NON-RESIDENTIAL NEW CONSTRUCTION BASELINE STUDY APPENDIX

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California State-Level Market Assessment and Evaluation Study

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Table of Contents

1. Quantitative Survey of Market Actors

This section of the appendix provides a detailed description of the methodology used to develop these data, including the survey instrument and the technical documentation for the resulting database. This section will also discuss our experience in using the Internet to collect these data.

Sample Methodology

The data used to construct the population of designers for both the qualitative and quantitative interviews was obtained from the F. W. Dodge New Construction Database. For a given year, the Dodge New Construction Database contains a listing of construction projects that began during that year. Only permits where the valuation for the project was $200,000 or higher were included in the Dodge database. For each permit record in the Dodge database, there are affiliated firms that provide various services for the project, including architectural, mechanical engineering, electrical engineering, and various other services. Since Dodge data does not reveal the primary business activity of a firm, firms were classified according to the type of services provided on projects. Firms who provided both types of services were included in both the architectural and engineering populations. Since Dodge data are permit records and not project completions, the permits dated during 1995 through 1997 were examined, with the aim of representing architectural and engineering firms that worked on projects completed from 1996 through the present time. To ensure a large enough pool of engineers from which to sample, it was necessary to examine permits dated during 1994.

Since it is likely that the populations of architectural and engineering firms differ in many ways, including distribution of firm size, it was desirable to allocate a proportion of the total sample to each of the two firm types being studied. Consequently, independent samples of size 80 were designed for both architectural and engineering firms. Within each firm type (architectural and engineering), the sample design calls for stratifying by size of the firm, defined as the sum of the valuation of all projects on which the firm provided services during the time periods of interest. Firms that provided both architectural and engineering services were included in both populations.

MBSS™ was used to develop stratified sample designs under optimal allocation. Optimal allocation strives to optimize precision by allocating the sample to evenly cover the expected variability in the population. This is in contrast to proportional allocation, which allocates the sample to evenly cover the population size, e.g., based on the number of customers, as opposed to the variability between customers. The estimates of relative precision in this document assume that ratio estimation will be used whenever possible in the analysis, i.e., that RLW will attempt to link sample results to available information for the population to improve the relative precision of results.

Several parameters need to be estimated for the sample design. For both firm types, the following choices of parameters were used for the sample design: β = 1.0 and error ratio equal to 1.0. For architectural firms, γ = 0.65 and for engineering firms, γ = 0.50 were selected. β is the estimate of the ratio between the measured variable in the sample, e.g., attitudes towards energy efficiency, and the explanatory variable for the population, e.g., total valuation. As many different types of ratios may be developed in the analysis, and β has limited impact on the estimates of precision, a β of 1 was used.

The parameter γ determines the extent to which larger customers will be included with a higher probability in the sample design, thus controlling for variability and optimizing precision. A γ=

0.8 is typical for characteristics studies of commercial populations. However, when γ= 0.8 was used, the sample design required 100% certainty sampling in the larger strata. Required certainty sampling is less than desirable, as the required respondents are not guaranteed to participate. For this reason, the designs with lower values of γ were selected. A lower value of γ controls for less of the variability in the population and typically leads to a slightly lower relative precision, but this is preferable to certainty sampling.

The error ratio is the critical variable for the determination of relative precision for a given sample size. Again, where there are many key target results for this baseline study, a typical error ratio for market research, 1.0, was selected. Also, given the potential range for different types of results, a highly conservative error ratio was used. The corresponding relative precision values are quite acceptable as can be seen in Table 1 and Table 2.

Table 1 and Table 2 show the sample designs for the architectural and engineering populations. For example, in the architectural-firm sample design, the first stratum consists of 1,870 firms that had valuation less than $2,579,400. In aggregate, these 1,870 firms comprised 65% of all firms but had had a total valuation of $1,579,730,853, only about 6% of the overall valuation. By contrast, the largest 52 firms had a total valuation of $10,437,034,027, about 41% of the overall valuation.

Stratum	Maximum Valuation ($)	Population Size	Population Total ($)	% of Total Valuation	Planned Sample Size	Actual Sample Size	Relative Precision
1	2,579,400	1870	1,579,730,853	6%	16	23	
2	9,175,010	558	2,838,891,311	11%	16	25	
3	29,521,116	261	4,216,686,154	13%	16	15	
4	95,453,550	125	6,372,934,105	19%	16	19	
5	1,000,000,000	52	10,437,034,027	53%	16	13	
Total		2866	25,445,276,450		80	95	18.6%

Table 1 – Strata Cut-points for Architectural Population

Stratum	Maximum Valuation ($)	Population Size	Population Total ($)	% of Total Valuation	Planned Sample Size	Actual Sample Size	Relative Precision
1	400,000	210	57,583,240	7%	16	14	
2	761,500	129	72,303,178	8%	16	9	
3	1,876,360	98	109,559,324	13%	16	20	
4	4,460,000	62	170,317,119	19%	16	11	
5	200,000,000	34	458,585,744	53%	16	11	
Total		533	868,348,605		80	65	19.3%

Table 2 – Strata Cut-points for Engineering Population

Internet Data Collection

While conducting the qualitative interviews, we found that it was very difficult to interview architects and engineers by telephone. The designers that we wanted to interview were very busy. Repeated callbacks were generally required to find them available to talk with us, and a high proportion refused to be interviewed.

While planning the quantitative survey, we felt that these issues would become even more severe due to both the detailed information we were seeking as well as the larger sample size required. We were concerned about minimizing the inconvenience to respondents as well as the time and effort required to collect the information. We were also concerned about potential bias from a low response rate.

To address these issues, we allowed respondents to complete the survey on the Internet, by fax, or on the telephone. We anticipated this approach would allow respondents to complete the survey in less time and at their convenience. At the same time, to minimize nonresponse bias, we used the telephone, e-mail, and a weekly lottery to encourage respondents to complete the survey.

Table 3 presents the number of designers contacted along the number who were not qualified to participate, the number who refused, the number who terminated the survey, and the number who completed the survey. Note that of the 160 completed surveys, 3 were conducted over the telephone and 15 were completed via fax. The response rate is 25%, which is quite acceptable for the type of highly qualified respondent we were seeking. We are confident that the survey results will not be adversely affected by a large degree of nonresponse bias.

Contacted by Phone	762
Not Qualified	128
Refused	140
Terminated	2
Completed	160
Response Rate	25%

Table 3: Response Rate Summary Information

Advantages of Internet Approach

The primary advantage of administering the quantitative survey via the Internet is that inconvenience to the respondent is minimized. When conducting the qualitative interviews on the telephone, we found that a high proportion of potential interviewees were not willing to spend the time required to complete the interview during business hours. Because the quantitative survey was implemented over the Internet, respondents were able to complete the survey whenever it was most convenient for them. Many respondents completed the survey in the evening hours or in the early morning hours. In fact, some designers completed the survey as late as 1 am or as early as 5 am. The majority of respondents completed the survey outside of the hours of 9 am to 5 pm.

Another major benefit of the Internet approach is cleaner data. Survey responses were directly entered into the database from the Internet as the respondent submitted their survey, eliminating the need for data entry. The lack of data entry results in a cleaner collection of data since there is no opportunity for transcription errors.

Lack of interviewer bias is another benefit associated with implementing the survey on the Internet as opposed to the telephone. Generally, in traditional telephone-based surveys, results are subject to interviewer bias since there is no guarantee that all interviewers will ask the set of questions in exactly the same way. If some interviewers read the question differently than the others or if some interviewers attempt to interpret the question for respondents, then the survey results can be adversely affected. With the Internet approach, respondents all read exactly the same question and must interpret the question on their own, eliminating the possibility of interviewer bias.

Issues of Internet Approach

There were a few issues associated with the Internet implementation of the quantitative survey. The primary issue we encountered is some potential respondents did not have Internet access. Such respondents usually represented the smallest firms. To include those without Internet access, we offered the options of completing the survey via fax or over the telephone.

Another issue that surfaced is that some potential respondents had incompatible web browsers. Two designers mentioned logging into the website and not being able to see the survey. This problem was sporadic and we determined that these designers had outdated web browsers.

Lastly, the start-up costs associated with implementing the survey over the Internet are greater than the start-up costs of telephone implementation. For the most part, the increased costs are due to the website development. After the survey instrument has been designed and approved, time and effort must be invested to design and thoroughly test the website. Much of the increased start-up costs are offset by the lack of data entry costs.

Although there are several issues associated with the Internet implementation of the survey, we feel that these negative factors are far outweighed by the positive features. The increased start-up costs are offset by the reduced data entry costs. Most respondents were pleased to learn they could complete the survey at their convenience as opposed to traditional survey research. We believe that the Internet approach was quite successful in surveying designers in the state of California.

Respondent Comments

At the end of the Internet survey, we provided a section where respondents could submit any comments they felt appropriate. Listed below are the various comments we received from architects about both the survey specifically or energy efficiency in general.

> *"I am an architect and urban planner who has practiced as an energy conservation consultant for architects and building owners for over 20 years. I am also the author of a publication entitled "Appropriate Technology for design of Housing". I have taught and lectured widely on the subject of energy conservation. Your questionnaire should be developed further to elicit the information needed to determine how best to encourage strategies that will result in buildings that exceed the requirements of Title 24."*

> *"A lot of the multiple choice questions had available answers which were a bit simplistic. Sometimes no available answer was really accurate, or really told the story. But overall should yield interesting database results."*

> *"It is hard getting past initial costs and showing the long term value added to the project. The discussions are mostly about money."*

"Survey was too long. Some questions seemed to be repeated."

"We own, build, operate and maintain our facilities so several questions were not relevant and may have been interpreted from our perspective as opposed to a typical consultant."

"This survey is a very good idea. I think is good for you to know how the energy efficient equipment is been used in reality."

"This was a good survey. Honest and unbiased questions! Good Luck."

"1. Architects need consultants knowledgeable in this field because we don't have the time to evaluate or design active energy efficient systems.

2. Educating clients and/or developers in the benefits of energy efficiency should be the first priority since they have the authority and money to implement it.

3. Passive energy efficient systems such as increased thermal mass, dual glazing, thicker insulation, etc., can be presented and/or designed into a buildings but are often first to be cut for budget reasons."

"Some of your questions are unclear and therefore will not lend itself for accurate answers. Also, asking one specific answer is not being realistic"

"I have no knowledge that would allow me to give a meaningful answer to either question 25 or 26. I personally have no knowledge of buildings that do not conform to Title 24."

"On the last section (agree/disagree) I work in a large metro area with many sophisticated consultants and owners who generally see the value of energy decisions: I don't know how it applies to rural areas. The consultants here know how to find out about and specify available energy conserving features and equipment."

"Energy efficient equipment is constantly being improved and introduced, and with increased acceptance and sales, the price is lowered."

"Do not have a broad knowledge of energy efficiency beyond T-24. Most of our work is high end residential"

> *"I am an Arizona architect that does not have to comply with Title 24 very often."*

> *"All energy efficiency studies are conducted by consultants for us, primarily, MEP."*

Listed below are the various comments we received from engineers about both the internet survey and energy efficiency in general.

> *"Energy, while more expensive today than it has been, is still relatively cheap."*

> *"Energy conservation measures generally increase first costs. When the first costs for energy conservation measures can be recovered in less than two to five years, then owners will consider energy efficiency."*

> *"The more energy costs rise, the more these things will apply."*

> *"Most of the work we do is outside of Title 24 areas. Most clients are private and will explore energy efficient equipment when incentives from utility companies can be given and/or 24 month payback on premium cost can be provided."*

> *"The development of energy efficient designs is the responsibility of the entire design team, not just the equipment selection."*

> *"Good format."*

> *"Some questions are not clear. Answer will depend on what the question is referencing."*

> *" Some of the questions do not provide the options I would expect or like to respond to."*

> *" Q3. How is the income of our firm related to this survey? Question not answered.*
>
> *Q13. What is an "integrated design team"? This is not a term used in our industry in this area.*

Q19. This question allows only one answer. We use several of these methods.

Q26. Buildings that do not meet t-24 do not fall into any of these categories. The non-residential projects that we are involved in that may not meet t-24 are "I" occupancy projects, which are exempt per code. These buildings are not analyzed for t-24 compliance so whether they meet is unknown."

Market Barriers

One component of the quantitative designer survey was created to determine the primary barriers to more efficient design practices. In this component of the survey, all respondents were provided 2 statements describing each market barrier under consideration and asked to rate their level of agreement with each statement. Listed below is the definition of each potential barrier[1] along with the two statements used to describe it.

Information or search costs - the costs of identifying energy-efficient products or services or of learning about energy-efficient practices. These can include the value of time spent finding out about or locating an energy-efficient product or service or hiring someone else to do it on the consumer's behalf. Search costs can be thought of as costs of acquiring information.

It's too time consuming to collect information about energy efficient options.

It isn't worthwhile to collect information about energy efficient options.

Performance uncertainties - the difficulties consumers face in evaluating claims about future benefits, which are made for many energy-efficiency investments and activities. This market barrier is closely related to high search costs; acquiring the information needed to evaluate claims regarding future performance is rarely costless. In some cases it may be impossible to obtain the relevant information; one may not be able to generalize from existing information but instead must "experience" the energy performance as it is affected by one's own unique operating conditions, practices, or preferences. Producers, as well as consumers, face these costs in forecasting the market response to decisions they make to manufacture, promote, stock, or offer energy-efficient products.

Building Owners prefer systems that have been proven to work in the past.

Evaluating vendor's performance claims about energy efficient equipment requires a high level of expertise.

Asymmetric information and opportunism - another aspect of the difficulties consumers face in evaluating the veracity, reliability, and applicability of claims made by sales personnel for a particular energy-efficient product or service. This barrier reflects the fact that sellers of energy-efficient products of services typically have more and better information about their offerings than do consumers. It also reflects the incentive that sellers have to provide misleading information. This market barrier is closely related to high information costs and performance uncertainties because obtaining the information required to assess claims adequately may be

[1] Eto, J., R. Prahl, and J. Schlegal, 1996. A Scoping Study on Energy -Efficiency Market Transformation by California Utility DSM Programs. Ernest Orlando Lawrence Berkeley National Laboratory, LBNL-39058.

costly or impossible. This barrier is different from high information costs however, in that appropriate use of the information may require specialized knowledge held only by the vendor; thus, opportunism on the part of those with the specialized knowledge is a special concern. This barrier is also related to bounded rationality, described below.

> *It's difficult to evaluate savings claims for energy efficient equipment.*
>
> *Vendors of energy efficient equipment cannot be trusted to provide accurate information about product performance.*

Hassle or transaction cost - the indirect costs of acquiring energy efficiency and are also closely related to information or search costs. These cost include the time, materials, and labor involved in obtaining or contracting for an energy-efficient product or service.

> *It's difficult to locate and obtain efficient equipment and materials.*
>
> *Dealing with technologically advanced systems costs too much time and money.*

Hidden costs - unexpected costs associated with reliance on or operation of energy-efficient products or services. These costs could include additional operating and maintenance costs associated with energy-efficient equipment or additional staff costs associated with monitoring or servicing transactions (e.g., contractor supervision). They might also include additional costs resulting from the quality of installation. Many of these unplanned costs are incurred after the acquisition of an energy-efficient product or service. To some extent, they can also be thought of as performance uncertainties.

> *If an energy efficient system breaks down, it will cost more to fix.*
>
> *Facility Operators require additional expertise to properly operate energy efficient systems.*

Access to financing - the difficulties associated with the lending industry's historic inability to account for the unique features of loans for energy savings projects (i.e., that future reductions in utility bills increase the borrower's credit-worthiness. In principle, accounting for energy-efficiency improvements funded by loans ought to result in lower borrowing costs. This market barrier can be analyzed as reflecting lenders' uncertainty regarding the reliability of future savings and reflecting the additional costs associated with formally recognizing this feature of energy savings projects (another aspect of hassle costs described previously). Institutionally, this market barrier manifests in the absence of secondary financial institutions such as those established in other markets to allow investors to "lay-off" separately the unique risks associate with the future performance of energy-efficiency investments.

> *The construction budget cannot handle the additional cost of energy efficient systems.*
>
> *Lending institutions will not finance a building with energy efficient options because it increases the cost too far above norms.*

Bounded rationality - the behavior of an individual during the decision making process that may seem inconsistent with an individual's goals. Everyone relies on "rules of thumb" to varying degrees. Sometimes rules of thumb are referred to as matters of habit or custom. Rules of thumb serve to limit the focus or scope of considerations for a given decision. Such behavior is hardly irrational, in view of the potentially high search and information processing costs associated with trying to make every decision based on first principles, e.g., net present value. As a result, behavior is often described as rational in intention, but limited in its execution. This barrier has sometimes been construed to include examples of what can only be characterized as plainly irrational behavior or behavior inconsistent with one's articulated goals and understanding. This barrier is distinct from high search costs, performance uncertainties, and asymmetric information because more or better information alone may be insufficient to change behavior. Instead, this barrier refers to the way in which individuals process and act (not necessarily logically) on whatever information they may have.

> *Building owners often claim their main objective is minimizing total costs, but when presented with the initial construction costs, they opt for less efficient equipment.*
>
> *Design and system decisions are made based on simplified rules of thumb.*

Organization practices or custom - organizational behavior or systems of practice that discourage or inhibit cost-effective energy-efficient decisions. This barrier is closely related to bounded rationality but applies to organizations or social networks rather than individuals. A good example is institutional procurement rules, policies, and practices that make it difficult for organizations to act on energy-efficiency decisions based on economic merit. This barrier is also closely related to hassle costs or subsequent hidden costs, which in this case might be faced by individuals acting within organizations.

> *Construction and operating budgets are often separate, so construction costs cannot be increased for the benefit of Operating and Maintenance costs.*
>
> *Building owners prefer having the same equipment at all facilities so they can take advantage of the related economies of scale.*

Misplaced or split incentives - institutional relationships which mean that the incentives of an agent charged with purchasing energy efficiency are not aligned with those of the persons who would benefit from the purchase. One example is in new construction where builders attempting to minimize first cost do not install higher-first-cost energy-efficiency features that would be valued by the future building owners who must pay the utility bills. In this case, the builder has no incentive to minimize utility bills she will not pay and every incentive to increase her profit by minimizing the first costs she does not incur. A second example arises in rental property where the landlord has no incentive to install energy saving retrofits in buildings where she does not pay the utility bills. In this case, the tenant, having no financial interest in the building structure or fixtures, is not to be in a position to authorize retrofits that would benefit her directly in the form of reduced utility bills.

> *The organization responsible for selecting the equipment is often not the same organization that is responsible for operating the equipment.*
>
> *Clients who build to lease care only about minimizing first cost.*

Product or service unavailability - the adequacy of supply. Unavailability of a product is different from high search costs that make it expensive for the consumer to locate a product or service. Unavailability is a market barrier created by the manufacturers and distributors of products or service providers that inhibits consumer demand. One result may be higher prices to reflect the fact that supplies are tight. Unavailability and high prices may be the result of collusive or anticompetitive practices to hold some products (or producers) off the market in favor of others that offer higher profit advantages (e.g., market share). Distributors may face high search and acquisition costs in order to accurately anticipate demand or they may react in a boundedly rational way to expectations for future demand caused, for example, by the newness of a product. As a result, they may limit shelf space for or not stock energy-efficient products.

> *Energy efficient equipment is much harder to find than standard equipment.*
>
> *Energy efficient equipment is a special order, and the construction budget cannot be held up to wait for it.*

Externalities - costs that are associated with transactions, but are not reflected in the price paid in the transaction. For example, environmental costs associated with electricity generation by fossil fuel are not incorporated into prices for electricity or fossil fuel use; these prices are too low in that they do not reflect the full cost to society of using these sources of energy. For markets to operate efficiently, transactions must incorporate full costs.

> *Building owners won't consider long-term operating expenses when selecting equipment.*
>
> *Environmental and societal costs are never considered when specifying equipment.*

Nonexternality mispricing - other factors that move prices away from marginal cost. An example of this barrier arises when regulated utility commodity prices are set using ratemaking practices based on average (rather than marginal) costs.

> *Manufacturers charge too much of a premium for energy efficient equipment.*
>
> *Prices of high efficiency equipment are artificially inflated.*

Inseparability of product features - the difficulties consumers sometimes face in acquiring desirable energy-efficiency features in products without also acquiring (and paying for) additional undesirable features that increase the total cost of a product beyond what the consumer would be willing to pay for just the added energy-efficiency features alone. For example, energy-efficiency may be offered as an option on only the highest priced models in a product line, which also include a variety of other non-energy amenities. There are two aspects of this phenomenon that need to be analyzed separately. On the one hand, if the decision to bundle product features is made at the discretion of manufacturers or distributors, then inseparability can be thought of as a market barrier that is closely related to product unavailability. On the other hand, if the inseparability is either required by law or unavoidable because it is inherent in the design of the product, then the phenomenon is not a market barrier in and of itself but is and (apparently) inescapable feature of the product. For the purpose of this study, a justification for utility energy-efficiency intervention to increase market adoption to overcome the high first cost associated with this second situation must be made based on overcoming some other market barrier (e.g., the presence of externalities or other forms of mispricing). Interventions other than conventional utility energy-efficiency programs might address this market barrier directly - e.g., changes to laws or basic research and development to change product designs.

> *Energy efficient equipment always includes other features that drive the price up too much.*
>
> *It would be preferable to purchase energy efficient features on equipment separately rather than packaged together.*

Irreversibility - once a decision to purchase an energy-efficient product or service is made, it is often difficult to revise it in light of future information because aspects of the decision are irreversible (e.g., if future energy prices go down, one cannot get "salvage" insulation that has already been blown into a wall). Irreversibility is an attribute of many energy-efficient products and closely related to performance uncertainty. Utility energy-efficiency programs to overcome irreversibility must be justified with reference to some other market barrier (e.g., externalities or mispricing). In other words, no conventional utility program intervention can change the irreversible nature of certain products although another type of intervention, such as basic research and development to change the physical characteristics of the measure could do so.

> *If energy efficient equipment is installed, it will be very difficult to change to a different system later.*
>
> *If design features incorporate energy efficiency, then remodeling later will be difficult.*

Database Documentation

Table 4 to Table 11 present the documentation for the quantitative survey database provided along with this report. The tables provide the variable name as given in the survey database, a brief description of the variable, and a comprehensive listing of all response codes. If a variable has the value “NA” in the column “Response Codes”, then there are no response codes affiliated with that variable, either because the responses are unique or because the variable is derived from others.

Variable	Description	Response Codes
Stratum	Stratum Number	1 = Stratum 1 2 = Stratum 2 3 = Stratum 3 4 = Stratum 4 5 = Stratum 5
RLWID#	Unique Identifying Number	NA
Type	Respondent Type	1 = Architect 2 = Engineer
Name	Respondent Name	NA
Company Name	Firm Name	NA
Phone Number	Respondent Phone Number	NA
q1	Firm's Primary Business	1 = Architectural 2 = Mechanical Engineering 3 = Electrical Engineering 4 = Other 5 = Multi-Disciplinary Architecture & Engineering
q1a	Firm's Primary Business - Other	NA
q2	Position Within Firm	1 = Project Engineer 2 = Senior Engineer 3 = Senior Architect 4 = Principal 5 = Owner 6 = Other 7 = Project Architect
q2a	Position Within Firm - Other	NA
q3	Firm's Annual Revenue	1 = Less Than $1 Million 2 = $1 Million to $2.5 Million 3 = $2.5 Million to $5 Million 4 = $5 Million to $10 Million 5 = $10 Million to $20 Million 6 = Over $20 Million
q4a	% of Work on Public Sector	NA
q4b	% of Work on Private, Owner-Occupied	NA
q4c	% of Work on Private, Speculative	NA
q4d	% of Work on All Other Types	NA
num_sect	Number of Sectors in which Respondent Works	1 = One Sector 2 = Two Sectors 3 = Three Sectors
sector	Primary Sector in which Respondent Works	1 = Public Sector 2 = Private, Owner-Occupied 3 = Private, Speculative Market
q5a	Change in % of Public Projects	1 = Decreased 2 = Remained Constant 3 = Increased
q5b	Change in % of Private, Owner-Occupied	1 = Decreased 2 = Remained Constant 3 = Increased
q5c	Change in % of Private, Speculative	1 = Decreased 2 = Remained Constant 3 = Increased
q6a	Importance of Energy Efficiency in Public Sector Projects	1 = Very Unimportant 2 = Somewhat Unimportant 3 = Neither Important or Unimportant 4 = Somewhat Important 5 = Very Important
q6b	Importance of Energy Efficiency in Private, Owner-Occupied Projects	1 = Very Unimportant 2 = Somewhat Unimportant 3 = Neither Important or Unimportant 4 = Somewhat Important 5 = Very Important
q6c	Importance of Energy Efficiency in Private, Speculative Projects	1 = Very Unimportant 2 = Somewhat Unimportant 3 = Neither Important or Unimportant 4 = Somewhat Important 5 = Very Important

Table 4: Quantitative Survey Database Documentation (1 of 8)

q7	Primary Responsibility for Designing Energy Efficiency Into Buildings	1 = Owner 2 = Tenant 3 = Architect 4 = Mechanical Engineer 5 = Electrical Engineer 6 = State Government 7 = Federal Government 8 = Local Government 9 = Builder 10 = Equipment Manufacturers 11 = Someone Else 12 = Nobody
q7a	Primary Responsibility - Someone Else	NA
q8	Primary Decision-Maker About Energy Efficiency Related Choices	1 = Owner 2 = Tenant 3 = Architect 4 = Mechanical Engineer 5 = Electrical Engineer 6 = Builder 7 = Someone Else 8 = Nobody
q8a	Primary Decision-Maker - Someone Else	NA
q9	Level of Knowledge About Efficiency Options Beyond Title 24	1 = Very Uninformed 2 = Somewhat Ininformed 3 = Neither Informed or Uninformed 4 = Somewhat Informed 5 = Very Well Informed
q10	Does Respondent Educate Clients?	0 = No 1 = Yes
q11	Ways of Presenting Efficiency Information	1 = Discuss O & M expenses vs. initial Construction Costs 2 = Discuss Energy Savings Relative to T-24 3 = Discuss Associated Comfort Benefits 4 = Discuss Associated Aesthetic Benefits 5 = Other
q11a	Ways of Presenting Information - Other	NA
q12	% of Projects Completed Using Optimized Energy Design	1 = 20% or less 2 = 21 - 40% 3 = 41 - 60% 4 = 61 - 80% 5 = 81 - 100% 98 = Don't Know
q13	Change in Use of Optimized Energy Design	1 = Decreased 2 = Remained Constant 3 = Increased
q14a	Is Mechanical Engineer among Top 3 Sources of Efficiency Information for Exceeding T-24?	0 = No 1 = Yes
q14b	Is Electrical Engineer among Top 3 Sources of Efficiency Information for Exceeding T-24?	0 = No 1 = Yes
q14c	Are Manufacurers among Top 3 Sources of Efficiency Information for Exceeding T-24?	0 = No 1 = Yes
q14d	Are Utilities among Top 3 Sources of Efficiency Information for Exceeding T-24?	0 = No 1 = Yes
q14e	Are Trade Publications among Top 3 Sources of Efficiency Information for Exceeding T-24?	0 = No 1 = Yes
q14f	Are Internet Resources among Top 3 Sources of Efficiency Information for Exceeding T-24?	0 = No 1 = Yes
q14g	Are Professional Associations among Top 3 Sources of Efficiency Info. for Exceeding T-24?	0 = No 1 = Yes
q14h	Are Seminars among Top 3 Sources of Efficiency Information for Exceeding T-24?	0 = No 1 = Yes
q14i	Is State of CA among Top 3 Sources of Efficiency Information for Exceeding T-24?	0 = No 1 = Yes
q14j	Is Energy Code among Top 3 Sources of Efficiency Information for Exceeding T-24?	0 = No 1 = Yes

Table 5: Quantitative Survey Database Documentation (2 of 8)

q14k	Are National Laboratories among Top 3 Sources of Efficiency Info. for Exceeding T-24?	0 = No 1 = Yes
q14l	Are Other Sources among Top 3 Sources of Efficiency Information for Exceeding T-24?	0 = No 1 = Yes
q14m	Sources - Other	NA
q14n	Is No Source Used for Efficiency Information for Exceeding Title 24?	0 = No 1 = Yes
q15	Ease of Obtaining Efficiency Information for Exceeding Title 24	1 = Very Difficult 2 = Somewhat Difficult 3 = Neither Easy Nor Difficult 4 = Somewhat Easy 5 = Very Easy 98 = Don't Know
q16	Ease of Understanding Efficiency Information for Exceeding Title 24	1 = Very Difficult 2 = Somewhat Difficult 3 = Neither Easy Nor Difficult 4 = Somewhat Easy 5 = Very Easy 98 = Don't Know
q17	Information for Exceeding T-24 that Would Be Most Useful for Educating Clients	1 = Newsletter/Brochure/Fact Sheet 2 = Seminar/Workshop 3 = Direct Contact with Utility Representatives 4 = Database of Recommended Products 5 = Software Selection Tool for Incorporating Efficiency into Purchase Decisions 6 = Utility Guidelines for Specific Market Segments and Space Types 7 = Central Websites 8 = Utility-sponsered Demonstrations in Prototypical Buildings 9 = None
q18a	Would Newsletter/Brochure/Fact Sheet be Useful for Educating Clients?	0 = No 1 = Yes
q18b	Would Seminar/Workshop be Useful for Educating Clients?	0 = No 1 = Yes
q18c	Would Direct Contact with Utility Reps. be Useful for Educating Clients?	0 = No 1 = Yes
q18d	Would Databse of Recommended Products be Useful for Educating Clients?	0 = No 1 = Yes
q18e	Would Software Selection Tool be Useful for Educating Clients?	0 = No 1 = Yes
q18f	Would Utility Guidelines for Market Segments & Space Type be Useful for Educating Clients?	0 = No 1 = Yes
q18g	Would Central Websites be Useful for Educating Clients?	0 = No 1 = Yes
q18h	Would Demonstrations in Prototypical Buildings be Useful for Educating Clients?	0 = No 1 = Yes
q18i	Is No Source Useful for Educating Clients?	0 = No 1 = Yes
q19	Methods Used to Determine Energy Savings	1 = Detailed Calculations based on Public-Sector Computer Simulations 2 = Detailed Calculations based on Propietary Computer Simulations 3 = Detailed Computer Analysis of Lighting and/or Daylighting Systems 4 = Simplified Energy Savings Estimates based on Spreadsheet Calculations 5 = Rule of Thumb Estimates based on Personal Knowledge 6 = Rule of Thumb Estimates by Others 7 = None 98 = Don't Know

Table 6: Quantitative Survey Database Documentation (3 of 8)

q20	Frequency of Utilizing an Energy Analysis Design Tool	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q21a	Frequency of Specifying High Performance Glass	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q21b	Frequency of Specifying Premium Efficiency Motors	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q21c	Frequency of Specifying Variable Frequency Drives	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q21d	Frequency of Specifying Occupancy Sensors	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q21e	Frequency of Specifying Daylighting Controls	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q21f	Frequency of Specifying Energy Management Systems	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q21g	Frequency of Specifying High Efficiency HVAC Systems	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q22	Familiarity with EPA's Energy Star Labeling Program for Buildings	0 = No 1 = Yes
q23	Meaning of Energy Star Label on a Building	NA
q24	Familiarity with Title 24 Requirements	1 = Not at All Familiar (Don't Know what Title 24 is) 2 = Not Very Familiar (Know Title 24 Compliance is required, but do not prepare or review) 3 = Somewhat Familiar (Review Title 24 Documentation Prepared by Others) 4 = Very Familiar (Prepare Title 24 Documentation)
q25	% of New Buildings which Do Not Meet T-24	1 = 20% or less 2 = 21 - 40% 3 = 41 - 60% 4 = 61 - 80% 5 = 81 - 100% 98 = Don't Know
q26	Primary Reason for Existence of New Buildings that Do Not Comply with Title 24	1 = Contractors Install Less Efficient Equipment than was Originally Specified 2 = Inconsistency in Title 24 enforcement 3 = Equipment and Materials Changes by the Building Owner 4 = Cost-Cutting After Initial Equipment Specification 98 = Don't Know
q27	Does Code Drive Practice or Does Practice Drive Code?	1 = Code Drives Practice 2 = Practice Drives Code 3 = Energy Code & Standard Practice are Unrelated 98 = Don't Know

Table 7: Quantitative Survey Database Documentation (4 of 8)

q28a	Change in Interest in Efficiency Among Public Sector Clients	1 = Decreased 2 = Remained Constant 3 = Increased 98 = Don't Know
q28b	Change in Interest in Efficiency Among Private, Owner-Occupied Clients	1 = Decreased 2 = Remained Constant 3 = Increased 98 = Don't Know
q28c	Change in Interest in Efficiency Among Private, Speculative Clients	1 = Decreased 2 = Remained Constant 3 = Increased 98 = Don't Know
q29a	Frequency of Documenting Design Intent	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q29b	Frequency of Incorporating Commissioning Requirements into Design Specifications	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q29c	Frequency of Inspection of Building Sytems During Construction (Other than Bldg. Dept.)	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q29d	Frequency of Delivery of As-Built Drawings, Specifications and Submittals	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q29e	Frequency of Testing of Building Equipment Performance	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q29f	Frequency of Testing of Building Control System Operation	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q29g	Frequency of Delivery of Operations and Maintenance Manuals	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q29h	Frequency of Training of Building Operators	1 = Never 2 = Seldom 3 = Somewhat Often 4 = Very Often 5 = Always
q30	Agreement with Barrier Statement: Information Costs	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q31	Agreement with Barrier Statement: Performance Uncertainties	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know

Table 8: Quantitative Survey Database Documentation (5 of 8)

q32	Agreement with Barrier Statement: Asymmetric Information	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q33	Agreement with Barrier Statement: Split Incentives	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q34	Agreement with Barrier Statement: Hidden Costs	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q35	Agreement with Barrier Statement: Access to Financing	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q36	Agreement with Barrier Statement: Bounded Rationality	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q37	Agreement with Barrier Statement: Hassle Costs	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q38	Agreement with Barrier Statement: Organizational Practices	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q39	Agreement with Barrier Statement: Product Unavailibility	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q40	Agreement with Barrier Statement: Externalities	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q41	Agreement with Barrier Statement: Nonexternality Mispricing	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q42	Agreement with Barrier Statement: Inseparability of Product Features	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know

Table 9: Quantitative Survey Database Documentation (6 of 8)

q43	Agreement with Barrier Statement: Irreversibility	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q44	Agreement with Barrier Statement: Information Costs	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q45	Agreement with Barrier Statement: Perfomance Uncertainties	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q46	Agreement with Barrier Statement: Hassle Costs	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q47	Agreement with Barrier Statement: Hidden Costs	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q48	Agreement with Barrier Statement: Access to Financing	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q49	Agreement with Barrier Statement: Bounded Rationality	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q50	Agreement with Barrier Statement: Organizational Practices	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q51	Agreement with Barrier Statement: Split Incentives	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q52	Agreement with Barrier Statement: Product Unavailibility	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q53	Agreement with Barrier Statement: Externalities	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know

Table 10: Quantitative Survey Database Documentation (7 of 8)

q54	Agreement with Barrier Statement: Nonexternality Mispricing	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q55	Agreement with Barrier Statement: Inseparability of Product Features	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q56	Agreement with Barrier Statement: Irreversibility	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
q57	Asymmetric Information	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither Agree Nor Disagree 4 = Somewhat Agree 5 = Strongly Agree 98 = Don't Know
Comments	Respondent Comments	NA
info_cos	Mean Agreement with Barrier: Information Costs (1/2)(q30 + q44)	NA
perform	Mean Agreement with Barrier: Perfomance Uncertainties (1/2)(q31 + q45)	NA
assym	Mean Agreement with Barrier: Asymmetric Information (1/2)(q32 + q57)	NA
split	Mean Agreement with Barrier: Split Incentives (1/2)(q33 + q51)	NA
hidden	Mean Agreement with Barrier: Hidden Costs (1/2)(q34 + q47)	NA
finance	Mean Agreement with Barrier: Access to Financing (1/2)(q35 + q48)	NA
bounded	Mean Agreement with Barrier: Bounded Rationality (1/2)(q36 + q49)	NA
hassle	Mean Agreement with Barrier: Hassle Costs (1/2)(q37 + q46)	NA
org_prac	Mean Agreement with Barrier: Organizational Practices (1/2)(q38 + q50)	NA
unavail	Mean Agreement with Barrier: Product Unavailibility (1/2)(q39 + q52)	NA
extern	Mean Agreement with Barrier: Externalities (1/2)(q40 + q53)	NA
misprice	Mean Agreement with Barrier: Nonexternality Mispricing (1/2)(q41 + q54)	NA
insep	Mean Agreement with Barrier: Inseparability of Product Features (1/2)(q42 + q55)	NA
irrev	Mean Agreement with Barrier: Irreversibility (1/2)(q43 + q56)	NA

Table 11: Quantitative Survey Database Documentation (8 of 8)

Survey Instrument Design

The primary data source for the DOE-2 models is the on-site survey. The survey form is designed so that the surveyors in the field will make key modeling decisions on model zoning and equipment/space association. The form is designed to follow the logical progression of an on-site survey process. The survey form used in this study will be substantially similar to those used in the previous NRNC impact studies. Modifications were made to accommodate the specific data needs of this study.

The form starts out with a series of interview questions. Conducting the interview first helps orient the surveyor to the building and allows time for the surveyor to establish a rapport with the customer. Once the interview is completed, an inventory of building equipment will be conducted. The survey begins with the HVAC systems, and progresses from the roof and/or other mechanical spaces into the conditioned spaces. This progression allows the surveyor to establish the linkages between the HVAC equipment and the spaces served by the equipment.

2. Audit and Modeling Methodology

A detailed description of the procedures used to develop the information about NRNC buildings, including the auditing and modeling methodology.

Recruiting

RLW Analytics recruited and scheduled all on-site surveys. All recruiting information was stored in a central recruiting database. Dodge data was used to populate the recruiting database. RLW staff added to the existing Dodge data set to create a complete database of contact information. Using various resources, RLW staff searched for missing information, such as phone numbers and addresses needed to make initial contact. All new data was added to the recruiting database as it was found. Once enough site-specific data was available, customer recruiting began.

The main objective of recruiting customers is to gain permission to conduct on-site interviews and audits for the study. An MS Access™ form linked to the recruiting database provided the RLW recruiting staff with the necessary information to begin recruiting. The scheduling form used provided the recruiter with site specific information necessary to complete the recruiting task. The form included the following items from the database:

1. Building name/owner
2. Building/site address
3. Contact personnel
4. Phone and fax numbers
5. Date of construction
6. Building type
7. Building area
8. Strata

The form also included blank spaces to be filled in by the recruiting staff. The following items will be filled in during phone recruitment:

1. Appointment time and date
2. Site contact
3. Audit team (RLW or AEC)
4. Miscellaneous Notes
5. Directions to site

A phone interview instrument was used each time a contact was made. Using this instrument, RLW staff conducted a short survey of questions with the contact person. In general, the contact people were building engineers, supervisors, or owner/operators. These personnel are usually the most knowledgeable people to speak to and gain full access with to the site.

A master calendar was updated each time an appointment was made. The calendar has the number of auditors and appointments available for each business day. All appointments made were entered into the master calendar either during the recruiting process or immediately following, eliminating the possibility of double scheduling sites. At the end of each business day, recruiting forms for each scheduled site were printed and forwarded on to the appropriate audit team.

Interview questions were aimed at determining valuable project information. In addition to the above listed items, RLW staff were confirming construction era, occupied date, key site personnel, and asking a battery of questions about the owners' views on energy efficiency. Specifically, we collected data from the facility managers about:

- Their attitudes toward energy efficiency
  - Does the company value energy efficiency?
    - In theory?
    - In practice?
  - Is there any organized program to systematically track energy efficiency?
  - Are performance measurements tied to energy efficiency?
- Motivations to build and run more efficient buildings
- Barriers to building and operating more efficient buildings
  - Economic?
    - Lowest first cost mentality
    - Short-term performance measures
  - Information?
  - Corporate culture?
  - Availability?
- Commissioning[2]
  - Have any of typical commissioning practices been done in the building?
  - Is there a regular preventive maintenance and / or diagnostic schedule?

This quantitative data will provide an understanding of the attitudes and behaviors of building managers. Similar data is available for the 1994 and 1996 datasets. To the extent that it is useful and relevant, it will be brought into the analysis.

Interview Questions

The surveyor used the interview questions to identify building characteristics and operating parameters that are not observable. The interview questions cover the following topics:

Building functional areas. Functional areas are defined on the basis of operating schedules. Subsequent questions regarding occupancy, lighting, and equipment schedules, are repeated for each functional area.

Occupancy history. The occupancy history questions are used to establish the vacancy rate of the building during 1997. The questions cover occupancy, as a percent of total surveyed floor space, and HVAC operation during the tenant completion and occupancy of the space. Responses to these questions are used to understand building start-up behavior.

Occupancy schedules. For each functional area in the building, a set of questions will be asked to establish the building occupancy schedules. First, each day of the week will be assigned to one of three daytypes: full occupancy, partial occupancy, and unoccupied. This is to cover

[2] A limited attempt to capture information about building commissioning will be made. The scope of this study does not allow for a thorough study of commissioning practices.

buildings that did not operate on a normal Monday through Friday workweek. Holidays and monthly variability in occupancy schedules will be identified.

Daily schedules for occupants, interior lighting, and equipment/plug loads. A set of questions is used to establish hourly occupancy, interior lighting, and miscellaneous equipment and plug load schedules for each functional area in the building. Hourly schedules are defined for each daytype. A value, which represents the fraction of the maximum occupancy and/or connected load is entered for each hour of the day. The entry of the schedule onto the form will be done graphically.

Daily schedules of kitchen equipment. A set of questions will be asked to establish hourly kitchen equipment schedules for each functional area in the building. Hourly schedules are defined for each daytype. A value that represents the equipment-operating mode (off, idle, or low, medium or high volume production) will be entered for each hour of the day. The entry of the schedule onto the form is done graphically.

Operation of other miscellaneous systems. General questions on the operation of exterior lighting systems, interior lighting controls, window shading, swimming pools, and spas are covered in this section.

Operation of the HVAC systems. A series of questions are asked to construct operating schedules for the HVAC systems serving each area. Fan operating schedules and heating and cooling setpoints are entered. Additional questions are used to define the HVAC system controls. The questions are intended to be answered by someone familiar with the operation of the building mechanical systems. The questions cover operation of the outdoor air ventilation system, supply air temperature controls, VAV system terminal box type, chiller and chilled water temperature controls, cooling tower controls, and water-side economizers.

Building-wide water use. A series of questions are used to help calculate the service hot water requirements for the building.

Refrigeration system. The operation of refrigeration systems utilizing remote condensers, which are common in groceries and restaurants, is covered in this section. The systems are divided into three temperature classes, (low, medium and high) depending on the compressor suction temperature. For each system temperature, the refrigerant, and predominant defrost mechanism is identified. Overall system controls strategies are also covered. Because restaurants and food stores are not included in this study, the only refrigeration systems in the study are likely to be in office building food service operations and campus dining halls.

Building Characteristics

The next sections of the on-site survey cover observations on building equipment inventories and other physical characteristics. Observable information on HVAC systems, building shell, lighting, plug loads, and other building characteristics are entered, as described below:

Built-up HVAC systems. Make, model number, and other nameplate data are collected on the chillers, cooling towers, heating systems, air handlers, and pumps in the building. Air distribution system type, outdoor air controls, and fan volume controls are also identified.

Packaged HVAC systems. Equipment type, make, model number, and other nameplate data are collected on the packaged HVAC systems in the building.

Zones. Based on an understanding of the building layout and the HVAC equipment inventory, basic zoning decisions are made by the surveyors according to the following criteria:

- ***Unusual internal gain conditions***. Spaces with unusual internal gain conditions, such as computer rooms, kitchens, laboratories are defined as separate zones.

- ***Operating schedules***. Occupant behavior varies within spaces of nominally equivalent use. For example, retail establishments in a strip retail store may have different operating hours. Office tenants may also have different office hours.
- ***HVAC system type and zoning***. When the HVAC systems serving a particular space are different, the spaces will be sub-divided according to HVAC system type. If the space is zoned by exposure, the space is surveyed as a single zone and a "zone option is selected on the survey form.

For each zone defined, the floor area and occupancy type is recorded. Enclosing surfaces are surveyed, in terms of surface area, construction type code, orientation, and insulation levels[3]. Window areas are surveyed by orientation, and basic window properties are identified. Interior and exterior shading devices are identified. Lighting fixtures and controls are identified and inventoried. Miscellaneous equipment and plug loads are also inventoried. Zone-level HVAC equipment, such as baseboard heaters, fan coils, and VAV terminals are identified and entered on the form.

Refrigeration systems. Refrigeration equipment is inventoried separately, and associated with a particular zone in the building. Refrigerated cases and stand-alone refrigerators are identified by case type, size, product stored, and manufacturer. Remote compressor systems are inventoried by make, model number, and compressor system type. Each compressor or compressor rack is associated with a refrigerated case temperature loop and heat rejection equipment such as a remote condenser, cooling tower, and/or HVAC system air handler. Remote condensers are inventoried by make, model number, and type. Nameplate data on fan and pump horsepower are recorded. Observations on condenser fan speed controls are also recorded.

Cooking equipment. Cooking equipment is inventoried separately and associated with a particular zone in the building. Major equipment is inventoried by equipment type (broiler, fryer, oven, and so on), size, and fuel type. Kitchen ventilation hoods are inventoried by type and size. Nameplate data on exhaust flowrate and fan horsepower are recorded. Each piece of kitchen equipment is associated with a particular ventilation hood.

Hot water/Pools. Water heating equipment is inventoried by system type, capacity, and fuel type. Observations on delivery temperature, heat recovery, and circulation pump horsepower are recorded. Solar water heating equipment is inventoried by system type, collector area, and collector tilt and storage capacity. Pools and spas will be inventoried by surface area and location (indoor or outdoor). Filter pump motor horsepower is recorded. Pool and spa heating systems are inventoried by fuel type. Surface area, collector type, and collector tilt angle data for solar equipment serving pools and/or spas is recorded.

Miscellaneous exterior loads. Connected load, capacity, and other descriptive data on elevators, escalators, interior transformers, exterior lighting, and other miscellaneous equipment will be recorded.

Establishing Component Relationships

In order to create a DOE-2 model of the building from the various information sources contained in the on-site survey, relationships between the information contained in the various parts of the survey needs to be established. In the interview portion of the form, schedule and operations data are cataloged by building functional area. In the equipment inventory section, individual pieces of HVAC equipment: boilers, chillers, air handlers, pumps, packaged equipment and so

[3] The insulation level will be directly observed where possible. In most cases, the insulation levels will be determined from a review of building plans while on-site. When plans are not available, standard levels will be assumed.

on are inventoried. In the zone section of the survey, building envelope data, lighting and plug load data, and zone-level HVAC data are collected. The following forms provide the information needed by the software to associate the schedule, equipment, and zone information.

System/Zone Association Checklist. The system/zone association checklist provides a link between each building zone and the HVAC equipment serving that zone. Systems are defined in terms of a collection of packaged equipment, air handlers, chillers, towers, heating systems, and pumps. Each system is assigned to the appropriate thermal zone in accordance with the observed building design.

Interview "Area" / Audit "Zone" Association Checklist. Schedule and operations data gathered during the interview phase of the survey are linked to the appropriate building zone. These data are gathered according to the building functional areas defined previously. Each building functional area could contain multiple zones. The association of the functional areas to the zones, and thereby the assignment of the appropriate schedule to each zone is facilitated by this table.

Engineering Models

The data collected during the on-site surveys will be used to develop DOE-2 simulation models for each surveyed building. If available and cost-effective, on-site data for buildings from SDG&E and/or SMUD evaluation studies will be translated into the Survey-IT database structure, and added to the database. Once these data are all in a consistent format, DOE-2 models will be automatically generated using the Model-IT software. This approach will provide a consistent set of models for all sites, eliminating biases due to the different modeling approaches taken by SDG&E and/or SMUD as well as to create comparable models from 1994, 1996 and 1997/8.

The keys to efficiently developing competent DOE-2 models are:

1. Collection of appropriate building information during the on-site survey. This relies on competent, well-trained engineers focused on collecting key building data. Keeping the responsibility for data collection in the hands of the engineers responsible for creating the DOE-2 models maintains a single-source responsibility from data collection to results. This approach was followed by RLW/AEC during the Edison and PG&E impact studies, which are anticipated to provide a large portion of the total data to the project.
2. Quality control over the on-site data collection and data entry, including range, internal consistency, and reasonableness checks.
3. Computerized tools to calculate model input parameters from the on-site survey databases and automatically generate as-built DOE-2 input files. The Model-IT automated modeling tool has been extensively documented and reviewed during the course of the 1994 and 1996 SCE and PG&E commercial new construction impact evaluations.
4. Model review and quality control by an experienced DOE-2 engineer.
5. Computerized tools to automatically perform the required parametric runs, and store the results in an electronic database.

Automated Modeling

The automated process outlined above will be used to develop the input files from the on-site surveys for all buildings in the study. High-quality DOE-2 models will be generated from the onsite survey database by the Model-IT software. Special features of the Model-IT software are listed below:

Space definition and model zoning. The building is defined in terms of a series of spaces that represent the principal uses of the building. For example, a building may contain a number of tenants and business types, including office, retail, restaurant uses within the same building. Each space is subject to a different baseline lighting power density allowance under Title 24. Within each space, building shell and internal load characteristics are calculated from the on-site survey data. For example, lighting power density is calculated from a fixture count, a lookup table of fixture wattage, and the space floor area. Lighting schedules are developed from the survey data and associated with the appropriate space in the building. Similarly, equipment power density is calculated from the equipment counts and connected loads in the on-site surveys. A factor is introduced to account for the discrepancy in nameplate verses actual running load inherent in certain types of equipment. The operating schedule is developed from the survey data and associated with the appropriate space in the building.

Another important element in the generation of the input files is an accurate representation of the diversity of heating and cooling loads within the building. Spaces are sub-divided according to the following criteria:

- ***Unusual internal gain conditions***. Spaces with unusual internal gain conditions, such as computer rooms, kitchens, laboratories are defined as separate spaces.
- ***Operating schedules***. Occupant behavior varies within spaces of nominally equivalent use. For example, retail establishments in a strip retail store may have different operating hours. Office tenants may also have different office hours.
- ***HVAC system type and zoning***. HVAC systems inventoried during the on-site survey are associated with the applicable space. When the HVAC systems serving a particular space are different, the spaces are sub-divided. Typical HVAC system zoning practices are followed.

Glazing system description. Particular attention is paid to defining the glazing systems, in terms of size, orientation, construction, internal shading, and external shading. Exterior shading by overhangs, side fins, trees, and buildings is considered, along with the use of interior blinds or other shading devices. Window construction details such as frame construction, number of glazing layers, tint, and the presence of any special coatings or gases is defined from on-site survey data, building plans and/or Title 24 documents. Surveyors will also make a measurement of solar transmission to estimate glazing parameters.

HVAC system assignment. The HVAC systems identified in the on-site survey are associated with the appropriate building space, so that the load imposed on the system, and thereby the energy consumption of the system, is well represented. For buildings in the RLW/AEC datatset, the assignments are identified by the on-site surveyor. Rules will be established to assign systems to spaces in a reasonable manner for other datasets.

HVAC system operating schedules. HVAC system operating schedules are an important driver in determining energy consumption of a building. Thermostat set point and setback schedules, fan operating schedules, and equipment availability schedule information collected during the on-site survey are associated with the appropriate HVAC system. Fan power is calculated from HVAC system nameplate data collected during the on-site survey.

Ventilation Air. Commercial HVAC systems are designed to introduce fresh air into the building to maintain a healthy indoor environment. The space type and its associated floor area are used to calculate outdoor air quantities according to Title 24 rules. Outdoor air fractions are calculated for each system from the total system air flowrate and the space outdoor air requirements.

System Efficiency. HVAC equipment manufacturers' nameplate information will be collected for all HVAC equipment during the RLW/AEC on-site surveys. Efficiency and capacity data are developed from manufacturers' catalog information for each unit surveyed. These data are processed into the input parameters required by DOE-2. Custom performance curves for advanced energy-efficient chillers are used in the models.

A series of parametric runs will be made. The calibrated as-built model will be run with long-term average weather data. A second run will be made, where baseline specifications from the Title 24 Energy Efficiency code will be substituted for the as-built parameters. This model will also be run with long-term average weather data. The difference in the results of these runs will provide, on a whole-building basis, the efficiency level of new construction relative to Title 24.

Quality Control

As mentioned previously, the key to a solid research project is high quality data collection. A solid research project design combined with quality assurance checks will assure high-quality data. During the initial stage of the on-site work, senior engineering staff from RLW/AEC will accompany the surveyors. This will allow quick resolution of data collection issues and provide the guidance necessary to insure accurate data collection for the remainder of the project. As the data are collected, each site will be entered into a central database. Range checks at the data entry level will be implemented, as in the 1996 impact evaluations. Once the data are entered, a DOE-2 model will be automatically generated along with a site performance report. This report will be used as an important quality step. The surveyor/modeler and a senior RLW/AEC engineer will review each report. Data quality criteria will be used to trigger an in-depth review of the input data and model. The overall quality assurance process is outlined as follows:

1. Individual data elements will be range checked during data entry.
2. A list of key physical attributes of the buildings will be summarized in a site summary report, and checked against a list of criteria.
3. The energy performance of the building will also be checked. Energy consumption statistics, such as the whole-building EUI (kWh/SF-yr.) and end-use shares will be examined against a list of criteria.
4. The baseline model will also be run, and the difference between the baseline and as-built energy consumption will be calculated. Sites with large variances will be further examined to investigate potential problems in the on-site data or modeling approach.

The models will be quality checked by experienced DOE-2 engineers. Quality assurance criteria will examine energy consumption statistics, such as the whole-building EUI (kWh/SF-yr.), and end-use shares, as well as building physical parameters such as window to wall ratio, overall shell conductance, lighting power density, equipment power density, floor area per ton of installed AC, sizing ratio, and so on. As discussed previously, quality assurance criteria from the 1996 impact study will be used in this project.

3. The Buildings

The following section of the appendix contains documentation on the calculation of the case weights, and graphics that summarize the schedules that are included in the database. The documentation and graphics were excluded from the final report due to the fact that the level of detail that is covered here is more than the typical reader may have desired in the actual report.

Weighting the Sample

In analyzing sample data, case weights are generally used to extrapolate the sample sites to the target population. This note explains how case weights will be developed for the new-construction sample sites to extrapolate them to the population of new construction in California.

In the case of the 1998 sample, the construction of weights is relatively straightforward. The Dodge database of 1998 new construction was used as the original sampling frame. The sample was stratified by building type and the Dodge estimate of the value of the project. The case weight of each sample site can be calculated as the reciprocal of the sampling fraction in each stratum.

In practice, we often calculate case weights using a technique called balanced stratification. With balanced stratification, size-based strata are constructed using the following steps:

a) Sort the sample sites by increasing size,
b) Group an equal number of sample sites to form each stratum, e.g., stratum 1, Stratum 2, etc.
c) Determine the cut-point separating each pair of strata by calculating the mean of
    a) the size of the largest site in the first stratum and
    b) the size of the smallest site in the second stratum.
d) Calculate the number of sites in the population corresponding to each stratum. If the population is represented by a weighted set of sites, then the number of sites is estimated by calculating the sum of the weights of all population sites in each stratum.
e) Calculate the case weight as the number of population sites divided by the number of sample sites in each stratum, i.e. as the reciprocal of the sampling fraction in each stratum.
f) Attach this case weight to each sample site in the corresponding stratum.

In the case of the 1994 and 1996 samples, the situation is more complex. These samples were originally developed for DSM program evaluation. Somewhat different sample designs were used in the two years. However, the basic approach was similar. The participant sample was drawn from the program tracking system and was stratified by estimated energy savings. The non-participant sample was drawn from a Dodge database and was stratified by the Dodge estimate of the value of the project. The samples were designed to include an approximately equal number of program participants and non-participants. For most building types, the proportion of program participants in the sample is believed to be much larger than the proportion of program participants in the population of new construction. We are seeking to develop sample weights that properly reflect the saturation of the programs.

In the best of worlds, we would develop case weights by post-stratifying the non-participant sample using a sampling frame comprised of Dodge sites that were not program participants. To do this it would be necessary to match the sites in the program tracking system to actual Dodge sites. In the 1994 DSM evaluation study, we tried to do this, but found it to be practically impossible. There were two basic problems.

First, the 1994 program participants consisted of projects that received rebates during 1994. The rebates were awarded when the construction was complete. By contrast, the Dodge database lists upcoming projects scheduled to begin construction in the next several weeks. Since construction could take anywhere from a few months to several years, we had to search through several years of Dodge data to hope of finding a given program participant.

The second problem was that the Dodge database often included only sketchy information identifying the project. Often the exact street address or even the city was missing or inaccurate. So it was hard to find a Dodge project that matched a given program participants.

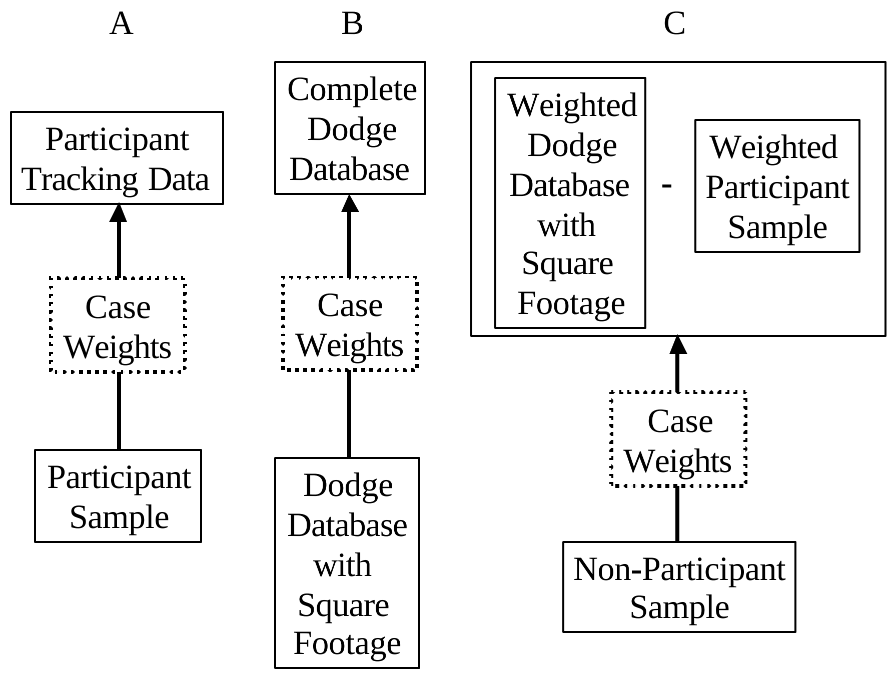
To make matters worse, the Dodge data contains limited information about the size of the project. Ideally we would like to know the square footage of each project in the Dodge database. In practice, square footage is missing for a large number of the sites in the Dodge database. Fortunately, most sites have an alternate measure of size, namely the Dodge estimate of value. But the value of the project is not known for program participants.

To get around these problems, a three-step approach was followed.

A. Calculate case weights for the sample of program participants using the program tracking data as the target population.
B. Calculate case weights for the sites in the Dodge database that have square footage using the entire Dodge database as the entire population.
C. Calculate case weights for the sample of non-participants using an artificial population comprised of the weighted Dodge sites with square footage, less the weighted participant sample sites.

Figure 1 summarizes the approach. In Step A, the set of all program participants is taken as the target population. The sample of participants is post-stratified by building type and the tracking estimate of savings due to the measures funded by the program. The savings-based strata are constructed using balanced stratification. Then case weights are calculated as the reciprocal of the sampling fraction in each stratum. The weighted sample of participants can be considered to be a statistical representation of the population of program participants.

Figure 1: Approach to Case Weights



Step B is an intermediate step to obtain a representation of the Dodge population with known square footage. In step B, the sample is taken to be the Dodge database with known square footage and value, and the population is taken to be the entire set of all Dodge sites with known value. Using balanced stratification, the sample is post-stratified by building type and value and the corresponding weights are attached to the Dodge sites with known square footage.

In step C, weights are calculated for the non-participant sample. To do this we obtain a representation of the population of all non-participants by combining the weighted samples from the preceding two steps. The weighted sample from Step B is taken to be a representation of all construction, both participants and non-participants. This database is reduced by the representation of the program participants obtained from Step A.

The underlying principle is the simple equation: The number of non-participants in the population is equal to the number of sites in the entire population minus the number of participants in the population. Now suppose weighted sample are used to represent the entire population and the population of participants. Then the number of non-participants in the population can be estimated as the sum of the weights for the sites representing the entire population minus the sum of the weights for the sites representing the participants in the population. Of course this principle applies to each stratum.

Motivated by this idea, we simply combine the two sets of sites and multiply the case weight by –1 for each site in the participant sample. Then using balanced stratification, the non-participant sample is post-stratified by building type and square footage and the corresponding weights are calculated. In each stratum, the resulting weight is the ratio between the estimated population size and the sample size. The estimated population size is the sum of the positive weights associated the sites representing the entire population and the negative weights associated the sites representing the participants in the population. These weights are attached to the non-participant sample sites.

The final step is to combine the weighted participant sample from Step A with the weighted non-participant sample from Step B. This gives a full sample of all new construction, both program participants and non-participants.

Technical Description

We let the population be represented by K sites, labeled 1 to K. Each site k has a case weight w_k. Ideally the case weight should be equal to the reciprocal of the probability that site k is included in the sample. In practice, the case weight is usually calculated for each site in any stratum S as the reciprocal of the sampling fraction:

$$w_k = \frac{N_S}{n_S}.$$

Here N_S is the number of population units in the stratum and n_S is the number of sample units in the stratum. In this case, if we let $\sum_{k \in S}$ denote the sum over all <u>sample</u> units in stratum S, then

$$\sum_{k \in S} w_k = \sum_{k \in S} \left(\frac{N_S}{n_S} \right) = N_S .$$

Now suppose the population is divided into participants, denoted P, and non-participants, denoted NP. Suppose, moreover, that we have three samples. The first sample represents the entire population. The second sample represents the participants in the population. The third sample represents the non-participants in the population. The first two of these samples have case weights. We want to calculate case weights for the third sample, i.e., the sample of non-participants.

Consider any stratum. Let N_S denote the number of population units in the stratum. We can estimate N_S as $\sum_{k \in S} w_k$. Here S denotes the set of all sites falling in the stratum from the first sample, i.e., the one representing the entire population.

Let N_S^P denote the number of participant population units in the stratum. We can estimate N_S^P as $\sum_{k \in S_P} w_k$. Here S_P denotes the set of all sites falling in the stratum from the second sample representing the participants.

Finally, let N_S^{NP} denote the number of non-participant population units in the stratum. Then $N_S^{NP} = N_S - N_S^P$. Therefore we define $\hat{N}_S^{NP} = \sum_{k \in S} w_k - \sum_{k \in S_P} w_k$ where $\hat{N}_S^{NP}$ is an estimate of N_S^{NP}

Now we define $S^* = S \cup S_P$, i.e., S^* is the set of all sample sites in the stratum from the first and second samples taken together. Finally we define $w_k^* = w_k$ if $k \in S$, and $w_k^* = -1 \times w_k$ if $k \in S_P$, Then

$$\hat{N}_S^{NP} = \sum_{k \in S} w_k - \sum_{k \in S_P} w_k = \sum_{k \in S^*} w_k^*$$

Finally we calculate a case weight in the third sample to be $\frac{\hat{N}_S^{NP}}{n_S^{NP}}$. Here n_S^{NP} denotes the number of sites in the stratum from the third sample. We apply this case weight to all sites falling in this stratum from the third sample. Now we can combine the second and third samples to represent the entire population.

Schedules

This section of the report presents the average schedules for lighting, cooling, fans, equipment, heating, and occupancy. The information used to create these schedules was collected during the on-site survey. The schedules were then used to simulate the as-built and baseline building energy usage, as reported in the previous section.

The following section looks at schedules by building type. This analysis describes the four building types, i.e., offices, retail, schools and public assembly buildings combining participants and non-participants and all years. A total of 667 buildings were used in the analysis. The types of schedules presented in this section can be produced for all the market segments for any day of the week.

Lighting

Figure 2 shows the Sunday average hourly lighting schedule for each hour of the day by building type. The graph shows the percentage of total lighting connected load that is turned on for each hour on a typical Sunday.

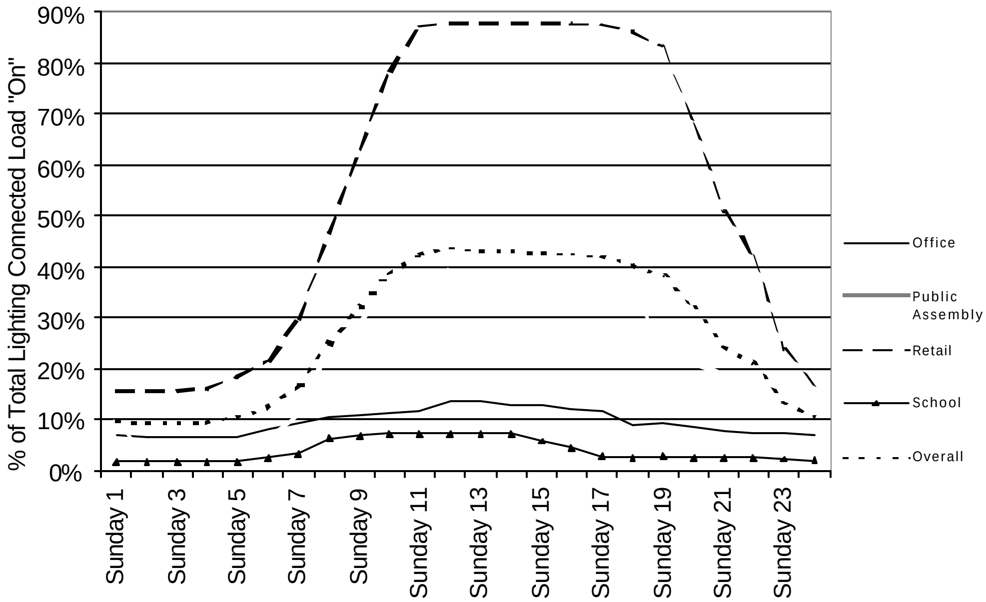


Figure 2: Average Sunday Hourly Lighting Schedule by Building Type

Figure 3 shows the average retail hourly lighting schedule for a typical week. This is another method of displaying that data that is available in the database to be provided.

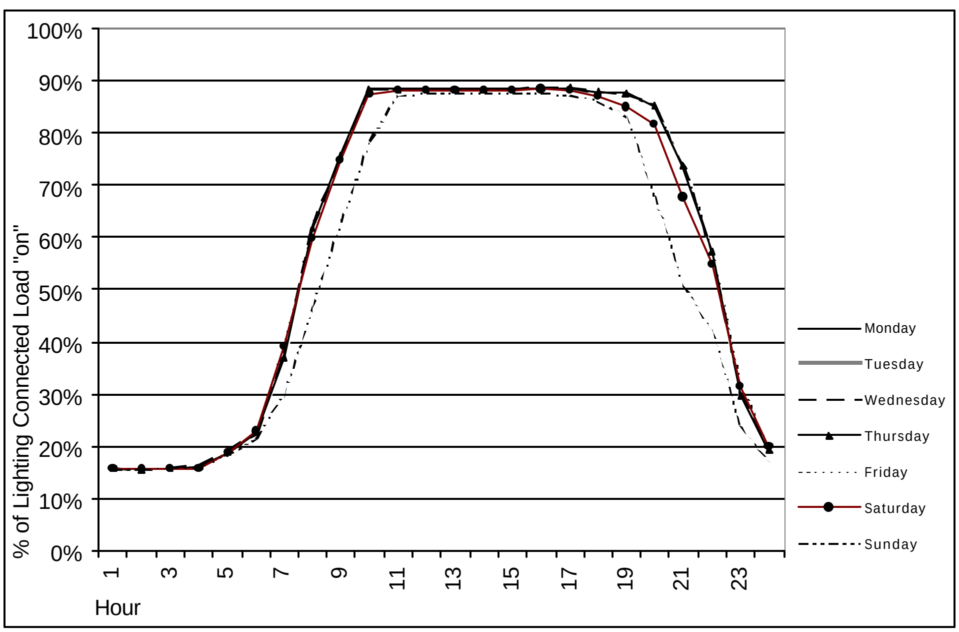


Figure 3: Average Hourly Retail Lighting Schedule

Cooling

Figure 4 shows the Monday average hourly cooling setpoint by building type. The graph displays the average degrees in Fahrenheit for each hour of the day for a typical Sunday.

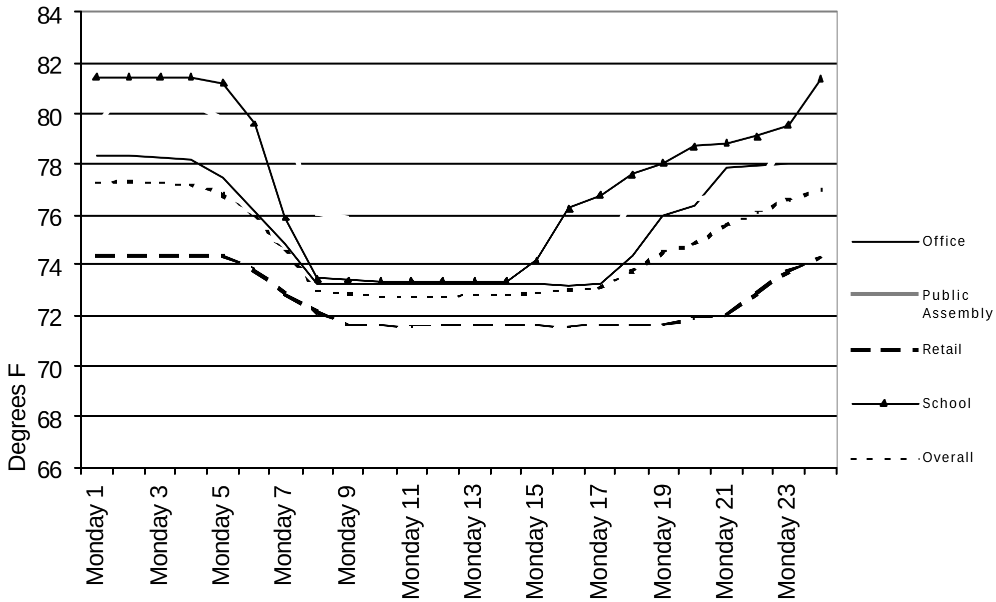


Figure 4: Average Monday Hourly Cooling Schedule by Building Type

Figure 5 shows the average hourly cooling schedule for public assembly buildings for all days of the week. The graph displays the average degrees in Fahrenheit for each hour of the day for a typical week.

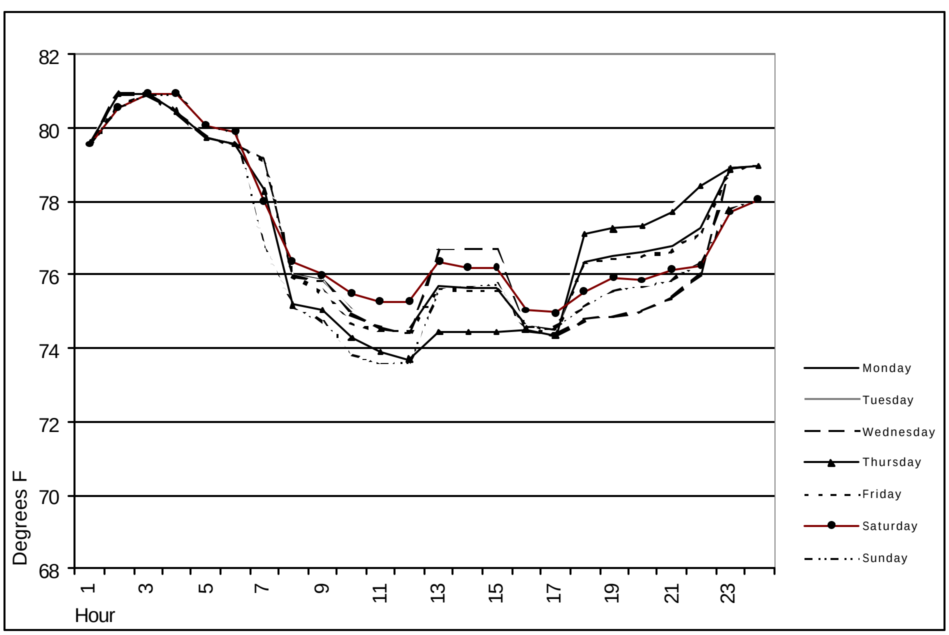


Figure 5: Average Public Assembly Hourly Cooling Schedule

Fans

Figure 6 shows the Saturday average hourly fan schedule by building type.

The graph shows the percentage of conditioned floor area served by fans for each hour on a typical Saturday.

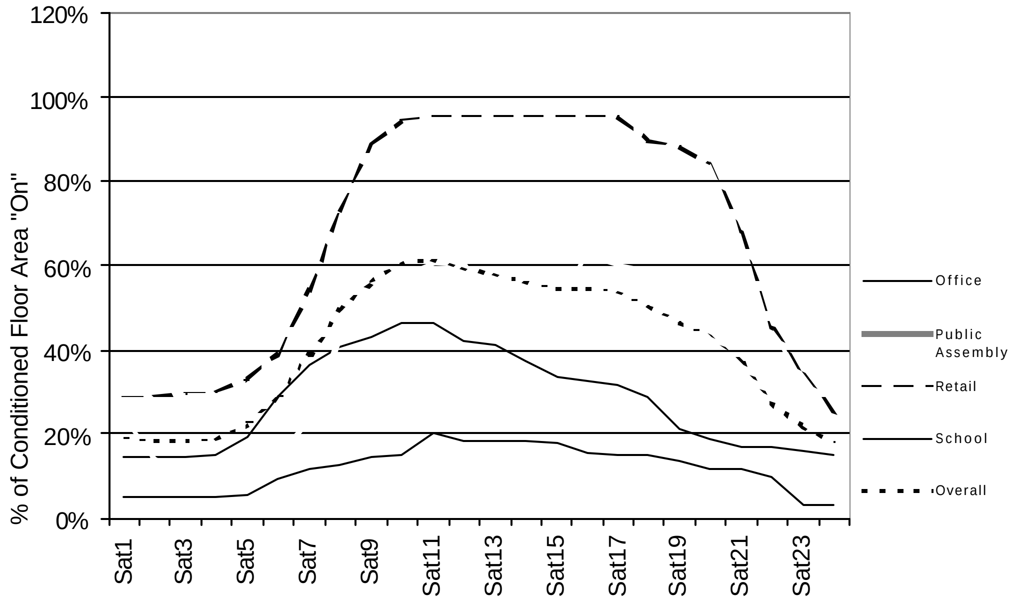


Figure 6: Saturday Average Hourly Fan Schedule by Building Type

Equipment

Figure 7 shows the Monday average hourly equipment schedule by building type. The graph shows the percentage of the connected load that is on for each hour.

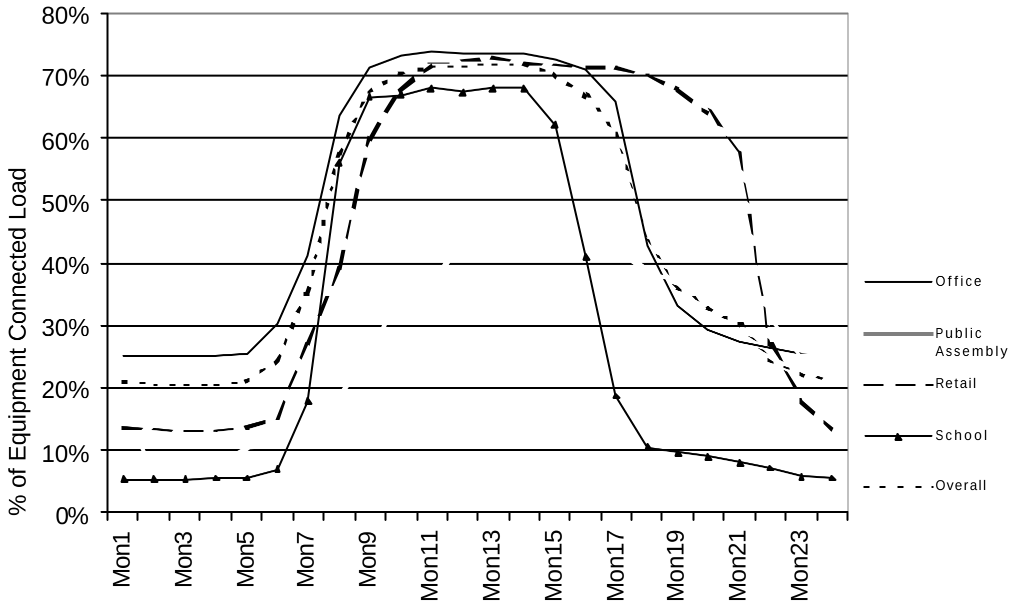


Figure 7: Monday Average Hourly Equipment Schedule by Building Type

Heating

Figure 8 shows the Friday average hourly heating schedule by building type. The graph shows the average temperature in degrees Fahrenheit for each hour of the day on a typical Friday.

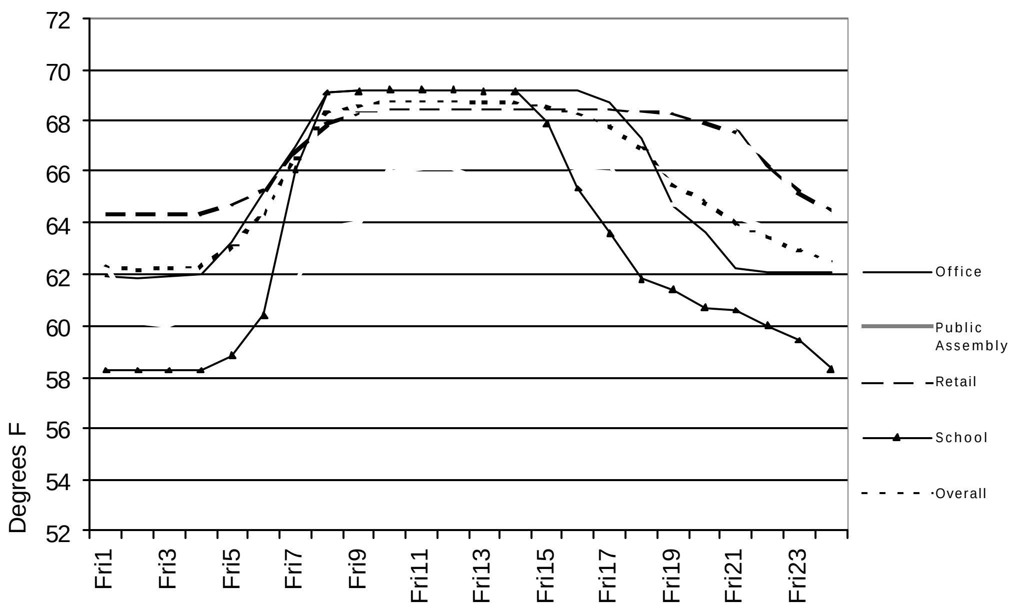


Figure 8: Friday Average Hourly Heating Schedule by Building Type

Occupancy

Figure 9 shows the Monday average hourly occupancy schedule by building type. The graph shows the occupancy in each hour as a percentage of the peak occupancy of each site.

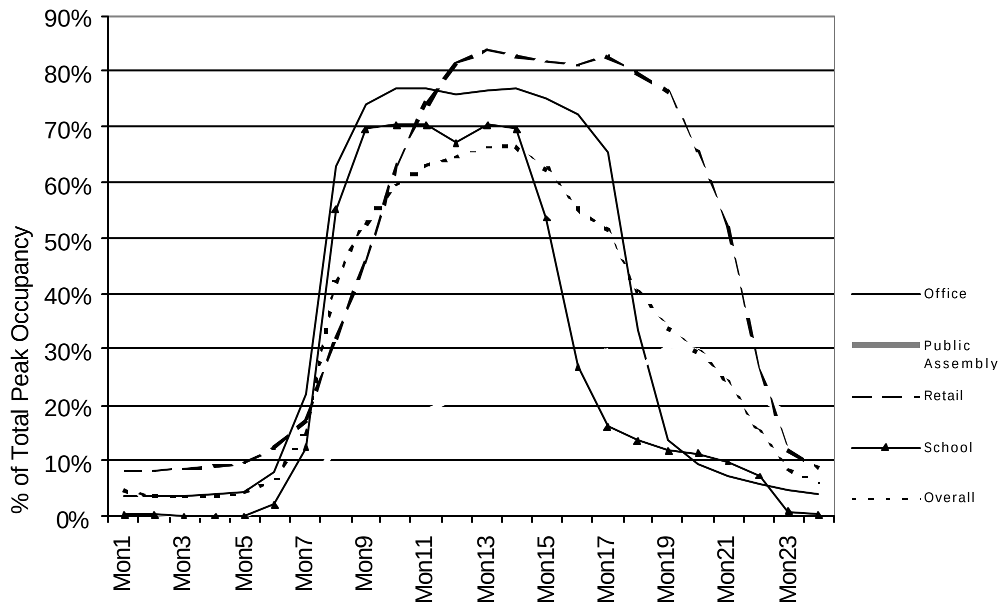


Figure 9: Monday Average Hourly Occupancy Schedule by Building Type

4. The NRNC Buildings Database

Technical documentation of the database developed in this study. This provides the information needed to extract additional technical information from the database.

Database Contents

Introduction

This document describes the database that will be delivered with the SCE/CBEE NRNC Baseline Report. The database will contain combined data collected during the Southern California Edison and Pacific Gas & Electric 1994 Non-Residential New Construction program evaluation, the 1995 SDG&E NRNC program evaluation, the 1996 Edison NRNC program evaluation, the 1996 PG&E NRNC program evaluation, and the 1998 CBEE/SCE NRNC Baseline study. A total of 990 new commercial construction sites were audited over the course of these projects. Each site was either a new commercial building, an addition to an existing building, or a renovation in the 1994, 1995, and 1996 studies. Only new buildings were audited in 1998. Only space that was new or remodeled was included in the audit. The audit information was used to build a DOE-2 model for each site to generate energy consumption estimates for each site.

Database Structure

The overall structure of the database is described in this section.

Overview

The database was developed using Microsoft® Access 97. The database tables can be divided into three categories:

- aggregated data tables
- site-level data tables
- lookup tables

The aggregated data tables are based on data queries and were developed for the baseline report. The site-level data tables contain audit information entered by the surveyors for individual buildings. The lookup tables are used by the database user interface.

Aggregated Data Tables

The following table lists the queries and tables developed to prepare the baseline report. Each table has the same basic structure: the first column contains the site identification number, the second column contains a basis used for weighting the data in the statistical analysis for the baseline report, and the remaining fields are the building parameters multiplied by the basis. For example, the basis for the table *CEC_WindowFrameType* is total window area, and the value in each field is the window area with that frame type. A more unusual example would be the table *CEC_AvgHeatSchedule* where the basis is the heated floor area in the building, and the value provided for each hour of the week is the average thermostat setting for the building multiplied by the basis. To calculate the average thermostat settings for the building, the data for each hour of the week must be divided by the basis.

The column on the left lists the highest level tables, used directly in statistical analysis for preparing the baseline report. The right-hand column describes the tables and lists sub-queries used in developing them.

Table Name	Description
CEC_GeneralInfo	The building type, climate zone, total floor area, unconditioned and conditioned
CEC_WindowTotalArea	Window area broken out by exposure (N, NE, E, SE, S, SW, W, NW)
CEC_WindowFrameType	Window frames broken out by type and area weighted
CEC_WinSCandUValues	Window U-value and shading coefficient broken out by orientation
CEC_SkylightFrameType	Skylight frames broken out by type and area weighted
CEC_SkySCandUValues	Skylight U-value and shading coefficient
CEC_AvgHeatSchedule	Average heating schedule for each day using SchTStat
CEC_AvgCoolSchedule	Average cooling schedule for each day using SchTStat
CEC_AvgLightSchedule	Average lighting loads for each day using Sched2
CEC_AvgEquipSchedule	Average equipment loads for each day using Sched2
CEC_AvgPeopleSchedule	Average occupancy schedule for each day
CEC_AvgFanSchedule	Average fan schedule for each day
CEC_WindowTotalArea	Window area broken out by exposure (N, NE, E, SE, S, SW, W, NW). *Subqueries:* CEC_WindowTotalArea All (basis) CEC_WindowTotalArea {N, NE, E, SE, S, SW, W, NW}
CEC_WindowGlassType	Window area broken out by combinations of glass type (clear, reflective, tinted) and number of panes (1, 2, 3). *Subqueries:* CEC_WindowTotalArea All (basis) CEC_WindowGlass1Pane {Clear, Reflec, Tint} CEC_WindowGlass2Pane {Clear, Reflec, Tint} CEC_WindowGlass3Pane {Clear, Reflec, Tint}
CEC_SkylightTotalArea	Total skylight area. *Subqueries:* CEC_TotalFloorArea (basis) CEC_SkylightTotalArea Subquery
CEC_SkylightGlassType	Skylight area broken out by glass type (clear, reflective, tinted). *Subqueries:* CEC_SkylightGlassType All (basis) CEC_SkylightGlassType {Clear, Reflec, Tint}
CEC_WallConstructionType	Wall area broken out by wall construction type. *Subqueries:* CEC_WallNetArea (basis) CEC_WallNetArea Subquery CEC_WallAreaByOri (wall area grouped by site, zone, orientation) CEC_WindowAreaByOri (window area grouped by site, zone, orientation) CEC_WallConstructionType {1, 2, 3, 4, 5, 6, 7, 8, 9}
CEC_WallUValue	Average wall U-value.

	Subqueries: CEC_WallUvalSum Subquery CEC_WallUval Subquery (calculate net wall area by reducing gross area by window fraction) CEC_WallUvalAreaByOri (wall area & area-weighted U-values grouped by site, zone, and orientation. Uses VBA module CEC_WallUValue to calculate U-values given wall type & R-value.) CEC_WindowAreaByOri (window area grouped by site, zone, orientation)
CEC_RoofConstructionType	Roof area broken out by roof construction type. *Subqueries:* CEC_RoofNetArea (basis) CEC_RoofNetArea Subquery (calculate net roof area by reducing gross area by skylight fraction) CEC_RoofAreaByZone (roof area grouped by site, zone) CEC_SkylightAreaByZone (skylight area grouped by site, zone) CEC_RoofConstructionType {10, 11, 12}
CEC_RoofUValue	Average roof U-value. *Subqueries:* CEC_RoofUvalSum Subquery CEC_RoofUval Subquery (calculate net roof area by reducing gross area by skylight fraction) CEC_RoofUvalArea (roof area & area-weighted U-values grouped by site, zone. Uses VBA module CEC_WallUValue to calculate U-values given roof type & R-value.) CEC_SkylightAreaByZone (skylight area grouped by site, zone)

Table Name	**Description**
CEC_LightingAndEquipLoads	Lighting loads, plug loads, electric process loads, and non-electric process loads. *Subqueries:* CEC_TotalFloorArea (basis) CEC_LightingLoadSum Subquery CEC_LightingLoadSumBySpace Subquery (sums power and area of each space) CEC_EqPlugLoad CEC_EqProcLoadWattSum (electric process loads) CEC_EqProcLoadWattUnion CEC_EqProcLoadBtuhSum (non-electric process loads) CEC_EqProcLoadBtuhUnion CEC_EqLoadSum Subquery CEC_EqLoadSumBySpace Subquery CEC_EqLoadUnion Subquery (union of "CEC_EqLoad Subquery" & "CEC_TypEqLoad Subquery") CEC_EqLoad Subquery CEC_EquipKW Subquery CEC_TypEqLoad Subquery (loads of any typical spaces) CEC_TypEquipKW Subquery CEC_KitEqLoadBySite (kitchen equipment load) CEC_KitEqLoadByZone CEC_KitEqKW
CEC_LightingFixtureTypes	Lighting load (kW), broken out by fixture type. *Subqueries:* CEC_LightingWatts (basis) CEC_LightingLamp {BX, CF, E, Fluor, H, HPS, I, MH, MV}
CEC_LightingLampBallast	Fluorescent lighting load (kW), broken out by lamp type (T8, T12) and ballast types (electronic, energy saving magnetic, standard magnetic). *Subqueries:* CEC_LightingLampFluor (basis) CEC_LightingLampBallastT8 {Elec, MagES, MagStd} CEC_LightingLampBallastT12 {Elec, MagES, MagStd}
CEC_LightingControlTypes	Lighting load (kW), broken out by control type. *Subqueries:* CEC_LightingWatts (basis) CEC_LightingControlType {1, 2, 3, 4, 5, 6, 7}
CEC_HVACControl	Conditioned floor area under HVAC control modes. *Subqueries:* CEC_HVACControl Subquery CEC_TotalFloorArea (basis) CEC_CondFloorArea2 CEC_HVACControl5 CEC_HVACControl10

	CEC_HVACControl13a CEC_HVACControl13b CEC_HVACControl14
CEC_DistribSys	Floor area served by HVAC distribution systems, broken out by type. *Subqueries:* CEC_TotalFloorArea (basis) CEC_UnCondFloorArea CEC_PkgHvacAll (sums area) CEC_VsysPkgHvacAll (virtual systems served) CEC_Centair {SingleDuct, DualDuct, Multizone} (sums area) CEC_VsysCentair {SingleDuct, DualDuct, Multizone} (virtual systems served) CEC_ZonalFloorArea (areas of virtual systems of type "Z") CEC_TotalZoneArea (area by space)
Table Name	**Description**
CEC_HeatingSysType	Floor area served by heating systems, broken out by heating system type (packaged, zone-level, built-up) and fuel type (electric, non-electric, mixed). *Subqueries:* CEC_HeatingSysType2 CEC_TotalFloorArea (basis) CEC_UnCondFloorArea CEC_PkgHvac {Elec, NonElec, Mixed, All} (sums area) CEC_VsysPkgHvac {Elec, NonElec, Mixed, All} (virtual systems served) CEC_ZoneHvac {Elec, NonElec, Mixed, All} Area (sums area) CEC_ZonesZoneHvac {Elec, NonElec, Mixed, All} (zones served) CEC_BuiltUp {Elec, NonElec, Mixed, All} (determines If built-up exists)
CEC_HeatingEffPkg	Heating COP * floor area served by packaged HVAC systems, broken out by combinations of system type (A, C, D) and size (S, M, L, XL). *Subqueries:* CEC_HeatingEffPkgA CEC_PkgHvacEff_HtgA {S, M, L, XL} (capacity-weights efficiency) CEC_PkgHvacEff_HtgA {S, M, L, XL} _Sum (sums COP * CoolingCapacity) CEC_PkgHvacArea_HtgA {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Htg (total packaged capacity, used to capacity-weight area) CEC_VsysPkgHvac_HtgA {S, M, L, XL} (virtual systems served) CEC_PkgHvac_HtgA {S, M, L, XL} (packaged systems that fit the criteria) CEC_HeatingEffPkgC CEC_PkgHvacEff_HtgC {S, M, L, XL} (capacity-weights efficiency) CEC_PkgHvacEff_HtgC {S, M, L, XL} _Sum (sums COP * CoolingCapacity) CEC_PkgHvacArea_HtgC {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Htg (total packaged capacity, used to capacity-weight area) CEC_VsysPkgHvac_HtgC {S, M, L, XL} (virtual systems served) CEC_PkgHvac_HtgC {S, M, L, XL} (packaged systems that fit the criteria) CEC_HeatingEffPkgD CEC_PkgHvacEff_HtgD {S, M, L, XL} (capacity-weights efficiency) CEC_PkgHvacEff_HtgD {S, M, L, XL} _Sum (sums COP * CoolingCapacity) CEC_PkgHvacArea_HtgD {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Htg (total packaged capacity, used to capacity-weight area) CEC_VsysPkgHvac_HtgD {S, M, L, XL} (virtual systems served)

	CEC_PkgHvac_HtgD {S, M, L, XL} (packaged systems that fit the criteria)
CEC_HeatingEffBasisPkg	Floor area served by packaged HVAC systems, broken out by combinations of system type (A, C, D) and size (S, M, L, XL). The basis values for CEC_HeatingEffPkg. *Subqueries:* CEC_HeatingEffBasisPkgA CEC_PkgHvacArea_HtgA {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Htg (total capacity, used to capacity-weight area) CEC_VsysPkgHvac_HtgA {S, M, L, XL} (virtual systems served) CEC_PkgHvac_HtgA {S, M, L, XL} (packaged systems that fit the criteria) CEC_HeatingEffBasisPkgC CEC_PkgHvacArea_HtgC {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Htg (total capacity, used to capacity-weight area) CEC_VsysPkgHvac_HtgC {S, M, L, XL} (virtual systems served) CEC_PkgHvac_HtgC {S, M, L, XL} (packaged systems that fit the criteria) CEC_HeatingEffBasisPkgD CEC_PkgHvacArea_HtgD {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Htg (total capacity, used to capacity-weight area) CEC_VsysPkgHvac_HtgD {S, M, L, XL} (virtual systems served) CEC_PkgHvac_HtgD {S, M, L, XL} (packaged systems that fit the criteria)

Table Name	Description
CEC_CoolingSysType	Floor area served by cooling systems, broken out by cooling system type. *Subqueries:* CEC_TotalFloorArea (basis) CEC_PkgHvac {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11} (sums area) CEC_VsysPkgHvac {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11} (virtual systems served) CEC_ChillerArea (chiller area = sum of areas of central air handlers and fan coil/induction terminal zonal heaters) CEC_ChillerSites (sites w/ chillers) CEC_Centair {SingleDuct, DualDuct, Multizone} (sums area) CEC_VsysCentair {SingleDuct, DualDuct, Multizone} (virtual systems served) CEC_ZoneHvacPipeArea (sums area) CEC_ZonesZoneHvacPipe (zones served by fan coil/induction terminal zonal heater)
CEC_CoolingEffPkg	Cooling EER * floor area served by packaged HVAC systems, broken out by combinations of system type (A, B, C, D) and size (S, M, L, XL). *Subqueries:* CEC_CoolingEffBasisPkgA CEC_PkgHvacEff_ClgA {S, M, L, XL} (capacity-weights efficiency) CEC_PkgHvacEff_ClgA {S, M, L, XL} _Sum (sums COP * CoolingCapacity) CEC_PkgHvacArea_ClgA {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Clg (total packaged capacity, used to capacity-weight area) CEC_VsysPkgHvac_ClgA {S, M, L, XL} (virtual systems served) CEC_PkgHvac_ClgA {S, M, L, XL} (packaged systems that fit the criteria) CEC_CoolingEffBasisPkgB CEC_PkgHvacEff_ClgB {S, M, L, XL} (capacity-weights efficiency) CEC_PkgHvacEff_ClgB {S, M, L, XL} _Sum (sums COP * CoolingCapacity) CEC_PkgHvacArea_ClgB {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Clg (total packaged capacity, used to capacity-weight area) CEC_VsysPkgHvac_ClgB {S, M, L, XL} (virtual systems served) CEC_PkgHvac_ClgB {S, M, L, XL} (packaged systems that fit the criteria) CEC_CoolingEffBasisPkgC CEC_PkgHvacEff_ClgC {S, M, L, XL} (capacity-weights efficiency) CEC_PkgHvacEff_ClgC {S, M, L, XL} _Sum (sums COP * CoolingCapacity) CEC_PkgHvacArea_ClgC {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Clg (total packaged capacity, used to capacity-weight area) CEC_VsysPkgHvac_ClgC {S, M, L, XL} (virtual systems served) CEC_PkgHvac_ClgC {S, M, L, XL} (packaged systems that fit the criteria) CEC_CoolingEffBasisPkgD CEC_PkgHvacEff_ClgD {S, M, L, XL} (capacity-weights efficiency) CEC_PkgHvacEff_ClgD {S, M, L, XL} _Sum (sums COP * CoolingCapacity) CEC_PkgHvacArea_ClgD {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Clg (total packaged capacity, used to capacity-weight area) CEC_VsysPkgHvac_ClgD {S, M, L, XL} (virtual systems served) CEC_PkgHvac_ClgD {S, M, L, XL} (packaged systems that fit the criteria)

Table Name	**Description**
CEC_CoolingEffBasisPkg	Floor area served by packaged HVAC systems, broken out by combinations of system type (A, B, C, D) and size (S, M, L, XL). The basis values for CEC_CoolingEffPkg. *Subqueries:* CEC_CoolingEffBasisPkgA CEC_PkgHvacArea_ClgA {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Clg (total capacity, used to capacity-weight area) CEC_VsysPkgHvac_ClgA {S, M, L, XL} (virtual systems served) CEC_PkgHvac_ClgA {S, M, L, XL} (packaged systems that fit the criteria) CEC_CoolingEffBasisPkgB CEC_PkgHvacArea_ClgB {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Clg (total capacity, used to capacity-weight area) CEC_VsysPkgHvac_ClgB {S, M, L, XL} (virtual systems served) CEC_PkgHvac_ClgB {S, M, L, XL} (packaged systems that fit the criteria) CEC_CoolingEffBasisPkgC CEC_PkgHvacArea_ClgC {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Clg (total capacity, used to capacity-weight area) CEC_VsysPkgHvac_ClgC {S, M, L, XL} (virtual systems served) CEC_PkgHvac_ClgC {S, M, L, XL} (packaged systems that fit the criteria) CEC_CoolingEffBasisPkgD CEC_PkgHvacArea_ClgD {S, M, L, XL} (sums area) CEC_VsysPkgHvac_Clg (total capacity, used to capacity-weight area) CEC_VsysPkgHvac_ClgD {S, M, L, XL} (virtual systems served) CEC_PkgHvac_ClgD {S, M, L, XL} (packaged systems that fit the criteria)
CEC_CoolingEffChill	Cooling EER * floor area served by chillers, broken out by combinations of system type (A, B, C, D) and size (S, M, L). *Subqueries:* CEC_ChillerAreaByType CEC_ChillerArea (chiller area = sum of areas of central air handlers and fan coil/induction terminal zonal heaters) CEC_ChillerSites (sites w/ chillers) CEC_Centair {SingleDuct, DualDuct, Multizone} (sums area) CEC_VsysCentair {SingleDuct, DualDuct, Multizone} (virtual systems served) CEC_ZoneHvacPipeArea (sums area) CEC_ZonesZoneHvacPipe (zones served by fan coil/induction terminal zonal heater) CEC_ChillerEff_All_Sum CEC_ChillerEff_A {S, M, L} (capacity-weights efficiency) CEC_ChillerEff_B {S, M, L} (capacity-weights efficiency) CEC_ChillerEff_C {S, M, L} (capacity-weights efficiency) CEC_ChillerEff_D {S, M, L} (capacity-weights efficiency) CEC_ChillerEff_A {S, M, L} _Sum CEC_ChillerEff_B {S, M, L} _Sum CEC_ChillerEff_C {S, M, L} _Sum CEC_ChillerEff_D {S, M, L} _Sum

Table Name	Description
CEC_CoolingEffBasisChill	Floor area served by chillers, broken out by combinations of system type (A, B, C, D) and size (S, M, L). The basis values for CEC_CoolingEffChill. *Subqueries:* CEC_ChillerAreaByType CEC_ChillerArea (chiller area = sum of areas of central air handlers and fan coil/induction terminal zonal heaters) CEC_ChillerSites (sites w/ chillers) CEC_Centair {SingleDuct, DualDuct, Multizone} (sums area) CEC_VsysCentair {SingleDuct, DualDuct, Multizone} (virtual systems served) CEC_ZoneHvacPipeArea (sums area) CEC_ZonesZoneHvacPipe (zones served by fan coil/induction terminal zonal heater) CEC_ChillerEff_All_Sum CEC_ChillerEff_A {S, M, L} _Sum CEC_ChillerEff_B {S, M, L} _Sum CEC_ChillerEff_C {S, M, L} _Sum CEC_ChillerEff_D {S, M, L} _Sum
CEC_Basis	A summary of the basis fields of all the CEC queries (except for heating efficiency, cooling efficiency, and schedules—because they have their own basis tables). This query requires the tables produced by the other queries; therefore, all the other queries must be run before running CEC_Basis. *Subqueries:* CEC_Basis1 CEC_Basis2

The remainder of this section describes the fields in each of the aggregate tables.

CEC_GeneralInfoTable

Field Heading	Value	Comments
SITEID		
T24Type	Type code 1 - 17	Building type according to Title 24 definitions. See definitions below.
Climate Zone	Climate zone	Corresponds to CEC climate zones
Cond Floor Area	Conditioned floor area (SF)	
UnCond Floor Area	Unconditioned floor area (SF)	
Floor Area	Total floor area (SF)	

Building type code definitions:

Type code	Definition
1	C&I Storage
2	Grocery Store
3	General C&I Work
4	Medical/Clinical
5	Office
6	Other

7	Religious Worship, Auditorium,
8	Restaurant
9	Retail and Wholesale Store
10	School
11	Theater

Type code	Definition
12	Unknown
13	Hotels/Motels
14	Fire/Police/Jails
15	Community Center
16	Gymnasium
17	Libraries

CEC_GeneralInfo uses the following subqueries for the area fields.

- CEC_CondFloorArea
- CEC_UnCondFloorArea
- CEC_TotalFLoorArea

Each of these queries rely on the CEC_TotalZoneArea query. This query determines the area per zone and whether that space is unconditioned or conditioned. The area queries simply separate the different types and sum them up.

CEC_BasisTable

Field Heading	Value	Comments
SITEID		
Basis	1	1 for all sites
EquipKW	Total equip connected load (kW)	Basis for CEC_AvgEquipSchedule
LightKW	Total lighting connected load (kW)	Basis for CEC_AvgLightSchedule
People	Total peak occupancy (people)	Basis for CEC_AvgPeopleSchedule
FanCondArea	Total Conditioned Floor Area (SF)	Basis for CEC_AvgFanSchedule
CoolingSys FloorArea	Total Building Floor Area (SF)	Basis for CEC_CoolingSysTypeTable
DistribSys FloorArea	Total Building Floor Area (SF)	Basis for CEC_DistribSysTable
HeatingSys FloorArea	Total Building Floor Area (SF)	Basis for CEC_HeatingSysTypeTable
LightEquipLoads FloorArea	Total Building Floor Area (SF)	Basis for CEC_LightingAndEquipLoadsTable
LightingControlKW	Total lighting connected load (kW)	Basis for CEC_LightingControlTypesTable
LightingFixtureKW	Total lighting connected load (kW)	Basis for CEC_LightingFixtureTypesTable
FluoresKW	Total fluorescent fixture connected load (kW)	Basis for CEC_LightingLampBallastTable
RoofArea	Total roof area (SF)	Basis for CEC_RoofConstructionTypeTable
SkylightFrame SkylightArea	Total skylight area (SF)	Basis for CEC_SkylightFrameTypeTable
SkylightGlass SkylightArea	Total skylight area (SF)	Basis for CEC_SkylightGlassTypeTable
SkySCandUValue SkylightArea	Total skylight area (SF)	Basis for CEC_SkySCandUValueTable
SkylightTotalArea FloorArea	Total Building Floor Area (SF)	Basis for CEC_SkylightTotalAreaTable
WallArea	Total gross (including windows) wall area (SF)	Basis for CEC_WallConstructionTypeTable
WindowFrame WindowArea	Total Window Area (SF)	Basis for CEC_WindowFrameTypeTable
WindowGlass WindowArea	Total Window Area (SF)	Basis for CEC_WindowGlassTypeTable

Field Heading	Value	Comments
WinUValue WindowArea	Total Window Area (SF)	Basis for CEC_WinUValueTable
E Area	Total East Window Area (SF)	Basis for CEC_WinSCEastTable
N Area	Total North Window Area (SF)	Basis for CEC_WinSCNorthTable
NE Area	Total Northeast Window Area (SF)	Basis for CEC_WinSCNETable
NW Area	Total Northwest Window Area (SF)	Basis for CEC_WinSCNWTable
S Area	Total South Window Area (SF)	Basis for CEC_WinSCSouthTable
SE Area	Total Southeast Window Area (SF)	Basis for CEC_WinSCSETable
SW Area	Total Southwest Window Area (SF)	Basis for CEC_WinSCSWTable
W Area	Total West Window Area (SF)	Basis for CEC_WinSCWestTable
WindowArea	Total Window Area (SF)	Basis for CEC_WindowTotalAreaTable
HVACControl FloorArea	Total Building Floor Area (SF)	Basis for CEC_HVACControlTable
EUIArea	Total Building Floor Area (SF)	Basis for CEC_EUITable
SizingRatio CondArea	Total Cooling Conditioned Floor Area (SF)	Basis for CEC_CoolingSizingTable
WallUVal Area	Net Wall Area (SF)	Basis for CEC_WallUValue
RoofUVal Area	Net Roof Area (SF)	Basis for CEC_RoofUValue

CEC_AvgEquipSchedule

Field Heading	Value	Comments
SITEID		
kW	Total connected load (kW)	Basis
Mon1	kW on this hour	
Mon2	Ditto above	
Mon3		
Mon4		
Mon5		
Etc		
Etc		
Sun 17		
Sun 18		
Sun 19		
Sun 20		
Sun 21		
Sun 22		
Sun 23		
Sun 24		

CEC_AvgLightSchedule

Field Heading	Value	Comments
SITEID		
kW	Total connected load (kW)	Basis
Mon1	kW on this hour	
Mon2	Ditto above	
Mon3		
Mon4		
Mon5		
Etc		
Etc		
Sun 17		
Sun 18		
Sun 19		
Sun 20		
Sun 21		
Sun 22		
Sun 23		
Sun 24		

CEC_AvgPeopleSchedule

Field Heading	Value	Comments
SITEID		
People	Total peak occupancy (people)	Basis
Mon1	People this hour	
Mon2	Ditto above	
Mon3		
Mon4		
Mon5		
Etc		
Etc		
Sun 17		
Sun 18		
Sun 19		
Sun 20		
Sun 21		
Sun 22		
Sun 23		
Sun 24		

CEC_AvgCoolSchedule

Field Heading	Value	Comments
SITEID		
Area	Total Conditioned Floor Area	Basis (SF)
Mon1	Cooling Setpoint * Area	Deg F - SF
Mon2	Ditto above	Ditto above
Mon3		
Mon4		
Mon5		
Etc		
Etc		
Sun 17		
Sun 18		
Sun 19		
Sun 20		
Sun 21		
Sun 22		
Sun 23		
Sun 24		

CEC_AvgFanSchedule

Field Heading	Value	Comments
SITEID		
Area	Total Conditioned Floor Area	Basis
Mon1	Conditioned floor area "on" this hour	SF
Mon2		
Mon3		
Mon4		
Mon5		
Etc		
Etc		
Sun 17		
Sun 18		
Sun 19		
Sun 20		
Sun 21		
Sun 22		
Sun 23		
Sun 24		

CEC_AvgHeatSchedule

Field Heading	Value	Comments

SITEID		
Area	Total Conditioned Floor Area	Basis
Mon1	Heating Setpoint * Area	Deg F - SF
Mon2		
Mon3		
Mon4		
Mon5		
Etc		
Etc		
Sun 17		
Sun 18		
Sun 19		
Sun 20		
Sun 21		
Sun 22		
Sun 23		
Sun 24		

CEC_CoolingSysTypeTable

Field Heading	Value	Comments
SITEID		
Floor Area	Total Building Floor Area	Basis SF
None	Area served by system type	Uncooled SF
SinglePkgRoofAC	Area served by system type	Rooftop Air Cond SF
SinglePkgRoofHP	Area served by system type	Rooftop Heat Pump SF
SplitSysAC	Area served by system type	Split system Air Cond SF
SplitSysHP	Area served by system type	Split system Heat Pump SF
PTAC	Area served by system type	Packaged Terminal AC SF
PTHP	Area served by system type	Packaged Terminal HP SF
WinWallAC	Area served by system type	Window/Wall AC SF
WinWallHP	Area served by system type	Window/Wall HP SF
WaterLoopHP	Area served by system type	Water loop heat pump SF
DualFuelHP	Area served by system type	Dual Fuel Heat Pump SF
EvapSys	Area served by system type	Evaporative cooler SF
Chiller	Area served by system type	Built-up system SF

CEC_DistribSystemTable

Field Heading	Value	Comments
SITEID		
Floor Area	Total Building Floor Area	Basis SF
None	Area served by system type	Unconditioned SF
Packaged	Area served by system type	Packaged system SF – see CEC_CoolSystemTypeTable for breakdown (excluding field “chiller”)
SingleDuct	Area served by system type	Single duct built-up system SF
DualDuct	Area served by system type	Dual duct built-up system SF
MultiZone	Area served by system type	Multizone built-up system SF
Zonal	Area served by system type	Zonal system (baseboard, unit heater, fan coil, etc.) SF

CEC_HeatingSysTypeTable

Field Heading	Value	Comments
SITEID		
FloorArea	Total Building Floor Area	Basis SF
PkgElec	Area served by system type	Packaged system w/ electric heat SF – includes resistance and heat pumps
PkgNonElec	Area served by system type	Packaged system w/ non-electric heat SF
PkgMixed	Area served by system type	Packaged system w/ both electric and non-electric heat SF – includes resistance and heat pumps
ZoneElec	Area served by system type	Zonal system w/ electric heat SF (baseboard, unit heater, fan coil, etc.)
ZoneNonElec	Area served by system type	Zonal system w/ non-electric heat SF (baseboard, unit heater, fan coil, etc.)
ZoneMixed	Area served by system type	Zonal system w/ both electric and non-electric heat SF (baseboard, unit heater, fan coil, etc.)
BuiltUpElec	Area served by system type	Built-up system w/ electric heat SF
BuiltUpNonElec	Area served by system type	Built-up system w/ non-electric heat SF
BuiltUpMixed	Area served by system type	Built-up system w/ both electric and non-electric heat SF
None	Area served by system type	Unheated SF

CEC_LightingAndEquipLoadsTable

Field Heading	Value	Comments
SITEID		
Floor Area	Total Building Floor Area SF	Basis
LightingW	Total lighting watts	Connected load
PlugLoadW	Total plug load watts	Connected load
ProcLoadElecW	Total electric process load watts	Connected load
ProcLoadNonElecBtuh	Total non-electric process load Btu/hr	Connected load

CEC_LightingControlTypesTable

Field Heading	Value	Comments
SITEID		
TotalKW	Total lighting connected load (kW)	Basis
OccSensKWCtrl	Total lighting load connected to occupancy sensor control (kW)	
OccSensKWCtrlOper	Total lighting load connected to functioning occupancy sensor control (kW)	Based on on-site survey observations of broken or disabled controls
DayltContDimKWCtrl	Total lighting load connected to continuous dimming daylight control (kW)	
DayltContDimKWCtrlOper	Total lighting load connected to functioning continuous dimming daylight control (kW)	Based on on-site survey observations of broken or disabled controls
DayltStepKWCtrl	Total lighting load connected to stepped dimming daylight control (kW)	
DayltStepKWCtrlOper	Total lighting load connected to functioning stepped dimming daylight control (kW)	Based on on-site survey observations of broken or disabled controls
LumenMaintKWCtrl	Total lighting load connected to lumen maintenance control (kW)	
LumenMaintKWCtrlOper	Total lighting load connected to functioning lumen maintenance control (kW)	Based on on-site survey observations of broken or disabled controls
OccSensDayltKWCtrl	Total lighting load connected to combined occupancy sensor and daylight control (kW)	
OccSensDayltKWCtrlOper	Total lighting load connected to functioning combined occupancy sensor and daylight control (kW)	Based on on-site survey observations of broken or disabled controls
OccSensLumenKWCtrl	Total lighting load connected to combined occupancy sensor and lumen maintenance control (kW)	
OccSensLumenKWCtrlOper	Total lighting load connected to functioning combined occupancy sensor and lumen maintenance control (kW)	Based on on-site survey observations of broken or disabled controls
DayltLumenKWCtrl	Total lighting load connected to combined daylighting and lumen maintenance control (kW)	
DayltLumenKWCtrlOper	Total lighting load connected to functioning combined daylighting and lumen maintenance control (kW)	Based on on-site survey observations of broken or disabled controls

CEC_LightingFixtureTypesTable

Field Heading	Value	Comments
SITEID		
TotalKW	Total lighting connected load (kW)	Basis
BiaxialKW	Total biax fixture connected load (kW)	

CompactFluorKW	Total compact fluorescent fixture connected load (kW)	
ExitKW	Total exit sign connected load (kW)	
FluoresKW	Total fluorescent fixture connected load (kW)	All fluorescent types except biax and CFL
HalogenKW	Total halogen fixture connected load (kW)	Halogen incandescent
SodiumKW	Total sodium fixture connected load (kW)	High-pressure and low-pressure sodium
IncandesKW	Total incandescent fixture connected load (kW)	Other incandescent (not halogen)
MetalHalideKW	Total metal halide fixture connected load (kW)	
MercuryKW	Total mercury vapor fixture connected load (kW)	

CEC_LightingLampBallastTable

Field Heading	**Value**	**Comments**
SITEID		
FluoresKW	Total fluorescent fixture connected load (kW)	Basis
T8ElecKW	Total fluorescent fixture with T-8 lamp and electronic ballast connected load (kW)	
T8MagESKW	Total fluorescent fixture with T-8 lamp and energy saving magnetic ballast connected load (kW)	
T12ElecKW	Total fluorescent fixture with T-12 lamp and electronic ballast connected load (kW)	
T12MagESKW	Total fluorescent fixture with T-12 lamp and energy-saving magnetic ballast connected load (kW)	
T12MagStdKW	Total fluorescent fixture with T-12 lamp and standard magnetic ballast connected load (kW)	

CEC_RoofConstructionTypeTable

Field Heading	**Value**	**Comments**
SITEID		
TotalArea	Total roof area (SF)	Basis
ConcDeckArea	Total pre-cast concrete deck roof area (SF)	
WoodJoistArea	Total roof area framed with wood joists (SF)	
MetalJoistArea	Total roof area framed with metal joists (SF)	

CEC_RoofUValueTable

Field Heading	**Value**	**Comments**
SITEID		
NetArea	Net roof area (SF)	Basis
AvgU-Value	U-value * net roof area	Btu-SF/hr-deg F

CEC_SkylightFrameTypeTable

Field Heading	**Value**	**Comments**

SITEID		
Total Skylight Area	Total skylight area (SF)	Basis
Std Metal	Total skylight area with standard metal frame (SF)	
Thermal Metal	Total skylight area with thermally broken metal frame (SF)	
Wood or Vinyl	Total skylight area with wood or vinyl frame (SF)	

The data from the CEC_SkylightFrameTypeTable is gathered from four queries. These queries gather the individual information in the above table.

- CEC_SkylightArea
- CEC_SkyStdMetal
- CEC_SkyThermalMetal
- CEC_SkyWoodVinyl

CEC_SkylightGlassTypeTable

Field Heading	Value	Comments
SITEID		
Total Area	Total skylight area (SF)	Basis
Clear Area	Total skylight area with clear glazing (SF)	
Reflective Area	Total skylight area with reflective glazing (SF)	
Tinted Area	Total skylight area with tinted glazing (SF)	

CEC_SkySCandUValueTable

Field Heading	Value	Comments
SITEID		
Total Skylight Area	Total skylight area (SF)	Basis
U-Value	U-Value * total skylight area	Btu/hr-deg F
SC	Shading coef. * total skylight area	Units of SF

The above table gets its data from the following two queries:

- The bottom query is CEC_SkylightValues. For every skylight in a particular site, it gathers the area, the u-value, the shading coefficient, the u-value*area, and the sc*area. If the u-value and/or the shading coefficient are not filled in, then the values are determined from the WinUoScLookup table.
- Next, the CEC_SkyAvgSum Subquery uses the CEC_SkylightValues to sum up the skylight area, the u-value area, and the shading coefficient area to get the average. The CEC_SkySCandUValue table uses this query to calculate the final results.

CEC_SkylightTotalAreaTable

Field Heading	**Value**	**Comments**
SITEID		
Floor Area	Total Building Floor Area (SF)	Basis
Skylight Area	Total skylight area (SF)	

CEC_WallConstructionTypeTable

Field Heading	**Value**	**Comments**
SITEID		
TotalArea	Total gross (including windows) wall area (SF)	Basis
BrickBrickArea	Total gross two layer brick wall area (SF)	Gross area includes windows
BrickConcArea	Total gross brick and concrete wall area (SF)	Gross area includes windows
BrickBlockArea	Total gross brick and concrete block wall area (SF)	Gross area includes windows
ConcFinishArea	Total gross finished concrete wall area (SF)	Gross area includes windows
BlockFinishArea	Total gross finished concrete block wall area (SF)	Gross area includes windows
WoodFrameArea	Total gross wood framed wall area (SF)	Gross area includes windows
MetalFrameArea	Total gross metal framed wall area (SF)	Gross area includes windows
CurtainWallArea	Total gross curtain wall area (SF)	Gross area includes windows
OpenArea	Total open area (SF)	Adjacent to conditioned space

CEC_WallUValueTable

Field Heading	**Value**	**Comments**
SITEID		
NetArea	Net wall area (SF)	Basis
AvgU-Value	U-value * net wall area	Btu-SF/hr-deg F

CEC_WindowFrameTypeTable

Field Heading	**Value**	**Comments**
SITEID		
Total Window Area	Total Window Area (SF)	Basis
Std Metal	Total window area with standard metal frames (SF)	
Thermal Metal	Total window area with thermally-broken metal frames (SF)	
Wood or Vinyl	Total window area with wood or vinyl frames (SF)	

The data from the CEC_WindowFrameTypeTable is gathered from four queries. These queries gather the individual information in the above table.

- CEC_WindowArea
- CEC_WinStdMetal

- CEC_WinThermalMetal
- CEC_WinWoodVinyl

CEC_WindowGlassTypeTable

Field Heading	Value	Comments
SITEID		
Total Window Area	Total Window Area (SF)	Basis
1 Pane Clear	Total window area with 1 pane clear glass(SF)	
1 Pane Reflective	Total window area with 1 pane reflective glass(SF)	
1 Pane Tinted	Total window area with 1 pane tinted glass(SF)	
2 Pane Clear	Total window area with 2 pane clear glass(SF)	
2 Pane Reflective	Total window area with 2 pane reflective glass(SF)	
2 Pane Tinted	Total window area with 2 pane tinted glass(SF)	
3 Pane Clear	Total window area with 3 pane clear glass(SF)	
3 Pane Reflective	Total window area with 3 pane reflective glass(SF)	
3 Pane Tinted	Total window area with 3 pane tinted glass(SF)	

CEC_WinUValueTable

Field Heading	Value	Comments
SITEID		
Total Window Area	Total Window Area (SF)	Basis
AvgU-Value	U-value * total window area	Btu-SF/hr-deg F

The CEC_WinUValue table gets its data from the following two queries:

- The bottom query is CEC_WinUValue Subquery. For every window in a particular site, it gathers the area, the u-value, and the u-value*area. If the u-value is not filled in, the values are determined from the WinUoScLookup table.
- Next, the CEC_WinUValueSum Subquery uses the CEC_WinUValue to sum up the window area, the u-value area, and to get the average. The CEC_WinUValue table uses this query to calculate the final results.

CEC_WinSCEastTable

Field Heading	Value	Comments
SITEID		
Area	Total East Window Area (SF)	Basis
Avg SCEast	East window shading coef. * east window area	Units of SF

- CEC_WinSCSumE Subquery - Sums up area and sc, and calculates the average sc.
- CEC_WinSCValueE Subquery – Gathers area, sc, and sc* area.

CEC_WinSCNorthTable

Field Heading	Value	Comments
SITEID		
Area	Total North Window Area (SF)	Basis
Avg SCNorth	North window shading coef. * north window area	Units of SF

- CEC_WinSCSumN Subquery - Sums up area and sc, and calculates the average sc.
- CEC_WinSCValueN Subquery – Gathers area, sc, and sc* area.

CEC_WinSCNETable

Field Heading	Value	Comments
SITEID		
NE Area	Total Northeast Window Area (SF)	Basis
Avg SC NEast	Northeast window shading coef. * northeast window area	Units of SF

- CEC_WinSCSumNE Subquery - Sums up area and sc, and calculates the average sc.
- CEC_WinSCValueNE Subquery – Gathers area, sc, and sc* area.

CEC_WinSCNWTable

Field Heading	Value	Comments
SITEID		
Area	Total Northwest Window Area (SF)	Basis
Avg SC NW	Northwest window shading coef. * northwest window area	Units of SF

- CEC_WinSCSumNW Subquery - Sums up area and sc, and calculates the average sc.
- CEC_WinSCValueNW Subquery – Gathers area, sc, and sc* area.

CEC_WinSCSouthTable

Field Heading	Value	Comments
SITEID		
Area	Total South Window Area (SF)	Basis
Avg SCSouth	South window shading coef. * south window area	Units of SF

- CEC_WinSCSumS Subquery - Sums up area, sc and calculates the average sc.
- CEC_WinSCValueS Subquery – Gathers area, sc, and sc* area.

CEC_WinSCSETable

Field Heading	Value	Comments
SITEID		
Area	Total Southeast Window Area (SF)	Basis
Avg SC SE	Southeast window shading coef. * southeast window area	Units of SF

- CEC_WinSCSumSE Subquery - Sums up area and sc, and calculates the average sc.
- CEC_WinSCValueSE Subquery – Gathers area, sc, and sc* area.

CEC_WinSCSWTable

Field Heading	Value	Comments
SITEID		
Area	Total Southwest Window Area (SF)	Basis
Avg SC SW	Southwest window shading coef. * southwest window area	Units of SF

- CEC_WinSCSumSW Subquery - Sums up area and sc, and calculates the average sc.
- CEC_WinSCValueSW Subquery – Gathers area, sc, and sc* area.

CEC_WinSCWestTable

Field Heading	Value	Comments
SITEID		
Area	Total West Window Area (SF)	Basis
Avg SCWest	West window shading coef. * west window area	Units of SF

- CEC_WinSCSumW Subquery - Sums up area and sc, and calculates the average sc.
- CEC_WinSCValueW Subquery – Gathers area, sc, and sc* area.

CEC_WindowTotalAreaTable

Field Heading	Value	Comments
SITEID		
Total Area	Total Window Area (SF)	Basis
N Area	Total North Window Area (SF)	
NE Area	Total Northeast Window Area (SF)	
E Area	Total East Window Area (SF)	
SE Area	Total Southeast Window Area (SF)	
S Area	Total South Window Area (SF)	
SW Area	Total Southwest Window Area (SF)	

W Area	Total West Window Area (SF)	
NW Area	Total Northwest Window Area (SF)	

CEC_CoolingEffPkgTable

Field Heading	Value	Comments
SITEID		
PkgAS	System EER * floor area served	Type A, small size range
PkgAM	System EER * floor area served	Type A, medium size range
PkgAL	System EER * floor area served	Type A, large size range
PkgAXL	System EER * floor area served	Type A, extra large size range
PkgBS	System EER * floor area served	Type B, small size range
PkgBM	System EER * floor area served	Type B, medium size range
PkgBL	System EER * floor area served	Type B, large size range
PkgBXL	System EER * floor area served	Type B, extra large size range
PkgCS	System EER * floor area served	Type C, small size range
PkgCM	System EER * floor area served	Type C, medium size range
PkgCL	System EER * floor area served	Type C, large size range
PkgCXL	System EER * floor area served	Type C, extra large size range
PkgDS	System EER * floor area served	Type D, small size range
PkgDM	System EER * floor area served	Type D, medium size range
PkgDL	System EER * floor area served	Type D, large size range
PkgDXL	System EER * floor area served	Type D, extra large size range

System type A:Single Package Rooftop AC, Single Package Rooftop Heat Pump, Split System AC, Split System Heat Pump, or Dual Fuel Heat Pump, without evaporative condenser.

System type B:Any units of system type A, with evaporative condenser.

System type C:Packaged Terminal AC, Packaged Terminal HP, Window/Wall AC Unit, Window/Wall HP

System type D: Water Loop Heat Pump

Size range small: 0 < ton <= 5.4

Size range medium*:* *5.4 < ton <= 11.25*

Size range large: 11.25 < ton <= 63.3

Size range extra large: ton > 63.3

CEC_CoolingEffBasisPkgTable

Field Heading	Value	Comments
SITEID		
PkgAS	Floor area served (SF)	Basis for type A, small size range
PkgAM	Floor area served	Basis for type A, medium size range
PkgAL	Floor area served	Basis for type A, large size range
PkgAXL	Floor area served	Basis for type A, extra large size range
PkgBS	Floor area served	Basis for type B, small size range
PkgBM	Floor area served	Basis for type B, medium size range
PkgBL	Floor area served	Basis for type B, large size range
PkgBXL	Floor area served	Basis for type B, extra large size range
PkgCS	Floor area served	Basis for type C, small size range
PkgCM	Floor area served	Basis for type C, medium size range
PkgCL	Floor area served	Basis for type C, large size range
PkgCXL	Floor area served	Basis for type C, extra large size range
PkgDS	Floor area served	Basis for type D, small size range
PkgDM	Floor area served	Basis for type D, medium size range
PkgDL	Floor area served	Basis for type D, large size range
PkgDXL	Floor area served	Basis for type D, extra large size range

System type A: Single Package Rooftop AC, Single Package Rooftop Heat Pump, Split System AC, Split System Heat Pump, or Dual Fuel Heat Pump, without evaporative condenser.

System type B: Any units of system type A, with evaporative condenser.

System type C: Packaged Terminal AC, Packaged Terminal HP, Window/Wall AC Unit, Window/Wall HP

System type D: Water Loop Heat Pump

Size range small: 0 < ton <= 5.4

Size range medium: *5.4 < ton <= 11.25*

Size range large: 11.25 < ton <= 63.3

Size range extra large: ton > 63.3

CEC_CoolingEffChillTable

Field Heading	**Value**	**Comments**
SITEID		
ChillAS	System EER * floor area served	Type A, small size range
ChillAM	System EER * floor area served	Type A, medium size range
ChillAL	System EER * floor area served	Type A, large size range
ChillBS	System EER * floor area served	Type B, small size range
ChillBM	System EER * floor area served	Type B, medium size range
ChillBL	System EER * floor area served	Type B, large size range
ChillCS	System EER * floor area served	Type C, small size range
ChillCM	System EER * floor area served	Type C, medium size range
ChillCL	System EER * floor area served	Type C, large size range
ChillDS	System EER * floor area served	Type D, small size range
ChillDM	System EER * floor area served	Type D, medium size range
ChillDL	System EER * floor area served	Type D, large size range

Chiller type A: Water cooled electric chiller
Chiller type B: Air cooled electric chiller
Chiller type C: Water cooled gas fired chiller
Chiller type D: Air cooled gas fired chiller

Size range small: 0 < ton <= 150
Size range medium*:* *150 < ton <= 300*
Size range large: ton > 300

CEC_CoolingEffBasisChillTable

Field Heading	**Value**	**Comments**
SITEID		
ChillAS	Floor area served (SF)	Basis for type A, small size range
ChillAM	Floor area served	Basis for type A, medium size range
ChillAL	Floor area served	Basis for type A, large size range
ChillBS	Floor area served	Basis for type B, small size range
ChillBM	Floor area served	Basis for type B, medium size range
ChillBL	Floor area served	Basis for type B, large size range
ChillCS	Floor area served	Basis for type C, small size range
ChillCM	Floor area served	Basis for type C, medium size range
ChillCL	Floor area served	Basis for type C, large size range
ChillDS	Floor area served	Basis for type D, small size range
ChillDM	Floor area served	Basis for type D, medium size range
ChillDL	Floor area served	Basis for type D, large size range

CEC_HeatingEffPkgTable

Field Heading	Value	Comments
SITEID		
PkgAS	Heating COP * floor area served	Type A, small size range
PkgAM	Heating COP * floor area served	Type A, medium size range
PkgAL	Heating COP * floor area served	Type A, large size range
PkgAXL	Heating COP * floor area served	Type A, extra large size range
PkgCS	Heating COP * floor area served	Type C, small size range
PkgCM	Heating COP * floor area served	Type C, medium size range
PkgCL	Heating COP * floor area served	Type C, large size range
PkgCXL	Heating COP * floor area served	Type C, extra large size range
PkgDS	Heating COP * floor area served	Type D, small size range
PkgDM	Heating COP * floor area served	Type D, medium size range
PkgDL	Heating COP * floor area served	Type D, large size range
PkgDXL	Heating COP * floor area served	Type D, extra large size range

System type A:Single Package Rooftop Heat Pump, Split System Heat Pump, or Dual Fuel Heat Pump

System type C:Packaged Terminal HP, Window/Wall HP

System type D: Water Loop Heat Pump

Size range small: 0 < ton <= 5.4

Size range medium*:* *5.4 < ton <= 11.25*

Size range large: 11.25 < ton <= 63.3

Size range extra large: ton > 63.3

CEC_HeatingEffBasisPkgTable

Field Heading	Value	Comments
SITEID		
PkgAS	Floor area served (SF)	Basis for type A, small size range
PkgAM	Floor area served	Basis for type A, medium size range
PkgAL	Floor area served	Basis for type A, large size range
PkgAXL	Floor area served	Basis for type A, extra large size range
PkgCS	Floor area served	Basis for type C, small size range
PkgCM	Floor area served	Basis for type C, medium size range
PkgCL	Floor area served	Basis for type C, large size range
PkgCXL	Floor area served	Basis for type C, extra large size range
PkgDS	Floor area served	Basis for type D, small size range
PkgDM	Floor area served	Basis for type D, medium size range
PkgDL	Floor area served	Basis for type D, large size range
PkgDXL	Floor area served	Basis for type D, extra large size range

CEC_HVACControlTable

Field Heading	**Value**	**Comments**
SITEID		
FloorArea	Total Building Floor Area (SF)	Basis
3a	Conditioned area under control mode	Condenser water setpoint fixed
3b	Conditioned area under control mode	Condenser water setpoint reset on outdoor temperature
5	Conditioned area under control mode	DDC of supply air flow rate based on terminal flow
10	Conditioned area under control mode	Optimum fan startup
13a	Conditioned area under control mode	Supply air temperature reset based on outside temperature
13b	Conditioned area under control mode	Supply air temperature reset based on zone temperature
14	Conditioned area under control mode	Outdoor air control with CO2 sensor

CEC_CoolingSizingTable

Field Heading	**Value**	**Comments**
SITEID		
Area	Total Cooling Conditioned Floor Area (SF)	Basis
Cooling Capacity	Cooling capacity for building	
Cooling Ratio	Cooling Sizing Ratio * Area	Sizing ratio times conditioned SF

CEC_EUITable

Field Heading	**Value**	**Comments**
SITEID		
Total Floor Area	Total Building Floor Area (SF)	Basis
Building KWH	Annual whole building kWH	Units are kWH
Heating	Annual building heating	Units are kWH
Cooling	Annual building cooling	Units are kWH
Lighting	Annual building lighting	Units are kWH
Fan	Annual building fans	Units are kWH
Refrigeration	Annual building refrigeration	Units are kWH
Other	Annual residual	Units are kWH

5. The MBSS Analysis Tool

This section of the appendix provides documentation of the software that has been provided with the buildings database.

The CBEE/SCE data includes a special software tool for summarizing building characteristics. This section describes how to use the software and the underlying principles. This software was initially created for the CEC, therefore the tables, queries, and forms of interest are named 'CEC_*'. But, these tables do contain the data for the CBEE/SCE Baseline study.

Purpose of the Software

MBSS is a powerful way to summarize the information in the database. Here are some examples of the type of statistic that you can obtain:

- The average or total floor area of different types of buildings.
- The average annual kWh energy of sites.
- The average energy use intensity (EUI) of sites, i.e., the annual kWh energy use per square foot.
- The average U-value of the windows of sites.
- The saturation of various AC equipment types, i.e., the proportion of the total floor area served by each type.
- The average efficiency of various types of equipment,
- The hourly schedule of use of various types of equipment.

This type of information can be developed for all sites, or for various classifications of buildings. Using the standard queries provided in the database, the sites can be classified by any combination of the following variables:

- T24 building type,
- California climate zone,
- Year of construction,
- Utility (PG&E, SCE, or SDGE),
- Participant status,
- Public / Private, and
- Owner-occupied / Spec.

Participant status indicates whether the site participated in the new-construction DSM programs offered by the utilities.

You can also use Access to design new queries to classify sites by any additional characteristics that you might want. Five category queries were used in the analysis:

'Categories' was used for the general analysis of the building parameters-including the T-24 bldg. Types.

'Categories2' was used to group the T-24 building types in to four building types.

'Categories3' was used to group the sites for the time series analysis.

'Categories4' was used to group the sites for the participant vs. non-participant analysis.

'Categories5' was used to group the sites for the speculative vs. owner occupied analysis.

MBSS calculates all averages to reflect the characteristics of interest and the underlying sampling, so that the resulting statistics are representative of the population of new commercial buildings in California. The software has options for calculating sample sizes and error bounds (at the 90% level of confidence).

MBSS has been used to prepare all of the information in this report. MBSS can be used to extract additional information from the underlying Access database using the queries that have been provided in the database. In addition, MBSS can be used to analyze new queries to provide even more specialized information.

Using the Software

MBSS can be installed on any computer running Windows 95 or Windows NT. An installation disk is available. When the software is run, the main menu will appear with the Data Base button activated.

Data Base

Click on the Data Base button to select the Microsoft Access database containing the data to be analyzed. Note that MBSS will write the results to this database.

Options

If desired, click on the Options button to select special options. The following special options are available:

Ratios for each site – calculate ratios for each individual sample site and write the ratios out to an Access table with the name "Sites_…" where … is the root table name. This is useful for reviewing the characteristics of each sample site.

Sample size for each group – calculate and write out the number of sites used to calculate the results for each group of sites. The results are written to an Access table with the name "SamSizes_…" where … is the root table name. If a site has a zero basis for a particular characteristic it is not counted.

Error bounds for each group – calculate and write out the error bounds for each characteristic in each group. The 90% level of confidence is assumed. The results are written to an Access table with the name "ErrBnds_…" where … is the root table name.

Separate basis for each analysis variable – read the basis in from a separate table of bases for each characteristic. This is the exception. In most cases, a single basis is used for each of the characteristics in a particular analysis.

If this option is selected, a list box will appear and display all of the queries in the database (except the query named 'Categories'). Select the appropriate query containing the separate bases.

Queries

Click on the Queries command button to select your Categories and Analysis queries.

Selecting the Categories query: The software will search the designated database for a query named 'Categories'. If it is found, it will be highlighted as the default selection in the Categories query list. In most applications, the default selection should be used.

Selecting the Analysis query: The Analysis Query list will display all queries in the database except the query named 'Categories'. Click on the desired query for your analysis. Caution: Do not select a 'bases' query as the analysis query.

Variables

Click on the Variable button to select the variables for grouping the sites and the variables to be summarized.

Selecting the Group By variables: If you are using the standard CEC categories query, the Group By list will contain the following variables: building type, climate zone, year, utility, participant. Building type will be selected. You can select or clear any of the variables by clicking the corresponding box. For example, if you select both building type and utility, results will be developed for all possible combinations of building type and utility. If no Group By variables are selected, the results will describe all buildings taken together.

Note: By default, the Categories query has been designed to exclude participants in the new-construction DSM programs offered by the two utilities. You can use Access to redesign the Categories query. Close the database in Access before opening the database in MBSS.

Selecting the Summarize variables: The list will display all of the variables contained in your analysis query except the Site ID and the bases. Each of the variables will be selected since you will usually want to summarize all of these variables.

If the list is very long (e.g., for the schedules), you may want to click on the Clear button to select none of the Summarize variables, and then manually select the variables you want to analyze. Click on the All button to select all of the Summarize variables. Click OK when you are ready to go on.

Results

Click on the Results button to execute the analysis. The screen will show the default name for the results table (the same name as the analysis query) and the default name for the first field (ID). The actual table will be called "Results_…" where … is the name that is shown. The results table will be added to the Access database. The ID field will have the value 1 for the first group, 2 for the second group, etc.

If the results table already exists in the Access database, the new results will be appended to the bottom of the table. The ID will be extended automatically.

As MBSS is processing your analysis, a message box will be displayed with the SQL (standard query language) for your analysis. This can usually be ignored. If a special basis is being used, a second message box will be displayed. This should be identical to the first message box.

When the analysis is complete, a message box will be displayed indicating that your results have been saved. You must use Access itself to review the results and to prepare reports. You can also export the results to Excel to create graphs.

After obtaining your results, you can change the options, queries, or variables and repeat the analysis. For example, suppose you have selected building type and utility as the Group By variables in your first analysis. You may want to continue the analysis by selecting only building type. This will summarize your analysis variables by building type across both utilities. Or you may want to select no group by variable. This will summarize your analysis variables across all buildings and both utilities. A message box will be displayed indicating that your new results will be appended to your existing results table unless you have typed in a new table name.

Note: You must click on the Results button each time you select different options, queries, or variables.

Note: You can open a results table in Access while MBSS is running. However, if you do additional MBSS analysis, you must re-open the database in Access to see the new MBSS results.

Hint: First select all of the Group By variables that you intend to use, and then drop variables from the analysis. This will improve the organization of your results table.

Exit

Click on exit to shut down MBSS.

Using Access to Create New Queries

You can obtain a wealth of information from the queries that are provided with the CEC database. However, you can also use Access to create additional queries. But if you create a new query you must make sure it follows the following format.

Note: You can not open an Access Table directly in MBSS. If your data is in a table, design an Access query based on your table.

Note: The name of each of your variables (fields) should start with a letter. Do not use numbers alone as field names.

Creating a new Categories Query

The Categories query contains the categorical variables that can be used to form groups of sites. For example, if you want to group the sites by size you can create a new Categories query with a Size categorical variable.

Note: Each categorical variable should take a limited number of distinct values. For example, you should use several square footage intervals rather than square footage itself.

Format of the Categories Query

The following format is required. Any deviation will cause an error.

Field 1: Site ID (required)

Field 2: Case weight (required)

Fields 3 to j: Any desired categorical variables

Creating a new Summarize Query

The Summarize query is used to specify the variables to be analyzed. Usually the Summarize query also includes the basis to be used in the analysis of each of the variables. In some cases, however, each of the analysis variables requires a separate basis. In this case the bases are provided in a separate query.

Format of the Summarize Query

The following format is required. Any deviation will cause an error.

Field 1: Site ID (required)

Field 2: Case weight (required)

Fields 3 to j: Exactly the same categorical variables as the Categories query

Field j+1: Site ID (required)

Field j+2: Basis (required unless a Special Basis is used; if a Special Basis is used this field must be omitted)

Added fields: All variables to be analyzed or summarized

Note: Fields 1 to k are the same as the Categories query. These are usually obtained by using Access to join the Categories query to a table containing the basis variable and the variables to be analyzed.

Note: Your Categories and Summarize queries must have the same number of records. This is usually achieved by joining the underlying tables or queries by Site ID.

Note: The basis and the variables to be summarized must be numeric. Empty fields are converted to zeros.

Note: If the basis is equal to 1.0 for all sites, then MBSS will give the average value of the analysis variable per site in the population. See the underlying principles for more information.

Creating a new Separate Basis Query

A separate basis query is used to summarize a set of related variables using a unique basis for each variable. For example, the efficiency of different types of equipment can be summarized using the connected load of each category as a separate basis.

Format of the Special Basis Query

The following format is required. Any deviation will cause an error.

Field 1: Site ID (required)

Field 2: Case weight (required)

Fields 3 to j: Exactly the same categorical variables as the Categories query

Field j+1: Site ID (required)

Added fields: The basis for each analysis variable included in the Summarize query.

Note: The Special Basis query must have the same number of variables as the Summarize query. <u>The name of each basis variable in the special basis query must be identical to the corresponding variable in the Summarize query</u>.

Note: Fields 1 to k are the same as the Categories query. These are usually obtained by using Access to join the Categories query to a table containing the basis variables.

Note: The basis variables to be summarized must be numeric. Empty fields are converted to zeros.

Note: Your Categories, Summarize, and Special Basis queries must have the same number of records. This is usually achieved by joining the underlying tables or queries by Site ID.

Combining Characteristics

Some of the existing queries may provide a higher level of detail than you want. For example, the lighting fixture query describes nine different types of lighting fixtures. For some purposes you may want to combine several of these types. To combine several types of fixture, simply create a new query from the existing query. Retain all of the categorical variables and the basis variable but construct a new analysis variable as the sum of the analysis variables in the original query corresponding to each of the types to be combined.

If a special basis is being used, a new special basis query should be constructed in the same way. The basis for the new combination should be the sum of the basis for each of the types to be combined.

Underlying Principles

Why is a special tool needed? Two issues must be considered in summarizing the characteristics of a set of sites. First, the summary must reflect the basis of each characteristic. Second, the summary must reflect appropriate sampling weights.

Example 1

As a first example, suppose you want to know the average electric EUI of new office sites in a given population. Note that the EUI of an office site is the total annual kWh energy use of the site divided by its total square footage.

Similarly, the EUI of a set of office sites is the total annual kWh energy use of the sites divided by their total square footage. This can be written as

$$EUI = \frac{\sum_{k \in P} kWh_k}{\sum_{k \in P} SF_k}$$

Here kWh_k is the annual kWh energy use of each site k and SF_k is the square footage of each site k in the target population P. The denominator of this equation, square footage, will be called the *basis* of the EUI characteristic.

The preceding equation can also be written as

$$EUI = \frac{\sum_{k \in P} (SF_k \times EUI_k)}{\sum_{k \in P} SF_k}$$

Here EUI_k is the EUI of each site k. This second equation shows that the average EUI is a weighted average of the EUI of each site, using square footage as the weight.

In practice, of course, we must work with a sample of sites rather than the full population. In this case, we define the case weight w_k of each sample site k to be the number of sites in the population that it is thought to represent. Then we can estimate the population EUI using the following equation:

$$EUI = \frac{\sum_{k \in s} w_k \; kWh_k}{\sum_{k \in s} w_k \; SF_k}$$

Here s denotes the sample sites. This can also be written as

$$EUI = \frac{\sum_{k \in P} w_k \,(SF_k \times EUI_k)}{\sum_{k \in P} w_k \; SF_k}$$

Example 2

Consider a second example. Suppose we want to describe the lighting schedule, i.e., the hourly use of lights in a population of sites. We have chosen to describe the schedule as the fraction of the total lighting wattage that is in use in each hour. We can write

$$S_h = \frac{\sum_{k \in P} L_{hk}}{\sum_{k \in P} L_k}$$

Here S_h denotes the fraction of the total connected lighting kW in the population that is in use in each hour *h*. L_{hk} is the lighting kW usage in site k in hour *h*, and L_k is the total connected kW of lighting in site k. As before, this can be written as

$$S_h = \frac{\sum_{k \in P} (L_k \times S_{hk})}{\sum_{k \in P} L_k}$$

Here S_{hk} denotes the fraction of the total connected lighting kW in site k that is in use in each hour *h*. If we are working with a sample, we can estimate the lighting schedule of the population by calculating the following for each hour *h*.

$$S_h = \frac{\sum_{k \in s} w_k \; L_{hk}}{\sum_{k \in s} w_k \; L_k}$$

This type of calculation can be carried out for any desired selection of sites. For example, we can calculate EUIs or lighting schedules for various building types, climate zones, or utility service areas.

General Form

The preceding examples have the same general form – that of a stratified ratio estimator.

For each site k, the characteristic of interest is often a ratio $R_k = y_k / x_k$, e.g., kWh per square foot, or kW in hour *h* divided by total connected kW. In general MBSS terminology, y_k is called the dependent variable and x_k is the explanatory variable. In the present application, we have called y_k the variable to be analyzed or summarized, and we have called x_k the basis variable.

Then the population characteristic of interest is the ratio

$$R = \frac{\sum_{k \in P} y_k}{\sum_{k \in P} x_k}$$

The preceding equation can also be written

$$R = \frac{\sum_{k \in P} x_k \; R_k}{\sum_{k \in P} x_k}$$

In this form it is evident that *R* is a weighted average of the values of R_k for all sites in the target population.

Generally we do not the values of both y_k and x_k for all sites in the population. But for each site in the sample, we do have a weight w_k that can be used to extrapolate the sample to the population. In this case we calculate an estimate of *R* that is denoted $\hat{R}$ and calculated using the equation:

$$\hat{R} = \frac{\sum_{k \in s} w_k \; y_k}{\sum_{k \in s} w_k \; x_k}$$

The preceding equation can also be written

$$\hat{R} = \frac{\sum_{k \in s} w_k \; x_k \; R_k}{\sum_{k \in s} w_k \; x_k}$$

Error Bounds

MBSS can calculate the statistical error bound for any ratio estimate. The error bound can be used to calculate a confidence interval for the true characteristic in the population. For example suppose the EUI has been found to be 10 kWh / square foot, with an error bound of 2 kWh / square foot. Then corresponding confidence interval is 10 ± 2 kWh / square foot, or 8 to 12 kWh / square foot. All error bounds are at the 90% level of confidence.

Following MBSS principles, the error bound *eb* is calculated using the following equations:

$$e_k = y_k - \hat{R}\, x_k$$

$$V\left(\hat{R}\right) = \frac{\sum_{k \in s} w_k \,(w_k - 1)\, e_k^2}{\left(\sum_{k \in s} w_k \; x_k\right)^2}$$

$$eb = 1.645\sqrt{V\left(\hat{R}\right)}$$

With ratio estimation, the error bound is affected by several factors including the sample size and the weights. But the most important factor is generally the strength of the association between the two variables y_k and x_k for all sample sites. If y_k is consistently close to $\hat{R}$ times x_k for all sample sites, then there is a strong association between the two variables. In this case, the error bound will be small. In effect, if R_k is fairly stable from site to site, then we can estimate the value of *R* in the population with good statistical precision.

Averages

MBSS can also estimate the average value of a variable in a population. We define *N* to be the total number of sites in the population. Then the population average of *y*, denoted μ, is defined to be

$$\mu = \frac{1}{N} \sum_{k=1}^{N} y_k$$

The sample estimate of the population mean μ is denoted $\bar{y}$. With a weighted sample, the sample mean is calculated using the equation

$$\bar{y} = \frac{\sum_{k \in s} w_k \; y_k}{\sum_{k \in s} w_k}$$

The preceding equation can be obtained from the standard ratio equation by defining $x_k = 1$. In words, the average of *y* is obtained by using *y* as the variable to be summarized and by choosing 1 as the basis.

Note: The error bound calculated by MBSS may be misleading in this situation since it does not reflect stratification.

General form of the Queries

This section describes the format of the queries using the notation developed in the preceding sections.

Categories Query

Field 1	Site ID, k
Field 2	Case weight, w_k
Field 3 to j	Any desired categorical variables used to group the sites

Analysis Query

Field 1	Site ID, k
Field 2	Case weight, w_k
Field 3 to j	The same categorical variables as in the categories query
Field j+1	Site ID, k
Field j+2	Basis, x_k (omitted if a special basis is used)
Added Fields	One or more y_k

Special Basis Query

Field 1	Site ID, k
Field 2	Case weight, w_k
Field 3 to j	The same categorical variables as in the categories query
Field j+1	Site ID, k
Added Fields	Basis, x_k for each y_k in the analysis query (with the same name)

Additional Options

MBSS provides special options for calculating:

- The sample size option calculates the number of sample sites for each result, excluding cases for which $x_k = 0$ and $y_k = 0$.
- The site specific ratios option calculates $R_k = y_k / x_k$ for each site k.

6. Instruments

CBEE Baseline Designer Interview Guide

- ❑ What type of projects does your company typically do? (building-use types, ownership types, new, remodel, additions etc.?)
- ❑ What is your personal focus? What is your role in the company?
- ❑ What is the approximate percentage breakdown of work by the categories listed above?
- ❑ How has that breakdown changed over the past 2 years? 5 years? 10 years?
- ❑ Who, besides you, is involved with energy efficiency decisions, lighting and mechanical choices that are made in the buildings that you/your company designs?

Energy efficiency in design:

These questions will be used to guide a more in-depth discussion of the factors that influence energy efficiency in design.

- ❑ How much of a factor is energy efficiency in design considerations?
- ❑ Who would best know about energy efficiency, lighting and mechanical choices that are made in the buildings that you/your company designs?
- ❑ How much direction do you get from clients to consider or not consider energy efficiency?
- ❑ What is your role with clients regarding overall design & efficiency and about educating them on equipment and design performance choices? Is this company policy? If you could do whatever you wanted, how would you approach the designing of efficiency into your buildings?
- ❑ How well informed do you feel about energy efficient options?
- ❑ Do you strive to design better than Title 24 requirements? If so, how far do you go?

- ❑ To what extent do you design-in occupant comfort versus relying on mechanical systems to provide this?

- ❑ What does commissioning mean to you, in terms of the building's energy systems?

- ❑ Do you suggest commissioning to your clients? If so, do they take your advice?

- ❑ Do you engage in commissioning activities for projects that you manage? Has there ever been an independent commissioning agent on any of your projects? If so, how well did that work out? What type of commissioning activities have you done or are you aware of on your projects?

Barriers to energy efficiency:

The following questions will probe for barriers to energy efficiency while keeping in mind that a *barrier is a characteristic of the market that helps to explain the gap between energy efficiency, or level of investment in, and the increased level that would be cost beneficial and that the cost benefit might be influenced by both energy and non-energy conditions.*

- ❑ What do you see as the primary barriers to making your building designs more energy efficient?

probe for barriers such as information & search costs, performance uncertainties, the role of opportunism & asymmetric information, transaction and hidden costs, access to financing, product unavailability, split incentives, organizational practices, bounded rationality, irreversibility and other externalities)

- ❑ If a cost response is given, the interviewer will probe into to what specifically lies beneath that response by asking how they determine this to be a market barrier over all other factors as well as probe for other factors cause them or their clients to consider other choices above efficiency. (probe for specific barriers where they show up)

- ❑ Why do you think these barriers exist?

- ❑ Describe the process, steps or stages you go through with your clients related to efficiency design and measures. Where/when in the process are there opportunities for you to discuss with or educate the client on efficient design and equipment choices? What information do you give them, how do you present it?

- ❑ What are you doing to change how your clients think about efficiency?

- ❑ To what extent do you exceed code requirements in your efficiency practices?

- ❑ How do you handle the fundamental differences in building types with the sole use VS mixed use properties? (ex. Warehouse or mfg/office or office/retail etc.)

A brief discussion here of the concept of barriers (introduction above) might occur to prompt the following questions:

- ❑ What can or should be done to overcome these barriers?

- ❑ Do these barriers vary by type of client (owner-occ, spec, bldg type, etc)?

- ❑ Who are or should be the leaders in overcoming these barriers?

Information about energy efficiency:

- ❑ Where do you obtain information about energy efficiency

- ❑ Do you think efficiency information is easy to find? To understand?

- ❑ What would make it easier for you to obtain the information you need about energy efficient options?

Public vs. private projects, speculative vs. owner driven projects, greenfield (new) construction vs. renovations & additions:

- ❑ How much of your work is on public and on private projects? How do public projects differ from private projects with respect to energy efficiency?

- ❑ How much of your work is for speculative developers and for owner-occupants? How do speculative developers treat energy efficiency compared to owner-occupants?

- ❑ Do you see any differences in energy efficiency opportunities between different building use types?

- ❑ How tough are the budget constraints on energy efficiency design and equipment in speculative projects?

- ❑ Do budget considerations for energy efficient design vary by project type or owner versus speculative? How are the decisions made for each? How do they vary. Who decides or guides the decision-making process?

Energy efficiency trends over time

The focus of this discussion will be to probe for distinctions among T-24 increases, utility program driven increases and "above & beyond" changes.

- ❑ Have you noticed any changes in your approach to energy efficiency over time? Over the last 2 years? 5 years? 10 years? We also want to determine what, if any effect of utility programs have influenced their efficiency decisions, and to what extent what they have learned has changed their practices.

- ❑ How do you think efficiency issues in your design practice will be treated in the future?

- ❑ Equipment improvements, changes, availability over time? (Effects of energy code and utility intervention?)

- ❑ Have you observed any changes in the demand for more energy efficient buildings?

- ❑ Have energy code changes tended to drive efficiency or is the code an acknowledgement of standard practice?

- ❑ Have you noticed any cases where the code has not caught up to the energy efficiency practices?

CBEE Baseline Quantitative Survey of Market Actors

Thank you for taking the time to complete this questionnaire. This research study is designed to learn more about energy efficiency issues in new non-residential buildings and is being conducted on behalf of the California Board for Energy Efficiency, a public board that advises the California Public Utilities Commission on energy efficiency issues. Your responses are very important, and we can assure you that your name and organization will not be identified with your responses in any report.

Background Information

Q1. Your firm's primary business is:

(1) Architectural

(2) Mechanical Engineering

(3) Electrical Engineering

(4) Other (specify)___________________

(98) Don't know → **Terminate**

(99) Refused → **Terminate**

Q2. What is your position within your firm?

(1) Project Engineer

(2) Project Architect

(3) Senior Engineer

(4) Senior Architect

(5) Principal

(6) Owner

(7) Other (Specify)__________________

(98) Don't Know → **Terminate**

(99) Refused → **Terminate**

Q3. Your firms annual revenue is approximately:

(1) Less than $1 million

(2) $1 million to $2.5 million

(3) $2.5 million to $5 million

(4) $5 million to $10 million

(5) $10 million to $20 million

(6) Over $20 million

(98) Don't know

(99) Refused

Q4. Approximately what percentage of your work is on public sector projects, private sector owner-occupied projects, and private sector speculative market projects? **[Must add to 100%]**

Public Sector projects	_________%
Private, owner Occupied	_________%
Private, Spec development	_________%
All other	_________%
Total	**100%**

NOTE TO WEBMASTER:

IN Q5, ONLY ASK ABOUT THOSE SECTORS FOR WHICH THE RESPONSE TO Q4 IS GREATER THAN ZERO.

Q5. How has the distribution of project types on which you work changed over the past two years? Has the percentage of public sector projects, private sector owner-occupied projects, and private sector speculative market projects increased, decreased, or remained constant over the past five years?

	Increased	**Remained Constant**	**Decreased**
Public Sector	3	2	1
Private, Owner-occupied	3	2	1
Private, Speculative Market	3	2	1

Energy Efficiency Decision-Making

Q6. Using a scale of 1 to 5, where 1 is very unimportant and 5 is very important, how important would you say energy efficiency considerations are in the design process for public sector buildings, private owner-occupied buildings, and speculative development?

	Public	**Owner-Occ**	**Spec**
Very Important	5	5	5
Somewhat important	4	4	4
Neither important nor unimportant	3	3	3
Somewhat unimportant	2	2	2
Very unimportant	1	1	1
Don't know	98	98	98
Refused	99	99	99

Q7. With whom do you think the **primary responsibility** for designing energy efficiency into buildings lies? **(ONE RESPONSE ONLY)**

(1) Owner

(2) Tenant

(3) Architect

(4) Mechanical Engineer

(5) Electrical Engineer

(6) State Government

(7) Federal Government

(8) Local Government

(9) Builder

(10) Equipment manufacturers

(11) Someone else (Specify)____

(12) Nobody

(98) Don't know

(99) Refused

Q8. In the majority of non-residential new construction projects you work on, who is the **primary decision-maker** about energy efficiency related choices? **(ONE RESPONSE ONLY)**

(1) Owner

(2) Tenant

(3) Architect

(4) Mechanical Engineer

(5) Electrical Engineer

(6) Builder

(7) Someone else (Specify)____

(8) Nobody

(98) Don't know

(99) Refused

Information about Energy Efficiency

Q9. How well informed do you feel about energy efficiency options beyond Title 24 requirements?

(5) Very well informed

(4) Somewhat informed

(3) Neither informed nor uninformed

(2) Somewhat uninformed

(1) Very uninformed

(98) Don't know

(99) Refused

Q10. Do you attempt to educate your clients about energy efficiency options that exceed Title 24 requirements?

(1) Yes → **GO TO Q11**

(2) No → **GO TO Q12**

(98) Don't know → **GO TO Q12**

(99) Refused → **GO TO Q12**

Q11. How do you present energy efficiency information to building owners?

(1) Discuss operating and maintenance expenses vs. initial construction costs

(2) Discuss energy savings relative to Title 24 requirements

(3) Discuss the comfort benefits associated with more energy efficient buildings

(4) Discuss the aesthetic benefits associated with more energy efficient buildings

(5) Other (Specify) ___________________________

(98) Don't Know

(99) Refused

Q12. What percentage of your non-residential new construction projects is completed using optimized energy design? By "optimized energy design" we mean conscientious teamwork to create an energy efficient building by optimizing system components and interactions of the components.

(1) 20% or less

(2) 21 – 40%

(3) 41 – 60%

(4) 61 – 80%

(5) 81 – 100%

(98) Don't know

(99) Refused

Q13. Has the use of optimized energy design on non-residential new construction projects increased, decreased, or stayed about the same in the last five years?

(3) Increased

(2) Same

(1) Decreased

(98) Don't know

(99) Refused

Q14. Which of the following sources do you look to most often for energy efficiency information for exceeding Title 24 requirements? Please indicate the top three sources.

(1) Mechanical Engineer

(2) Electrical Engineer

(3) Manufacturers

(4) Utilities

(5) Trade publications

(6) Internet resources

(7) Professional associations (AIA, ASHRAE, etc)

(8) Seminars/Workshops

(9) State of California

(10) Energy Code/Energy Efficiency Standards

(11) National Laboratories

(11) Other (Specify)____

(12) None

(98) Don't know

(99) Refused

Q15. How easy do you think energy efficiency information for exceeding Title 24 requirements is to obtain?

(5) Very easy

(4) Somewhat easy

(3) Neither easy nor difficult

(2) Somewhat difficult

(1) Very difficult

(98) Don't know

(99) Refused

Q16. How easy do you think energy efficiency information for exceeding Title 24 requirements is to understand?

(5) Very easy

(4) Somewhat easy

(3) Neither easy nor difficult

(2) Somewhat difficult

(1) Very difficult

(98) Don't know

(99) Refused

Q17. Which of the following sources and types of energy efficiency information for exceeding Title 24 requirements do you feel would be the **most** useful for educating clients? **(ONLY ONE RESPONSE PERMITTED)**

(1) Newsletter/Brochure/Fact Sheet

(2) Seminar/Workshop

(3) Direct contact with utility representatives

(4) Database of recommended products

(5) Software selection tool for incorporating efficiency into purchase decisions

(6) Utility guidelines for specific market segments and space types

(7) Central websites

(8) Utility-sponsored demonstrations in prototypical buildings

(9) None → **GO TO Q19**

Q18. Which of the following sources and types of energy efficiency information for exceeding Title 24 requirements do you feel would be useful for educating clients? **(MULTIPLE RESPONSES PERMITTED)**

(1) Newsletter/Brochure/Fact Sheet

(2) Seminar/Workshop

(3) Direct contact with utility representatives

(4) Database of recommended products

(5) Software selection tool for incorporating efficiency into purchase decisions

(6) Utility guidelines for specific market segments and space types

(7) Central websites

(8) Utility-sponsored demonstrations in prototypical buildings

(9) None

Q19. Which of the following methods do you use to determine the energy savings resulting from an energy-efficient building design?

(1) Detailed calculations based on public-sector computer simulations

(e.g. DOE-2, PowerDOE, Energy-10)

(2) Detailed calculations based on proprietary computer simulations

(e.g. HAP, Trace)

(3) Detailed computer analysis of lighting and/or daylighting systems

(e.g. Lumen Micro, Lightscape)

(4) Simplified energy savings estimates based on spreadsheet calculations

(5) Rule of thumb estimates based on personal knowledge

(6) Rule of thumb estimates by others

(7) None

(98) Don't know

(99) Refused

Q20. How often do you utilize an energy analysis design tool to provide energy savings estimates for your clients?

(5) Always

(4) Very Often

(3) Somewhat Often

(2) Seldom

(1) Never

(98) Don't know

(99) Refused

Usage of High Efficiency Products

Q21. How often do you specify the following materials and equipment in non-residential new construction projects?

	Always	Very Often	Somewhat Often	Seldom	Never
High Performance Glass	5	4	3	2	1
Premium Efficiency Motors	5	4	3	2	1
Variable Frequency Drives	5	4	3	2	1
Occupancy Sensors	5	4	3	2	1
Daylighting Controls (eg. Continuous Dimming, etc)	5	4	3	2	1
Energy Management System	5	4	3	2	1
High Efficiency HVAC Systems	5	4	3	2	1

Awareness of Energy Star Labeling Program

Q22. Are you familiar with the EPA's (Environmental Protection Agency) Energy Star labeling program for non-residential new commercial **buildings**?

(1) Yes → **GO TO Q23**

(2) No → **GO TO Q24**

(98) Don't Know → **GO TO Q24**

(99) Refused → **GO TO Q24**

Q23. What does the presence of an Energy Star label on a building mean to you?

Title 24 Energy Code Requirements

Q24. Using a scale of 1 to 4, where a 1 means not at all familiar and a 4 means very familiar, how familiar are you with Title 24 energy requirements?

(4) Very Familiar (Prepare Title 24 documentation)

(3) Somewhat Familiar (Review Title 24 documentation prepared by others)

(2) Not Very Familiar (Know Title 24 compliance is required, but do not prepare or review)

(1) Not at all Familiar (Don't know what Title 24 is)

(99) Refused

Q25. Overall, what percentage of non-residential new buildings do you believe do **not** meet Title 24 requirements?

(1) 20% or less

(2) 21 – 40%

(3) 41 – 60%

(4) 61 – 80%

(5) 81 – 100%

(98) Don't know

(99) Refused

Q26. What is the primary reason for the existence of new buildings that do not comply with Title 24 requirements? **(ONE RESPONSE ONLY)**

(1) Contractors install less efficient equipment than was originally specified

(2) Inconsistency in Title 24 enforcement

(3) Equipment and materials changes by the building owner

(4) Cost cutting after the initial equipment specification

(98) Don't know

(99) Refused

Q27. Would you say that standard practice with respect to energy efficiency is driven by energy code changes or that energy code changes are driven by standard practice?

(1) Code drives practice

(2) Practice drives code

(3) Energy code and standard practice are unrelated

(98) Don't know

(99) Refused

Interest in Energy Efficiency

Q28. In the past 5 years, has interest in energy efficiency beyond Title 24 requirements among your clients increased, decreased, or stayed about the same?

	Public	Owner-Occ	Spec
Increased	3	3	3
Same	2	2	2
Decreased	1	1	1
Don't know	98	98	98
Refused	99	99	99

Commissioning

Q29. How often are the following procedures performed on buildings you design?

	Always	Very Often	Somewhat Often	Seldom	Never
Documentation of design intent	5	4	3	2	1
Incorporation of commissioning requirements into design specifications	5	4	3	2	1
Inspection of building systems during construction (other than bldg. department)	5	4	3	2	1
Delivery of as-built drawings, specifications, and submittals	5	4	3	2	1
Testing of building equipment performance	5	4	3	2	1
Testing of building control system operation	5	4	3	2	1
Delivery of operations and maintenance manuals	5	4	3	2	1
Training of building operators	5	4	3	2	1

Barriers to Energy Efficiency

We are interested in learning possible reasons why non-residential new buildings might be built with inefficient equipment.

Please indicate your level of agreement with each of the following statements. Use a 1 to indicate that you "completely disagree" with statement and a 5 to indicate that you "completely agree" with the statement.

Q30. It's too time consuming to collect information about energy efficient options.

1 2 3 4 5 DK REF

Q31. Building owners prefer systems that have been proven to work in the past

1 2 3 4 5 DK REF

Q32. It's difficult to evaluate savings claims for energy efficient equipment.

1 2 3 4 5 DK REF

Q33. The organization responsible for selecting equipment is often not the same organization that is responsible for operating the equipment.

1 2 3 4 5 DK REF

Q34. If an energy efficient system beaks down, it will cost more to fix.

1 2 3 4 5 DK REF

Q35. The construction budget cannot handle the additional cost of energy efficient systems.

1 2 3 4 5 DK REF

Q36. Design and system decisions are made based on simplified rules of thumb.

1 2 3 4 5 DK REF

Q37. It's difficult to locate and obtain efficient equipment and materials.

1 2 3 4 5 DK REF

Q38. Construction and operating budgets are often separate, so construction costs cannot be increased for the benefit of Operating and Maintenance costs.

1 2 3 4 5 DK REF

Q39. Energy efficient equipment is much harder to find than standard equipment.

1 2 3 4 5 DK REF

Q40. Building owners won't consider long-term operating costs when selecting equipment.

1 2 3 4 5 DK REF

Q41. Manufacturers charge too much of a premium for energy efficient equipment.

1 2 3 4 5 DK REF

Q42. Energy efficient equipment always includes other features that drive the price up too much.

1 2 3 4 5 DK REF

Q43. If energy efficient equipment is installed, it will be very difficult to change to a different system later.

1 2 3 4 5 DK REF

Q44. It isn't worthwhile to collect information about energy efficient options.

1 2 3 4 5 DK REF

Q45. Evaluating vendor's performance claims about energy efficient equipment requires a high level of expertise.

1 2 3 4 5 DK REF

Q46. Dealing with technologically advanced systems costs too much time and money.

1 2 3 4 5 DK REF

Q47. Facility operators require additional expertise to properly operate energy efficient systems.

1 2 3 4 5 DK REF

Q48. Lending institutions will not finance a building with energy efficient options because it increases the cost of the building too far above norms.

1 2 3 4 5 DK REF

Q49. Building owners often claim their main objective is minimizing total costs, but when presented with the initial construction costs, they opt for less efficient equipment.

1 2 3 4 5 DK REF

Q50. Building owners prefer having the same equipment at all facilities so they can take advantage of the related economies of scale.

1 2 3 4 5 DK REF

Q51. Clients who build to lease care only about minimizing first cost.

1 2 3 4 5 DK REF

Q52. Energy effic ient equipment is a special order, and the construction schedule cannot be held up to wait for it.

1 2 3 4 5 DK REF

Q53. Environmental and societal costs are never considered when specifying equipment.

1 2 3 4 5 DK REF

Q54. Prices of high-efficiency equipment are artificially inflated.

1 2 3 4 5 DK REF

Q55. It would be preferable to purchase energy efficient features on equipment separately rather than packaged together.

1 2 3 4 5 DK REF

Q56. If design features incorporate energy efficiency, then remodeling later will be very difficult.

1 2 3 4 5 DK REF

Q57. Vendors of energy efficient equipment cannot be trusted to provide accurate information about product performance.

1 2 3 4 5 DK REF

Name ___________________________________

Company Name __________________________

Phone Number ______________________________

Would it be okay to call you for clarification of your responses if necessary?

(1) Yes
(2) No

CBEE Baseline Recruiting & Facility Manager Survey

Site ID : ___________

Contact Log

	Date	Time	By	Who	Result	Comment
1						
2						
3						
4						
5						
6						

- Call contact (owner or site manager first) and identify yourself.
- Describe the survey project

> **"We are an independent research organization hired the California Board for Energy Efficiency to perform a research study to understand how new buildings are built. Neither I nor anyone else connected with this study will attempt to sell you anything, and your name and responses will not be used for any purpose other than this study."**

Screener

Q1. Are you the owner or the owner's representative of the building at {address}?

Yes
No **(Get contact info)** **Name:____________________**
Don't Know **(Get contact info)** **Phone:____________________**
Refused **(Thank and terminate)**

Q2. Was there a new construction project at this address that was completed and occupied during 1997 or 1998?

Yes

No **(Thank and Terminate)**

Don't Know **(Get contact info)** **Name:**______________________

Refused **(Thank and Terminate)** **Phone:**______________________

Q3. How would you describe the project at {address}?

A new building (brand new construction)

Tenant improvement in an existing shell building **(Thank and Terminate)**

Renovation of an existing building **(Thank and Terminate)**

Addition to an existing building (Go to Q3a)

Renovation and addition (Go to (Q3a)

Gut Rehab **(Thank and Terminate)**

Don't know **(Get contact info)** **Name:**

Refused **(Get contact info)** **Phone:**

Q3a. Where in the building was the addition built? **(describe)**

____

____

Q4. Our information shows that this building is <TYPE OF BUILDING>, is this correct?

Yes

No **(If no, Ask what type of building – If not on list of building types for this study, Thank and terminate)**

____

If answered yes to all Q1, Q2, Q3, and Q4, then attempt to schedule on-site.

Scheduled **Date/Time**:___________________

Not Authorized/talk to someone else **Name/Phone**:__________________

Refused **(Thank and terminate)**

Secure cooperation for FM questions

Call back **Date/Time**:___________________

Call someone else **Name/Phone**:__________________

Building Classification

Q5. Was this building constructed by a private company or a public agency?

Privately

Publicly

DK/REF

Q6. Was this building built to be occupied by the owner of the building or built by a developer with the intent to lease space?

Built to be Owner Occupied

Built by a developer with the intent to lease space

DK/REF

Q7. Does this building have a central plant?

Yes

No

DK/REF

Q8. Is the maintenance and operation of this building handled in house or do you have an outside contractor who does this?

In house (Go to Question 8a)

By outside contractor **(Get Name and Phone Number – Goto Q9)**

Name:_________________________

Phone:_________________________

Q8a. Do you have building plans available at the site for review?

Yes

No

DK/REF

Q9. When this building was constructed, what would you say was the most import financial decision criteria for the project?

Lowest first cost

Lowest lifetime cost

Simple payback

Other

DK/REF

Q10. Did this building use a set of pre-existing plans (cookie cutter)?

Yes

No

DK/REF

Q11. Approximately what percentage of your O&M costs are for energy?

ENTER NUMBER:_________

Don't know/Refused

Energy Attitudes

Q12. How would you describe the level of importance of energy efficiency when your company built this building?

Very unimportant
Somewhat unimportant
Neither important nor unimportant
Somewhat important
Very important
Don't know/Refused

Q13. How would you describe the level of importance of energy efficiency in the daily operation of this building?

Very unimportant
Somewhat unimportant
Neither important nor unimportant
Somewhat important
Very important
Don't know/Refused

Q14. Does your company have any policy on energy efficiency?

Yes
No
DK/REF

Q15. Is the energy performance of the company used in the review of anyone's performance or compensation?

Yes
No
DK/REF

Energy Performance

Q16. When this building was built, would you say it…

Was just efficient enough to comply with the energy code
It was a little better than required by the energy code
It was much better than required by the energy code
DK/REF

Q17. How would you describe the energy performance of this building?

It could be much more efficient than it is
It could be somewhat more efficient than it is
The building is about as efficient as it can be
This building is an example for others to follow
DK/REF

Information & Commissioning

Q18. During the construction of this building, did anyone provide you with infomration about options that would increase the energy efficiency of the building?

Yes – Goto Q18a
No – Goto Q19
DK/REF

Q18a. Who provided you with that information?

Architect
M Engineer
E Engineer
Local Utility
In-house staff
Consultant
General Contractor
Other
DK/REF

Q19. Did you have anyone certify that the HVAC system and the lighting systems were working as designed at the completion of construction?

Yes – Goto Q19a
No – Goto Q20
DK/REF

Q19a. Who did this?

General Contractor
Sub-contractor
In-house staff
Outside consultant
Other
DK/REF

Q20. Does your company measure the energy performance of its buildings on a regular basis?

Yes
No
DK/REF

CBEE Baseline On-Site Survey

General Information

Site ID # [ ]

Surveyor Name: Building Name:

Date: Primary Contact: Phone:

Building Address:

City Zip

Start Time: Finish Time:

Circle any incidents as applicable:

1 None to report
2 Complaint about rates
3 Complaint about energy costs or lack of savings
4 Complaint about outages or power quality
5 Complaint about technology reliability
6 Complaint about utility customer service
7 Contact person unavailable or unaware of survey appointment
8 Customer expressed dissatisfaction with survey (list reason(s))
9 Property damage occurred during on-site survey
10 Personal injury occurred during on-site survey
11 Other (list)

Interview Questions

The following interview questions will be used to help us identify unobservable aspects of your building. These aspects include occupancy history, schedules, and heating and cooling controls. Answers to these questions will be coupled with data collected from our walk-through audit to produce a computer model which simulates the annual energy use of the building.

Building Overview

Q1. What is the overall building floor area? ____________SF

Q2. What is the floor area of the new construction?

❑ same as overall building floor area
❑ _____________SF

Q3. Characterize the site by circling the appropriate description:

1. New building ("green field")
2. Alteration of existing building
3. Addition to existing building
4. Alteration of existing building and addition to existing building

Note: If site is an alteration (2), contact the RLW scheduler immediately. If site is an addition (3) or addition and alteration (4), indicate the "old" construction in check boxes provided throughout the survey.

Q4. How many individual tenants (businesses) occupy this building? ________________

Q5. Do the majority of tenants have their own electric meter? Y N

Q6. How many floors? ___________

The remainder of this survey addresses only the new construction

Q7. What was the method used for Title 24 compliance?

Envelope (ENV):	❑ Component	❑ Overall envelope	❑ Performance	❑ DK	
Mechanical (MECH):	❑ Prescriptive	❑ Performance	❑ DK		
Lighting (LTG):	❑Complete building	❑ Area category	❑ Tailored	❑ Performance	❑ DK

- If new construction complied using the ***performance method***, or ***tailored lighting*** approach, copy the PERF or LTG compliance reports, or obtain the name and phone number of the firm that did the compliance analysis:

  Name:

  Phone:

Q8. Did this project receive an energy-efficiency rebate from the local utility? Y / N / DK

1.1.1.1.1.1.If yes, complete the survey, and contact the RLW scheduler.

Q9. Circle the appropriate building type description:

Building types ***included*** in study:

1	Financial Svc	9	Elementary Schools	17	Gym & Field house
2	Govt Administration	10	Community College	18	Museums
3	Office	11	High Schools	19	Worship Facilities
4	Vocational School	12	Post Office	20	Performing Arts Theaters
5	Special School	13	Other Stores	21	Recreation Bldgs
6	Sunday Schools	14	Shopping Centers	22	Arenas, Auditoriums, Exhibit halls
7	College & University	15	Funeral facilities	23	Other (list)
8	Middle Schools	16	Indoor Swimming pools		

Building types ***not included*** in study:

24	Military Facilities	32	Industrial Waste Treatment	40	Hotels & Motels
25	Food Mfg	33	Parking garage	41	Auto & Truck maintenance
26	YMCA	34	Parks, Fields, landscape	42	Food Stores
27	Clinics & Medical Office	35	Communications Bldgs	43	Other Mfg
28	Outdoor swimming pools	36	Residence halls	44	Detention facilities
29	Animal-Fish-Plant facilities	37	Labs, test, R&D	45	Libraries
30	Refrigerated Warehouse	38	Police & Fire Station	46	Other Warehouse
31	Stadiums	39	Restaurants	47	Apartments

If building type matches any of the types not included in the study, contact the RLW scheduler immediately.

Q10. If there are shades or blinds on windows, which ***best*** describes their general use?

- ❑ Always open
- ❑ Always closed
- ❑ Operated by occupants to control comfort
- ❑ Open when space is occupied, closed otherwise

Q11. If different areas of the building (departments, tenants, etc.) have *substantially* different operational schedules, divide the building into up to five areas with differing schedules, and provide a name for each area:

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________

❑ **Building-Wide** **- or -**	**Area #___ and Area Name ______________________**
(fill out only one page)	(fill out one page per area)

Schedules

The following questions will help us establish schedules for the building.

Q12. What would be the best way to group the days of the week to describe the operation of this area? One of the three operation levels must be assigned to each day of the week.

	M	Tu	W	Th	F	Sa	Su	Holiday
Full operation:	❑	❑	❑	❑	❑	❑	❑	❑
Light operation:	❑	❑	❑	❑	❑	❑	❑	❑
Closed:	❑	❑	❑	❑	❑	❑	❑	❑

Q13. Are there any months that this area has higher or lower than normal operating hours? Indicate months of increased or decreased operating hours. Normal (100%) is assumed for blank entries.

	Lighting % of Normal	HVAC % of Normal	Equip and Process % of Normal
Jan	____%	____%	____%
Feb	____%	____%	____%
Mar	____%	____%	____%
Apr	____%	____%	____%
May	____%	____%	____%
Jun	____%	____%	____%
Jul	____%	____%	____%
Aug	____%	____%	____%
Sep	____%	____%	____%
Oct	____%	____%	____%
Nov	____%	____%	____%
Dec	____%	____%	____%

Q14. Which holidays are observed (check all that apply)

❑ New Years day ❑ MLK day ❑ Presidents' day ❑ Easter ______ days

❑ Memorial day ❑ July 4th ❑ Labor day ❑ Columbus day

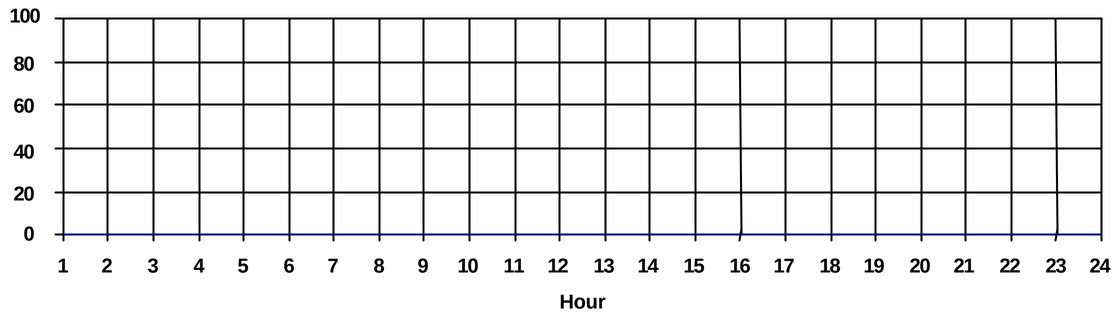
❑ Veteran's day ❑ Thanksgiving ____ days ❑ Christmas _____ days

Note: Holidays for 1998

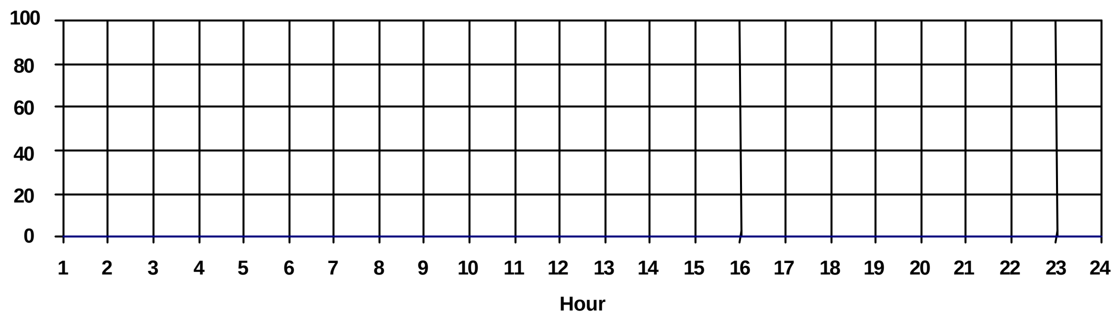
Holiday	Day/Date	Holiday	Day/Date
New Years day	Thur Jan 1	Labor day	Mon Sep 7
MLK day	Mon Jan 19	Columbus day	Mon Oct 12
Presidents' day	Mon Feb 16	Veteran's day	Wed Nov 11
Easter	Sun Apr 12	Thanksgiving	Thur Nov 26
Memorial day	Mon May 25	Christmas	Fri Dec 25
July 4th	Fri Jul 3		

❑ **Building-Wide** **- or -**	**Area #___ and Area Name ______________________**
(fill out only one page)	(fill out one page per area)

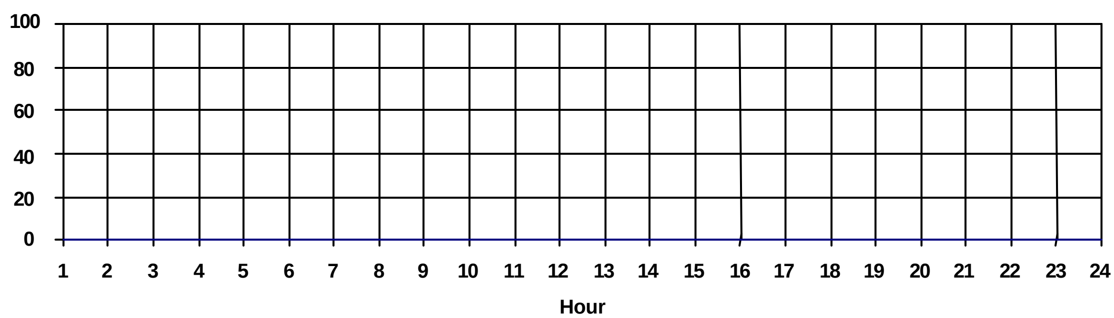
Q15. Draw a line that describes the ***occupancy*** schedule for a ***full operation day***.



Q16. Draw a line that describes the ***occupancy*** schedule for a ***light operation day***.

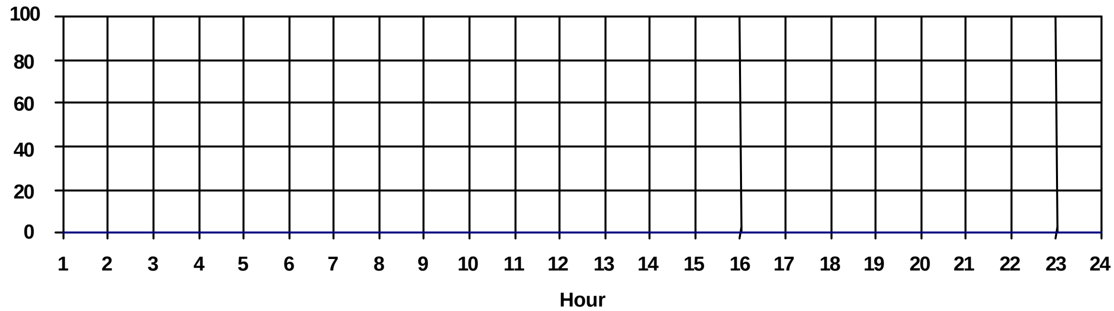


Q17. Draw a line that describes the ***occupancy*** schedule for a ***closed operation day***.

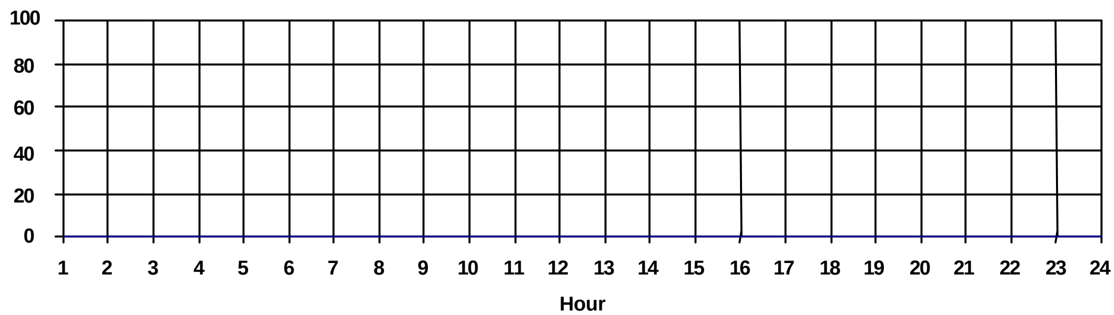


❑ **Building-Wide** **- or -** ______________________	**Area #___ and Area Name**
(fill out only one page)	(fill out one page per area)

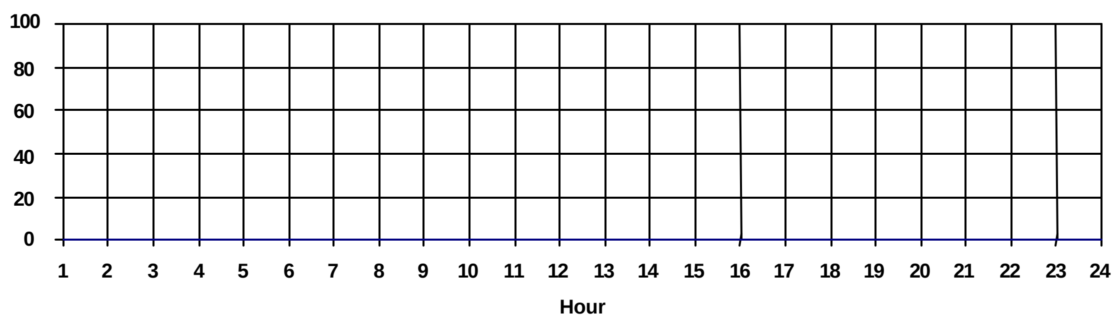
Q18. Draw a line that describes the schedule of use for ***interior lighting*** for a ***full operation day***.



Q19. Draw a line that describes the schedule of use for ***interior lighting*** for a ***light operation day***.



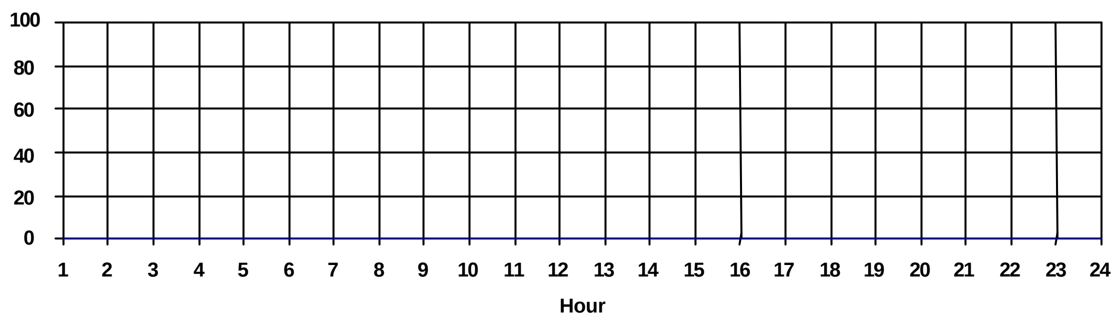
Q20. Draw a line that describes the schedule of use for ***interior lighting*** for a ***closed operation day***.



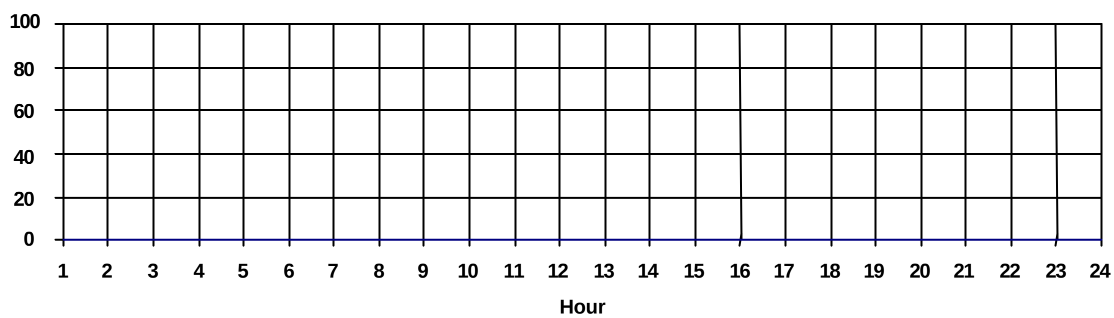
❑ **Building-Wide** **- or -**	**Area #___ and Area Name** ______________________
(fill out only one page)	(fill out one page per area)

Miscellaneous equipment and plug loads refer to any electrical equipment located in the conditioned space which is not lighting or HVAC

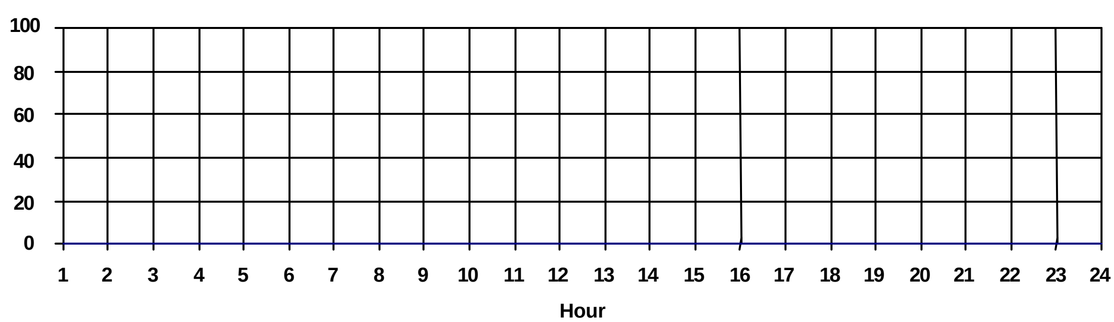
Q21. Draw a line that describes the schedule of use for ***miscellaneous equipment and plug loads*** for a ***full operation day***.



Q22. Draw a line that describes the schedule of use for ***miscellaneous equipment and plug loads*** for a ***light operation day***.



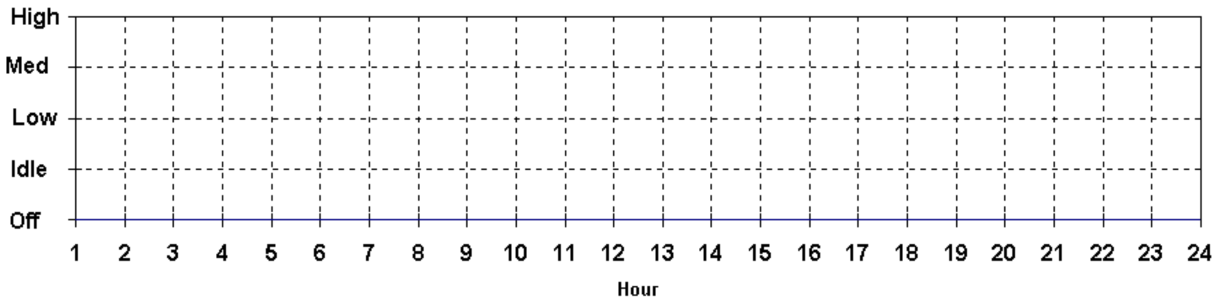
Q23. Draw a line that describes the schedule of use for ***miscellaneous equipment and plug loads*** for a ***closed operation day***.



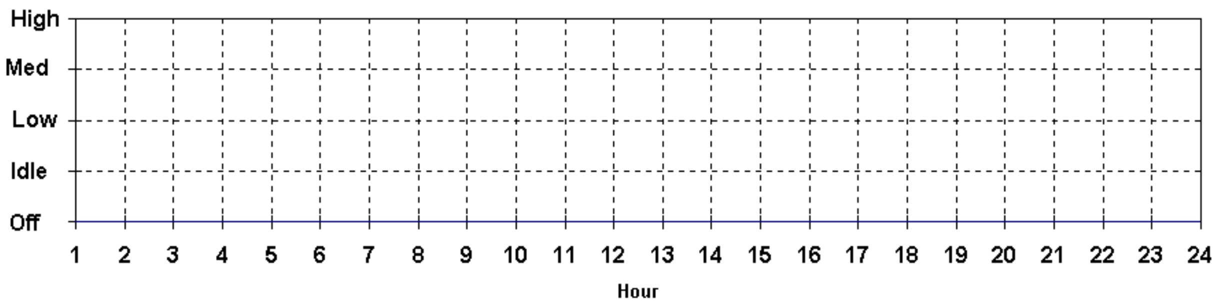
❑ **Building-Wide** **- or -**	**Area #___ and Area Name**
(fill out only one page)	(fill out one page per area)

Kitchen Operation

Q24. If the area has a commercial kitchen, draw a line that describes the schedule of use for ***kitchen equipment*** for a ***full operation day***.



Q25. If the area has a commercial kitchen, draw a line that describes the schedule of use for ***kitchen equipment*** for a ***light operation day***.



❑ **Building-Wide** **- or -**	**Area #___ and Area Name** ______________________
(fill out only one page)	(fill out one page per area)

Room Thermostat Setpoints

Q26. Enter the values for heating and cooling thermostat setpoints during normal (occupied) and setback (unoccupied) periods

Period	**Heating Setpoint**	**Cooling Setpoint**
Occupied		
Unoccupied		

Set CSP to 99 for "off," set the HSP to 45 for "off"

Q27. Are room temperatures in this area controlled by the building EMS? Y N DK

Q28. Does the setback schedule in this area follow the fan on/off schedule? Y N DK

If the answer is N or DK, define the setback schedule below:

Q29. Draw a line that defines the occupied and unoccupied mode for a ***full operation day***.
DK

Occupied																								
Unoccupied																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Q30. Draw a line that defines the occupied and unoccupied mode for a ***light operation day***.
DK

Occupied																								
Unoccupied																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

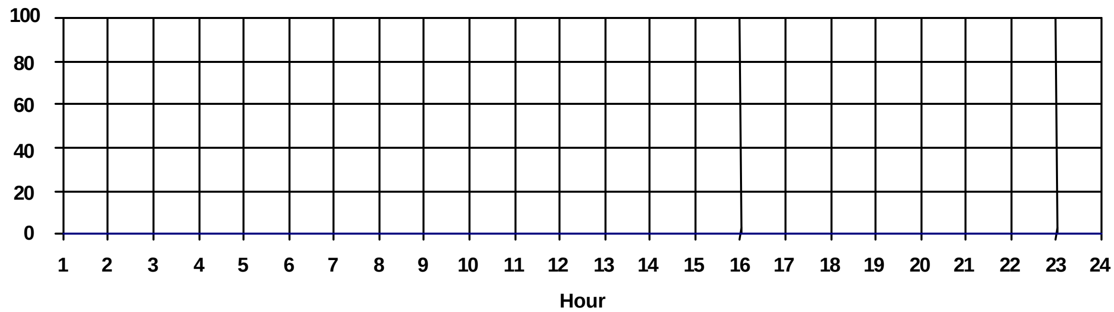
Q31. Draw a line that defines the occupied and unoccupied mode for a ***closed operation day***.
DK

Occupied																								
Unoccupied																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Exterior Lighting

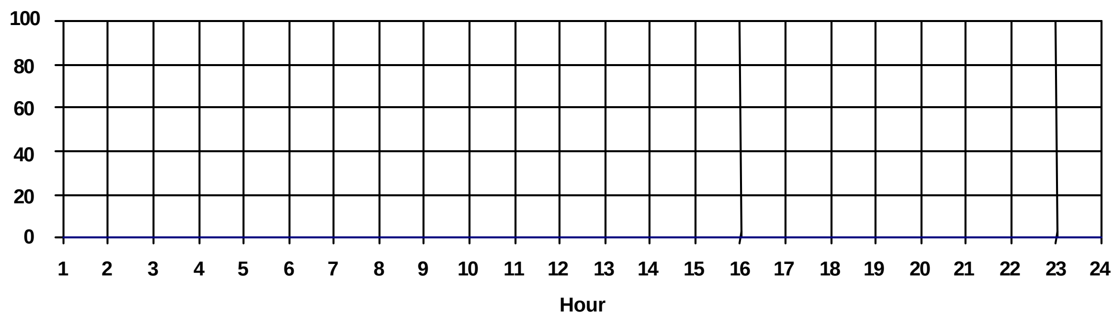
Q32. How are the exterior lights controlled? ❑ Time clock ❑ Photocell ❑ DK

Q33. If the exterior lights are controlled with a time clock, draw a line that describes the schedule

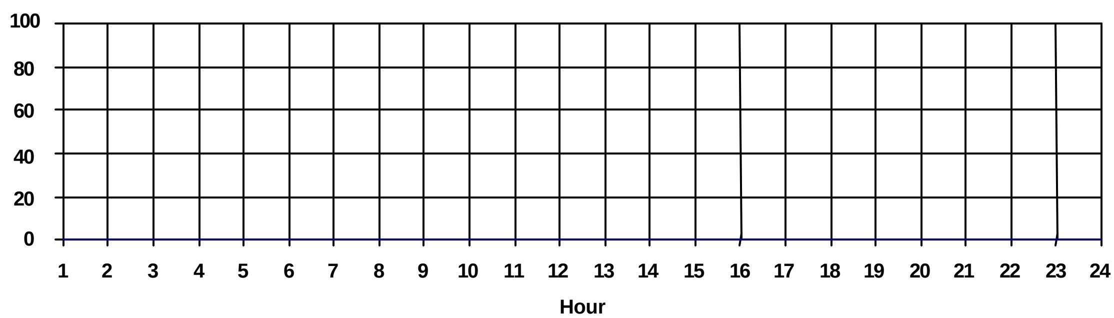


Exterior Miscellaneous Equipment

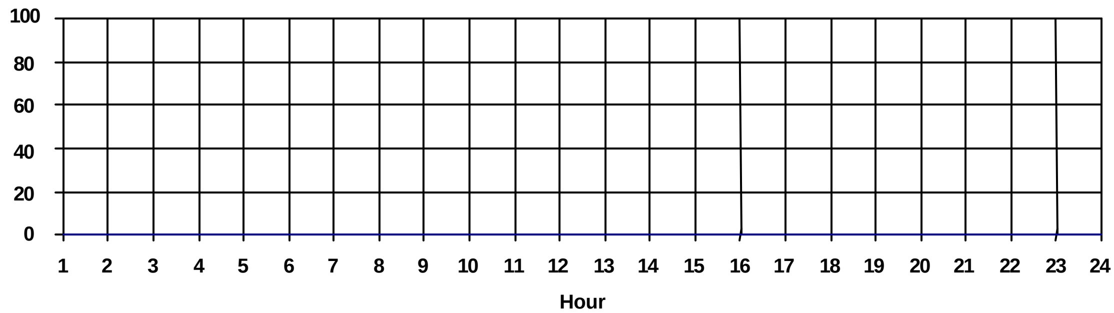
Q34. Provide a schedule for miscellaneous equipment ***not*** in the conditioned space for a ***full operation day***



Q35. Provide a schedule for miscellaneous equipment ***not*** in the conditioned space for a ***partial operation day***



Q36. Provide a schedule for miscellaneous equipment ***not*** in the conditioned space for a ***closed operation day***



Central HVAC Design and Control

The following questions will help us to understand how the HVAC systems operate in the building. (These questions are designed to be answered by someone familiar with the operation of the building mechanical and control systems.) If the building has an energy management system (EMS), indicate which actions are controlled by the EMS.

Q37. What is the minimum cooling supply air temperature setpoint ______°F DK

Q38. How is the supply air temperature controlled? ❑ EMS?

- ❑ Fixed
- ❑ Reset based on outside air temp
- ❑ Reset based on zone temp
- ❑ DK

Q39. What is the condenser water setpoint temperature? ______°F DK ❑ EMS?

Q40. How is the condenser water setpoint temperature controlled? ❑ EMS?

- ❑ Fixed
- ❑ Reset based on outside temp
- ❑ DK

Q41. If the system is VAV, how is the flow rate determined? ❑ EMS?

- ❑ Duct static pressure
- ❑ Measured air flow at the zone VAV boxes
- ❑ DK

Q42. Are CO_2 sensors used to control outdoor air quantities? Y N DK ❑ EMS?

Q43. Is the heating system turned off (locked out) on a seasonal basis? Y N DK

Q44. If yes, indicate the months when the heating system is typically available:

J F M A M J J A S O N D DK

Q45. If the building has chillers and cooling towers, is the system equipped with a water-side economizer? Y N DK

Q46. If yes, what type of water-side economizer is used?

❑ Strainer cycle ❑ Thermosyphon ❑ Plate-frame heat exchanger ❑ DK

Q47. Circle the months of the year when the water-side economizer system is typically used:

J F M A M J J A S O N D DK

HVAC Fan System Operation

This section is used to establish the fan system schedule. List the hours that the fans are "on" or "off." "On" indicates occupied mode, where the fans run continuously. "Off" indicates unoccupied mode, where the fans cycle on only if needed to satisfy space temperature needs, or are shut off regardless of space temperature..

Q48. Draw a line that describes the fan system operation for a ***full operation day***:

on																								
off																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Q49. Draw a line that describes the fan system operation for a ***light operation day***.
DK

on																								
off																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Q50. Draw a line that describes the fan system operation for a ***closed operation day***.
DK

on																								
off																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Q51. Is the fan system described above controlled by the building EMS? Y N DK

Q52. Is the fan system described above controlled using an optimum start algorithm? Y N
DK

Note: For fans with optimal start/stop, indicate the building occupancy schedule - e.g. the time when the building needs to be at normal operating temperature.

List all air handling units, building areas, and/or packaged HVAC systems that run on this schedule below:

Refrigeration System

Q53. Does the building have a refrigeration system with remote condensers? Y N DK
If no or DK, skip the remaining questions pertaining to refrigeration systems.

Q54. What refrigerants are used in each circuit of the system?

a. Low temp (Ice cream) R-______________ DK

b. Med temp (Frozen food) R-______________ DK

c. High temp (All others) R-______________ DK

Q55. What is the minimum condensing temperature setpoint? ______°F, _____ psig DK

Q56. For each circuit temperature, what type of defrost is typically used?

a. Low temp (Ice cream) ❑ electric ❑ hot gas ❑ time off ❑ DK

b. Med temp (Frozen food) ❑ electric ❑ hot gas ❑ time off ❑ DK

c. High temp (All others) ❑ electric ❑ hot gas ❑ time off ❑ DK

Q57. Are the anti-sweat heaters controlled on store humdity? Y N DK

Q58. If yes, list setpoints: RH off _____ % RH on_____ % DK

Swimming Pools

Q59. If the building has a heated swimming pool, what water temperature is maintained? ______°F DK

Q60. If the building has a heated swimming pool, is a pool cover used? Y N DK

Q61. If a cover is used, at what time is it normally put on the pool? _____ (military time, blank if DK)

Q62. If a cover is used, at what time is it normally removed from the pool? _____ (military time)

Spas

Q63. If the building has a spa, what water temperature is maintained? ________°F DK

Q64. If the building has a spa, is a cover used? Y N DK

Q65. If a cover is used, at what time is it normally put on the spa? _____ (military time, blank if DK)

Q66. If a cover is used, at what time is it normally removed from the spa? _____ (military time)

Building-Wide Power Generation

Q67. Do you have an emergency back-up generator or cogeneration system? Y N DK

If yes, fill out the supplemental on-site power form

Thermal Energy Storage

Q68. Does the building have a thermal energy storage (TES) system? Y N DK

If yes, fill out the supplemental TES form.

Operations and Maintenance

Q69. Please list any equipment or system operating problems that cause thermal discomfort or excessive energy consumption?

Problem	**Equipment and/or Systems Affected**
System under or oversized	
Insufficient or excess air flow	
Faulty control sensors	
Improper control sensor installation or location	
Insufficient sensor points for control and/or monitoring	
Improper EMS or control system programming	
Control systems "locked out" (left in manual position)	
Faulty valve or damper linkage or actuator	
Loose fan belts and / or improper alignment	
Improper ductwork installation or leakage	
Leaky valves, pipes, or fittings	
Defective major components (compressors, pumps, fans, etc.)	
Refrigerant leakage	
Fouled evaporative cooler media	
Water treatment problems (corrosion or bacterial growth)	

Other (list)

Code	Equipment/system
1	Air distribution
2	Boiler
3	Chilled water
4	Chillers
5	Condenser water

Code	Equipment/system
6	Cooling towers
7	Daylight control(s)
8	Fans
9	Hot water
10	HVAC

Code	Equipment/system
11	Lighting
12	Occupancy sensor(s)
13	VSDs
14	Other

Built-Up HVAC Systems *(Do not enter backup or stand-by equipment)*

Chillers/ Large Split DX

	CH-	CH-	CH-
Equipment Name			
Old Construction?	❏	❏	❏
Location		________________	
Quantity			
Manufacturer			
Model Number			
Serial Number			
Size (tons)			
Chiller Type	recip / screw / cent / absorp / gas eng	recip / screw / cent / absorp / gas eng	recip / screw / cent / absorp / gas eng
Full-load efficiency (kW/ton)			
Condenser Type	Air / Water	Air / Water	Air / Water
Air-Cooled Cond. Fan hp			

Enter condenser fan hp only if not included in equipment efficiency rating

Towers/ Evaporative Condensers

	T-	T-	T-
Equipment Name			
Old Construction?	❏	❏	❏
Location			
Quantity			
Manufacturer			
Model Number			________________
Rated Capacity (kBtuh)			
Out WB Temp @ rating			
Lv Cond Temp @ rating			
Fan Control	1-Sp / 2-Sp / Pony / VSD	1-Sp / 2-Sp / Pony / VSD	1-Sp / 2-Sp / Pony / VSD
Large Fan hp			
Large Fan motor efficiency			
Small fan hp			
Small fan motor efficiency			
Spray Pump hp			
Spray Pump motor effic.			

If one fan motor per tower or cell, enter size and efficiency under “Large fan.” If two motors, indicate size and efficiency of both motors.

Built-Up HVAC Systems (cont.) (Do not enter backup or stand-by equipment)

Heating System

	HS-	HS-	HS-
Equipment Name			
Old Construction?	❑	❑	❑
Location			
Quantity			
Capacity	KW / kBtuh	KW / kBtuh	KW / kBtuh
Type	Steam / HW / Duct Htr	Steam / HW / Duct Htr	Steam / HW / Duct Htr
Fuel	Electric / Other	Electric / Other	Electric / Other

Pumps

Pump	**Name**	**Old Const?**	**HP**	Motor effic %	**Control**	**EMS ?**	**Location**	**Loop**	**Use**
P-		❑			CV / VSD	❑		CHW / Cond / HW	Pri / Sec
P-		❑			CV / VSD	❑		CHW / Cond / HW	Pri / Sec
P-		❑			CV / VSD	❑		CHW / Cond / HW	Pri / Sec
P-		❑			CV / VSD	❑		CHW / Cond / HW	Pri / Sec
P-		❑			CV / VSD	❑		CHW / Cond / HW	Pri / Sec
P-		❑			CV / VSD	❑		CHW / Cond / HW	Pri / Sec
P-		❑			CV / VSD	❑		CHW / Cond / HW	Pri / Sec
P-		❑			CV / VSD	❑		CHW / Cond / HW	Pri / Sec
P-		❑			CV / VSD	❑		CHW / Cond / HW	Pri / Sec
P-		❑			CV / VSD	❑		CHW / Cond / HW	Pri / Sec

Built-Up HVAC Systems (cont.) ***(Do not enter backup or stand-by equipment)***

Central Air Handlers

Name	AH-	AH-	AH-
Equipment Name			
Old Construction?	❑	❑	❑
Location			
Quantity			
Type (circle one)	Single Duct Dual Duct Multi-Zone	Single Duct Dual Duct Multi-Zone	Single Duct Dual Duct Multi-Zone
Evaporative System Type (circle one)	None / Direct / Ind / Ind-Dir	None / Direct / Ind / Ind-Dir	None / Direct / Ind / Ind-Dir
Supply Fan Type (circle one)	CV / VAV	CV / VAV	CV / VAV
Supply Fan Control (if VAV - circle one)	VSD / Discharge / Inlet Vane	VSD / Discharge / Inlet Vane	VSD / Discharge / Inlet Vane
EMS control of supply fan?	❑	❑	❑
Supply Fan Flow Rate (cfm)			
Supply Fan Motor HP			
motor efficiency			
Return/ Relief Fan HP			
motor efficiency			
OA Control (circle one)	Fixed / Temp / Enthal	Fixed / Temp / Enthal	Fixed / Temp / Enthal
EMS control of OA?	❑	❑	❑
Min OA Fraction			

Packaged HVAC Systems

	AC-	AC-	AC-
Equipment Name			
Old Construction?	❑	❑	❑
Location			
Quantity			
Type Code			
Manufacturer			
Model No. (outdoor - all)			
Model No (indoor if split)			
Cooling Capacity (ton)			
Cooling Efficiency (circle units)	EER SEER	EER SEER	EER SEER
Supply CFM			
Heating Fuel (circle one)	Elec / Other	Elec / Other	Elec / Other
Heating Capacity (kBtuh) (heating capacity for heat pumps is for compressor only)			
Heating Efficiency (circle COP or HSPF for heat pumps, AFUE for gas heat)	COP HSPF AFUE	COP HSPF AFUE	COP HSPF AFUE
Condenser Type (circle one)	Dry Coil / Evap. Cond. Pad pre-cooler	Dry Coil / Evap. Cond. Pad pre-cooler	Dry Coil / Evap. Cond. Pad pre-cooler
Evaporative System Type (circle one)	None / Direct / Ind / Ind-Dir	None / Direct / Ind / Ind-Dir	None / Direct / Ind / Ind-Dir
System Type (circle one)	CV / VAV	CV / VAV	CV / VAV
Supply Fan Control (if VAV, circle one)	VSD / Discharge / Inlet Vane	VSD / Discharge / Inlet Vane	VSD / Discharge / Inlet Vane
EMS control of Supply Fan?	❑	❑	❑
Supply Fan HP			
Return/Relief Fan HP			
OA Control	Fixed / Temp / Enthal	Fixed / Temp / Enthal	Fixed / Temp / Enthal

EMS control of OA?	❑	❑	❑
Min OA Fraction			

Type Code	Description	Type Code	Description	Type Code	Description
1	Single Package Rooftop AC	5	PTAC	9	Water Loop Heat Pump
2	Single Package Rooftop Heat Pump	6	PTHP	10	Dual Fuel Heat Pump
3	Split System AC	7	Window/Wall AC Unit	11	Evaporative System
4	Split System Heat Pump	8	Window/Wall HP		

Zone _____

Name ____________________ Zone Multiplier _______ HVAC zoning by exposure? Y N

Exterior Surfaces

Assembly Name	**Old Const?**	**Type Code**	Insul R-value (or)	Overall U-value	**Orientation** (N, NE, E, …, H)	**H (ft)**	**W (ft)**
	❑						
	❑						
	❑						
	❑						
	❑						
	❑						
	❑						
	❑						

Height and width are gross dimensions, including windows

Enter "0" for R-value if uninsulated, leave blank if unknown

	Opaque Surface Type
1	Face Brick + Brick
2	Face Brick + Poured Concrete
3	Face Brick + Concrete Block
4	Poured Concrete + Finish

	Opaque Surface Type
5	Concrete Block + Finish
6	Wood Frame Wall
7	Metal Frame Wall
8	Curtain Wall

	Opaque Surface Type
9	Open
10	Concrete Deck Roof.
11	Wood Frame Roof
12	Metal Frame Roof

Zone-Level HVAC Equipment (Not Central, Not Packaged)

Name	**Type Code**	**Quantity**	Fan Hp	CFM	**Heat Source**	kW (If elec. heat)
					None / Elec. / Other	
					None / Elec. / Other	
					None / Elec. / Other	
					None / Elec. / Other	
					None / Elec. / Other	
					None / Elec. / Other	
					None / Elec. / Other	
					None / Elec. / Other	

Zone-Level HVAC Equipment

Type Code	Zone-Level HVAC Equipment Description
1	Baseboard or radiant heater
2	Two-pipe fan coil
3	Four-pipe fan coil
4	Two pipe induction terminal
5	Four pipe induction terminal
6	Unit heater

Type Code	Zone-Level HVAC Equipment Description
7	Unit ventilator
8	Non-powered VAV terminal
9	Series fan-powered VAV terminal
10	Parallel fan-powered VAV terminal
11	Computer equipment cooler
12	Exhaust fan

Zone _____ (contd)

Windows Types

Ref. No.	Assembly Name	Old Const?	No. Panes	Glass Type	Frame Type	Meas.Trans.	SC	U- value
1		❑						
2		❑						
3		❑						
4		❑						
5		❑						
6		❑						
7		❑						
8		❑						
9		❑						
10		❑						

	Glass Type
1	Clear
2	Tinted
3	Reflective

	Frame Type
1	Standard Metal Frame
2	Thermally Broken Metal Frame
3	Wood/Vinyl Frame

	Interior Shade Type
1	Blinds
2	Light Shades or Drapes
3	Dark Shades or Drapes

Window Geometry

Ref No. (from above)	**Orient** (N, NE, .. H)	**H (ft)**	**W (ft)**	**Qty**	Int. Shade Type	Otr Ex Shd%	OH Offset	OH Proj

Otr Ex Shd% refers to exterior shading from adjacent buildings, building self-shading, thick vegetation, hillsides etc.

Space _____

Name ___________________ Floor Area_________SF

Corridor/Restroom/Support Area______% Space Multiplier______

Circle appropriate occupancy code:

1 Auditorium
2 Church /chapel
3 Convention, meeting
4 Courtroom
5 Exhibit
6 Main entry lobby
7 Motion picture theater
8 Performance theater
9 Bars, lounge, casino
10 Dining
11 Kitchen
12 Bank/financial institution
13 Medical / clinical office
14 Office - Other
15 Computer center
16 EEG/EKG/MRI/Radiation
17 Hospital - Emergency
18 General hospital area
19 Hospital laboratory
20 Patient room/ nursery
21 Therapy (OT, PT)
22 Pharmacy
23 Radiology
24 Recovery
25 Surgical & OB suite
26 Hotel function
27 Hotel guest room
28 Hotel lobby
29 Barber, beauty shop
30 Bowling alley
31 Coin op laundry
32 Comm'l dry cleaners
33 Grocery
34 Mall, arcade, atrium
35 Retail, whlse sales flr
36 Classroom
37 Day care
38 Dormitory
39 Gymnasium
40 Library
41 Locker room
42 School shop
43 Swimming pool
44 Aircraft hanger
45 Auto repair workshop
46 General C&I work
47 Precision C&I work
48 Storage, warehouse
49 Other (Describe)

Lighting

Name	**Fixture Code**	**Fixture Count**	**Fixture type**	**Controls** (circle all that apply)	EMS?	**% fix ctrl**	**% ctrl oper**
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		
			Rec / Dir / Ind / Ind-Dir / Task	1 / 2 / 3 / 4	❑		

Define lighting not included in LPD as task lighting - includes portable task lights, display case lighting, medical examination lighting.

Lighting Control Codes

1 = Occupancy sensor 2 = Daylight - contin. dimming 3 = Daylighting - stepped 4 = Lumen maintenance

Miscellaneous Equipment and Plug Loads

❑ Use typical value: 1 2 3 4 ❑ Define additional or unique loads (use next page)

Space _____ contd

Miscellaneous Equipment and Plug Loads

❑ Use typical value: 1 2 3 4 plus additional loads listed below:

❑ Define unique loads for this space only

Name	**Equip. Code**	**Count**	kW/ Unit or	Motor HP or	kBtuh Input	Under Hood?
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N

Equipment - Record kW for equipment without default or if default is not appropriate

	Equipment Description	Equip Code	Default kW
General	Personal Computer w/ Monitor	1	0.5
	Terminal	2	0.15
	Laser Printer	3	0.85
	Copier	4	1.4
	Fax Machine	5	0.1
	Mini-Computer + Periph	6	1.0
	Main Frame Computer + Periph	7	
	Microwave	8	1.7
	Misc. Appliance	9	
	Television	10	0.15
	Washer	11	0.5
	Dryer	12	4.
	Cash Register	13	0.15
	Box Crusher	14	10.
	Gasoline pump	15	0.7
	ATM	16	.5
	Video game	17	.5
	Exercise equipment	18	.5

	Equipment Description	Equip Code	Default kW
Grocery	Meat Grinder	19	7.
	Meat Saw	20	2.5
	Meat Slicer	21	0.25
	Wrapper	22	0.9
	Check stand	23	1.5
Hospital	Laboratory Equipment	24	
	Monitoring, Life Support	25	1.1
	EEG	26	1.1
	EKG	27	1.1
	MRI	30	26.
	X-ray machine	31	5.
	Radiation Therapy Machine	32	10.
Indust	Air Compressor	33	
	Welder	34	
	Battery Charger	35	1.5
	Machine Tools	36	
	Motor	37	
Misc.	Other	38	

Typical Miscellaneous Equipment and Plug Loads 1 2 3 4

Floor area surveyed ___________________ SF

Name	**Equip. Code**	**Count**	kW/ Unit or	Motor HP or	kBtuh Input	Under Hood?
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N

Equipment - Record kW for equipment without default or if default is not appropriate

	Equipment Description	Equip Code	Default kW
General	Personal Computer w/ Monitor	1	0.5
	Terminal	2	0.15
	Laser Printer	3	0.85
	Copier	4	1.4
	Fax Machine	5	0.1
	Mini-Computer + Periph	6	1.0
	Main Frame Computer + Periph	7	
	Microwave	8	1.7
	Misc. Appliance	9	
	Television	10	0.15
	Washer	11	0.5
	Dryer	12	4.
	Cash Register	13	0.15
	Box Crusher	14	10.
	Gasoline pump	15	0.7
	ATM	16	.5
	Video game	17	.5
	Exercise equipment	18	.5

	Equipment Description	Equip Code	Default kW
Grocery	Meat Grinder	19	7.
	Meat Saw	20	2.5
	Meat Slicer	21	0.25
	Wrapper	22	0.9
	Check stand	23	1.5
Hospital	Laboratory Equipment	24	
	Monitoring, Life Support	25	1.1
	EEG	26	1.1
	EKG	27	1.1
	MRI	30	26.
	X-ray machine	31	5.
	Radiation Therapy Machine	32	10.
Indust	Air Compressor	33	
	Welder	34	
	Battery Charger	35	1.5
	Machine Tools	36	
	Motor	37	
Misc.	Other	38	

Refrigerated Cases

Zone: ___

Name	**Old Const?**	**Type**	**Qty**	**Unit Dim. (ft, CF)**	**Walk-in SF**	**Product**	**Comp Loc**	Door type (Reach-in)	Display Ltg (blank if none)	EE Mtr
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N
	❑						Int / Rem		Std / Ebal / T-8	Y / N

Enter SF for walk-in or walk-in/reach-in only

Type Code	Case Description	Unit Dim.	Default kW/unit
1	Island, open, single-level narrow	ft	0.1
2	Island, open, single-level wide	ft	0.1
3	Island, open, island, single level double	ft	0.2
4	Island, closed, single-level narrow	ft	0.1
5	Island, closed, single-level wide	ft	0.1
6	Island, closed, single level double	ft	0.2
7	Open Single-deck	ft	0.3
8	Open Multi-deck	ft	0.3
9	Reach-in Multi deck	ft	0.3
10	Closed rear-entry multi-deck	ft	0.03
11	Curved glass rear entry multi deck	ft	0.06
12	Walk-in / Reach-in	ft	0.3
13	Walk-in	ft	0.015
14	Under counter Reach-in	CF	0.03
15	Blast Chiller	CF	0.03
16	Ice Maker	CF	0.04
17	Residential Reach-in Refrigerator	CF	0.03
18	Residential Reach-in Freezer	CF	0.03
19	Residential Closed Coffin Freezer	CF	0.03
20	Refrigerated Vending Machine	CF	0.03
21	Water cooler	each	0.5
22	Slurpee, frappaccino machine	each	
23	Other	kBtuh	

Product Code	Product
1	Ice Cream
2	Frozen Food
3	Fresh Meat
4	Deli
5	Dairy/Beverage
6	Produce

Door Code	Door Type
1	Single glazed
2	Double glazed
3	Triple glazed, no heater controls
4	Triple glazed, w/ heater controls
5	Triple glazed, no heaters
6	Quadruple glazed, no heater controls
7	Quadruple glazed, w/ heater controls
8	Quadruple glazed, no heaters

Refrigeration Plant

Compressors / Compressor Racks

Name	**Make**	**Model**	**Old Const?**	**Comp Code**	Circuit	SST °F	Evap tons	AHU Ht. Rec
CR-			❑		LT / MT / HT			Y / N
CR-			❑		LT / MT / HT			Y / N
CR-			❑		LT / MT / HT			Y / N
CR-			❑		LT / MT / HT			Y / N

LT circuit is for ice cream cases (product code 1), MT is for frozen food cases (product code 2) and HT is for all others
Supply evaporator tons and rack suction temperature (SST) if known

Comp Code	Compressor type	Comp Code	Compressor type
1	Stand-alone	3	Parallel equal multiplex
2	Stand-alone w/ VSD	4	Parallel unequal multiplex

Refrigeration Condenser

	RC-	RC-	RC-	RC-
Equipment Name				
Old Construction?	❑	❑	❑	❑
Location				
Quantity				
Type	Air / Water	Air / Water	Air / Water	Air / Water
Manufacturer	________________			
Model Number				
Compressors served				
Rated Cap (kBtuh)				
Outdoor Temp @ rating	WB DB	WB DB	WB DB	WB DB
Cond Temp @ rating				
Fan Control	1-Sp / 2-Sp / Pony VSD	1-Sp / 2-Sp / Pony VSD	1-Sp / 2-Sp / Pony VSD	1-Sp / 2-Sp / Pony VSD
Large Fan hp				
Large Fan motor effic				
Small Fan hp				
Small Fan motor effic				
Spray Pump hp				
Spray Pump motor effic				

If one fan motor per tower or cell, enter size and efficiency under “Large fan.” If two motors, indicate size and efficiency of both motors.

Foodservice

Zone: _______

Kitchen Equipment

Appliance Name	**Qty**	**Type Code**	**Fuel**	KW ***or***	Volts / Amps ***or***	kBtuh Input ***or***	**Trade Size**	**Hood**
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N
			Elec. / Other		/			Y / N

Hoods

Name	**Type**	**Size (SF)**	Flow (cfm)	Fan hp	**Makeup Air Source**
	Canopy / Island Canopy / Backshelf				Cond / Uncond
	Canopy / Island Canopy / Backshelf				Cond / Uncond
	Canopy / Island Canopy / Backshelf				Cond / Uncond
	Canopy / Island Canopy / Backshelf				Cond / Uncond
	Canopy / Island Canopy / Backshelf				Cond / Uncond
	Canopy / Island Canopy / Backshelf				Cond / Uncond

Type Code	Description	Trade size	Default kW/unit
1	Broiler (include cheesemelter)	ft	1.7
2	Char Broiler	ft	3.7
3	Griddle, single sided	ft	4.5
4	Griddle, clam shell	ft	7.5
5	Fryer, countertop	lb	0.3
6	Fryer, free-standing	lb	0.3
7	Fryer, pressure	lb	0.3
8	Fryer, donut	lb	0.3
9	Kettle, Pasta cooker	qt	0.25
10	Heat lamps	lamps	0.5
11	Range top	ft	5.
12	Oven, pizza or bake	decks	7.
13	Oven, conveyor	decks	13.
14	Oven, range	ft	2.

Type Code	Description	Trade size	Default kW/unit
15	Oven, convection, combi, or retherm	doors	3.8
16	Food warmer	ft	0.6
17	Heated display case	ft	0.5
18	Microwave oven		1.7
19	Toaster, pop-up		1.8
20	Toaster, conveyor		4.6
21	Coffee pot	burners	1.
22	Steam table	ft	0.6
23	Dishwasher, single tank	racks/hr	0.3
24	Dishwasher, conveyor	racks/hr	0.1
25	Steam jacketed kettle	qt	0.4
26	Braising pan/skillet	qt	0.1
27	Other	kW	

Hot Water

Conventional Water Heating Equipment

Name	**Location**	**Type Code**	**Old Cost?**	Storage Cap (gal)	**Fuel**	Pump hp
			❑		Elec / Other	
			❑		Elec / Other	
			❑		Elec / Other	
			❑		Elec / Other	

Solar Water Heating Equipment

Name	Location	System Type Code	Collector Area (SF)	Tilt (deg, horiz =0)	Storage Cap (gal)

Pools/ Spas

Name	Location	Surface Area (SF)	**Filter Motor hp**	**Heating System**
	Outside / Inside			None / PH-___
	Outside / Inside			None / PH-___
	Outside / Inside			None / PH-___
	Outside / Inside			None / PH-___

Pool/Spa Heating System

Name	Location	**Fuel Code**	Solar Collector Type	Collector Area (SF)	Tilt (deg, horiz =0)	Heat Recovery
PH-1		Elec / Other	Glazed / Unglazed			Y / N
PH-2		Elec / Other	Glazed / Unglazed			Y / N
PH-3		Elec / Other	Glazed / Unglazed			Y / N
PH-4		Elec / Other	Glazed / Unglazed			Y / N

WH Type Code	Water Heater Description
1	Storage
2	Instantaneous
3	Heat Pump

SWH Type Code	Solar Water Heater Description
1	Active flat plate
2	Passive flat plate
3	Integral Collector/Storage
4	Active evacuated tube
5	Active concentrating E-W tracking
6	Active concentrating N-S tracking

Miscellaneous

Vertical Transportation

Name	**Type**	**Qty**	Motor hp	Elevator **Number of Floors**	**Width (ft)**	Escalator **Rise (ft)**	**Run (ft)**
	Elev / Esc						
	Elev / Esc						
	Elev / Esc						
	Elev / Esc						
	Elev / Esc						
	Elev / Esc						

Exterior Lighting

Name	Old Const ?	**Fixture Code**	**Count**
	❑		
	❑		
	❑		
	❑		
	❑		
	❑		

Collect only if connected to electric meter serving occupied space

Miscellaneous Exterior Electric Loads

Name	**Equip Code**	**Quantity**	kW/unit or	Hp/unit

Collect only if connected to electric meter serving occupied space

Equipment Description	Equipment Code	Default kW
Misc. Appliance	1	
Washer	2	0.5
Dryer	3	4.
Cash Register	4	0.15
Box Crusher	5	10.
Gasoline pump	6	0.7
Air Compressor	7	

Equipment Description	Equipment Code	Default kW
Welder	8	
Battery Charger	9	1.5
Machine Tools	10	
Motor	11	
Refrig vending machine	12	
Ice merchandizer	13	
Other	14	

Meters

Meter Number	**Surveyed Space kWh / Metered Space kWh (%)**	**Meter Location**

❑ Some or all meter information not available

Notes:

System / Zone Association Checklist

DOE-2 "Virtual" System ----→	1	2	3	4	5	6	7	8	9	Zonal HVAC only	Uncond
Packaged HVAC											
AC-1											
AC-2											
AC-3											
AC-4											
AC-5											
AC-6											
AC-7											
AC-8											
AC-9											
AC-10											
AC-11											
AC-12											
AC-13											
AC-14											
AC-15											
AC-16											
AC-17											
AC-18											
AC-19											
AC-20											
Air Handlers											
AH-1											
AH-2											
AH-3											
AH-4											
AH-5											
AH-6											
AH-7											
AH-8											
AH-9											
AH-10											
AH-11											
AH-12											
AH-13											
AH-14											
AH-15											
AH-16											
AH-17											
AH-18											
AH-19											
AH-20											
Zone 1											
Zone 2											
Zone 3											
Zone 4											
Zone 5											

Zone 6											
Zone 7											
Zone 8											
Zone 9											
Zone 10											

Check 'Zonal HVAC only' if zone is conditioned only by baseboard, radiant, or unit heaters, or unit ventilators.

Plant / System Association Checklist

DOE-2 "Virtual" System ----→	1	2	3	4	5	6	7	8	9
Chillers / AC Compressors									
CH-1									
CH-2									
CH-3									
CH-4									
CH-5									
CH-6									
CH-7									
CH-8									
CH-9									
CH-10									
Towers / Evap. Condensers									
T-1									
T-2									
T-3									
T-4									
T-5									
T-6									
T-7									
T-8									
T-9									
T-10									
Heating Systems									
HS-1									
HS-2									
HS-3									
HS-4									
HS-5									
HS-6									
HS-7									
HS-8									
HS-9									
HS-10									
Pumps									
P-1									
P-2									
P-3									
P-4									
P-5									
P-6									
P-7									
P-8									
P-9									
P-10									
P-11									
P-12									
P-13									
P-14									

P-15									
P-16									
P-17									
P-18									
P-19									
P-20									

Interview "Area" / Audit "Zone" Association Checklist

Areas	1	2	3	4	5
Zone 1					
Zone 2					
Zone 3					
Zone 4					
Zone 5					
Zone 6					
Zone 7					
Zone 8					
Zone 9					
Zone 10					

Space/Zone Association

	Zone									
Space	Z 1	Z 2	Z 3	Z 4	Z 5	Z 6	Z 7	Z 8	Z 9	Z 10
1										
2										
3										
4										
5										
6										
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30										

Sketch of Building Floor Plan

Be sure to include dimensions, North arrow, and zone and HVAC equipment locations