conducted by private sector actors because of the State's restructuring activities. Below are a few observations on end user surveying and analysis related to baseline information in the context of this study:

- ***The last two years have seen the birth of a new set of studies that have attempted to identify and measure market barriers***. ***Much has been learned from these studies but they have suffered from several constraints.*** Although much progress has been made in identifying, understanding, and measuring market barriers, most studies to date have attempted to analyze market barriers while at the same time meeting a host of other research objectives, such as measurement of other baseline indicators, development of market characterizations, and measurement of market effects. The result has been a wide mix of findings, continued limitations around some key barriers, and an inadequate resolution of several barrier-related measurement issues.
- ***Despite the fact that tens of thousands of energy-related surveys are conducted every few years in California, over-surveying of individual sample targets is not an issue for most groups, with the notable exception of the largest non-residential customers.*** The residential sector with close to nine million customers in the three IOUs service territories provides a sampling pool in which few potential respondents are likely to receive multiple survey attempts. The same is also generally true for small and medium commercial customers, which have populations of accounts of roughly one million (<20 kW) and two

hundred thousand (20 to 100 kW), respectively. The situation begins to change, however, for the over 500 kW group, which is comprised of just several thousand accounts. When the very largest size strata is pulled out, for example the 500 customers that make up 15 percent of total non-residential usage, the potential for over-surveying and response bias increases dramatically.

Given that typical sample dispositions often show that five or more customers must be contacted per survey actually completed, a pool of 500 customers can be contacted *as a census* in a single study targeting a sample size of 50 to 100 of the largest users. It is clear that across multiple studies, including those conducted by private entities seeking market research around the choice of electricity providers made by this group (approximately 30 percent of whom have switched providers), this group of customers typically receives *several requests* to participate in energy-related surveys *per year*.

Based on these observations and other considerations, we provide several recommendations for consideration below:

- ***Continue development and exploration of more advanced methods for identifying and analyzing barriers and related customer needs***. As identified in the CADMAC Summary Study, several techniques and approaches were explored within some of CADMAC's fifteen market effects studies conducted between 1996 and 1998. Some of the techniques and approaches included factor analysis, structural equation modeling, and the use of diffusion of innovation as an organizing framework. Unfortunately, these methods did not often eventuate in completely satisfactory and convincing results. This was likely because of several factors. For example, these studies were first attempts at some of these methods, the researchers were faced with multiple project objectives, and time and resources were limited. Before drawing final conclusions on the merits of the techniques employed in the first 15 studies, as well as additional techniques, consideration should be given to conducting a research project or set of projects that are focused exclusively on systematically conducting and assessing new techniques. This work could be done using a combination of existing data sources, leveraging data collection efforts on other projects, or through unique data collection efforts.
- ***Formalize coordination between studies that wish to survey the largest end users and integrate needs as much as possible.*** The fact that the largest 500 or so customers make up approximately 15 percent of the non-residential energy usage indicates that continuing to understand and track the efficiency-related actions and attitudes of this market segment will be important. To do so, and to maintain credibility with this highly sensitive and sometimes critical group, it will be more and more important that utilities, regulators, the CBEE, the CEC, and other stakeholders work together to coordinate research activities that require the cooperation and participation of the largest non-residential customers. Concerted efforts should be made to meet multiple research needs with as few contacts as possible with this group.

- ***Conduct a study focused on better understanding barriers associated with non-residential customers' decision-making processes and organizational structures; particularly, the organizational practices and bounded rationality barriers***. To date, organizational practices and bounded rationality have been described in fairly generic, catch-all types of phrases. This reflects a lack of understanding about the specific manifestations of these barriers with non-residential customers' organizations. In particular, some aspects of these barriers lend themselves less to quantitative scoring and require, instead, in-depth interviews by trained professionals (i.e., they do not lend themselves to exploration through close-ended surveys conducted by phone-house level personnel).

  We propose consideration of a study that would focus on medium and large customers that would consist of in-depth interviews with *multiple decision-makers within the same organization*. The unique aspect of this study would be on the structured inclusion of multiple decision makers in the same organization who often have conflicting and competing needs and wants that affect energy-efficiency related decisions. These decision makers would be drawn from different levels and different departments based on their roles in energy and closely related decision-making processes. The study would seek to more explicitly characterize the specific types of organizational barriers to energy efficiency that exist with organizations. Results should be presented through both case studies (as part of an initial scoping analysis) and quantitative analyses. Interviews should be conducted with 50 to 100 unique organizations within a set of predetermined market segments.

4.5.3 Assessment and Tracking of Market Transformation Potential

In the late 1980s and early 1990s, a number of studies were conducted by California utilities that produced quantitative estimates of the technical, economic, achievable, and market potential of energy efficiency. These studies were conducted within the DSM resource acquisition policy framework of the time. The studies provided detailed estimates of the potential for savings for individual measures by market segment and over time. These estimates were used by program planners to help identify and prioritize program efforts aimed at capturing cost-effective DSM savings. Since the time of these studies much has changed in California's energy markets, most notably, selected efficient technologies have penetrated certain markets in major ways while others have not, the choice of electric supply has been unbundled and made competitive, and the State has embarked on an efficiency path that incorporates market transformation as a core operating paradigm.

It appears that the only recent (relatively) resource assessment or opportunity screening studies that have been conducted are the CEC's State of California DSM Resource Assessment Model Methodology (September, 1995; See study #770 in Appendix A), and the study on Selecting Targets for New Market Transformation Initiatives in Northern California conducted for PG&E (March 1998; see study #910 in Appendix A). In addition, an opportunity-screening assessment

was conducted as part of the *Market Share Tracking Feasibility Study* that was based on scores developed from a pool of industry experts and stakeholders.

Any new energy-efficiency potential studies conducted should appropriately balance the need to quantify specific potential savings opportunities with market transformation-oriented planning criteria such as the extent of existing market barriers, the likelihood of reducing identified barriers, likelihood of sustainability, and long-term cost-effectiveness. Any updated opportunity assessment should be conducted at a statewide level and should also document the savings achieved from measures that have significantly penetrated the market over the past five to ten years. The results of such a study could provide a useful underpinning to the PY2000 program planning process by adding a more quantitative element than was available in the PY99 process.

4.5.4 Measure Cost Data

Comprehensive measure cost studies were conducted for multipurpose use in California in 1992, 1994, and 1996. The primary objective of these studies was to develop full and incremental measure cost estimates that could be used by utilities in their forecasts and evaluations of DSM programs. In addition, the cost data was used by other energy groups conducting various DSM studies in California. Access to a common set of cost data helped to improve the consistency of information and assumptions used in DSM analyses conducted in the State. In the last measure cost study, full and incremental cost estimates were developed for 149 unique measures.

Although originally developed for the purposes of supporting cost-effectiveness analyses associated with DSM resource acquisition policies, the measure cost studies have also been referenced in several market effects studies. Changes in incremental costs were identified as potential market effects in the *Market Transformation Scoping Study* (Eto, Prahl, and Schlegel, 1996); subsequent market effects studies demonstrated that it was likely that such changes had, in fact, occurred for selected measures.

Not unlike the cross-cutting supply-side issues raised previously, the need for useful and accurate longitudinal measure cost data raises important questions about the most effective and appropriate means of conducting cost analyses. On one hand, measure costs could be once again developed and updated in a single study that includes a large number of measures; an alternative approach would be to include development of measure costs with market-specific studies being conducted for market characterization or market effects purposes.

As was recommended in the 1996 measure cost study, we believe that future studies could be broken into at least two types: comprehensive cost studies and targeted cost studies. The comprehensive studies would be similar to the 1994 and 1996 studies in that a large number of measures across multiple technology types would be covered. The targeted cost studies, however, would focus on particular technologies or industries that are hypothesized to be experiencing rapid changes in their price and efficiency characteristics. The targeted studies could be conducted within or in support of baseline and market effects studies. The comprehensive studies would be conducted on a periodic basis, whereas the targeted studies would be implemented as needed.

There are several issues associated with comprehensive type study. If previous budget levels for the comprehensive measure cost studies were to continue, then our general recommendation would be that such studies should be conducted less frequently than every two years. This is because it is difficult to observe anything but large changes in prices over a two-year period given the diluted sample sizes for most measures.[2] These sample sizes are limited by the fact that the fixed budget available must be spread over a large number of measures. Thus, in 1996 we recommended conducting the comprehensive studies every three or four years, with the targeted studies being employed during the intervening years. In addition, we recommended a scoping study be conducted in three years (i.e., 1999), just before, or as part of, the next comprehensive study. The purpose of the scoping study would be to assess which measures would be included in the comprehensive study; to review available methods and data sources; and to further assess the precision levels of price estimates from the previous studies.

Finally, we note that it is possible that some of the data collection efforts being proposed as part of the *Market Share Tracking Feasibility Study* could be leveraged to include collection of selected measure cost data as well.

4.5.5 Integration of Existing Sources

There are several existing baseline sources that provide valuable information but are limited in one or more ways. The most consistent limitation occurs with respect to service territories covered. The two most obvious sources of high-value data whose usefulness is currently limited by service territory fragmentation over time are the utilities' RASS and CEUS studies. There is a wealth of data in these sources, particularly with respect to baseline penetration of efficient equipment and characterization of the mix of products in end-user markets. However, using RASS and, particularly, CEUS studies in a comprehensive way at the statewide level is difficult in practice because of the following:

- It is difficult to obtain complete information from those studies that have been completed or are in the process of being completed. Typically most researchers external to the development of the studies themselves are only able to obtain copies of survey instruments and highly generalized reports of results. The core value of the CEUS, in particular, is its measure-level data (based on on-site surveys); however, these data are very difficult to find and obtain.
- There are differences in survey year, instruments, reporting, and data between the three utilities. Assuming each of the RASS and CEUS could be obtained in their entirety, a fair amount of work would be required to produce consistent, integrated analyses at the statewide level.

We believe that an integrated, detailed analysis of these sources would be of value to the broad group of researchers that will be conducting MA&E studies in 1999 and beyond. Because of the difficulties noted above, however, and the amount of work entailed, it is unlikely that these sources

[2] Despite the fact that several thousand raw cost observations are collected during the comprehensive studies, they become diluted over the 150 or so measures to levels of 10 to 30 per measure.

will be leveraged to the extent warranted by their rich content if individual researchers must do so on their individual projects. Any individual researcher working within an otherwise limited budget and scope will be constrained in his or her ability to comprehensively mine these data sources. For these reasons, we believe there are important economies that could be captured by scoping a project or projects aimed at integrating existing RASS and CEUS studies. The resulting detailed reports **and** data sets, would be extremely valuable across MA&E researchers and projects. In fact, almost all of the first 11 MA&E projects critically need this resource.

A

SOURCES REVIEWED

ID	Title	Type	Source	Author/Consultant	Date	Region
10	Impact Evaluation of PG&E's 1996 Residential New Construction Program	Evaluation	PG&E	XENERGY	01-Mar-98	PG&E
20	Impact Evaluation of Pacific Gas & Electric Company's 1996 Residential Appliance Efficiency Incentives Programs	Evaluation	PG&E	XENERGY	01-Mar-98	PG&E
30	Evaluation of Pacific Gas & Electric Company's 1995 Nonresidential Energy Efficiency Incentives Program for Commercial Sector Lighting Technologies	Evaluation	PG&E	Quantum Consulting	01-Mar-97	PG&E
40	Evaluation of PG&E's 1995 Non-Residential Energy Efficiency Incentives Program for Commercial Sector HVAC Technologies	Evaluation	PG&E	Quantum Consulting	01-Mar-97	PG&E
50	PG&E and SDG&E Commercial Lighting Market Effects Study	Market Effects	SDG&E/PG&E	XENERGY	07-Aug-98	California & Outside CA
60	Residential New Construction: Market Transformation Study	Market Effects	SCE/PG&E	Barakat & Chamberlain, Shel Feldman Mgmnt., Heschong Mahone Group	18-Mar-97	California
70	Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights	Market Effects	SDG&E/PG&E	Hagler Bailly	24-Apr-98	California
80	CTAC Market Effect Study	Market Effects	SCE	Hagler Bailly	24-Mar-98	SCE
90	Consumers' Attitudes Toward Energy Efficient Appliances in the Los Angeles Area	Market Effects	SCE	Brown & Whiting, Washington, DC		SCE
100	Evaluating the Market Effects of Southern California Edison's Commercial and Industrial Energy Efficiency Programs	Market Effects	SCE	Quantum Consulting	30-Mar-98	SCE
110	Home Energy Fitness Program Market Effects Evaluation	Market Effects	SCG	AAG & Associates	10-May-98	SCG
120	SCE Hydraulic Services Program Market Effects Study No. 3507 - Final Report	Market Effects	SCE	RLW Analytics & Economic Development Research Group	01-Feb-98	SCE
130	PG&E Statewide Multi-year Billing Analysis Study: Commercial Lighting Technologies	Market Effects	PG&E	Quantum Consulting	13-Jul-98	PG&E
140	Study of Market Effects on The Supermarket Industry	Market Effects	PG&E	Quantum Consulting	15-Jul-98	PG&E

ID	Title	Type	Source	Author/Consultant	Date	Region
150	Indirect costs and benefits (ICB) pilot study of SDG&E's Commercial Lighting Program Final Report Proj. No. 2092T	Market Effects	CADMAC	BCI, Shel Feldman Mgmnt. Consulting, Macro Intl.	07-Apr-98	SDG&E
160	PG&E Energy Center - Market Effects Study	Market Effects	PG&E	TecMRKT Works	01-Dec-97	PG&E
170	Residential Market Effects Study	Market Effects	SCG/SDG&E	Regional Economic Research (RER)	30-Jun-98	Southern California
180	Commercial/Industrial Market Effects Baseline Study Results	Baseline	PG&E	Quantum Consulting	15-Jul-98	PG&E
190	Residential Lighting Market Transformation Study	Market Effects	SCE	Decision Sciences Research Associates	01-Sep-98	SCE
220	Industrial Retrofit Program Evaluation of Lighting Technologies	Evaluation	PG&E	Quantum Consulting	01-Feb-96	PG&E
230	Impact Evaluation of PG&E's 1996 Industrial Sector Energy Efficiency Incentives Programs: Lighting; HVAC; Process	Evaluation	PG&E	SBW Consulting	01-Mar-98	PG&E
240	Evaluation of PG&E's 1995 Non-Residential Energy Efficiency Incentives Program for Commercial Sector Refrigeration Technologies	Evaluation	PG&E	Quantum Consulting	01-Mar-97	PG&E
250	SCE CBEE Non-Residential New Construction Statewide Baseline Study (Proposal)	Evaluation	SCE, CBEE	RLW Analytics	15-Jun-98	California
260	Impact Evaluation of PG&E's 1996 Commercial Sector Energy Management Services Program	Evaluation	PG&E	Quantum Consulting	01-Mar-98	PG&E
270	First-Year Load Impacts of SCG's 1994 Energy Advantage Home Program	Evaluation	SCG	Regional Economic Research (RER)	24-Feb-97	SCG
280	Impact Evaluation of PG&E's 1995 Residential Direct Assistance and 1995 Residential Energy Management Services Programs	Evaluation	PG&E	XENERGY	28-Feb-97	PG&E
290	1994 Residential Weatherization Retrofit Incentives and Appliance Efficiency Incentives Programs Impact Evaluation	Evaluation	PG&E	XENERGY	28-Feb-97	PG&E
300	Efficiency Market Share Needs Assessment and Feasibility Scoping Study - Final Research Plan	Market Effects	PG&E	Regional Economic Research (RER)	04-Feb-97	California
310	Specific Conditions - Statewide Measure Performance Study - Phase 3A	Evaluation	CADMAC	Proctor Engineering Group		California

ID	Title	Type	Source	Author/Consultant	Date	Region
311	Specific Conditions - Statewide Measure Performance Study - Phase 3B	Evaluation	CADMAC	Proctor Engineering Group		California
312	Statewide Measure Performance Study - An Assessment of Relative Technical Degradation Rates - Final Report	Evaluation	CADMAC	Proctor Engineering Group	24-Apr-98	California
313	Statewide Measure Performance Study #2: An Assessment of Relative Technical Degradation Rates	Evaluation	CADMAC	Proctor Engineering Group	14-May-98	California
320	1996 Commercial Energy Efficiency Incentives Program - First Year Load Impact Evaluation	Evaluation	SDG&E	XENERGY, VIEWTech	01-Mar-98	SDG&E
330	1996 Residential Weatherization Retrofit Incentives	Evaluation	SDG&E	Patrick Kirkland	01-Mar-98	SDG&E
340	1996 Residential Appliance Efficiency Incentives Program: High Efficiency Lighting First Year Load Impact Evaluation	Evaluation	SDG&E	Hagler Bailly Consulting (NTG Analysis for CFLs only)	01-Mar-98	SDG&E
350	Impact Evaluation of the 1995 Residential Direct Assistance Program	Evaluation	SCE	XENERGY	19-Feb-97	SCE
360	Evaluation of the SCE 1996 DSM Bidding Program	Evaluation	SCE	Ridge & Associates/ KVDR	30-Apr-98	SCE
370	1996 Industrial Energy Efficiency Incentive Program Impact Study 541	Evaluation	SCE	Alternative Energy Systems Consulting	02-Mar-98	SCE
380	Realization Study of 1995 Power Savings Partners Program: Commercial Sector, Industrial Sector, Residential Sector	Evaluation	PG&E	PG&E with data from PSP Partners	01-Mar-97	PG&E
390	Impact Evaluation of Pacific Gas & Electric Company's 1996 Nonresidential New Construction Program	Evaluation	PG&E	RLW Analytics	01-Mar-98	PG&E
400	Evaluation of PG&E's 1996 Commercial Energy Efficiency Incentives Program: HVAC Technologies - Final Report - Study No. 351	Evaluation	PG&E	Quantum Consulting	01-Mar-98	PG&E
410	Evaluation of PG&E's 1996 Commercial EEI Program Lighting Technologies	Evaluation	PG&E	Quantum Consulting	01-Mar-98	PG&E
420	1996 Agricultural and Water Supply Customers Energy Efficiency Incentive Program First Year Load Impact Evaluation	Evaluation	SCE	HDR Engineering/ ASW Engineers	27-Feb-98	SCE
ID	Title	Type	Source	Author/Consultant	Date	Region

ID	Title	Type	Source	Author/Consultant	Date	Region
430	1995 In-Home Audit Program Evaluation	Evaluation	SCE	Regional Economic Research (RER)	12-Feb-97	SCE
440	Southern California Edison 1996 Non-Residential New Construction Evaluation (Final Report)	Evaluation	SCE	RLW Analytics	18-Feb-98	SCE
450	1996 Commercial Energy Management Hardware Rebate Program Impact Evaluation - Study 540	Evaluation	SCE	Regional Economic Research (RER)	27-Feb-98	SCE
460	Impact Evaluation of PG&E's 1996 Agricultural Programs - EEI Program: Pumping and Related End Use (354); Indoor Lighting End Use (385); Energy Management Services Program (360)	Evaluation	PG&E	Equipoise Consulting	01-Mar-98	PG&E
470	Summaries of California Utilities' Measurement and Evaluation Studies as Presented in the Database of Energy Efficient Resources (DEER)	Evaluation	CCIG/CEC	CEC	Ongoing	California
480	1996 Agricultural Energy Efficiency Incentives Program - First Year Load Impact Evaluation - Final Report	Evaluation	SDG&E	XENERGY	01-Feb-98	SDG&E
490	1996 Industrial Energy Efficiency Incentives Program - First Year Load Impact Evaluation - Final Report - Study ID No. 995	Evaluation	SDG&E	XENERGY	01-Feb-98	SDG&E
500	1995 Nonresidential New Construction Program - First-Year Load Impact Evaluation	Evaluation	SDG&E	Regional Economic Research (RER)	05-Mar-97	SDG&E
620	Commercial End Use Survey Questionnaire for PG&E	Saturation	PG&E	PG&E		PG&E
630	Commercial Saturation Survey	Saturation	SCE	SCE	01-May-97	SCE
640	Commercial End Use Survey Questionnaire	Saturation	SDG&E	SDG&E		SDG&E
650	1995 Residential Appliance Saturation Documentation	Saturation	SCE	XENERGY	30-Oct-96	SCE
660	Residential Energy Survey Report	Saturation	PG&E	PG&E		PG&E
670	Home Energy Survey for 1998	Saturation	SDG&E	SDG&E		SDG&E
690	Impact Evaluation of PG&E's 1996 Industrial Sector Energy Management Services Program	Evaluation	PG&E	SBW Consulting, KVDR	01-Mar-98	PG&E
710	Impact Evaluation of the Spare Refrigerator Recycling Program CEC Study #537	Evaluation	SCE	XENERGY	30-Apr-98	SCE

ID	Title	Type	Source	Author/Consultant	Date	Region
720	EIA/DOE Residential Energy Consumption Survey (RECS)	Government Source	EIA/DOE	DOE		California & Outside CA
730	EIA/DOE 1994 Manufacturing Energy Consumption Survey (MECS)	Government Source	EIA/DOE	DOE		California & Outside CA
740	EIA/DOE Commercial Buildings Energy Consumption Survey (CBECS)	Government Source	EIA/DOE	DOE		California & Outside CA
750	California Energy Efficiency Policy and Program Priorities	Other	CBEE	Robert Mowris & Associates	11-Sep-98	California
770	State of California DSM Resource Assessment Model Methodology (Final Report - Volumes 1 and 2)	DSM Potential	CEC	NEOS Corporation	15-Sep-95	California
780	Proposed QFER Database	Other	CEC	CEC	01-Sep-98	California
790	Impact Evaluation of PG&E's Agricultural Energy Efficiency Incentives Programs: Pumping and Related End Use; Indoor Lighting End Use	Evaluation	PG&E	Quantum Consulting	01-Mar-97	PG&E
800	1993 Residential Field Data Project	Evaluation	CEC/CADMAC	Berkeley Solar Group, Recom Technologies, Charles Miles, Mark Modera, Taber Chaitin Associates	30-Apr-95	California
810	Statewide Baseline Assessment of Non-Residential New Construction: Phase 1 Sample Selection	Baseline	CADMAC	Synergic Resources Corporation	23-Jun-95	California
830	Post Occupancy Residential Survey	Evaluation	CEC	NEOS Corporation	24-Feb-97	California
840	Comparison of Residential Building Standards Projects	Evaluation	CEC	NEOS Corporation	01-Mar-97	California
870	Evaluation of CBEE Residential Standard Performance Contract (Proposal)	Market Effects	CBEE	Wirtshafter Associates	12-Jul-98	California
880	1996 Nonresidential New Construction Program- First Year Load Impact Evaluation	Evaluation	SDG&E	Regional Economic Research (RER)	25-Feb-98	SDG&E
900	New England C&I Lighting Market Transformation and Baseline Study	Market Effects	NE Utilities	Easton Consultants	16-Apr-97	Outside California
910	Selecting Targets for New Market Transformation Initiatives in Northern California	Other	PG&E	ACEEE and XENERGY	01-Mar-98	Northern California

920	SCE Industrial Survey Final Report Volume 3: Technical Report	Saturation	SCE	Aspen Systems Corporation	20-Mar-98	SCE
930	United States Industrial Electric Motor Systems Market Opportunities Assessment	Baseline	ORNL	XENERGY	22-Aug-98	California & Outside CA
940	Database for Energy Efficient Resources Computer Software Program	Government Source	CEC	California Conservation Inventory Group	01-Dec-95	California
950	Super Efficient Refrigerator Program (SERP) Evaluation, Volume 2: Preliminary Impact and Market Transformation Assessment	Evaluation	EIA/DOE	Pacific Northwest National Laboratory - operated by BATTELLE	01-Aug-96	California & Outside CA
960	1998 Baseline Energy Outlook	Other	CEC	CEC	01-Aug-98	California
970	CEC Database of Book/Report/Magazine/Journal Items	Other	CEC	CEC	01-Sep-98	California & Outside CA
980	California Baseline Lighting Efficiency Technology Report	Baseline	CEC	Heschong Mahone Group	30-May-97	California
990	Coming Clean about Resource-Efficient Clothes Washers: An Initial WashWise Program and Market Progress Report	Market Effects	NEEA	Pacific Energy Associates	28-Jan-98	Outside California
1000	A Second WashWise Market Progress Evaluation Report	Market Effects	NEEA	Pacific Energy Associates	28-Jul-98	Outside California
1010	Energy Star Fixtures Program Baseline Data Analysis	Market Effects	NEEA	Pacific Consulting Services	13-May-98	Outside California
1020	The Super Good Cents Manufactured Housing Venture - Baseline Market Assessment and Market Characterization	Market Effects	NEEA	Pacific Energy Associates	14-Aug-98	Outside California
1050	Market Transformation: Residential Windows	Market Effects	PG&E	Opinion Dynamics Corp.	01-Jan-98	PG&E
1060	1996 Appliance Dealer/Contractor Survey	Evaluation	PG&E	ADF Research	01-Aug-96	PG&E
1070	1996 Compact Fluorescent Lighting Program - Wave 3 Audit Report	Market Effects	PG&E	Freeman, Sullivan and Co.	01-Jul-97	PG&E
ID	**Title**	**Type**	**Source**	**Author/Consultant**	**Date**	**Region**
1090	GeoExchange Awareness Survey - Phase I: Baseline Study	Market Effects	PG&E	Telephone Marketing Research	01-Dec-97	PG&E
1100	Daylighting: Baseline Design Practices; Market Transformation: Daylighting	Market Effects	PG&E	Opinion Dynamics Corp.; Catherine Cooper Marketing	11-Aug-98	PG&E

	Daylighting			Research		
1210	Strategies to Promote Energy-Efficient Motor Systems in North America's OEM Markets	Evaluation	DOE	Easton Consultants	01-Nov-95	National
1220	Industrial Air Compressor Commissioning Baseline "Mini-Study"	Market Effects	PG&E	XENERGY	30-Mar-98	Northern California

B

END-USE MARKET ASSESSMENTS

APPENDIX B CONTENTS

B.1 RESIDENTIAL HVAC

***Best Compiled Sources*:**

110 (Home Energy Fitness Program Market Effects Evaluation for SCG by AAG & Associates - 1998)
910 (Selecting Targets for New Market Transformation Initiatives in Northern California for PG&E by ACEEE and XENERGY - 1998)
660 (Residential Energy Survey Report for PG&E - 1994)
650 (1995 Residential Appliance Saturation Documentation for SCE by XENERGY - 1996)
830 (Post Occupancy Survey for the CEC by NEOS - 1997)
170 (Residential Market Effects Study for SCG/SDG&E by RER - 1998)
870 (Evaluation of CBEE Residential Standard Performance Contract (Proposal) for the CBEE by Wirtshafter Associates - 1998)

Baseline Information Strengths:

✓ Heating and cooling system type and efficiencies are well documented for each utility area.
✓ Household demographics and home characteristics are well documented by utility area.
✓ Gas heating system data are good for SCG service area including efficiencies, energy use, efficiency of replacement equipment.
✓ Baseline information on distribution channels and market structure for gas heat equipment is fairly complete.
✓ Some consumer behavioral and decision-making information is available for gas heat.
✓ Residential SPC evaluation might provide current statewide market barriers, actors and decision-making information.

Source 170

1) Provides good 1998 information on the efficiencies of gas heating equipment installed since 1985.
2) Some relevant market structure information.

Source 870

1) Is the proposal to conduct the SPC evaluation; it may provide statewide information on residential market, barriers, actors, and decision-making.

Source 110

1) Provides baseline information on gas furnace efficiencies, replacement efficiencies, energy use.
2) Includes data on distribution channels for gas heat.
3) Consumer decision making and information sources.
4) Includes demographic data.
5) Includes energy behavioral information.
6) Provides data on end-user attitudes.
7) Mix of data from 1997 and before.

Source 910

1) 1998 Resource.
2) Includes summary information on evaporative cooling, duct sealing, central air conditioning, ground source heat pumps, gas furnaces, and furnace blowers.
3) Presents some market barriers.
4) Provides some measure cost.
5) Has some market information.

Source 660
1) Provides demographic data.
2) Provides data on house characteristics
3) Includes information on furnace and air conditioner approximate age.
4) Operations information.

Source 830
1) Is from 1997 data.
2) Includes HVAC efficiencies for a representative sample of homes built since 1989.
3) Presents statewide data.

Source 650
1) Has SCE appliance data from 1995.
2) Includes data on household characteristics.
3) Includes data on heating and cooling equipment type for a large sample.
4) Includes data on heating and cooling efficiency for a sub-sample of audited homes.

Baseline Information Weaknesses/Gaps:

- ✖ There is little statewide information; most is utility-area specific.
- ✖ There is little information on market functioning; market structure for products other than gas heating systems; market barriers; or market leverage points.
- ✖ There is little or no information on consolidators and retailers who sell directly to consumers. Consolidators are a growing market segment with some incentives to promote more efficient equipment. Some consumers purchase HVAC equipment directly from retailers, although this market is small currently.
- ✖ There is little information on either consumers' or supply-side actors' awareness, knowledge, or decision-making.
- ✖ There is little information on products or services characteristics other than limited efficiency data.

Source 170
1) Is limited to only new gas heating information in Southern California and targets new construction.

Source 870
1) Is only a proposal and it emphasizes SPC issues.

Source 110
1) Is for the SCG area only and is for gas heating only.

Source 910
1) Presents only summary information.

Source 660
1) Is for the PG&E area only.

Relationship to Programs/Intervention Strategies:

- Residential MA&E Efforts Supporting Contractor Initiatives: HVAC upgrades are likely to be a major component of any residential retrofit/renovation program, but HVAC contractors are not the only contractors that would be included in a broad retrofit/renovation program. Existing baseline market information is very limited and would require supplementing in several areas.
- Residential Retrofit and Renovation Program
- Residential HVAC Program
- Support of Codes and Standards and Local Government Initiatives Program
- Residential New Construction Program

General Research Recommendations:

- Build upon the most recent utility RASS studies and investigate possibility of developing a statewide database integrating these studies.
- Monitor RSPC evaluation, identify information that it can provide to document baseline conditions, and build upon the results.
- Expand gas heating market information for areas other than SCG.
- Develop thorough baseline market information on HVAC and other residential contractors emphasizing all categories of baseline market characteristics (structure/functioning, products/services, actor characteristics).
- Emphasize information collection for product retrofits including air conditioning, insulation, duct services, and windows.
- Develop baseline information on consumer information channels, decision-making, attitudes, and awareness about energy efficiency.
- Characterize residential retrofit/renovation issues and processes.
- Assess potential effects of training and certification based on consumer and industry interests and response.

Research Project Recommendations:

1. Review most recent RASS studies and investigate HVAC equipment efficiency data gaps and explore opportunities for developing statewide data from these sources. Assess whether available HVAC cost data are recent enough to be useful. If these sources are inadequate or data cannot be integrated then a statewide study may be required.
2. Conduct statewide study of the market for residential retrofit/renovation involving all types of HVAC equipment, heating and cooling distribution systems, and building shell upgrades. Characterize consumer attitudes, awareness, barriers, and decision-making. Characterize supply-side actors' characteristics, attitudes, awareness, barriers, and marketing strategies and include HVAC consolidators and retailers.

3. Monitor national residential HVAC standards upgrade program and coordinate baseline market research efforts with the national effort.
4. Conduct study of residential HVAC and envelope weatherization contractor certification. Focus on consumer awareness and interest in certification and impacts of certification on consumer demand in the context of the consumer information search and decision-making process. Conduct study of service provider receptivity to training and certification and potential market impacts. Note, this project could be integrated with project 2.

B.2 RESIDENTIAL LIGHTING:

Best Compiled Sources:

70 (Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights for SDG&E by Hagler Bailly Consulting - 1998)

190 (Residential Lighting Market Transformation Study for SCE by Decision Sciences Research - 1998)

1070 (1996 Compact Fluorescent Lighting Program - Wave 3 Audit Report for PG&E by Freeman, Sullivan and(1997)

1010 (Energy Star Fixtures Program Baseline Data Analysis for NEEA by Pacific Consulting - 1998)

980 (California Baseline Lighting Efficiency Technology Report for the CEC by Heschong & Mahone - 1997)

910 (Selecting Targets for New Market Transformation Initiatives in Northern California for PG&E by ACEEE and XENERGY - 1998)

650 (1995 Residential Appliance Saturation Documentation for SCE by XENERGY - 1996)

660 (Residential Energy Survey Report for PG&E - 1994)

670 (Home Energy Survey for 1998 for the CEC and SDG&E - 1998)

Baseline Information Strengths:

✓ Most information is relatively recent (1997-1998).

✓ CFL studies provide a strong foundation for future work, with good information on consumers and downstream supply-side actors.

Source 70

1) Contains a good start at characterizing the CFL market (includes small sample of interviews with retailers and manufacturers).
2) Useful baseline information for CFL penetration (1996), plus some data on market share over time (based on utility program penetration estimates and RASS data).

Source 190

1) Good characterization of a specific market (retail sales environment for SCE area) for a specific manufacturer of CFLs (Lights of America).
2) Good description of consumer awareness, attitudes and practices related to shopping for and using CFLs.

Source 1070

1) Good assessment of stocking, pricing, and promotion effects.
2) Research completed in a variety of supply channels.

Source 1010

1) Study design has value (i.e., benchmarking availability of CF fixtures).
2) Provides data and insight useful in characterizing the structure, barriers, actors, etc. pertaining to the market for CF fixtures.

3) Includes data on equipment prices.
4) Includes information on stocking practices at 39 stores in NW and some information on store displays.

Source 980
1) Good description of market structure/functioning and market barriers.
2) Includes supply-side interviews.

RASS Sources:
1) Indoor and outdoor lighting covered by SDG&E and SCE.
2) CFLs covered by all three utilities.

Baseline Information Weaknesses/Gaps:

- ✖ Market characterization is somewhat inadequate for both the demand and supply sides.
- ✖ Baseline saturation data is inadequate and not terribly recent.
- ✖ Data sources are specific geographic areas so statewide information is inadequate.
- ✖ Detailed information is available primarily for CFLs.

Source 70
1) Limited insight from manufacturers.
2) Sample of retailers too small.

Source 190
1) Limited to SCE area.
2) Limited to SCE's program.
3) Limited to one product.

Source 1070
1) Limited to PG&E program.
2) Limited to SF Bay Area.

Source 1010:
1) Northwest focus.
2) Limited to CF fixtures.

Source 980
1) Data collected in SCE territory.
2) Not very recent for use as PY99 program baseline of demand-side information (saturation).

Source 910
1) Summary data only.
2) Somewhat limited to Northern California markets and PG&E programs.

RASS Sources
1) Utility service area specific.
2) Data is not recent.

3) Saturation data is inconsistent across utilities (e.g., PG&E only collected data on CFLs).

Relationship to Programs/Intervention Strategies:

- Residential Retrofit and Renovation Program: Existing baseline market information on lighting in the retrofit/renovation market is very limited and requires supplementing.
- Residential Lighting Program: Existing baseline market information is limited and requires supplementing in several areas.

General Research Recommendations:

- Expand lighting market information for products other than CFLs.
- Develop thorough baseline information (i.e., structure/functioning, market share/sales data, actor characteristics) for all applicable lighting technologies (e.g., screw-in lamps, hard-wired fixtures, torchieres).
- Develop baseline information on consumer information channels, decision-making, attitudes, and awareness as it specifically relates to energy efficient lighting.

Research Project Recommendations:

1. Put demand and supply-side baselines in place for other appliances that are included in program initiatives (e.g., screw-in lamps, hard-wired fixtures, torchieres).
2. Continue working with manufacturers and major suppliers to further assess attribution issues and to monitor changes in production and sales trends. Coordinate with EPA's evaluation of the Energy Star program; complete assessment of Energy Star in California.
3. Develop equipment saturation, energy consumption, and supply-side baselines. Address upstream supply-side market actor issues for a wide variety of lighting technologies (CFLs, torchieres, hard-wired fixtures, etc.). Also (or as part of a separate study), conduct more in-depth, statewide research in the area of retail market dynamics (earlier studies did not go far enough in this area and were not conducted on a statewide basis). For example, more information is needed on a statewide/regional basis on why certain market barriers still exist for high efficiency lighting (e.g., why aren't CFLs sold in drug stores?) and how the programs should intervene to reduce these retail-level market barriers in a way that is consistent with the objectives of market transformation.
4. Include a greater focus on consumer and supply-side actor segmentation within baseline research.

B.3 RESIDENTIAL APPLIANCES

Best Compiled Sources:

70 (Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights for SDG&E/PG&E by Hagler Bailly Consulting - 1998)

90 (Consumers' Attitudes Toward Energy Efficient Appliances in the Los Angeles Area for SCE by Brown & Whiting - 1997)

950 (Super Efficient Refrigerator Program (SERP) Evaluation, Volume 2: Preliminary Impact and Market Transformation Assessment for EIA/DOE by Pacific Northwest National Laboratory - 1996)

990 (Coming Clean about Resource-Efficient Clothes Washers: An Initial WashWise Program and Market Progress Report for NEEA by Pacific Energy Associates - 1998)

1000 (A Second WashWise Market Progress Evaluation Report for NEEA by Pacific Energy Associates - 1998)

910 (Selecting Targets for New Market Transformation Initiatives in Northern California for PG&E by ACEEE and XENERGY - 1998)

650 (1995 Residential Appliance Saturation Documentation for SCE by XENERGY - 1996)

660 (PG&E Residential Energy Survey Report - 1994)

670 (Home Energy Survey for 1998 - 1998)

Baseline Information Strengths:

- ✓ There is good coverage of refrigerator market issues from both supply- and demand-side perspectives.
- ✓ Some information from NW may be applicable to CA market for clothes washers (i.e., market barriers, market structure/functioning, market actors).
- ✓ RASS studies contain saturation data on refrigerators, second refrigerators, freezers, dishwashers, clothes washers and room air conditioners.
- ✓ RASS studies are based on large samples with (presumably) reliable and valid sampling approaches.

RASS Sources

1) Saturation surveys are fairly comprehensive and cover all home appliances and energy using equipment (e.g., refrigerators, second refrigerators, freezers, dishwashers, clothes washers and room air conditioners).

Sources 70 and 90

1) Good coverage of market structure/functioning from supply- and demand-side perspective.

Source 950

1) Study assessed leading market indicators to assess effectiveness and impact of program.
2) Includes upstream supply-side (manufacturer, distributor, dealers) market actor perspective.
3) Valuable discussions on market transformation in the context of impact evaluation.

Sources 990 and 1000

1) Detailed assessment of the resource-efficient clothes washer market in the NW.
2) Includes description of market barriers and market size.

Baseline Information Weaknesses/Gaps:

- ✖ Market characterization is inadequate for appliances other than refrigerators (on both the demand and supply sides).
- ✖ Baseline saturation data is not recent.
- ✖ Data sources are specific geographic areas so statewide information is inadequate.
- ✖ Detailed information is available primarily for refrigerators and (somewhat) clothes washers.

RASS Sources
1) Data is not statewide.
2) Data is not recent (1994-1995).

Source 90
1) Limited to LA area only.

Source 950
1) SERP program and technology focus.
2) Focus is on supply-side actors; no direct coverage of consumer issues (except indirect references from dealers).

Sources 990 and 1000
1) NW region focus.
2) NW program focus

Relationship to Programs/Intervention Strategies:

- ➪ Residential Statewide Lighting and Appliance Programs: Baseline saturations needed for appliances targeted through program (e.g., refrigerators, freezers, clothes washers, dishwashers, room AC). Also need baseline market assessment/characterization (i.e., market structure/functioning, attitudes, end-user and supply-side behavior, etc.) for all products (building on existing research for refrigerators and clothes washers).

General Research Recommendations:

- ➪ Explore statewide integration of the RASS data.
- ➪ Build upon the information developed in the refrigerator and clothes washer market evaluation studies and expand information on market characteristics for other appliances (e.g., market structure/functioning market baseline characteristics, products/services, and supply side data).
- ➪ Focus on expanding the information available on supply-side actors including data on number of firms offering efficient options (manufacturers), equipment stocking and ordering practices (distributor/dealers).

Research Project Recommendations:

1. Conduct statewide study of supply side baseline market characteristics for appliances other than refrigerators and clothes washers. Focus on developing baseline data on supplier attitudes, behavior, market barriers, distribution channels, and product and services.
2. Coordinate efforts with national/regional Energy Star market studies.
3. Conduct statewide baseline saturation survey.
4. Consider broader market characterization study for appliance removal/recycling programs to achieve deeper understanding of market structure/functioning and involvement of different market actors.
5. Consider market baseline, characterization study of fuel switching applications (e.g., electric v. gas clothes dryers, stoves and water heaters).

B.4 RESIDENTIAL BUILDING SHELL

***Best Compiled Sources*:**

170 (Residential Market Effects Study for SCG/SDG&E by RER - 1998)
171 (Post Occupancy Residential Survey for CEC by NEOS - 1997)
1050 (Market Transformation: Residential Windows for PG&E by Opinion Dynamics - 1998)
910 (Selecting Targets for New Market Transformation Initiatives in Northern California for PG&E by ACEEE and Xenergy - 1998
650 (1995 Residential Appliance Saturation Documentation for SCE by Xenergy - 1996)
660 (Residential Energy Survey Report for PG&E -1994)
670 (Home Energy Survey for 1998 for CEC/SDG&E - 1998)

Baseline Information Strengths:

✓ Most information is relatively recent.
✓ Characterization of and key actors in window markets is fairly complete.

Source 170

1) Provides good 1998 information on building shell measures in new construction markets in Southern California.
2) Addresses a variety of market actor perspectives (e.g., manufacturers, consumers, contractors, distributors).
3) Provides good information on market structure and market barriers that may be relevant statewide.

Source 830

1) Includes home characteristics and appliance data for homes built after 1989.
2) Addresses shell insulation and windows.
3) Presents statewide data.

Source 1050

1) Includes supply-side information (e.g., window manufacturers, window contractors).
2) Provides baseline window sales data.
3) Provides window incremental costs.
4) Provides market actor awareness and attitudes about window efficiency.
5) Identifies barriers to installing more efficient windows.
6) Presents ways to reduce market barriers and leverage points for market changes.

Source 910

1) Presents typical end-use information including incremental cost and energy savings.
2) Includes a few building shell measures (i.e., efficient windows and light-colored roofs).

RASS Sources

1) SCE study includes baseline data on building shell measures (e.g., insulation R-values).

2) PG&E and SDG&E studies contain data on building shell characteristics (e.g., insulation present).
3) Contains dwelling and customer demographic information.

Baseline Information Weaknesses/Gaps:

✖ Market characterization is inadequate for both the demand and supply sides.
✖ Baseline saturation and efficiency for building shell measures in retrofit/replacement applications is inadequate.
✖ Data sources are specific geographic areas so statewide information is inadequate.
✖ Detailed information is available for only for windows.

Source 170
1) Limited to new construction markets.
2) Limited to Southern California.

Source 830
1) Small sample sizes.
2) Addresses recently built new homes (1989-1997).

Source 1050
1) Covers windows only (both new and replacement.)
2) Addresses PG&E service territory only.
3) Does not include information on window distributors and retailers.

Source 910
1) Presents only summary data.
2) Addresses Northern California markets only (and PG&E programs).

RASS Studies
1) Utility specific.
2) Limited baseline efficiency data on building shell measures.
3) The data is not recent.
4) No data on market structure and functioning (supply side).
5) No data on consumer decision-making practices and criteria (demand side).

Relationship to Programs/Intervention Strategies:

➪ Residential MA&E Efforts Supporting Contractor Initiatives: Building shell measures (including windows) are likely to be a major component of any residential retrofit/renovation program. However, HVAC contractors are not the only contractors that would be included in a broad retrofit/renovation program. Existing baseline market information is very limited and would require supplementing in several areas.

General Research Recommendations:

- Expand building shell market information for areas other than new construction and Southern California.
- Develop thorough baseline information on building shell market characteristics (i.e., structure/functioning, products/services, actor characteristics).
- Develop baseline information on consumer information channels, decision-making, attitudes, and awareness about energy efficiency as it specifically relates to building shell measures.
- Characterize residential retrofit/renovation issues and processes.

Research Project Recommendations:

1. Conduct scoping study to identify specific baseline efficiency information needs for building shell measures.
2. Conduct a statewide baseline study to collect baseline efficiency data on building shell measures, including but perhaps not limited to major insulation upgrades (ceiling, wall, floor), windows, and minor insulation and seal-up measures (weatherstripping, caulking).
3. Conduct one or a coordinated group of studies of the residential retrofit/renovation market for relevant energy efficiency products and services (e.g., HVAC equipment, heating and cooling distribution systems, and building shell upgrades). Characterize consumer attitudes, awareness, barriers, and decision-making. Characterize supply-side actors' characteristics, attitudes, awareness, barriers, and marketing strategies.
4. Conduct study of residential weatherization contractor certification. Focus on consumer awareness and interest in certification and impacts of certification on consumer demand in the context of the consumer information search and decision-making process. Conduct study of service provider receptivity to training and certification and potential market impacts.

B.5 RESIDENTIAL RENOVATION

***Best Compiled Sources*:**
1050 (Market Transformation, Residential Windows for PG&E by Opinion Dynamics, 1998)

Baseline Information Strengths:
✓ Characterization of and key actors in window markets is fairly complete.

Source 1050
1) Includes supply-side information (e.g., window manufacturers, window contractors)
2) Provides baseline window sales data
3) Provides window incremental costs
4) Provides market actor awareness and attitudes about window efficiency
5) Identifies barriers to installing more efficient windows
6) Presents ways to reduce market barriers and leverage points for market changes

Baseline Information Weaknesses/Gaps:
✖ Characterization is inadequate for renovation markets on both the demand and supply sides.
✖ Baseline saturation of energy efficiency measures in renovation projects is inadequate.
✖ Detailed information is available for only for windows.

Source 1050
1) Covers windows only (both new and replacement)
2) Addresses PG&E service territory only
3) Does not include information on window distributors and retailers.

Relationship to Programs/Intervention Strategies:
➪ Residential MA&E Efforts Supporting Contractor Initiatives: Existing baseline information for the renovation market is virtually non-existent. Issues relevant to the renovation market in particular should be addressed from both the demand and supply side.

General Research Recommendations:
➪ Develop thorough baseline information on renovation market characteristics (i.e., structure/functioning, products/services, actor characteristics).
➪ Develop baseline information on consumer information channels, decision-making, attitudes, and awareness about energy efficiency as it applies to renovation projects.
➪ Characterize renovation issues and processes.

Research Project Recommendations:
1. Conduct scoping study to identify specific baseline efficiency information needs for renovation market applications.
2. Integrate (via sample stratification or other means) renovation market applications into a statewide baseline efficiency data collection study.

3. Conduct one or a coordinated group of studies of the residential retrofit/renovation market for relevant energy efficiency products and services (e.g., HVAC equipment, heating and cooling distribution systems, and building shell upgrades). Characterize consumer attitudes, awareness, barriers, and decision-making. Characterize supply-side actors' characteristics, attitudes, awareness, barriers, and marketing strategies.

B.6 NON-RESIDENTIAL HVAC

***Best Compiled Sources*:**

180 (Commercial/Industrial Market Effects Baseline Study Results for PG&E by Quantum Consulting - 1998)
620 (Comprehensive End-Use Survey Questionnaire for PG&E- 1993)
630 (Commercial Saturation Survey for SCE - 1997)
640 (Non-residential Non-participant Survey Results & Instrument for SDG&E by VIEWtech - 1996)

Baseline Information Strengths:

✓ Most comprehensive source was published in mid-1998.
✓ The information on end-users and market channels is probably appropriate to all of California.
✓ CEUS data are based on reasonably large samples and PG&E market effects study uses reliable and valid sampling approaches.
✓ Schools, universities, hospitals, and offices are well covered by PG&E study. Information is good for these end-users on barriers, distribution channels, and information channels.
✓ Structural equation modeling presented in PG&E study shows promise as a methodology to examine barriers and behaviors.
✓ CEUS provide good end-user firmographics and energy use data.

Source 180

1) The most complete source of data on non-residential HVAC.
2) Relatively current and fairly comprehensive in terms of end-user information.

CEUS Sources

1) Provide relatively good information on inventories of customer equipment and usage patterns.

Baseline Information Weaknesses/Gaps:

The major gaps and weaknesses are a shortage of information on the supply side, lack of detailed information on a range of equipment types and geographic areas, and key market characteristics.

✖ The only source of comprehensive market information applies to a single area: the PG&E service area.
✖ There is only one relatively comprehensive information source available.
✖ There is little or no information on either the end-user or supply side of commercial markets other than the four noted above.
✖ The single comprehensive study covers only packaged A/Cs.
✖ There is little information on the supply-side even in the markets that are well covered.
✖ Market structure/functioning characteristics information is especially limited regarding causal links, leverage points, and market size.

- ✖ Market products/services characteristics information is very limited.
- ✖ CEUS market actor characteristics data are not from the same year.

Relationship to Programs/Intervention Strategies:

- ➪ Large Comprehensive Retrofit Program: HVAC is one measure to be included in comprehensive retrofits. Existing information would have to be supplemented with more information on current practices, penetration of different technologies/measures, attitudes, supply-side behavior, additional end-user types, and market structure/functioning.
- ➪ Small Comprehensive Retrofit Program: In addition to the above needs, an additional focus would be required on small end-users. Existing and additional baseline information would be essential in designing programs in this area.
- ➪ HVAC Equipment Turnover: Critical needs in this program area emphasize equipment turnover processes and practices with an emphasis on equipment cost data, equipment availability, penetration rates, O&M practices, buyer awareness and attitudes, and supply-side actor information.
- ➪ Remodeling /Renovation: Very little information is available on the remodeling/renovation process. Comprehensive information is needed on the supply-side.

General Research Recommendations:

- ➪ Build upon the information developed in the NSPC evaluation.
- ➪ Focus on expanding the information available on supply-side actors.
- ➪ Review latest CEUS data (not all were available during initial review) and explore statewide integration of the information.
- ➪ Supplement existing PG&E information with broad studies in other geographic areas.
- ➪ Expand baseline information to products other than packaged A/C.
- ➪ Expand information on all market characteristics poorly covered by the PG&E study and CEUS studies (particularly products/services and structure/functioning market baseline characteristics).
- ➪ Emphasize baseline information for small commercial end-users.
- ➪ Collect information needed to design a small commercial program.
- ➪ Characterize turnover event issues and process.
- ➪ Characterize remodeling/renovation issues and process.

Research Project Recommendations:

1. Conduct statewide study of supply side baseline market characteristics for commercial sector products and services. Target filling in information pertaining to poorly covered areas such as turnover, remodeling and renovation.
2. Conduct study of available end-user baseline information cutting across different commercial products and services (beyond the HVAC area addressed here) to compile an integrated set of end-user baseline information.
3. Conduct a scoping study to assess possible sources of supply-side market actor information suitable for developing statewide sampling frames.

B.7 NON-RESIDENTIAL LIGHTING

***Best Compiled Sources*:**

50 (PG&E and SDG&E Commercial Lighting Market Effects Study by XENERGY - 1998)

980 (California Baseline Lighting Efficiency Technology Report. by Heschong Mahone Group - 1997)

910 (Selecting Targets for New Market Transformation Initiatives in Northern California by ACEEE and XENERGY - 1998)

140 (Study of Market Effects on the Supermarket Industry by Quantum Consulting - 1998)

620 (Comprehensive End-Use Survey Questionnaire for PG&E- 1993)

630 (Commercial Saturation Survey for SCE - 1997)

640 (Non-residential Non-participant Survey Results & Instrument for SDG&E by VIEWtech - 1996)

Baseline Information Strengths:

- ✓ Data on manufacturers, distributors, designers and installers.
- ✓ Data on percent of stock of fluorescent equipment accounted for by efficient technologies.
- ✓ CEUS data on market size, customer demographics, appliance saturations and usage patterns extensive.
- ✓ Data on products and services extensive.
- ✓ CEUS data are based on large samples with reliable and valid sampling approaches.
- ✓ CEUS data provide good end-user firmographics and energy use data.
- ✓ CEUS data includes retrofit data.
- ✓ CEUS data includes useful information on information channels.
- ✓ Data on suppliers by six and eight digit SIC codes is weak.
- ✓ Market penetration data of lighting technologies in the small C&I market is limited.

Source 50:

1) Complete characterization of supply side actors and end users provided.
2) Market barriers, distribution channels, information channels and linkages discussed at length.
3) Supply side product flows and market sizes discussed.
4) Includes information on end-user product saturations by building types. Also includes data on relative share of market by purchase events, i.e. new construction, remodel, renovation, retrofit and replacement.
5) Data on market actors extensive including thorough discussion of supply side motivation and disposition towards energy efficient products and services.

Source 980

1) Detailed assessment of lighting market size by various sectors, usage patterns and usage preferences.
2) Detailed analysis of market barriers based on over 150 interviews with market actors.
3) Detailed discussion of linkages specifically pertaining to vendor issues, sales barriers, standards, certification/compliance and equipment problems.

4) Data on market actor behavior and reasons for their actions for a wide range of market actors.

Source 910
1) Data on the following non-residential lighting measures: improved lighting design practices, commercial lighting remodeling and daylight dimming controls and high performance glazing.
2) Data on market barriers for the specific measures listed above.
3) Data on distribution channels, information channels, market size, behavior, efficiency and cost pertaining to the specific lighting measures listed above.

Source 140:
1) Data on products and services extensive.
2) Extensive discussion on past and current barriers pertaining to supermarket industry.
3) Baseline data on attitudes for both end-user and supply side actors.
4) Baseline data on percentage of existing and new stores that have energy efficient products and/or practices. Data on contractor reported % of stores with energy efficient equipment.

CEUS Data:
1) CEUS data on market size, end-user demographics, appliance saturations and usage patterns extensive.
2) CEUS data are based on large samples with reliable and valid sampling approaches.
3) CEUS data provide good end-user firmographics and energy use data.
4) CEUS data includes retrofit data.
5) CEUS data includes useful information on information channels.

Baseline Information Weaknesses/Gaps:
- ✓ Data on integrated design and installation practices is lacking.
- ✓ Data on code enforcement and role of local governments is limited.
- ✓ Data on remodeling/renovation practices is lacking.
- ✓ Data on the following specific lighting technologies is lacking: occupancy sensors, HID, exit signs, T-5 fluorescent technology, lighting controls, LED traffic signals, outdoor lighting and daylighting.
- ✓ Data on industrial lighting energy usage limited.
- ✓ Cost data is limited.
- ✓ Studies pertaining to lighting controls and operation are limited and contradictory.

Source 140:
1) Baseline data supporting discussion on supply side actors, information channels and market barriers is lacking.
2) Market size data and demographic data is national rather than California based.
3) No detailed data on efficiency levels of equipment in the supermarket industry.
4) No detailed data on first cost or life cycle cost of energy efficiency equipment.

Source 980
1) Baseline data analysis based on existing CEUS data which not necessarily representative of CA market.
2) No detail on sales volume or cost of specific energy efficient lighting products.
3) Data is outdated due to the fact that the base sources of the data were the1992 - 1994 CEUS reports.
4) Commercial data is all drawn from the southern California data sets. No PG&E data were used.
5) The report was unable to assess lighting baseline for the industrial sector.
6) Data on occupancy sensors and outdoor lighting was weak due to the limitations of the CEUS data.

Source 910
1) Data is not comprehensive in nature and only represents specific lighting measures.
2) Market size and market potential data is only representative of PG&E's service territory.

CEUS Data
1) CEUS data is by service territory and not statewide.
2) Market structure and functioning data, such as distribution channels, market barriers and linkages, is lacking for both end-users and supply side actors.
3) Supply side data is lacking.
4) 1993 CEUS data for PG&E's service territory, Report 620, is dated. More recent 1996 CEUS data is confidential.

Relationship to Programs/Intervention Strategies:
- Commercial Remodeling and Renovation Program: There is very little information on the remodeling/renovation process. Lighting is a big component of this program. Follow-up research required to characterize market, determine baseline tracking variables, and monitor changes in market indicators.
- Large and Small Non Residential Comprehensive Retrofit Programs: Lighting is a major component of these programs. Existing information would have to be supplemented with more information on current retrofit practices, market structure/functioning, attitudes, end-user and supply-side behavior, and products and services.
- HVAC Turnover Program: Further research required on integrated technologies and design.
- C&I New Construction Programs: Focus research on tracking specified indicators of program success. Track awareness of and compliance with Title 24 requirements.
- Support of Codes and Standards and Local Government Initiatives Program: Characterize and develop baseline data on the role of local governments in supporting Title 24. Assess impact of 1999 revisions to Title 24 on the remodeling and renovation market

General Research Recommendations:
- Build upon the information developed in the NSPC evaluation
- Analyze cross program linkages to determine most efficient intervention strategies.
- Focus on expanding the information available on supply-side actors including data on design criteria and practices. Include data on number of firms promoting energy efficiency design as

component of services and number of owners/developers offering energy efficiency warranties to tenants.

- 1996 Measure Cost Study may be useful supplement for baseline data on cost of different lighting technologies.
- Track end-user awareness of and compliance with the revised Title 24 requirements.
- Analyze market barriers to integrated technologies and design.
- Explore statewide integration of the CEUS data.
- Supplement existing PG&E information with 1996 CEUS study.
- Explore viability of CBEE database on lighting suppliers and manufacturers.
- Track market penetration of different lighting technologies in the small C&I market.
- Expand upon industrial lighting baseline data.

Research Project Recommendations:

1. Conduct a statewide study characterizing the supply side of the lighting market. Focus on developing baseline data to support the tracking of specified indicators of program success. Note the numerous cross program linkages identified above.
2. Conduct a scoping study to assess possible sources of supply-side market actor information suitable for developing statewide database on specific firms. Focus on improving the viability of existing data on suppliers and manufacturers by six and eight digit SIC codes.
3. Conduct statewide study of the remodeling/renovation market , comprehensive retrofit market and new construction market specifically focusing on developing baseline data on integrated design practices. Analyze the degree of institutionalization of energy efficiency financial analysis as a component of design practices. (Note: This project has been recommended in the other in the Comprehensive Retrofit Market and the Remodeling/Renovation market.)
4. Conduct statewide baseline study of role of local government in code implementation and enforcement. Include end-user, builder, and product and equipment supplier perspectives on role of codes in lighting energy efficiency decisions.

B.8 NON-RESIDENTIAL MOTORS

***Best Compiled Sources*:**

180 (Commercial/Industrial Market Effects Baseline Study Results by Quantum Consulting - 1998)

930 (U.S. Industrial Electric Motor Systems Market Opportunities Assessment by Xenergy - 1998)

910 (Selecting Targets for New Market Transformation Initiatives in Northern California by ACEEE and Xenergy - 1998)

620 (Comprehensive End-Use Survey Questionnaire for PG&E- 1993)

630 (Commercial Saturation Survey for SCE - 1997)

640 (Non-residential Non-participant Survey Results & Instrument for SDG&E by VIEWtech - 1996)

1210 (Strategies to Promote Energy Efficient Motor Systems in North America's OEM Markets by Easton Consultants - 1995)

Baseline Information Strengths:

- ✓ Source 930 provides thorough inventory of motor systems for the U.S by SIC codes. This data could be extrapolated to characterize the California market by SIC code stratification.
- ✓ Source 930 has useful information on motor purchase decision making practices and penetration of high efficiency motors.
- ✓ Sources 180 provides extensive data on perceived market barriers.
- ✓ Source 930, 910 and 1210 complement the CEUS data to provide information on market structure and functioning.
- ✓ Baseline data on energy efficiency levels, energy use, and efficiency of replacement equipment.
- ✓ Most data sources are recent and are drawn from large, statistically valid, sample sizes.
- ✓ CEUS data on market size, customer demographics, motor size, usage patterns, equipment age extensive.
- ✓ CEUS data are based on large samples with reliable and valid sampling approaches.
- ✓ CEUS data provide good end-user firmographics and energy use data.
- ✓ CEUS data includes retrofit data.
- ✓ Sufficient baseline data to support the assessment of key intervention strategies.

Source 170:

1) Useful data on market structure and functioning for motors in PG&E's territory, particularly the data on market barriers.
2) Baseline data on market actors and distribution channels.
3) Data on baseline product efficiency.
4) Comprehensive data on end-user attitudes, practices and purchase intentions.
5) Identification of critical points of intervention in the market.

Source 930:
1) Provides overview of the US industrial motor system inventory.
2) Identifies opportunities for energy savings by measure and industry segment.
3) Reviews motor system design, purchase and maintenance practices.
4) Profiles major manufacturing groups and provides motor inventory by SIC group.

Source 910:
1) Includes data on market structure and functioning including discussion of distribution channels, information channels, an analysis of major market barriers effecting market for 59 markets in PG&E's territory.
2) Both the end-user and supply side of the market were reviewed.
3) Data on energy efficiency and cost is included.

Sources 620, 630, and 640:
1) Studies provide comprehensive data on customer demographics, appliance saturations and usage patterns in PG&E, SCE and SDG&E service territories, respectively.

Source 1210
1) Provides a national overview of the commercial and industrial motors market with detail on the market structure, function and product offerings.
2) Details on energy saving opportunities and efficiency levels of air compressor systems, fan and blower systems, process pumping systems and HVAC water pumping systems.
3) Provides sales volume and marketing information for a range of equipment types and sizes.
4) Outlines strategies for transforming different segments of the motors market.
5) Provides energy consumption breakdown by market segment.

Baseline Information Weaknesses/Gaps:

The major gaps and weaknesses are a lack of a consolidated statewide database regarding the motors market. Disaggregated sources of data make it difficult to perform an assessment of market opportunities and key intervention strategies.

✓ CEUS data is by service territory and not statewide.
✓ 1993 CEUS data for PG&E's service territory, Report 620, is dated. More recent 1996 CEUS data is confidential.
✓ Statewide data on market products and services, cost, availability, promotional practices and sales is lacking.
✓ Gaps exist in the baseline data for cost and availability of premium or high-efficiency motors.
✓ Limited data on turnover of high efficiency pumps and fans.
✓ Source 180 is limited in scope focusing on motors in the 10-100 hp ranging PG&E's territory. It also has limited data on supply side firmographics, products and services.
✓ Limited information on stocking practices, promotional activities of vendors, design criteria, etc..
✓ Limited data on impact of DOE's Motor Challenge program?
✓ Data is limited for supply-side firmographics, products and services.

Relationship to Programs/Intervention Strategies:

- Motor Turnover: Critical needs in this program include characterization of motor turnover practices including data on penetration levels of high efficiency motors, controls, sizing, awareness and attitudes regarding high efficiency equipment, and supply side product and services information.
- New Construction Commercial and Industrial Program: The MA&E efforts supporting the New Construction Commercial and Industrial Program will have to be closely coordinated with the efforts of the Non-Residential Motor Program.
- New Construction Agricultural Program: The MA&E efforts supporting the New Construction Agricultural Program will have to be closely coordinated with the efforts of the Non-Residential Motor Program.
- Non-Residential Comprehensive Retrofit Program: The MA&E efforts supporting the small and large comprehensive retrofit programs will have to be closely coordinated with the efforts of the Non-Residential Motor Program.

General Research Recommendations:

- Characterize motor turnover events and practices focusing on the following three end-user segments: 1)Premium efficiency motors, 2)Efficient pumps and fans, and 3)Optimized motor system sizing and design.
- Study effectiveness of differing intervention strategies utilized by utilities.
- Consolidate baseline data from various sources into a centralized database, extrapolate data from Source 930 and 1210. High priority measures for tracking include:
    - level of penetration of premium efficiency equipment, controls, sizing and installation practices,
    - availability and cost of premium efficiency equipment,
    - awareness and attitudes of market participants toward premium efficiency equipment,
    - amount of vendor marketing material featuring higher equipment efficiency,
    - supplemental controls or compliance with sizing/installation protocols,
    - number of engineers, vendors, and contractors offering optimal sizing and installation services in their scope of services, and
    - stocking and ordering decisions on the part of distributors and vendors.
- Research and identify motor energy savings opportunities by measure and user segment.
- Coordinate research with NSPC, Large and Small Comprehensive Retrofit Program and with Non-residential New Construction Programs. Analyze cross program linkages to determine most efficient intervention strategies.
- Focus on expanding the information available on sales and cost data of high efficiency motors.
- Explore statewide integration of the CEUS data.
- Supplement existing PG&E information with 1996 CEUS study.
- Develop baseline data on linkage and promotion of DOE, CEE, NEEP, EPA and other product labeling and certification programs including DOE's Motor Challenge Program.

Research Project Recommendations:

1. Conduct a market opportunities assessment for the motors market in California. Focus on identifying motor energy savings opportunities by measure and user segment.
2. Conduct a scoping study to assess possible sources of supply-side market actor information suitable for developing statewide database on market share held by specific firms.
3. In the NSPC Evaluation Project, focus on developing statewide baseline data to track key market indicators in the motors market.

B.9 NON-RESIDENTIAL REFRIGERATION

***Best Compiled Sources*:**

140 (Study of Market Effects on the Supermarket Industry for PG&E by Quantum Consulting 1998

620 (Comprehensive End-Use Survey Questionnaire for PG&E - 1993)

630 (Commercial Saturation Survey for SCE - 1997)

640 (Non-residential Non-participant Survey Results & Instrument for SDG&E by VIEWtech 1996)

920 (SCE Industrial Survey Final Report for SCE by Aspen Systems - 1998)

910 (Selecting Targets for New Market Transformation Initiatives in Northern California for PG&E by ACEEE and XENERGY - 1998)

Baseline Information Strengths:

✓ PG&E market effects study was performed in 1998 for the supermarket industry and its centralized refrigeration systems and measures. Study covers the market structure, market actors, and energy efficient product offerings from both a supply and demand perspective.

✓ PG&E market effects study data are probably applicable to most of California.

✓ CEUS data provide state-wide inventory of commercial refrigeration equipment, efficiency measures implemented, and general energy usage. The SCE IEUS provides an inventory of industrial refrigeration. The saturation studies all have reasonably large samples.

Source 140:

1) Is current since it was performed in 1998.
2) Provides detail on the supermarket industry from both supply and demand sides with interviews of decision makers, architects, designers, and vendors.
3) Discusses market penetration, market barriers, distribution channels, and information channels.
4) Covers supermarket centralized refrigeration systems in detail including energy usage by technology and their associated energy efficiency measures.
5) Provides an external comparison to supermarkets in Illinois.

Sources 620, 630, and 640:

1) Include detailed state-wide inventories based on large customer samples.
2) Provide an inventory of refrigeration equipment and basic efficiency measures installed by site activity and SIC code.

Source 920:

1) Represents the industrial market in Southern California.
2) Provides detailed saturation data on refrigeration capacities and general equipment by industrial sector.

Source 910:
1) Provides a top line assessment of three key refrigeration measures and their energy efficiency potential: High Efficiency Packaged Refrigeration Equipment, Commercial Integrated Design and Industrial Gas Refrigeration.

Baseline Information Weaknesses/Gaps:
- ✖ There is no state-wide study of the refrigeration market available.
- ✖ There are no supply-side baseline data available for refrigeration markets other than supermarkets
- ✖ The CEUS end-use studies were not all performed in the same year.
- ✖ There are no industrial sector end-use market baseline data available other than in SCE's territory
- ✖ Both CEUS and IEUS data are limited to inventory data at a very summary level.

Source 140:
1) Is only focused on large supermarkets. Initial focus groups identified large differences between supermarkets and convenience stores so study narrowed its focus to larger stores.
2) Focuses on qualitative analyses. Data limitations prevented modeling that was originally hoped to show how interventions affect attitudes/barriers and how they in-turn affect actions/intentions.
3) Probably permits extrapolation to the state since large chains were included, but the target area was only the PG&E service territory.

Sources 620, 630, and 640:
1) Provides results from different years: PG&E 1993; SCE 1995; SDG&E 1996.
2) Includes refrigeration survey questions that are broadly focused and often use yes/no responses to capture general presence of equipment, but limited detail.

Source 920:
1) Is limited to SCE's service territory.
2) Includes refrigeration survey questions that are broadly focused and often use yes/no responses to capture general presence of equipment, but limited detail.

Source 910:
1) Presents results at a very high summary level with no primary data available.

Relationship to Programs/Intervention Strategies:
- ➪ Large Comprehensive Retrofit: Refrigeration could be a component of the large retrofit programs. More information is needed to assess the refrigeration market state-wide and to determine leverage points for transforming the market.
- ➪ Small Comprehensive Retrofit Program: Refrigeration is a viable component of the small commercial retrofit programs. It will be important to gather baseline data in areas such as market structure, function, actor behavior, and products for the smaller customers to determine how refrigeration improvements play a role in the transformation of their market.

- SPC components of Retrofit Programs (large and small): Because refrigeration improvements may not be the direct focus of program offerings, it will be valuable to assess the market structure and functioning of the SPC programs and their ties to market actors to determine how they create leveraged market transformation opportunities for specific end-uses that might otherwise be ignored.
- Process Overhaul Program: More baseline data is needed in this area including information on the market structure and function, market actors and their behaviors, and product and services. Because refrigeration improvements are likely to be very site and industry specific, detailed baseline data may be most useful if collected by industry once an overview of the market has been developed and industries prioritized for maximum market transformation opportunities.
- Commercial Remodeling /Renovation Program: Site remodeling/renovation may incorporate refrigeration improvements. Baseline data on the structure of the remodeling/renovation market and the ways that refrigeration improvements tie into market events will be useful to help clarify the market function and actors involved.

General Research Recommendations:

- Determine the structure, market actors, and product offerings for refrigeration modifications in a variety of businesses (such as convenience stores or warehouses) using the supermarket sector and study results as a base.
- Identify the most beneficial target markets for refrigeration improvements. Determine the market structure, actors, and products for these specific commercial and industrial targets.
- Supplement existing saturation information with broad studies in other geographic areas. Current data is limited to equipment inventories. Expand coverage to incorporate market actor information and customer behaviors.
- Assess the market structure and actors within the SPC offerings to determine if and how them promote refrigeration improvements. End-use specific baseline data in this market will help identify targets that might otherwise be lumped into more general categories.
- Assess the market structure and actors within the renovation/remodeling offerings to determine if and how them promote refrigeration improvements. End-use specific baseline data in this market will help identify targets that might otherwise be lumped into more general categories.
- Characterize turnover event issues by identifying leverage points for most effectively transforming the market.

Research Project Recommendations:

1. Expand the initial review of the convenience market segment discussed in the PG&E supermarket study to develop a more detailed understanding of this market.
2. Conduct statewide study of refrigeration supply side baseline market characteristics for commercial and industrial sector products and services with a focus on better defining the market structure.
3. Leverage existing CEUS data to develop a statewide inventory of refrigeration equipment and efficiency baselines with a focus on the end-user perspective.
4. Perform case study analyses of industrial segments to identify how industry behaviors, market structure, and actors compare within a similar industry.

5. Include specific survey questions about the refrigeration end-use in SPC and renovation/retrofit baseline projects to enhance the understanding of end-uses that do not have direct program/research efforts targeting them..
6. Emphasize baseline information for small commercial end-users and collect information needed to design a small commercial program.

B.10 NON-RESIDENTIAL OFFICE EQUIPMENT

***Best Compiled Sources*:**

EPA (Evaluation of Energy Star Office Equipment Program for EPA by XENERGY - work in progress.)
620 (Comprehensive End-Use Survey Questionnaire for PG&E- 1993)
630 (Commercial Saturation Survey for SCE - 1997)
640 (Non-residential Non-participant Survey Results & Instrument for SDG&E by VIEWtech - 1996)

Baseline Information Strengths

- ✓ The EPA study will provide valuable data on market penetration and sales of Energy Star office equipment including computers, monitors and copiers.
- ✓ CEUS studies are based on large samples with reliable and valid sampling approaches.
- ✓ CEUS studies include data on market size, building characteristics, end-user firmographics.
- ✓ CEUS studies include limited office equipment saturations of .PC's, printers, typewriters, MF Terminals, mini computers, mail equipment, copiers and "other".
- ✓ CEUS studies include limited baseline data on energy efficiency improvement measures that pertain to office equipment, specifically on "copier standby measures".
- ✓ CEUS studies provide some information on attitudes and practices of market participants.
- ✓ CEUS studies include some data on information channels.

Baseline Information Weaknesses/Gaps:

There is a major gap in data on office equipment - from both the end-user and the supply-side perspectives. The CEUS data does not include energy efficiency improvement measures for office equipment with the exception of copier standby. There is no source which compiles information specifically on office equipment with the exception of the EPA study noted above which is national in scope. End-user and supply side data on market structure and functioning, market actors and product and services is lacking.

- ✖ Baseline data on office equipment is almost non-existent.
- ✖ Data is by service territory and not statewide.
- ✖ Data on energy efficiency improvements in office equipment is lacking.
- ✖ Data on distribution channels and linkages is lacking.
- ✖ Supply side characterization and baseline data is lacking, particularly data on firmographics, availability and characterization of high efficiency products, stocking practices and sales.
- ✖ 1993 CEUS data for PG&E's service territory (# 620) is dated. More recent 1996 CEUS data was confidential at the time of our review but it should be obtained for baseline data purposes.
- ✖ There is a significant gap in baseline data regarding end-user and supply side actor behavior and decision making criteria pertaining to the office equipment market; specifically data on market barriers, distribution channels, linkages is lacking.

Relationship to Programs/Intervention Strategies:

- Support of Codes and Standards and Local Government Initiatives Program: Information on Energy Star office equipment should be included in MA&E tracking activities. Baseline data should include information on recognition and installation of the Energy Star label/brand.

General Research Recommendations:

- Develop baseline data on office equipment for the non-residential sector.
- Add office equipment component to the NSPC evaluations.
- Expand baseline data collection activities of future CEUS studies to include more thorough data on office equipment.
- Supplement existing PG&E information with 1996 CEUS study.
- Characterize office equipment turnover issues and practices.
- Collect data on office equipment which would support the efforts to redesign the Small Commercial SPC Program.
- Explore extrapolating national data on Energy Star office equipment (Pending XENERGY Report. for the EPA) to develop California baseline data.

Research Project Recommendations:

1. Conduct statewide baseline study of office equipment. Analyze impact of government sponsored Energy Star Program as well as penetration of other high efficiency office equipment. Include data on market barriers, distribution channels, and linkages, attitudes and practices of both end-users and supply side actors. Focus on gathering data on availability and cost of high efficiency products, vendor stocking practices, and end-use efficiency levels.
2. Coordinate statewide integration of CEUS data to develop baseline data to support high efficiency office equipment tracking activities.

B.11 NON-RESIDENTIAL COMPRESSED AIR

***Best Compiled Sources*:**

1210 (Strategies to Promote Energy Efficient Motor Systems in North America's OEM Markets for DOE by Easton Consultants - 1995)
1220 (Industrial Air Compressor Commissioning Baseline "Mini-Study" for PG&E by XENERGY - 1998)
620 (Comprehensive End-Use Survey Questionnaire for PG&E- 1993)
630 (Commercial Saturation Survey for SCE - 1997)
640 (Non-residential Non-participant Survey Results & Instrument for SDG&E by VIEWtech - 1996)
920 (SCE Industrial Survey Final Report for SCE by Aspen Systems - 1998)
910 (Selecting Targets for New Market Transformation Initiatives in Northern California for PG&E by ACEEE and XENERGY - 1998)

Baseline Information Strengths:

✓ A market strategy report outlines the structure and functioning of the compressed air market. Results are based on discussions with a range of market players with a focus on the supply side.
✓ National perspective of the strategy report is likely reflective of California.
✓ Strategy report defines market barriers, linkages, and proposed methods for transforming the market for compressed air installations.
✓ Compressed air mini-study offers a quick assessment of air compressor vendors and their market structure and functioning. Also includes information on air compressor commissioning services.
✓ CEUS data provides state-wide inventory of commercial air compressor equipment. The saturation studies have reasonably large samples.

Source 1210:

1) Provides a national overview of the compressed air market with detail on the market structure, function, as well as products and services. Strongest focus is the detail on the information and distribution channels, market barriers, linkages, customer and supplier behaviors, and energy efficiency opportunities.
2) Details energy saving opportunities for compressed air systems from the equipment, design/control, and operations/maintenance standpoints.
3) Provides energy consumption breakdown of air compressors by their size, type, market segment.
4) Provides sales volume and marketing information for a range of equipment types and sizes.
5) Outlines strategies for transforming the market.

Source 1220:

1) Includes assessment of vendor barriers, behaviors, and leverage points.
2) Outlines the structure of the aid compressor sales and maintenance/service contractor market.
3) Provides baseline data on vendor interests in a variety of potential program offerings.

Sources 620, 630, and 640:
1) Include detailed state-wide inventories based on large customer samples.
2) Provide an inventory of compressed air equipment by site activity and SIC code.

Source 920:
1) Represents the industrial market in Southern California.

Source 910:
1) Provides a generalized assessment of industrial compressed air system improvements.

Baseline Information Weaknesses/Gaps:

- ✖ The only comprehensive study is a few years old and does not provide detail on the sampling methodology.
- ✖ The PG&E mini-study provides good baseline data, but is limited in scope to air compressor vendors and their service offerings.
- ✖ There is little information available on baseline market characteristics of compressed air end-users.
- ✖ The CEUS studies were not all performed in the same year.
- ✖ The IEUS data were compiled in SCE's territory only.
- ✖ Both CEUS and IEUS compressed air data are limited to inventory data at a very summary level.

Source 1210:
1) Provides qualitative data with little detail on interview sample sizes.
2) Was performed between 1993 and 1995 so it is a few years old.
3) Is nationally focused and may differ from California market due to market effects of previous commercial/industrial programs.

Source 1220:
1) Is a "mini-study" limited to a small sample of Northern California air compressor vendors.

Sources 620, 630, and 640:
1) Provide results from different years: PG&E 1993; SCE 1995; SDG&E 1996.
2) Include compressed air survey questions that are limited to whether or not customer use compressed air and the system wattage.

Source 920:
1) Is limited to SCE's service territory.
2) Contains only one survey question about air compressors that asks the types of controls that are used with air compressor systems.

Source 910:
1) Presents results at a very high summary level with no primary data available.
2) Is particularly limited in the compressed air section.

Relationship to Programs/Intervention Strategies:

- Large Comprehensive Retrofit Program: Compressed air could be a component of the large retrofit programs. More information is needed to assess the compressed air market state-wide and to determine leverage points for transforming the market.
- Small Comprehensive Retrofit Program: Compressed air is a viable component of the small commercial retrofit programs. It will be important to gather baseline data in areas such as market structure, function, actor behavior, and products for the smaller customers to determine how compressed air improvements play a role in the transformation of their market.
- SPC components of retrofit programs (large and small): Because compressed air improvements may not be the direct focus of program offerings, it will be valuable to assess the market structure and functioning of the SPC programs and their ties to market actors to determine how they create leveraged market transformation opportunities for specific end-uses that might otherwise be ignored.
- Process Overhaul: More baseline data is needed in this area including information on the market structure and function, market actors and their behaviors, and product and services. A large percentage of the energy associated with compressed air is used in plant processes. O&M improvements are one avenue for effecting change and should be studied further to assess leverage points for market transformation.
- Remodeling /Renovation: Site remodeling/renovation may incorporate compressed air improvements. Baseline data on the structure of the remodeling/renovation market and the ways that compressed air improvements tie into market events will be useful to help clarify the market function and actors involved.

General Research Recommendations:

- Determine the structure, market actors, and product offerings for compressed air modifications in a variety of businesses.
- Identify the most beneficial target markets for compressed air improvements. Determine the market structure, actors, and products for these specific commercial and industrial targets.
- Supplement existing saturation information with broad studies in other geographic areas. Current data is limited to equipment inventories. Expand coverage to incorporate market actor information and customer decision making behaviors.
- Assess the market structure and actors within the SPC offerings to determine if and how them promote compressed air improvements. End-use specific baseline data in this market will help identify targets that might otherwise be lumped into more general categories.
- Assess the market structure and actors within the renovation/remodeling offerings to determine if and how them promote compressed air improvements. End-use specific baseline data in this market will help identify targets that might otherwise be lumped into more general categories.
- Characterize turnover event issues by identifying leverage points for most effectively transforming the market.

Research Project Recommendations:

1. Conduct statewide study of end-user baseline market characteristics for compressed air to develop a better understanding of the overall market structure and market actors. Use the PG&E mini-study as a starting point and gather more actor information as well as broadening the study to cover the whole state.
2. Leverage existing state-wide commercial CEUS data and Southern California industrial data to develop a state-wide inventory of the compressed air market from the end-user perspective with a focus on understanding customer behaviors, market barriers, and leverages for transforming the market.
3. Perform a focused study of the California market to determine if national baseline data from the strategy study can be applied to California.
4. Include specific survey questions about the compressed air end-use in SPC and renovation/retrofit baseline projects to enhance the understanding of end-uses that do not have direct program/research efforts targeting them..
5. Emphasize baseline information for small commercial end-users and collect information needed to design a small commercial program.

B.12 NON-RESIDENTIAL BUILDING SHELL

***Best Compiled Sources*:**

910 (Selecting Targets for New Market Transformation Initiatives in Northern CA by ACEEE and XENERGY - 1998)
620 (Comprehensive End-Use Survey Questionnaire for PG&E - 1993)
630 (Commercial Saturation Survey for SCE - 1997)
640 (Non-residential Non-participant Survey Results & Instrument for SDG&E by VIEWtech - 1996)

Baseline Information Strengths:

✓ The Market Transformation study contains valuable end-use data on window film and roof spray measures.
✓ CEUS studies are based on large samples with reliable and valid sampling approaches.
✓ CEUS studies include data on market size, end-user demographics, saturations of building shell measures and energy usage patterns.
✓ CEUS studies include information on age of building, square footage, percent of building with energy efficient measures and installation dates.
✓ CEUS studies provide some information on attitudes and practices of market participants.
✓ CEUS studies include some data on information channels.

Source 910

1) 59 measures reviewed to target new market transformation initiatives in Northern California.
2) Provides detailed overview of window film and roof spray measures.
3) Information on average baseline and new measure efficiency levels, energy usage per sq. ft., savings information, cost information, major market barriers and likelihood of measure success.

CEUS Sources

1) Include baseline data on building specifications of exterior walls, roof/ceiling types, floor types and glazing types.
2) Includes baseline data on energy efficiency improvement measures that pertain to the building shell. Baseline data available on percent of existing square footage and year installed for the following measures: roof insulation, ceiling insulation, wall insulation, window treatment and weather stripping.

Baseline Information Weaknesses/Gaps:

There is a major gap in supply-side data, particularly data on product and services, distribution channels and linkages. Additionally, there is a gap in baseline data regarding end-user decision making.

✖ Data is by service territory and not statewide.
✖ Data on energy efficiency improvements in building shell is lacking.
✖ Data on distribution channels and linkages is lacking.

- ✖ Supply side characterization and baseline data is lacking, particularly data on product and services, distribution channels and linkages.
- ✖ Data on high efficiency product and services availability, stocking practices and sales is lacking.
- ✖ 1993 CEUS data for PG&E's service territory (# 620) is dated. More recent 1996 CEUS data was confidential at the time of our review but it should be obtained for baseline data purposes.
- ✖ There is a significant gap in baseline data regarding end-user decision-making.

Source 910

1) Energy end-use savings potential is estimated for PG&E's service territory and is not statewide.
2) For window film, a small office building was modeled, but the results were applied to all commercial buildings. This isn't representative of buildings with a higher glass to floor area ratio which would have a higher savings per square foot of floor area.

CEUS Sources

1) Baseline data on market structure and functioning is quite limited.
2) Baseline data on end-user decision-making practices and criteria is limited.
3) Data is by service territory and not statewide.
4) Product and service data, particularly pertaining to supply side, is limited.

Relationship to Programs/Intervention Strategies:

- ➪ Large Non Residential Comprehensive Retrofit Program: Existing information would have to be supplemented with more information on building shell retrofit practices, market structure/functioning, attitudes, end-user and supply-side behavior, and products and services.
- ➪ Small Non Residential Comprehensive Retrofit Program: In addition to the above needs, an additional focus would be required on small end-users. Existing and additional baseline information would be essential in designing new programs in this area.
- ➪ Support of Codes and Standards and Local Government Initiatives Program.

General Research Recommendations:

- ➪ Explore statewide integration of the CEUS data.
- ➪ Build upon the information developed in the NSPC evaluation.
- ➪ Expand information on all market characteristics poorly covered by the CEUS studies and the NSPC evaluations (particularly structure/functioning market baseline characteristics, products/services, and supply side data).
- ➪ Focus on expanding the information available on supply-side actors including data on number of firms offering integrated design services, design practices and equipment stocking and ordering practices.
- ➪ Supplement existing PG&E information with 1996 CEUS study.
- ➪ Collect information needed to redesign the small SPC program.

Research Project Recommendations:

1. Conduct statewide baseline study of role of local government in code implementation and enforcement. Include end-user, builder, product and equipment supplier perspectives on the role of codes in energy-efficiency decisions.
2. Conduct a study to characterize the non-residential building shell market focusing on developing baseline data on end-user and supplier attitudes, behavior, market barriers, distribution channels, and product and services.
3. Coordinate statewide integration of CEUS data to develop baseline data to support building shell measure tracking activities.
4. Conduct statewide study of supply side baseline market characteristics for commercial sector building shell market. Focus on gathering data on availability and cost of high efficiency products, vendor stocking practices and installation practices.

B.13 NON-RESIDENTIAL PROCESS

***Best Compiled Sources*:**

120 (SCE Hydraulic Services Program Market Effects Study No. 3507 - Final Report for SCE by RLW Analytics - 1998)

1210 (Strategies to Promote Energy Efficient Motor Systems in North America's OEM Markets for DOE by Easton Consultants - 1995)

920 (SCE Industrial Survey Final Report Volume 3: Technical Report for SCE by Aspen Systems - 1998)

910 (Selecting Targets for New Market Transformation Initiatives in Northern California for PG&E by ACEEE and XENERGY - 1998)

Baseline Information Strengths:

- ✓ An SCE market effects study targets the agricultural and water supply pumping industry with detail on market actors, barriers, as well as customer awareness and decision making.
- ✓ A market strategy report outlines the structure and functioning of the process pumping market with a focus on the petroleum, chemical, and paper and pulp industries. It also covers non-HVAC fan and blower systems. Results are based on discussions with a range of market players with a focus on the supply side.
- ✓ National perspective of the strategy report is likely reflective of California.
- ✓ Strategy report defines market barriers, linkages, and proposed methods for transforming the market for process pumping applications and non-HVAC fan/blower systems.
- ✓ Industrial saturation data provides a generalized inventory of process equipment.

Source 120:

1) Provides good customer sampling approaches as well as a broad range of supply side data on the agricultural and water supply pumping industry.
2) Compares market structure, actor behavior, and actor sales data with a comparison area (Arizona) that does not currently have pumping programs.
3) Includes detailed discussion of the market structure including barriers and linkages; actor behavior and energy use; and energy efficiency and sales information about available products.

Source 1210:

1) Provides a national overview of the process pumping market with detail on the market structure, function, as well as products and services. Strongest focus is the detail on the information and distribution channels, market barriers, linkages, customer and supplier behaviors, and energy efficiency opportunities.
2) Details energy efficiency opportunities for process pumping applications from the equipment, speed control, and system design standpoints.
3) Provides market structure, function, and product information for non-HVAC fan/blower systems with similar detail as presented above for process pumping.

4) Provides sales volume and marketing information for a range of equipment types and sizes.
5) Outlines strategies for transforming the two process markets.

Source 920:
1) Provides industrial saturation data for a full range of industrial businesses in the Southern California market. Focus is on energy usage and presence of energy efficient equipment.
2) Includes behavioral data on customers' proposed renovations and/or process enhancements.

Source 910:
1) Provides a top line assessment of two key process measures and their energy efficiency potential: Industrial pumps, fans, and blowers; and Agricultural irrigation pumps system optimization. Includes summaries of numerous other general measures that may be intertwined with process improvements.

Baseline Information Weaknesses/Gaps:

- ✖ The two comprehensive studies have narrowly focused markets: agricultural and water supply pumping, process pumping in the petroleum, chemical, and paper and pulp industries.
- ✖ The coverage of non-HVAC fan and blower systems may be too general for specific industrial applications.
- ✖ The customer perspective is limited since the strategy report focuses on the supply side and overall energy use for the market.
- ✖ The IEUS data were compiled for SCE's territory only and have limited detail.

Source 120:
1) Limits focus to narrow overall market data or specific cost data of hydraulic pumping services for agricultural and water supply customers.
2) Has no Northern California focus since it is limited to SCE's service territory with comparison to Arizona.

Source 1210:
1) Provides qualitative data with little detail on interview sample sizes.
2) Was performed between 1993 and 1995 so it is a few years old.
3) Is nationally focused and may differ from California market due to market effects of previous commercial/industrial programs.

Source 920:
1) Is limited to SCE's service territory.
2) Only includes data on the presence of certain process equipment and does not provide much detail on the products, actors, or market structure.

Source 910:
1) Provides very high summary level data about energy efficiency with no primary data available.

Relationship to Programs/Intervention Strategies:

- Large Comprehensive Retrofit: Process improvements could be a component of the large retrofit programs. More information is needed to assess the process market state-wide from all baseline angles and to highlight leverage points for transforming the market.
- Small Comprehensive Retrofit: Although process improvements are more likely to fall under the large comprehensive retrofit programs, it will be important to gather baseline data in areas such as market structure, function, actor behavior, and products for the smaller customers to determine how process improvements play a role in the transformation of their market.
- SPC components of retrofit programs (large and small): Because process improvements may not be the direct focus of program offerings, it will be valuable to assess the market structure and functioning of the SPC programs and their ties to market actors to determine how they create leveraged market transformation opportunities for specific end-uses that might otherwise be ignored.
- Motor Turnover: Since many process improvements involve motor, ASD fans, and pumps, this program is likely to be involved in process changes. Motor baseline data is more widely available than industry specific process data and provides a valuable overlap to the process market. See the motor assessment for more detail on gaps.
- Process Overhaul: This program area will cover the bulk of the process improvements. More baseline data is needed in this area including information on the market structure and function, market actors and their behaviors, and product and services. Because process improvements are likely to be very site and industry specific, detailed baseline data may be most useful if collected by industry once an overview of the market has been developed and industries prioritized for maximum market transformation opportunities.
- Commercial Remodeling /Renovation Program: Site remodeling/renovation is likely to be a good driver for process improvements. Baseline data on the structure of the remodeling/renovation market and the ways that process improvements tie into market events will be useful to help clarify the market function and actors involved in process improvements.

General Research Recommendations:

- Determine the structure and function of the process market. Since the market overlaps with several other end-use markets, it will be important to understand who the market actors are and how their behavior links to market transformation.
- Identify the most beneficial target markets for process improvements (petroleum, chemical, and paper and pulp industries appear to have good opportunities). Determine the market structure, actors, and products for these specific industrial targets.
- Identify end-use market overlaps that have the biggest impact on the process market and integrate baseline research between these markets. For example, motor modifications may make up a large portion of process improvements.
- Supplement existing SCE industrial saturation information with broad studies in other geographic areas. Current data is limited to equipment inventories. Expand coverage to incorporate market actor information and customer behaviors.
- Assess the market structure and actors within the SPC offerings to determine if and how them promote process product and service improvements. End-use specific baseline data in this market will help identify targets that might otherwise be lumped into more general categories.
- Assess the market structure and actors within the renovation/remodeling offerings to determine if and how them promote process product and service improvements. End-use specific

baseline data in this market will help identify targets that might otherwise be lumped into more general categories.

- ➪ Characterize turnover event issues by identifying leverage points for most effectively transforming the market.

Research Project Recommendations:

1. Perform a focused study of the California market to determine if national baseline data from the strategy study can be applied to California.
2. Leverage Southern California industrial data and add more process detail as well as expand data collection across the state. Focus on determining energy usage and efficiency issues as well as actor behavior with respect to process improvements.
3. Perform case study analyses of industrial segments to identify how industry behaviors, market structure, and actors compare within a similar industry.
4. Include specific survey questions about the process end-use in SPC and renovation/retrofit baseline projects to enhance the understanding of end-uses that do not have direct program/research efforts targeting them..

B.14 NON-RESIDENTIAL COMPREHENSIVE RETROFIT

***Best Compiled Sources*:**

620 (Comprehensive End-Use Survey Questionnaire for PG&E- 1993)
630 (Commercial Saturation Survey for SCE - 1997)
640 (Non-residential Non-participant Survey Results & Instrument for SDG&E by VIEWtech - 1996)

Baseline Information Strengths

The most useful sources of information are the utility CEUS studies which provide thorough information on end-user demographics, appliance saturations and usage patterns.

- ✓ CEUS data are based on large samples with reliable and valid sampling approaches.
- ✓ CEUS data includes data on , end-user demographics, appliance saturations, and penetration of high efficiency appliances.
- ✓ CEUS data includes information on equipment age, sizing, usage patterns and date of last retrofit.
- ✓ CEUS data provides some information on practices of market participants.
- ✓ CEUS data includes some data on information channels.

Baseline Information Weaknesses/Gaps:

The major gaps and weaknesses are a shortage of information on the market structure and functioning of the nonresidential comprehensive retrofit market. There is a major gap in supply-side data; particularly, data on firmographics, behavior and products and services is lacking. Additionally, gaps exist in data on end-user attitudes and behavior practices regarding integrated design and installation of high efficiency products and services.

- ✓ Data is by service territory and not statewide.
- ✓ Data on distribution channels, market barriers, linkages is lacking.
- ✓ Supply side characterization and baseline data specifically pertaining to the comprehensive retrofit market is lacking. Data on supply side distribution channels, market barriers to integrated comprehensive design, information channels, market linkages, firmographics and products and services is weak.
- ✓ Data on high efficiency equipment cost, stocking practices and sales is lacking.
- ✓ End-use data on equipment retirement and planned overhauls is lacking.
- ✓ Data on integrated design, optimal sizing, or installation practices lacking.
- ✓ 1993 CEUS data for PG&E's service territory (# 620) is dated. More recent 1996 CEUS data is confidential.

Relationship to Programs/Intervention Strategies:

- ➪ Large Non Residential Comprehensive Retrofit Program: Existing information would have to be supplemented with more information on current retrofit practices, market structure/functioning, attitudes, end-user and supply-side behavior, and products and services.
- ➪ Small Non Residential Comprehensive Retrofit Program In addition to the above needs, an additional focus would be required on small end-users. Existing and additional baseline information would be essential in designing new programs in this area.

- Large SPC

General Research Recommendations:

- Explore statewide integration of the CEUS data.
- Build upon the information developed in the NSPC evaluation.
- Expand information on all market characteristics poorly covered by the CEUS studies (particularly structure/functioning market baseline characteristics, products/services and supply side data).
- Focus on expanding the information available on supply-side actors including data on number of firms offering integrated design services, design practices and equipment stocking and ordering practices.
- Supplement existing PG&E information with 1996 CEUS study.
- Expand baseline information to include data on planned retirement of equipment or planned overhauls.
- Characterize turnover issues and processes and identify critical intervention points.
- Characterize impact of electric competition on the both the small and large commercial retrofit market and expand baseline information to include tracking variables. Baseline data should include whether end-user had been contacted by alternative electric suppliers and the type of products and services offered.
- Collect information needed to redesign the small NSPC program.
- Research efforts for the non-residential comprehensive retrofit program should be carefully coordinated with research efforts targeted to specific end-uses.

Research Project Recommendations:

1. Conduct statewide study of supply side baseline market characteristics for commercial sector products and services. Target filling in information pertaining to poorly covered areas such as availability and cost of high efficiency equipment, vendor stocking practices and integrated design services Additionally, target information supporting the Small NSPC program.
2. Conduct study of available end-user baseline information cutting across different commercial products and services to compile an integrated set of end-user baseline data and support development of Small NSPC program. Focus on the identified target areas of HVAC, lighting, motor-drive systems and process. Determine feasibility of analyzing data to determine average efficiency of installed HVAC, lighting and motor-drive equipment and the percentage of installed equipment that is properly sized.

B.15 NON-RESIDENTIAL REMODELING/RENOVATION

***Best Compiled Sources*:**

250 (SCE CBEE Non-Residential New Construction Statewide Baseline Study (Proposal) for SCE/CBEE by RLW Analytics - 1998)
620 (Comprehensive End-Use Survey Questionnaire for PG&E- 1993)
630 (Commercial Saturation Survey for SCE - 1997)
640 (Non-residential Non-participant Survey Results & Instrument for SDG&E by VIEWtech - 1996)

Baseline Information Strengths

✓ The CBEE/NRNC data is statewide
✓ The CBEE/NRNC data provides information on new construction building types, square footage, climate zones, and EUI's.
✓ The CBEE/NRNC data to include supply-side information.
✓ CEUS data on market size, end-user demographics, appliance saturations and usage patterns extensive.
✓ CEUS data includes information on equipment age, usage patterns and efficiency of end-use target measures.
✓ CEUS data are based on large samples with reliable and valid sampling approaches.
✓ CEUS data provide good end-user firmographics and energy use data.
✓ CEUS data includes retrofit data.
✓ CEUS data includes useful information on information channels.

Source 250

1) Outlined a project which consolidates data for the non-residential new construction market in California (CBEE/NRNC).
2) According to the scoping study, this project will develop baseline data on the new construction market, including major renovation projects, and will include data on market barriers, information channels and practices of design firms.

Sources 620, 630 and 640 (CEUS Studies)

1) Provide comprehensive data on end-user demographics, appliance saturations and usage patterns in PG&E, SCE and SDG&E service territories, respectively.

Baseline Information Weaknesses/Gaps:

The major gaps and weaknesses are a shortage of information on the market characteristics of the nonresidential remodeling/renovation market. Very little data is available to assess key points of intervention in this market. There are gaps in data regarding end-user decision making criteria related to decisions to remodel/renovate prior to equipment failure. Additionally, data regarding supply side actor's behavior and products and services is lacking.

✓ The CBEE/NRNC data is not a complete market overview and applies only to new construction and major renovation markets.
✓ CEUS data is by service territory and not statewide.

- ✓ Market structure and functioning data, such as distribution channels, market barriers and linkages, is lacking for both end-users and supply side actors.
- ✓ Supply side data is lacking.
- ✓ Data on market size of non-residential remodel/renovation market is lacking.
- ✓ 1993 CEUS data for PG&E's service territory, Report 620, is dated. More recent 1996 CEUS data is confidential.
- ✓ Market products and services data on cost, availability, promotional practices and sales is lacking.
- ✓ Data on integrated design and installation practices lacking.
- ✓ Data on code enforcement and role of local governments limited.

Relationship to Programs/Projects:

- ➪ Commercial Remodeling and Renovation Program: There is very little information on the remodeling/renovation process. Follow-up research required to characterize market, determine baseline tracking variables, and monitor changes in market indicators.
- ➪ Support of Codes and Standards and Local Government Initiatives Program: Characterize and develop baseline data on the role of local governments in supporting Title 24. Assess impact of 1999 revisions to Title 24 on the remodeling and renovation market.

General Research Recommendations:

- ➪ Characterize non-residential remodeling/renovation market focusing on issues and processes and developing baseline information on remodeling cycles. Existing information should be supplemented with data on integrated lighting design practices, end-user decision making criteria specifically pertaining to remodeling/renovation practices and supply side firmographic data. Baseline data on daylighting, occupancy and lighting controls should also be developed.
- ➪ Identify cross program linkages to determine most efficient strategy for tracking indicators of program success. Because lighting is the primary component of the remodeling/renovation program, linkages to other programs which promote high efficiency lighting design and equipment should be identified. Tracking specified indicators of program success should be coordinated across programs.
- ➪ Focus on expanding the information available on supply-side actors including data on design criteria and practices.
- ➪ Explore statewide integration of the CEUS data.
- ➪ Expand information on all market characteristics poorly covered by the CEUS studies (particularly structure/functioning market baseline characteristics, products/services and supply side data).
- ➪ Supplement existing PG&E information with 1996 CEUS study.
- ➪ Build upon the information developed in the NSPC evaluation.
- ➪ Review existing lighting studies to extract useful baseline data as it pertains to the remodeling/renovation market.

Research Project Recommendations:

1. Conduct study to characterize non-residential remodeling/renovation market focusing on baseline information such as end-user attitudes, awareness, market barriers decision-making criteria regarding remodeling/renovation and remodeling cycles by building segment.
2. Conduct statewide study of supply side baseline market characteristics for commercial sector products and services. Target filling in information pertaining to current remodeling/renovation design practices.
3. Conduct statewide baseline study of role of local government in code implementation and enforcement. Include end-user, builder, and product and equipment supplier perspectives on role of codes in remodeling/renovation energy efficiency decisions.
4. Conduct study of available baseline information cutting across different market areas to compile an integrated set of end-user baseline data. This project can be integrated with projects number 1 and 2 listed above.

B.16 RESIDENTIAL NEW CONSTRUCTION

***Best Compiled Sources*:**

170 (Residential Market Effects Study for SCG and SDG&E on gas equipment by RER - 1998

60 (Residential New Construction: Market Transformation Study, which includes Residential New Construction Market Characterization Report, for PG&E and SCE by Barakat & Chamberlain et al. - 1997)

1050 (Windows Market Transformation Study for PG&E by Opinion Dynamics - 1998)

910 (Selecting Targets for New Market Transformation Initiatives in Northern California for PG&E by ACEEE and XENERGY - 1998)

10 (Impact Evaluation of PG&E's 1996 Residential New Construction Program by XENERGY - 1998)

830 (Post Occupancy Survey for CEC by NEOS - 1997)

270 (First-year Load Impacts of SCG's 1994 Energy advantage Home Program for SCG by RER - 1997)

800 (1993 Residential Field Data Project for CEC and CADMAC by BSG et al. - 1995)

Baseline Information Strengths:

✓ Most information is relatively recent.
✓ Data for gas heating and water heating is relatively complete.
✓ Window data for products, market structure and functioning, and market actors are fairly complete.
✓ Duct characteristics data are fairly complete.
✓ Baseline efficiency data are fairly complete.
✓ Construction and equipment characteristics for new homes are good in some geographic areas.

Source 170

1) Provides good 1998 southern California information on the gas heating equipment, gas water heating, windows, and shell insulation markets.
2) Uses a comparison area.
3) Covers manufacturers, consumers, builders, developers, HVAC contractors, distributors, lenders, building inspectors, government staff, and energy consultants.
4) Provides good information on market structure.
5) Market structure information is probably relevant to all of California.
6) Includes baseline efficiency data (based on CEC source for all areas and building dept. data).
7) Includes good information on market barriers.

Source 60

1) Covers northern and southern California utilities.
2) Presents information from 1996-1997.
3) Provides good market structure/function and barrier information for all key market actors.
4) Assesses alternative market interventions used in programs.
5) Addresses market effects indicators.

6) Applies analytic hierarchy process (AHP) to assess barriers and market changes.

Source 1050
1) Covers the windows market well.
2) Includes information from window manufacturers, production builders, window contractors, Energy consultants, building inspectors, and home owners
3) Provides baseline window sales data
4) Provides information on builder motivations and window selections
5) Provides window incremental costs.
6) Provides market actor awareness and attitudes about window efficiency.
7) Identifies barriers to installing more efficient windows.
8) Presents ways to reduce market barriers (including building codes) and leverage points for market changes.

Source 910
1) 1998 resource.
2) Presents typical incremental costs.
3) Presents typical energy savings.
4) Includes gas water heaters, air conditioner evaporative pre-cooler, duct sealing, high efficiency air conditioners, efficient windows, integrated space conditioning/water heating heat pumps, integrated gas space/water heaters, instantaneous water heaters, wastewater heat recovery, residential HVAC measures, improved building code enforcement, light-colored roofs.

Source 10
Contains some baseline air conditioner and duct efficiency information for PG&E area.

Source 830
1) Has home characteristics and appliance data.
2) Has shell insulation and window data.
3) Has water heater, heating, and cooling efficiencies for a representative sample of homes built since 1989.
4) Presents statewide data.

Source 270
1) Provides data for comparison group of new homes constructed in 1994 in SCG area.
2) Includes building characteristics.
3) Includes occupant demographics.
4) Includes some appliance stock data.
5) Includes gas space and water heating equipment information.
6) Includes some home leakage and duct test results.
7) Presents some builder/developer energy-efficiency attitudes, awareness, and decision-making information.

Source 800

1) Provides data for central California new homes in 1993.
2) Provides home characteristics data.
3) Includes insulation levels, window characteristics, heating and cooling equipment efficiencies, and duct efficiency data.
4) Includes energy consumption estimates.

Source 1020
1) Provides some information on manufactured housing market in Pacific Northwest.

Baseline Information Weaknesses/Gaps:

The major gaps and weaknesses are a shortage of information on the supply side, lack of detailed information on a range of equipment types and geographic areas, and limited information on key market characteristics.

- ✖ Data sources are usually for specific geographic areas so statewide information is inadequate.
- ✖ Comprehensive information is available for only certain products such as windows and gas heating equipment.
- ✖ Market actor information is limited for both the demand and supply sides.
- ✖ There is little available information on code enforcement.
- ✖ There is little information on statewide code compliance.
- ✖ There is no information on the California manufactured housing market.

Source 60
1) Has relatively small sample sizes, and 2) contains no firsthand home owner information.

Source 1050
1) Covers only windows (both new and replacement) in the PG&E service territory and does not include information on window distributors/retailers.

Source 910
1) Presents only summary information and focuses on only PG&E area (although information is probably relevant statewide).

Source 10
1) Is for PG&E area only and is limited to air conditioning and duct efficiency and gas heating and clothes dryer hook ups.

Source 830
1) Has a very small sample size of the most recently built homes.

Source 270
1) Is limited to SCG area, is about 6 years old, and has no market structure information.

Source 800
1) Is for central California homes only and provides only house characteristics and energy use information.

Relationship to Programs/Intervention Strategies:
- Support of Codes and Standards and Local Government Initiatives Program: There is almost no information in existing sources on baseline local government code activities. One source provides information on code compliance, but does not address role of code officials.
- Residential New Construction Program: There is some good information on code compliance, but in selected geographic areas only. There is no baseline information on manufactured housing characteristics or this market. (Note that latest market data show rapid growth in California manufactured homes market.)

General Research Recommendations:
- Investigate possibilities of integrating existing studies of local areas to determine what statewide information can be compiled.
- Enhance information on market structure and functioning and market actors for residential new construction as a whole and for all products and components of new buildings.
- Develop more complete information on consumer attitudes, awareness, and decision-making regarding energy efficiency in new homes although consumer role is relatively small in new homes market.
- Develop market information for manufactured housing.
- Develop information on role of local government in code enforcement and compliance.

Research Project Recommendations:
1. Conduct statewide baseline study of role of local government in code implementation and enforcement. Include consumer, builder, and product and equipment supplier perspectives on role of codes in new home energy efficiency.
2. Conduct limited study of northern California market of both demand- and supply-side baseline market characteristics for new residential construction to supplement Source 170 for southern California new homes market.
3. Conduct baseline study of manufactured housing market in California including home buyers, home manufacturers, product suppliers, and role of codes and government. Review and extract relevant information from Pacific Northwest studies.

B.17 COMMERCIAL NEW CONSTRUCTION

***Best Compiled Sources*:**

250 (SCE CBEE Non-Residential New Construction Statewide Baseline Study (Proposal) for SCE/CBEE by RLW Analytics - 1998)

160 (PG&E's Energy Center Market Effects Study for PG&E by TecMRKT Works - 1997)

50 (PG&E and SDG&E Commercial Lighting Market Effects Study for PG&E & SDG&E by XENERGY - 1998)

910 (Selecting Targets for New Market Transformation Initiatives in Northern California for PG&E by ACEEE and XENERGY - 1998

Baseline Information Strengths:

- ✓ State-wide baseline study provides a solid effort to consolidate existing data and create a centralized database of baseline information.
- ✓ Ongoing baseline study provides feedback on the market structure, barriers, actors, and products with a state-wide focus.
- ✓ Ongoing efforts in the baseline study include comparing current construction practices with Title 24 requirements.
- ✓ PG&E's Energy Center study defines the structure of that market including penetration figures and leverage points for transforming the market.
- ✓ The new construction lighting market is well defined in the lighting market effects study with detail on the market actors, structure, functioning, and products.

Source 250:

1) Provides a consolidated baseline assessment of the market using data from PG&E and SCE evaluations to create a central database. Future efforts include incorporating additional geographic areas and collecting new onsite data.
2) Assesses current construction practices and energy efficient products from numerous actor perspectives providing an overview of the market structure, barriers, actor behaviors, and functioning.
3) Uses statistical weighting of the data (including ongoing work) to provide a state-wide overview that is representative of the new construction market.
4) Provides some comparison of current construction practices against Title 24 requirements with more work planned in this area.

Source 160 :

1) Outlines the market structure from the viewpoint of services offered by the center.
2) Provides baseline data on market penetration and information provided by the energy center.
3) Provides information on leverage points used by the center to transform the market and how customer behaviors have been effected.

Source 50:
1) Provides a baseline overview of the lighting market with detail on the market structure, barriers, actors, linkages, and products.
2) Details market share data by purchase events including new construction.
3) Is important for the new construction market because of the magnitude of the lighting end-use in commercial facilities.

Source 910:
1) Provides a top line assessment of two key new construction measures and their energy efficiency potential: Integrated Commercial Building Design and Commissioning Existing Commercials Buildings (which also mentions initial commissioning needs). Includes summaries of numerous other general measures that may be intertwined with new construction projects.

Baseline Information Weaknesses/Gaps:
- ✖ Commercial businesses besides offices, retail, schools, and public assembly are not included in the baseline assessment. Because of low usage and data available, these other areas would likely involve more intensive field studies to achieve comparable results to the baseline study underway. It is unclear if relocatable classrooms will be assessed, but it appears that they may be incorporated into several utility programs which might heighten the need for baseline data.
- ✖ Current baseline study will attempt to resolve missing geographic data so results are not yet available on the success of this effort. The largest gap appear to be the City of Los Angeles. Onsite surveys may be able to remedy this gap.
- ✖ Baseline data may become dated if planned Title 24 changes occur in 1999 and impact the market.
- ✖ Energy center baseline data is limited to PG&E's San Francisco center and does not include non-participant information.

Source 250:
1) Is underway so some findings are not complete at this time.
2) Limits focus to four building types: offices, retail, schools, and public assembly. However, these groups represent 72% of the commercial square footage and 70% of the energy use.
3) Incorporates onsite data that is old (94-96) in some cases. This may become an issue if planned code changes occur in 1999 that have an effect on the market.

Source 160:
1) Focuses on the PG&E market only with an even narrower scope of market actors who visited the energy center.
2) Offers no clear distinction between markets making it difficult to know if some of the actors also work in the industrial or agricultural new construction markets.

Source 50:
1) Is a lighting study so has a broader focus than just new construction.

Source 910:

1) Provides very high summary level data about energy efficiency with no primary data available.

Relationship to Programs/Intervention Strategies:

- Commercial New Construction: Baseline data is currently being developed for this market and should provide a solid start towards gathering the necessary information about the market structure, actors, and products. It will be important to assess the importance and efficiency opportunities in the business types not included in the ongoing study to determine if they too need additional baseline data to support programs. Additional state-wide baseline data may be required around the energy centers to determine their market function and leverage points for transforming the market.
- New Construction Codes and Standards Support and Local Government Initiatives Program: There is very little baseline data on codes and standards or government initiatives in the non-residential sector. Because there are planned Title 24 changes targeted for 1999, it will be important to better understand the market actors and structure with respect to codes and government initiatives in a timely manner.

General Research Recommendations:

- Assess the importance of all commercial business types to determine if additional areas should be covered in conjunction with the ongoing baseline study that is targeted at offices, retail, schools, and public assembly. Gather additional baseline data on these other markets' structure, functioning, and leverage points for transforming the market.
- Integrate baseline data from individual end-use markets such as lighting and motors into the New Construction information to determine best leverage points for transforming the market.
- Maintain current focus on developing baseline database and use findings to determine next steps and gaps.
- Expand research on energy centers to determine how they function in the market and how they effect customer behavior and overall market transformation.

Research Project Recommendations:

1. Continue focus on current baseline study being sure to adequately deal with geographic gaps that have been identified.
2. Conduct a study (or include in the current study) about relocatable classrooms to determine the market actors, structure, products and leverage points for transforming the market. Include baseline information on code issues and local government involvement in this growing business.
3. Conduct a study of business areas not covered in the current baseline study using the initial study as a base to determine if the actors, market structure, and products for other businesses are similar to those covered in detail in the current study.
4. Conduct a state-wide study on the energy centers to determine their baseline characteristics such as market structure, penetration rates, market barriers, supply-side and end-user behavior, and product/service offerings. Leverage the existing PG&E study as a starting point.
5. Review the scope of the proposed changes to Title 24 and identify areas that might need additional baseline data as the changes are put in place. Depending on the scope of proposed changes, the study may be combined with baseline data collection in a particular end-use market.

6. Conduct a state-wide assessment of the role local governments play in supporting Title 24. Gather data on the market actors and structure to determine how codes are enforced from the planning phase of a project through actual completion.

B.18 INDUSTRIAL NEW CONSTRUCTION

***Best Compiled Sources*:**
160 (PG&E's Energy Center Market Effects Study for PG&E by TecMRKT Works - 1997)

Baseline Information Strengths:
✓ PG&E's Energy Center study defines the structure of that market including penetration figures and leverage points for transforming the market.

Source 160 :
1) Outlines the market structure from the viewpoint of services offered by the center.
2) Provides baseline data on market penetration and information provided by the energy center.
3) Provides information on leverage points used by the center to transform the market and how customer behaviors have been effected.

Baseline Information Weaknesses/Gaps:
✖ There is no baseline data on the industrial new construction market.
✖ Energy center baseline data is limited to PG&E's San Francisco center and does not include non-participant information.

Source 160:
1) Focuses on the PG&E market only with an even narrower scope of market actors who visited the energy center.
2) Offers no clear distinction between markets making it difficult to know if some of the actors also work in the industrial new construction market.

Relationship to Programs/Intervention Strategies:
➪ Industrial New Construction: There is currently no baseline data for this market. Baseline information is needed to determine the market structure, actors, and products. Additional baseline data may be required around the energy centers to determine their leverage points for transforming the market.
➪ New Construction Codes and Standards Support and Local Government Initiatives Program: There is no baseline data on codes and standards or government initiatives in the industrial sector. Because there are planned Title 24 changes targeted for 1999, it will be important to better understand the market actors and structure with respect to codes and government initiatives in a timely manner.

General Research Recommendations:
➪ Assess the importance of industrial new construction projects to determine where to start gathering baseline data on the market structure, functioning, and leverage points for transforming the market.
➪ Integrate baseline data from individual end-use markets such as lighting and motors into the New Construction information to determine best leverage points for transforming the market.

Research Project Recommendations:

1. Conduct a state-wide study of industrial new construction to define the actors, market structure, and products.
2. Review the scope of the proposed changes to Title 24 and identify areas that might need baseline data as the changes are put in place. Depending on the scope of proposed changes, the study may be combined with baseline data collection in a particular end-use market.
3. Conduct a state-wide assessment of the role local governments play in supporting Title 24. Gather data on the market actors and structure to determine how codes are enforced from the planning phase of a project through actual completion.

B.19 AGRICULTURAL NEW CONSTRUCTION

***Best Compiled Sources*:**
160 (PG&E's Energy Center Market Effects Study for PG&E by TecMRKT Works - 1997)

Baseline Information Strengths:
✓ PG&E's Energy Center study defines the structure of that market including penetration figures and leverage points for transforming the market.

Source 160:
1) Outlines the market structure from the viewpoint of services offered by the center.
2) Provides baseline data on market penetration and information provided by the energy center.
3) Provides information on leverage points used by the center to transform the market and how customer behaviors have been effected.

Baseline Information Weaknesses/Gaps:
✖ There is no baseline data on the agricultural new construction market.
✖ Energy center baseline data is limited to PG&E's San Francisco center and does not include non-participant information.

Source 160:
1) Focuses on the PG&E market only with an even narrower scope of market actors who visited the energy center.
2) Offers no clear distinction between markets making it difficult to know if some of the actors also work in the agricultural new construction market.

Relationship to Programs/Intervention Strategies:
➪ Agricultural New Construction: There is currently no baseline data for this market. Baseline information is needed to determine the market structure, actors, and products. Additional baseline data may be required around the energy centers to determine their leverage points for transforming the market.
➪ New Construction Codes and Standards Support and Local Government Initiatives Program: There is no baseline data on codes and standards or government initiatives in the agricultural sector. Because there are planned Title 24 changes targeted for 1999, it will be important to better understand the market actors and structure with respect to codes and government initiatives in a timely manner.

General Research Recommendations:
➪ Assess the importance of agricultural new construction projects to determine where to start gathering baseline data on the market structure, functioning, and leverage points for transforming the market.
➪ Integrate baseline data from individual end-use markets such as lighting and motors into the New Construction information to determine best leverage points for transforming the market.

Research Project Recommendations:

1. Conduct a state-wide study of agricultural new construction to define the actors, market structure and products.
2. Review the scope of the proposed changes to Title 24 and identify areas that might need baseline data as the changes are put in place. Depending on the scope of proposed changes, the study may be combined with baseline data collection in a particular end-use market.
3. Conduct a state-wide assessment of the role local governments play in supporting Title 24. Gather data on the market actors and structure to determine how codes are enforced from the planning phase of a project through actual completion.

C

CBEE's MA&E Projects Memo

This appendix provides documentation of a memorandum sent in mid-February 1999 that provided early findings from this CABD Study to MA&E Study Liaisons and Project Managers involved in developing scopes of work for the CBEE's second-round of MA&E studies to be conducted in 1999. This memorandum organizes findings around the 11 second-round MA&E projects planned by the CBEE. Note that the findings and recommendations have changed in some cases between the time of the memorandum and this final report.

- MEMORANDUM -

TO: Ralph Prahl, TSC to CBEE and Athena Besa, SDG&E

FROM: Mike Rufo and Allen Lee, XENERGY Inc.

DATE: February 17, 1999

RE: Draft Baseline-Related Findings for the First 11 MA&E Research Projects

The purpose of this memo is to provide an intermediate deliverable for the CABD Study that focuses on recommendations for baseline data collection efforts that are linked to the CBEE's 11 initial MA&E projects for 1999. This memorandum also serves as an opportunity to obtain early feedback on part of what will be included in the recommendations section of the final report. This memo supplements the information provided in our Interim Report completed in October 1998. The Interim Report summarized the availability of information about baseline market characteristics for California energy-efficiency markets. The CBEE used the results presented in the first interim report with other resources to develop an initial set of Market Assessment and Evaluation (MA&E) research projects for 1999.

This memo presents more detailed and targeted information distilled from the sources reviewed. The purpose of this memo is to assist the CBEE, its technical consultants, and the utility MA&E managers in defining the specific requirements and objectives of the initial set of MA&E research projects that have been selected for 1999. Our next step will be to develop a set of recommendations that go beyond the first, high-priority eleven projects.

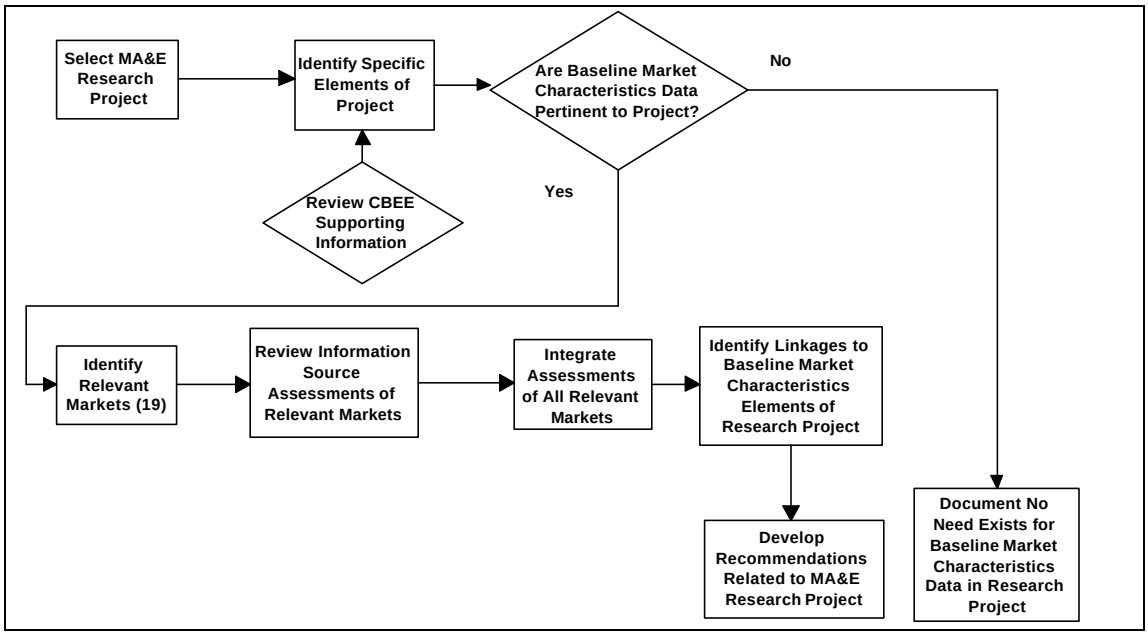
This memo is divided into three sections. The first provides an overview of our approach to developing recommendations associated with the 11 MA&E research projects to fill baseline market characteristics information gaps that we have identified. The second section presents a few research ideas that cut across the 11 projects. The third section presents the recommendations themselves along with background information on the strengths and weaknesses of existing sources for each of the research projects.

C.1 APPROACH TO DEVELOPMENT OF FINDINGS AND RECOMMENDATIONS

The CABD Study was structured to address 19 specific energy-efficiency products and services markets. These markets were defined in conjunction with the CBEE Study Director and Project Manager to reflect the organization of the CBEE's program areas.

The CBEE programs and interventions do not correspond exactly to the 19 markets used in our study. Likewise, many of the 11 MA&E research projects span several of the 19 markets. To provide the CBEE with useful research suggestions based on our study, we have designed a process for mapping our findings into the 11 research projects as illustrated in Figure 1.

Figure 1
Process to Map Findings to CBEE MA&E Research Projects



We used this process and the information compiled from our information sources database to develop recommendations and suggestions for the CBEE to reflect in its planning for the 11 research projects. These recommendations and suggestions are summarized the section that follows.

C.2 CROSS-CUTTING BASELINE RESEARCH NEEDS

The objective of this deliverable is to provide recommendations for baseline data development that tie as directly as possible into the CBEE's first 11 high-priority MA&E projects. There are some important baseline research needs, however, that apply to multiple projects among the first 11. This is not surprising given, as Ralph noted in his December 11th memo to the CBEE, that there are a number of different organizing principles with the 11 projects and the fact that there are a number of previous studies organized along still different principles. Thus, before discussing recommended baseline activities for each of the 11 projects, we begin by discussing important baseline needs that cut across these efforts.

C.2.1 Supply-Side Needs

Our review of existing sources indicates that current processes of developing comprehensive, statistically reliable supply-side are generally weak. There are several problems with the way in which supply-side data have been collected to date, including the following:

- Supply-side population frames are problematic at best, and commonly are not utilized at all. Existing sources of supply-side data, such as D&B's MarketPlace database are very

inaccurate at the 6- and 8-digit SIC levels, which are the levels required to identify the specific market actors of interest (for example, SIC 5603-04 is supposed to be: *Electrical apparatus and equipment - lighting fixtures*).

- Most of the studies conducted to date have used relatively small sample sizes of supply-side interviews. This has resulted in limited or nonexistent statistical precision.
- Partly because of inadequate samples, most studies have not attempted to segment supply-side actors based on the end-use markets that they serve (e.g., small versus large customers) or their types of business.
- A number of studies with supply-side data have cut across end-use markets; however, studies of moderate scope that cover multiple end-use markets typically result in too much diffusion in the number and type of supply-side data collected. The result is often broad but shallow results inadequate for quantitative baseline development and market characterization.

There are two recommendations that we believe arise from the observations above:

1. *Conduct a scoping study of supply-side data collection issues focused on determining the optimal approach to developing more homogenous and statistically reliable sample frames*. Such a study should compare existing sources, such as D&B and utility SIC codes, and determine their relative level of adequacy. The study should also investigate whether any new approaches to creating supply-side sample frames should be implemented expressly for the purpose of meeting the statewide MA&E needs for measuring supply-side market indicators over time.
2. *Consider organizing baseline data collection using some of the funds set aside for 1999 MA&E needs (including those in the first 11 projects) by supply-side, end-use market*. The current problem is that if supply-side data collection is diffused across multiple projects that have competing research priorities, it is unlikely that adequate baselines will be developed for any key end-use markets. For example, there are four to five non-residential projects in the first 11 projects that require supply-side data: these are Project Numbers 4, 5, 6, maybe 7, and 9 based on Ralph's December 11th memo. If each of these projects attempts to collect supply-side baseline and market characterization data across multiple end-use markets, the result is likely to be four studies with anecdotally interesting results, but no comprehensive supply-side baseline data sets. Note that, within the CADMAC market effects studies, there were some excellent examples of what could be done in projects organized around markets such as lighting and HVAC.

   Obviously, a challenge to organizing supply-side baseline data collection around end-use markets is that such projects would have to coordinate very closely with a number of MA&E project managers and program implementation managers to ensure that the information collected can be used to for multiple programs. The advantage of scoping some baseline projects in this way is that it is much more likely that the major supply-side markets of interest will be comprehensively characterized with a level of rigor

commensurate with what is expected on the demand side. Any such studies should be carried out statewide to parallel current statewide end-user surveys.

C.2.2 Integration of Existing Sources

There are a several existing baseline sources that provide valuable information but are limited in one or more ways. The most consistent limitation occur with respect to service territories covered. The two most obvious sources of high-value data whose usefulness is currently limited by service territory fragmentation across territories and over time are the utilities' RASS and CEUS studies. There is a wealth of data in these sources, particularly with respect to baseline penetration of efficient equipment and characterization of the mix of products in end-user markets. Using RASS and, particularly, CEUS studies in a comprehensive way at the statewide level is difficult in practice because of the following:

- It is difficult to obtain complete information from those studies that have been completed or are in the process of being completed. Typically most researchers external to the development of the studies themselves are only able to obtain copies of survey instruments and highly generalized reports of results. The core value of the CEUS, in particular, is its measure-level data (based on on-site surveys); however, these data are very difficult to find and obtain.
- Differences in survey year, instruments, reporting, and data between the three utilities. Assuming each of the RASS and CEUS could be obtained in their entirety, a fair amount of work would be required to produce consistent, integrated analyses at the statewide level.

We believe that an integrated, detailed analysis of these sources would be of very high value to the broad group of researchers that will be conducting MA&E studies in 1999 and beyond. Because of the difficulties noted above, however, and the amount of work entailed, it is unlikely that these sources will leveraged to extent warranted by their rich content if individual researchers must do so on their individual projects. Any individual researcher working within an otherwise limited budget and scope will be constrained in his or her ability to comprehensively mine these data sources. For these reasons, we believe there are important economies that could be captured by scoping at least two projects aimed at integrating existing RASS and CEUS studies. The resulting detailed reports **and** data sets, would be extremely valuable across MA&E researchers and projects. In fact, almost all of the first 11 MA&E projects critically need this resource.

C.3 DISCUSSION OF FINDINGS AND RECOMMENDATIONS

In this section we provide a template that summarizes our assessment of existing baseline sources and needs that link to each of the first 11 MA&E project areas.

C.3.1 Project #1. MA&E Efforts in Support of Residential Contractor Initiatives

Strengths of Existing Sources

- Basic HVAC equipment saturation data are available by utility service area through RASS studies
- End-use consumption estimates are available from utilities and CEC end-use forecasts
- Gas heat market structure and end-user information is available in specific markets
- Some statewide HVAC efficiency data are available for homes built since 1989

Gaps/Weaknesses

- Little information is available at a statewide level
- Little information is available on HVAC and envelope market functioning, non-gas heat market structure, market barriers, or leverage points
- Little information is available on HVAC and weatherization retailers/contractors
- Little information is available on HVAC or envelope products or services characteristics.
- Little information is available on end-user or supplier awareness, knowledge, decision-making

Recommendations Involving Baseline Market Characteristics Research

1. Develop statewide baseline data for the residential retrofit/renovation market for all relevant products/services. Characterize consumer attitudes, awareness, barriers, and decision-making. Characterize supply-side actors' characteristics, attitudes, awareness, barriers, and marketing strategies. Focus on characterizing decision-making processes around key market events (e.g., equipment failure, remodeling, home ownership turnover).

2. Focus on HVAC and envelope weatherization contractor market. Target certification, specifically, contractor interest, consumer perceptions/attitudes, and consumer equipment decision-making process. Focus on service provider receptivity to training and certification and potential market impacts. For comparative purposes, identify, characterize, and assess the penetration and role of non-energy certification services, both public and private (e.g., ValueStar).

3. Conduct scoping analysis of the adequacy of existing supply-side population frames. If feasible, develop appropriately segmented frames from which statistically reliable samples can be drawn.

4. Develop explicit market indicators for measuring effects over time and ensure first-year measurement.
5. Monitor and coordinate as necessary with relevant national research efforts associated with residential standards upgrade program and Energy Star.

Useful Related Sources:
RASS: sources 650 and 660..
Target Markets: source 910.
Market Effects Studies: sources 110 and 170.
Residential SPC: sources 870.
Post Occupation Survey: source 830.

C.3.2 Project #2. MA&E Efforts in Support of Statewide Residential Lighting and Appliance Programs

Strengths of Existing Sources

- Good refrigerator market structure/functioning and supply-side information is available. Clothes washer market structure/functioning and supply-side information is available, but from studies conducted in other regions (primarily the Northwest).
- Existing lighting studies provide a strong foundation for future work.. provide good information on consumers and downstream supply-side actors
- Basic appliance saturation data are available by utility service area through RASS studies
- Some market barrier information is available; particularly for lighting and refrigerators

Gaps/Weaknesses

- RASS studies have not been integrated across state
- Some differences in lighting and refrigerator studies between service territories.
- Little information is available on consumer decision-making, attitudes, etc. at a statewide level
- Little information is available on supply-side actors for products other than refrigerators and lighting

Recommendations Involving Baseline Market Characteristics Research

1. Build upon existing consumer research in the refrigerator market, which is extensive. Put demand and supply-side baselines in place for other appliances that are included in program initiatives (e.g., clothes washers).
2. Supply-side appliance issues to focus on include characterizing product trends (i.e., changes in product design, marketing, packaging, etc.), characterizing distribution channels, further analyzing market barriers, and determining program influence points. Beyond documenting how the current market is characterized and organized, it is critical to also

explore how best to go about leveraging program dollars to initiate and sustain desired market effects.

3. Continue working with manufacturers and major suppliers to further assess attribution issues and to monitor changes in production and sales trends. Coordinate with EPA's evaluation of the Energy Star program; complete assessing of Energy Star in California..

4. For lighting, develop equipment saturation, energy consumption, and supply-side baselines. Address upstream supply-side market actor issues for a wide variety of lighting technologies (CFLs, torchieres, hard-wired fixtures, etc.). Also (or as part of a separate study), conduct more in-depth, statewide research in the area of retail market dynamics (earlier studies did not go far enough in this area and were not conducted on a statewide basis). For example, more information is needed on a statewide/regional basis on why certain market barriers still exist for high efficiency lighting (e.g., why aren't CFLs sold in drug stores?) and how the programs should intervene to reduce these retail-level market barriers in a way that is consistent with the objectives of market transformation.

5. Include a greater focus on consumer and supply-side actor segmentation within baseline research.

Useful Related Sources:
Residential Saturation Surveys: sources 650, 660, 670.
Residential Energy Consumption Survey: source 720.
Refrigerators: sources 70, 950 and 90.
Clothes Washers: sources 990 and 1000.
Lighting General: source 980.
CFLs: sources 70, 190, and 1070.
CF Fixtures: source 1010.

C.3.3 Project #3. High Priority Residential Market Share Tracking Activities

Not applicable. The *Market Share Tracking Feasibility Study* is addressing the needs of Project #3. The key issue is that this project must coordinate very closely with all related baseline data collection efforts.

C.3.4 Project #4. Follow-Up Evaluation of Large SPC

Strengths of Existing Sources

- 1998 SPC evaluation will provide baseline information on a wide-variety of end-users' energy-efficiency-related practices, policies, preferences, knowledge, attitudes, and awareness. 1998 baseline will includes awareness and penetration of performance contracting. Also includes baseline interviews with variety of EESPs.
- CEUS studies provide good baseline data on measure saturation, building and equipment characteristics, and end-user firmographics.
- Good lighting information is available for characterizing supply-side actors and end-users, market barriers, distribution channels, information channels, linkages, market sizes, and saturations.
- Lighting market information is available on supply-side energy-efficiency attitudes and awareness for selected technologies (generally, T8s and electronic ballast).
- Good motors and compressed air data are available on market structure, products, and energy consumption, but only at the national level.
- Good supermarket refrigeration data are available on measure penetration, market barriers, distribution channels, information channels, and market actors; but only for one utility.

Gaps/Weaknesses

- No single source of statewide supply-side data exists. Available supply-side data varies by utility. Existing supply-side data is limited in its ability to segment providers of large customers from those serving small and medium end users. There is little information on market supply-side in California for building shell, motors, and refrigeration.
- HVAC supply-side baseline information is very limited.
- CEUS data are difficult to obtain and are not all current or integrated statewide.
- Cost data for most products/services are becoming dated.
- Little information is available on certain lighting technologies such as occupancy sensors, HIDs, exit signs, T-5 fluorescents, lighting controls, and daylighting.
- Refrigeration information is limited to supermarkets and one service territory.
- Limited information on industrial customer decision-making processes and barriers.

Recommendations Involving Baseline Market Characteristics Research

1. CEUS data from pre-program period (pre-1998) will be valuable as an on-site based measure penetration baseline with which future CEUS or SPC-specific surveys can be compared. As stated under cross-cutting baseline needs, build upon latest CEUS data and explore integration to create statewide data for large C&I customers.

2. SPC Evaluation does not include supply-side actors other than EESPs (which were mostly ESCOs in the 1998 program). A more comprehensive supply-side baseline is needed for this and all non-residential programs. See discussion under cross-cutting research needs.

3. Conduct scoping analysis of the adequacy of existing supply-side population frames. If feasible, develop appropriately segmented frames from which statistically reliable samples can be drawn. Again, see discussion under cross-cutting research needs.

4. If statewide supply-side baselines are not conducted, integrate relevant baseline data from existing studies, e.g.,

    - Build upon available motors and compressed air market information from national studies.

    - Build upon available single-territory HVAC market characterization.

    - Build upon available single-territory supermarket refrigeration study information.

    - Build upon extensive available lighting market information developed for PG&E/SDG&E. Fill out technology gaps (e.g., CFLs, T5s, HID, controls).

5. Note that because SPC implementation and evaluation are being split in 1999 between small and large customers, the 1998 baseline data may need to bifurcate. Consequently, the large customer sample may need to be increased in 1999 or in a future year when longitudinal data are collected.

Useful Related Sources:
CEUS data: sources 620, 630 and 640.
Industrial saturation survey: source 920.
Lighting: sources 50 and 980.
HVAC: source 180.
Compressed air: source 1220.
Motors: source 180 and 930.
Process: sources 120, 1210 and 920.
Supermarket industry: source 140.
General: source 910.
1998 NSPC Evaluation First and Second Interim Reports.

C.3.5 Project #5. MA&E Efforts in Support of Marketing Efforts Targeting Small C&I Customers

Strengths of Existing Sources

- See strengths under Project #4 above.
- Much of 1998 SPC baseline information is applicable (see summary of elements under Project #4). 1998 baseline was designed to be representative of entire C&I (CA and national); half of 1,000 sample points are for small and medium sized customers.

Gaps/Weaknesses

- See weaknesses under Project #4 above.
- Existing data do not always differentiate small C&I customers from others.
- Besides 1998 SPC baseline, there is little information available on end-user awareness, attitudes, and decision-making

Recommendations Involving Baseline Market Characteristics Research

1. See Recommendations under Project #4.
2. Because multiple programs will address small customers, it will likely be necessary to expand upon the 1998 SPC baseline by conducting a statewide study targeted at small C&I customers to determine decision-making, information channels, energy-efficiency awareness, etc. Leverage data and instruments from 1998 SPC.
3. Ensure that any statewide study on supply-side actors adequately segments and baselines those who service the small C&I market.
4. Include focus on equipment turnover with emphasis on identifying end user and supply-side decision-making processes, policies, and role of EE in emergency replacement decisions and associated unique barriers.
5. Explore more detailed segmentation of small customer market than has been possible in previous studies. Identify key barriers by segment. Characterize ownership and control of equipment-related decision-making processes. Identify key market intervention leverage points.

Useful Related Sources:

CEUS data: sources 620, 630 and 640.
Industrial saturation survey: source 920.
Lighting: sources 50 and 980.
HVAC: source 180.
Compressed air: source 1220.
Motors: source 180 and 930.
Process: sources 120, 1210 and 920.
Supermarket industry: source 140.
General: source 910.

1998 NSPC Evaluation First and Second Interim Reports.

C.3.6 Project #6. MA&E Efforts in Support of Non-Residential Remodeling and Renovation Program

Strengths of Existing Sources

- Same as large and small C&I discussed under Projects 4 and 5.

Gaps/Weaknesses

- See gaps/weaknesses discussed under Project 4 and 5.
- In addition, there is very little information available about market characteristics that are specific to the remodeling/renovation process.

Recommendations Involving Baseline Market Characteristics Research

1. Characterize, at a minimum:
    - Renovation and remodeling (R&R) rates by segment
    - Key decision-making steps in R&R process
    - Relative role and importance of energy efficiency in R&R decision-making processes
    - Roles of different market actors in design and decision-making processes
    - Energy-efficiency penetration rates in R&R activities
    - Unique barriers and opportunities associated with R&R
2. Identify market indicators for evaluating market effects and implement baseline measurements
3. Build upon existing sources as discussed under Projects 4 and 5

Useful Related Sources:
CEUS data: sources 620, 630 and 640.
Industrial saturation survey: source 920.
Lighting: sources 50 and 980.
HVAC: source 180.
General: source 910.
New Construction: source 250.
Remodel: source 300.
1998 NSPC Evaluation First and Second Interim Reports.

C.3.7 Project #7. High Priority Non-Residential Market Share Tracking Activities

Not applicable. The *Market Share Tracking Feasibility Study* is addressing the needs of Project #7. The key issue is that this project must coordinate very closely with all related baseline data collection efforts.

C.3.8 Project #8. MA&E Efforts in Support of Codes and Standards and Local Government Initiatives Program

Strengths of Existing Sources

- CEC has conducted some studies of compliance levels.

Gaps/Weaknesses

- There appears to be little or no information in compiled studies on codes and standards baseline information.

Recommendations Involving Baseline Market Characteristics Research

1. Identify and review past energy code program evaluations for California and other states having strict energy codes. Build upon available information in these studies on local code official practices, enforcement barriers, and motivations.
2. Collect baseline information on building starts, enforcement practices and barriers, compliance verification, code awareness, and attitudes. Focus on code officials and local government administrators.
3. Differentiate between residential and non-residential buildings.
4. Identify and target representative local jurisdiction "market segment."
5. Collect baseline attitudinal, market barrier, and decision-making information on non-residential building sector actors and code officials to help predict response to new code.

Useful Related Sources:
CEUS data: sources 620, 630 and 640.
Lighting: sources 50 and 980.
HVAC: source 180.
General: source 160..
New Construction: Nonresidential source 250, Residential: sources 830 and 840.

C.3.9 Project #9. MA&E Efforts in Support of Residential and Non-Residential New Construction Programs

Strengths of Existing Sources - Residential

- Most information is relatively recent.
- Data for gas heating and water heating is relatively complete.

- Products, market structure/functioning, and market actors data are fairly complete for windows (in one service territory).
- Duct characteristics data are fairly complete.
- Baseline efficiency data are fairly complete.
- Construction and equipment characteristics for new homes are good in some geographic areas.

Gaps/Weaknesses - Residential

- Data sources are usually for specific geographic areas so statewide information is impcomplete.
- Comprehensive information is available for only certain products such as windows and gas heating equipment.
- Market actor information is limited for both the demand and supply sides.
- There is little available information on code enforcement.
- There is little information on statewide code compliance.
- There is no information on the California manufactured housing market.

Strengths of Existing Sources - Nonresidential

- Current CBEE baseline study is consolidating existing data sources to provide statewide data.
- Current CBEE baseline study covers major commercial building types.
- Current CBEE baseline study will provide market structure, barriers, actor, and product information.
- PG&E Energy Center study provides leverage point information.
- Lighting market in new buildings is well defined in existing market effects study.

Gaps/Weaknesses: Non-Residential

- Current baseline study does not include several commercial building types.
- Some of current baseline commercial building study data are 1994-96 vintage.
- No industrial or agricultural new construction baseline data are available.
- There is no information on relocatable classrooms.

Recommendations Involving Baseline Market Characteristics Research

1. Review information provided by recent CADMAC market effects studies on residential and non-residential new construction and utilize relevant information.
2. Continue assessing possibilities of integrating baseline data compiled for individual utility areas to create statewide data.

3. Further assess completeness of available residential baseline information on gas space and water heating and build upon information for these technologies. Emphasize baseline data collection on products other than gas space and water heating.
4. Identify remaining gaps and conduct residential and non-residential baseline studies targeted at information gaps.
5. Develop baseline information on all market characteristics for manufactured housing. Review extensive manufactured housing market information developed in the Pacific Northwest and assess usefulness of data and methods.
6. Initiate baseline information collection on relocatable classrooms.

Useful Related Sources:
Residential new construction: sources 10, 60, 830, and 840.
Non-residential new construction: source 250.
Lighting: sources 50 and 980.
HVAC: source 180.
General: sources 160 and 910.
Motors: source 180 and 930.
Process: sources 120 and 1210.
Supermarkets: sources 140.
CEUS data: sources 620, 630 and 640.
Industrial saturation survey: source 920.

C.3.10 Project #10. Scoping Study on Tracking of Market Share by Firm

Strengths of Existing Sources

- Limited firm-specific market share data is available from secondary sources for manufacturers in some industries (e.g., air conditioners, furnaces, fluorescent tubes, ballasts).

- Baseline data collection within 1998 SPC Evaluation has produced market share by firm estimates for retail energy service providers (i.e., shares of customers who have switched to an ESP and left bundled UDC service). Share by firm estimates are also available from the same study for performance contracting market, but are of limited accuracy due to low penetration levels in comparison with sample sizes.

Gaps/Weaknesses

- Besides for manufacturers in a few industries, and ESPs, only very limited firm-specific market share data are available.

Recommendations Involving Baseline Market Characteristics Research

1. Conduct scoping study on collection of firm market share data to establish baseline data. Investigate possible third-party information sources. Investigate and assess confidentiality issues. Previous experience indicates private firms will not disclose proprietary share

data unless required to by law. A census-based approach to share requires disclosure, a sample-based approach that asks one actor to disclose the anothers sale does not (e.g., asking end users which vendor they selected for a particular product or service). Compare costs, benefits, and feasibility of census versus sampling approaches.

2. Further clarify the justification and need for firm-specific market share estimates. Because of the cost and barriers involved, a compelling case is needed to justify this effort. Investigate the need for firm-specific market share on a product-by-product basis. Determine whether firm-specific share data is needed at one or more levels of the product distribution chain (e.g., retail, wholesale, and manufacturer).
3. Ensure that program tracking systems have the ability to track in-program, participant firm shares.

C.3.11 Project #11. Development of New Methods for Forecasting and Estimation of Benefits from Market Effects

Strengths of Existing Sources

- Diverse studies provide useful alternative techniques for identifying market effects.
- Diverse studies provide alternative ways for assessing sustainability of market effects.
- Extensive previous research and experience is available in product forecasting and diffusion analysis.

Gaps/Weaknesses

- Little information is available in compiled studies on how to utilize market effects in cost-effectiveness analyses

Recommendations Involving Baseline Market Characteristics Research

1. Review and assess alternative methods for using baseline information to assess market effects and sustainability.
2. Use existing studies to identify non-energy benefits associated with market effects for incorporation in cost-effectiveness analysis.