2004-2005 Statewide Emerging Technologies Program

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Final Evaluation Report

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ECONorthwest

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Acknowledgments

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The 2004-05 Statewide Emerging Technologies Program (ETP) is an information-only program that seeks to accelerate the introduction of innovative energy efficient technologies, applications, and analytical tools that are not widely adopted in California. The ETP works to accelerate a product's market acceptance by reducing the performance uncertainties associated with new products and facilitating adoption of the new technologies into energy efficiency (EE) programs. This is done primarily through technology assessments, where technologies are tested in a controlled environment in an effort to assess equipment performance, savings potential, and customer satisfaction.

Beginning in 2000, the utilities and the California Energy Commission's (CEC) Public Interest Energy Research (PIER) staff met to discuss and coordinate statewide activities through the Emerging Technologies Coordinating Council (ETCC). Through PIER, the CEC helps to develop, test and demonstrate products up to the end of the Research and Development (R&D) cycle. During the 2003 meetings, the PIER program managers and contractors reviewed with the utilities those projects and technologies that have advanced enough to warrant utility Emerging Technologies Program consideration.

The program consists of two parts: Demonstration & Information Transfer, and the ETCC. The Demonstration & Information Transfer portion of the program focuses on the assessment of near-commercial and commercial energy efficient applications with low market penetration. Assessment projects, conducted at either customer sites or in controlled environments, provide design, performance, and verification of energy efficient systems, thereby helping to reduce the market barriers to their wider acceptance. The Assessment projects help to measure, verify, analyze, and quantify the potential demand and energy savings. Information Transfer disseminates the results of the emerging technology application assessment projects, and is customized to the targeted markets.

The ETCC is a statewide information exchange and coordination effort between Pacific Gas & Electric (PG&E), Southern California Edison (SCE), Southern California Gas (SoCalGas), and San Diego Gas & Electric (SDG&E), and the CEC PIER program. The PIER program, like other public and private R&D efforts, develops, tests, and demonstrates prototype products. ET Program efforts to select technology applications for assessment projects include working with the CEC PIER program, members of the research and design communities, manufacturers, energy efficiency advocates, and industry groups such as EPRI, GTI, Universities, E-Source, California Institute for Energy and Environment (CIEE), Air-Conditioning and Refrigeration Institute (ARI), American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), national laboratories, Department of Energy (DOE), Environmental Protection Agency (EPA), National Aeronautics and Space Administration (NASA), engineering firms, industry and trade groups.

Evaluation Components

Within this program implementation context, the evaluation of the 2004-05 ETP had three primary components:

1. **Documentation of program activities.** The first part of the evaluation involved collecting information from each utility and documenting ETP activities and accomplishments during the 2004-05 program cycle.
2. **Process evaluation.** The second major evaluation task involved a formal process evaluation that focused on the ETP as it was implemented in 2004-05.

   The purpose of the interviews was to gain an understanding of how different components of the ETP function in practice. Specifically, the process evaluation and the interviews focused on:

   - How the ETP identifies new technologies
   - How technologies are screened and selected for assessment, and
   - How results of the assessments are disseminated, including the use of assessed technologies in other energy efficiency programs.

   A total of 18 in-depth interviews were conducted with the following people:

   - ETP Program Managers
   - ETP Project Managers
   - Program Managers from Express Efficiency, Standard Performance Contracting (SPC), and residential energy efficiency programs
   - Representatives from account services and the Public Interest Energy Research Program (PIER).
3. **Program logic model and case studies.** The ETP logic model and program theory were developed as part of the 2004-05 evaluation. Based on the logic diagram and program theory, indicators of program activities, progress and effectiveness are derived. These indicators (when measured properly) can help confirm the underlying program logic by demonstrating that key linkages between planned activities and expected outcomes are in fact working according to expectations.

   To demonstrate this, 8 case studies of technology assessments performed during the 2004-2005 analysis period are presented and used to show program progress based on the indicators linked to the logic model. For each assessment, the case study identifies strengths of the assessment (i.e., aspects that worked in accordance with the logic model), weaknesses, and recommendations for improvement based on the comparison with the logic model.

Each of these three activities resulted in a separate interim report provided to the CPUC and shared with the ETP program implementers during the course of the 2004-05 evaluation. These reports are included here as separate sections of the final evaluation report.

Conclusions

Based on these evaluation activities, the following general conclusions are drawn from the data sources and analyses presented in the report:

The 2004-2005 program years were a period of transition for the ETP. Where previously the ETP's focus was to "assess and showcase technologies," the new focus became "accelerate the adoption of new technologies into energy efficiency programs." This change was stimulated by the need of EE programs to incorporate new technologies to meet increasingly higher energy savings goals. To compound the necessity for new energy efficient technologies, past technologies that EE programs have depended on are, or will be phased out as energy efficiency Codes and Standards are made increasingly stringent. In response to this shift, many of the processes and coordination efforts implemented by the ETP were also in a period of transition during the 2004-2005 program years. In general, the changes made to ETP processes were designed to encourage greater integration between the ETP and other EE programs.

Coordination between the ETP, EE programs, and parties that deliver the EE programs to customers is essential for successful commercialization of emerging technologies. According to the current program logic for the ETP, successful technologies are brought to commercialization by being passed from the ETP to EE programs where they are promoted directly to customers. Coordination between the ETP, EE programs, and other entities that help deliver programs to customers, such as account executives, is therefore critical for achieving the goal of accelerating new energy efficiency technologies into the market.

The current ETCC website contains inconsistencies. One problem that was encountered is that the ETCC database does not always contain the most current information on program activities. Many of the assessment initiation dates in the database were not correct, and few of the completed assessments had an ending date in the database, making it difficult to know the true status of many assessments. In addition, few of the completed projects included final reports in the database. In some cases the report was finished but had not been added to the website. In other cases the report had not been finalized, sometimes several months after the project work had been completed. That said, most of the assessments that program staff confirmed were active during the 2004-2005 program years were able to be located in the database.

One of the reasons for the database inconsistencies is that the website was launched in the last quarter of 2005, and all projects entered into the old database prior to 2005 had to be imported into the new database using an automated program. This problem was compounded by the fact that each utility uses different internal tracking mechanisms, and assessment names sometimes varied across reports (final report vs. monthly progress reports, for example). Staff at all of the utilities also agreed that a major obstacle preventing them from cleaning up the database was a lack of time and resources.

The redesign of the ETCC website and database needs further refinement to deliver relevant content to its target audience. The website currently provides summary information about the ET program and its activities, results of various projects, and allows for information exchange between the outside entities and the ET program. Although the website does a successful job at making this information easily accessible, it is of little use to key audiences of the ETP, such as EE program staff, account representatives, and ETP staff themselves. We found no evidence that the database is used by ETP staff, EE program staff, or account representatives. ETP staff

have little use for the database because they can get more detailed and up-to-date information through personal communications and ETCC quarterly meetings. EE program staff and account executives were generally unaware of the database, but indicated that they would be interested in such a resource if it contained up-to-date information such as project contact information mid-term status reports. In addition, the ETCC database does not always contain the most current information on program activities. Many of the assessment initiation dates in the database were not correct, and few of the completed assessments had an ending date in the database, making it difficult to know the true status of many assessments. Also, few of the completed projects included final reports in the database. That said, most of the assessments that program staff confirmed were active during the 2004-2005 program years were able to be located in the database.

The ETP has been successful at identifying numerous candidate technologies for its assessments. Personal networking, industry contacts, and research were commonly cited as the most important methods for identifying new technologies. ETP project managers typically have relationships with many manufacturers, vendors, and R&D organizations. Through these relationships the ETP project managers learn about new technologies that are entering the market.

The ETP and PIER have made significant improvements in their coordination. To keep ETP staff up-to-date on PIER program activities and discuss future activities, the PIER program now makes formal presentations to the ETP. PIER has also tailored the way information is presented to make is more user friendly for ETP staff. In addition, the programs have worked together to help guide the PIER program's research so that is more applicable to ETP projects.

Residential and mass markets present a challenge for the ETP. Although technology identification and selection in general are going well, the ETP's ability to identify and select technologies for the residential and mass markets was limited in 2004-05. Program managers indicated that this is due in part to the longer development period required for technologies targeting these markets. While the reasons for this were not explored further in the evaluation, it is possible that the more custom technologies have shorter development periods as they are designed to fit very specific needs and/or customer groups. Conversely, mass market and residential technologies must appeal to a broader range of customers and applications. This requires longer development periods (and results in more commercialization uncertainty) as multiple needs and groups must be considered. These products are also more reliant on popular tastes and advertising to be successful, which increases the challenge to the ETP.

The ETP has adopted a strategy of identifying broader markets for proven energy efficiency technologies. This strategy allows the ETP to provide new resources for EE programs in a shorter timeframe. It also allows the program to increase its success rate, as it is working with technologies that have demonstrated that they are beyond the R&D stage as they are being adopted in some market sectors.

During the 2004-2005 program years, ETP's selection process was revamped in order to help better align the program with energy efficiency programs. One of the major changes that has occurred was the development of a formal technology selection process. The selection process now evaluates technologies

based on specific criteria that have important implications for the technologies' potential impacts on the market (this is discussed in more detail in the main report). It should be noted that some of the IOUs are just now implementing this process (SCG and SDG&E), while others (PG&E and SCE) began to use their new process during 2005. In any case, the more structured selection process is an improvement over the more informal and inconsistent process that was used previously.

The ETP has begun to include EE program managers and utility account executives in the technology selection process. In some cases EE program managers are required to endorse each proposal before it can become an assessment. In other cases EE program managers help the ETP to prioritize a list of assessments based on their needs. By providing an endorsement or prioritizing the assessments, EE program managers indicate that based on preliminary information, the given technology could be a viable addition to an EE program depending on the final results of the ETP assessment. Energy efficiency program managers are pleased with their involvement in the selection process and stated that it will have a significant impact on the chances of ETP technologies being included in their programs.

During the 2004-2005 program years the ETP also began to implement more formalized coordination processes with EE programs and account executives. Previously, coordination between the ETP, energy efficiency program staff, and account executives was done on a project-by-project basis. ETP staff and EE program managers reported that on the projects that they coordinated on, results were transferred successfully.

During 2004-2005 the ETP began to create marketing pieces for their successful assessments. EE program managers and account executives stated this kind of summary information is valuable to them with regards to promoting the technologies to customers.

Awareness of the ETP on the part of EE program managers has been limited in the past, but is improving. EE program managers had limited knowledge about ETP activities during the 2004-2005 program years. They also did not have a clear understanding of how the ETP functioned and therefore how ETP was supposed to be integrated with their program. This is due in part due to the fact that ETP processes were previously not designed to specifically feed technologies to EE programs. Another factor that contributed to the limited awareness ETP activities by EE program managers is that since ETP assessments are spread out in essentially all markets, the number of assessments relevant to any particular market has not been large. Awareness should increase as the ETP grows and conducts more assessments. In addition, many of the recommendations below involve greater coordination between the ETP and other entities such as EE program staff and account executives. Greater coordination with these should also serve to increase awareness among these parties.

Communication between the ETP and EE program managers will sometimes lag during the implementation of assessments. EE program managers reported that while coordination has improved during the initial stages of an assessment, it has a tendency to drop off as the assessment progresses. As one EE program manager put it, "sometimes it seems like ETP projects disappear into a black hole."

Energy efficiency program managers and account executives need to be able to keep up with a rapidly changing market, and believe that the ETP can play a role in these efforts. To leverage the ETP, these individuals would like to be to be kept informed about which ETP assessments that are in the pipeline and receive updated information about the statuses of the assessments.

It should be noted that EE program managers have been invited to quarterly briefings where performance and technical information related to ETP results are presented, but few EE program managers have attended these meetings.

Based on these conclusions, we offer the following recommendations for the ETP:

Coordination between the ETP and other entities should be considered an essential aspect of the program implementation. The ETP should therefore budget sufficient time and resources for ETP staff to conduct necessary coordination activities. Specific recommendations for improving coordination and information sharing include the following:

- Consider using market-specific ETP project managers as point people for communication with relevant EE program managers.
- Set clear expectations by clearly communicating the role that the ETP plays within the utility and the services it can and cannot provide to various groups. Also set expectations on when the timing of this communication should occur and during which phases of the technology assessment.
- Develop a consistent process for providing timely feedback to EE program managers when they submit a request to the ETP.
- Provide regular assessment updates and results to EE programs and account representatives in the form of monthly emails, a database dedicated to this purpose, or both. If both an email and database are used to coordinate ETP and EE program activities, the emails could be used to provide more up-to-date information and notify parties about updates to the database, while the database contains information pertaining to certain benchmarks, mid-term results, and final reports.
- ETP results should be shared with EE programs and account executives across utilities. It would be helpful if EE program managers and account executives had access to a single coherent list that included ETP assessments from all four IOUs. The ETCC database could serve this purpose, but since it currently designed to provide limited information to the public, it is not adequate to serve this purpose in its current form (see database recommendation below).
- The four IOUs should work together to share best practices in order to maximize the success of ETP assessments.

Write and complete final reports for all assessments in a timely manner. This includes those assessments that find that the technology is not yet ready for inclusion in the EE programs. All reports should be readily available to any interested reader. When appropriate, include a section in the final reports that addresses future R&D opportunities regarding the specific technology. This section should be directed

towards PIER. Marketing materials (such as fact sheets) should be developed for all completed assessments that are ready for EE programs.

Refine ETCC website to meet the needs of a target audience. Since ETP program staff already have established communication channels across utilities, it seems that the database could best serve as a way for EE program staff to stay up-to-date on ETP activities across utilities. EE program staff were unaware of the current ETCC database, though they did express an interest in having a database to access ETP information. For the database to be of use to EE program staff, it would need to include additional technical information beyond what is provided in the current summaries. In addition, it would need to be updated consistently to provide up-to-date information about the assessment status and preliminary results. The database could also facilitate communication between the EE programs and the ETP by providing a way for EE program staff to connect directly to the people involved with implementing the assessment. If it is decided that EE program staff should be the primary audience of the ETCC database, we recommend that the ETP consult with EE program managers to ensure that the content in the database meets their needs.

The ETP should continue to develop a strong relationship with PIER. This includes having a formal process to ensure that PIER results are being transmitted effectively to the ETP. The ETP should also work closely with the Public Interest Natural Gas Research program (PINGR) as it develops its gas research program.

Continue developing a formalized technology selection process. Sufficient time should be budgeted to allow ETP staff to conduct a thorough selection process. The program should consider using contractors to perform this work if ETP staff do not have the capacity. Each IOU should have a formalized selection process that specifically takes into account key market metrics, including market size, potential savings, alternative technologies, and other barriers and opportunities. In addition, EE program managers and account executives indicated that customers are more likely to adopt a technology if it is produced by multiple manufactures and vendors. Some technologies that are earlier in the commercialization phase will likely have only one manufacturer. Although these technologies may have higher risks, they could also have a higher potential payback and should not be disregarded by the ETP. The decision regarding risk versus payoff is a policy decision that each IOU will need to make on its own.

By the end of 2005, the IOUs were at different stages in regards to developing their selection process. SCE and PG&E had created technology selection forms and had already begun to use the forms and implement a more formalized selection process by the end of 2005. SCG and SDG&E had not yet created such forms, but were reportedly working on developing their selection process.

The ETP should continue to look for opportunities to incorporate EE program managers and account executives into the technology identification and selection processes. The commercialization of emerging technologies ultimately depends on the coordination between the ETP, EE programs, and the people who help deliver the EE programs to customers. Incorporating these entities into the ETP selection process will help stimulate high-level coordination between the various groups. In addition, account executives have intimate knowledge of

customer needs, and can therefore help the ETP stay in touch with the markets in which it operates.

Case studies of individual technology assessments can be a useful exercise for demonstrating the program logic. The case studies done as for this evaluation were useful for demonstrating parts of the program logic and evaluating the program implementation processes. Due to the long timeline for these assessments, however, the case studies are only applicable to the short-term activities, outputs and outcomes. Long-term effects by definition require a longer time horizon to track. In addition, the current data tracking procedures used by the ETP are not adequate for tracking program effects of individual assessments over time, which limits how much of the logic model can be tested with existing data sources. While the case studies did highlight some elements of the ETP logic model, tracking a series of metrics for each assessment over time will likely provide a more useful evaluation tool, as discussed in the next recommendation.

To aid with future evaluation work for the ETP, we recommend that a set of common metrics be tracked and clearly documented for every assessment. These metrics are designed to facilitate the 'aggregation analysis' discussed in the Evaluation Protocols. Many of these metrics can easily be incorporated into the formal selection criteria, as some utilities have already done. Other criteria could be incorporated into the final project reports, provided that the reports are completed for all projects.

Specific metrics that we recommend formally tracking for each assessment include:

- Formal application form used for technology assessment (Y/N)
- Formal review process used to approve technology for assessment (Y/N)
- Estimated savings potential (kW, kWh, therms)
- Estimated market size
- End uses covered
- Measures covered
- Target market sector
- Number of sites considered for the assessment
- Number of sites used for the assessment
- Number of technologies included
- More than one source of assessed technology (Y/N)
- EE program brought the technology to the ETP (Y/N)
- Assessment completed & technology recommended to EE programs (Y/N)
- Problems encountered during assessment related to site characteristics (Y/N)
- Assessment completed, technology referred back to manufacturer for additional work (Y/N)
- Known technical issues addressed (Y/N)

- Follow up assessment being done on technology used in previous assessment (Y/N)
- EE Program involved with assessment implementation (Y/N)
- Assessment done in conjunction with other IOUs (list which ones)
- Other collaboration with assessments (universities, national labs, etc.)
- PIER involved (Y/N)
- PIER funding ($)
- Co-funding from other sources? (Source and $ amount)
- Assessment results in ETCC database? (Y/N)
- Final report completed (Y/N)
- Fact sheet produced (Y/N)
- Other information dissemination (Specify)

1. INTRODUCTION

The 2004-05 Statewide Emerging Technologies Program (ETP) is an information-only program that seeks to accelerate the introduction of innovative energy efficient technologies, applications, and analytical tools that are not widely adopted in California. The intent of the ETP is to help accelerate a product's market acceptance through a variety of approaches, but mainly by reducing the performance uncertainties associated with new products and applications. This is done primarily through technology assessments, where technologies are tested in a controlled environment in an effort to confirm manufacture claims regarding equipment performance and savings potential.

The 2004-2005 statewide Emerging Technologies Program is a continuation of the 2003 program. In 2003, the utilities and the California Energy Commission's (CEC) Public Interest Energy Research (PIER) staff met to discuss and coordinate statewide activities through the Emerging Technologies Coordinating Council (ETCC). Through PIER, the CEC helps to develop, test and demonstrate products up to the end of the R&D cycle. During the 2003 meetings, the PIER program managers and contractors reviewed with the utilities those projects and technologies that have advanced enough to warrant utility Emerging Technologies Program consideration.

The program consists of two parts: Demonstration & Information Transfer, and the ETCC. The Demonstration & Information Transfer portion of the program focuses on the assessment of near-commercial and commercial energy efficient applications with low market penetration. Technology assessment, conducted at either customer sites or in controlled environments, provide design, performance, and verification of energy efficient systems, thereby helping to reduce the market barriers to their wider acceptance. The assessments help to measure, verify, analyze, and quantify the potential demand and energy savings. Information Transfer disseminates the results of the emerging technology application assessment projects, and is customized to the targeted markets.

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Within this program implementation context, the evaluation of the 2004-05 ETP had three primary components:

1. **Documentation of program activities.** The first part of the evaluation involved collecting information from each utility and documenting ETP activities and accomplishments during the 2004-05 program cycle.

2. **Process evaluation.** The second major evaluation task involved a formal process evaluation that focused on the ETP as it was implemented in 2004-05.

   The purpose of the interviews was to gain an understanding of how different components of the ETP function in practice. Specifically, the process evaluation and the interviews focused on:

   - How the ETP identifies new technologies
   - How technologies are screened and selected for assessment, and
   - How results of the assessments are disseminated, including the use of assessed technologies in other energy efficiency programs.

   A total of 18 in-depth interviews were conducted with the following people:

   - ETP Program Managers
   - ETP Project Managers
   - Program Managers from Express Efficiency, Standard Performance Contracting (SPC), and residential energy efficiency programs
   - Representatives from account services and the Public Interest Energy Research Program (PIER).

3. **Program logic model and case studies.** The ETP logic model and program theory were developed as part of the 2004-05 evaluation. Based on the logic diagram and program theory, indicators of program activities and progress are derived. These indicators (when measured properly) can help confirm the underlying program logic by demonstrating that key linkages between planned activities and expected outcomes are in fact working according to expectations.

   To demonstrate this, 8 case studies of technology assessments performed during the 2004-2005 analysis period are presented and used to show program progress based on the indicators linked to the logic model. For each assessment, the case study identifies strengths of the assessment (i.e., aspects that worked in accordance with the logic model), weaknesses, and recommendations for improvement based on the comparison with the logic model.

Each of these three activities resulted in a separate interim report provided to the ETP during the course of the 2004-05 evaluation. These reports are included here as separate sections of the final evaluation report.

The remainder of the report is organized as follows. The results of the interim Activities Report are summarized in the following section *2004-05 ETP Activities*. This is followed by the *Process Evaluation* section, which was also a separate interim report provided to the ETP during this evaluation. Following this is the *Program Logic and Case Studies* chapter. The evaluation report concludes with a *Recommendations and Conclusions* section. Additional detail on 2004-05 ETP activities from the interim Activities Report is included in *Appendix A*. The interview guides used in the process evaluation are included in *Appendix B*.

2. 2004-05 ETP ACTIVITIES

This section of the report documents the activities of the ETP during the 2004-2005 program period. The information presented in this section is generally quantifiable, and is based on information that was provided by the utilities in the summer of 2006. The program activity metrics documented in this section include:

- The number of assessments initiated;
- The number of assessments completed;
- The type and number of information transfer events; and
- Attendance at each information transfer event (where available).

Data for this section of the report were collected from the following sources:

- ETP monthly reports;
- Emerging Technologies Coordinating Council (ETCC) Database; and
- Data provided by utility program staff.

Additional information about these activities (i.e., how assessments are selected, planned and executed) is presented in subsequent sections of this report.

DATA COLLECTION ISSUES

The redesign of the ETCC website and database was a major achievement for the ETP program. The website provides public information about the ET program and its activities, provides results of various projects, and allows for information exchange between the public and the ET program. The database is a versatile information bank that allows the public to retrieve information about individual projects through specific searches in a variety of categories. The new database also includes published ET program final reports for downloading, along with additional reports and project links, if applicable or available.

One problem that was encountered is that the ETCC database does not always contain the most current information on program activities. Many of the assessment initiation dates in the database were not correct, and few of the completed assessments had an ending date in the database, making it difficult to know the true status of many assessments. In addition, few of the completed projects included final reports in the database. That said, most of the assessments that program staff confirmed were active during the 2004-2005 program years were able to be located in the database.

One of the reasons for the database inconsistencies is that the website was launched in the last quarter of 2005, and all projects entered into the old database prior to 2005 had to be imported into the new database using an automated program. It is possible that some fields may not have transferred correctly during the data import process. Staff at all of the utilities also agreed that a major obstacle preventing them from cleaning up the database was a lack of time and resources.

Another issue that was encountered is that the utilities often use different assessment identifiers (e.g., project names) in different tracking instruments. For example, the

name of a project in the ETCC database may differ from that used in the utility monthly reports or that used by program staff to identify a project. This made it more difficult to merge project information from different sources for this report.

Lastly, each utility has a unique system for tracking ETP program data. As a result, there are differences in the information provided in this report about each utility's program activities.

The remainder of this report section summarizes the ETP program activities for each utility. More detailed descriptions of the assessments listed in tabular form are included in *Appendix A* of this report.

SCE Program Activities 2004-2005

Table 1 shows the 2004-2005 budget for SCE's ETP program. Because projects have three years to be completed from the date that the agreement is signed, the 2004-2005 budget does not expire until 2009. The program can also file for an extension to extend a project's budget if necessary.

Table 1: 2004-2005 Budget - SCE

Budget and Expenditures	Budget	Percent of Total Budget
Administration	$981,000	27%
Marketing	$20,000	1%
Direct Implementation	$2,599,000	71%
EM&V	$79,000	2%
Total	**$3,679,000**	**100%**

Assessments Initiated

The SCE ETP program initiated a total of 26 assessments during the 2004-2005 program years. Of the 26 assessments, 12 were initiated during 2004 and 14 during 2005. According to 2004-2005 Program Implementation Plan (PIP) filing with the CPUC, SCE had a goal of initiating 10 assessments in both 2004 and 2005. In both years SCE exceeded their goal for initiated assessments.

Assessments Initiated During 2005

Table 2 lists the assessments that were initiated during 2005. As shown in the table, none of these assessments had been completed as of summer 2006, which is not unusual since most ETP assessments are multi-year projects.

Table 2: Assessments Initiated During 2005 – SCE

Assessment	Status	Completion Date Or Estimated Completion Date
Bi-Level Control of Area Lights	Ongoing	12/31/07
Carbon Dioxide Dry Cleaning	Ongoing	
Compressed Air System Index	Ongoing	3/31/07
Desuperheater for Ammonia Refrigeration System	Ongoing	
Fiber Optic Display Case Lighting System	Ongoing	
Hybrid LED Pathway Light	Ongoing	
LED Street Lights	Ongoing	12/31/07
LED Taxiway Lights	Ongoing	
Magnetic Suspended Refrigerant Compressor	Ongoing	
Petroleum Dry Cleaning	Ongoing	
Professional Wet Cleaning	Ongoing	
Pumps and fans Initiative	Ongoing	3/31/06
Silicone Dry Cleaning	Ongoing	
Variable Speed Dust Collection System	Ongoing	

Assessments Initiated During 2004

Table 3 lists the assessments that SCE initiated during 2004. Two of the 12 assessments that were initiated during 2004 have been completed, and one of the assessed technologies - Optical Demand Defrost - was transferred into another energy efficiency program (SPC).

Table 3: Assessments Initiated During 2004 - SCE

Assessment	Status	Completion Date Or Estimated Completion Date
Advanced Heuristic Thermostatic Control System for Hotels	Ongoing	12/1/05
California Kitchen Down-Lights	Ongoing	6/1/06
LED Task Lights	Ongoing	12/1/06
Light Emitting Diode (LED) Outdoor Lights	Ongoing	12/1/06
Occupancy Sensor Nightlight Wall Switches for Hotel Guest Room Bathrooms	Ongoing	2/1/06
Optical Demand Defrost	Completed	11/30/05
Plastics Resin Dryer	Ongoing	12/30/06
Portable Office Floor Lamp	Ongoing	12/1/06
Residential Economizer Cycle Retrofits	Ongoing	8/31/06
Residential Variable Speed Swimming Pool Pumps	Ongoing	6/1/08
Wireless Power Meters & Sensors	Completed	11/1/05
Wireless Residential Energy Monitoring System	Ongoing	12/1/06

Continuing Assessments

The assessments listed in Table 4 - Table 6 were initiated in years prior to 2004, but work continued on these projects during the 2004-2005 program years.

Assessments Initiated During 2003

As shown in Table 4, SCE worked on a total of 15 assessments that were initiated during 2003. Of these 15 assessments, 13 were completed during 2004 and 2005. Of the 13 completed assessments, 8 have resulted in technologies being transferred to other energy efficiency programs as shown in the last column of Table 4.

Table 4: Assessments Initiated during 2003 - SCE

Assessment	Status	Completion Date	Technology Transferred to Other Energy Efficiency Program
Advanced Classroom Lighting System	Completed	12/1/04	
Advanced Control for Plastic Granulators	Completed	12/1/05	SPC
Anti Corrosion Coatings for Condenser Coils	Completed	7/11/06	
Carbon Dioxide Dry Cleaning	Completed	11/1/05	
Cold Storage Refrigeration Control	Completed	11/1/05	Express Efficiency
Displacement Ventilation	Completed	12/1/05	SPC
Electrochromic Glazing	Ongoing		
Instant Start "Super" T-8 Lamp/Ballast	Completed	11/1/05	Express Efficiency
Network Management of Computer Power Option Settings	Completed	12/1/05	SPC
Petroleum Dry Cleaning	Completed	11/1/05	
Professional Wet Cleaning	Completed	12/1/04	SPC
Rapid Start "Super" T-8 Fluorescent Lamp/Ballast	Completed	11/1/05	Express Efficiency
Salt Reduction of Waste Water Precipitation of Salts for Fluid Bed/Lime Process	Completed	2/1/05	SPC
Silicone Dry Cleaning	Completed	11/1/05	
Voltage Reducer System for Dimming Control	Ongoing		

Assessments Initiated during 2002

Table 5 lists the assessments that were initiated in 2002, but continued into 2004 and 2005. Of the 10 assessments listed, eight have been completed, two were ongoing, and one was terminated. Of the seven completed assessments, six have resulted in technologies being transferred to other energy efficiency programs.

Table 5: Assessments Initiated during 2002 - SCE

Assessment	Status	Completion Date Or Estimated Completion Date	Technology Transferred to Other Energy Efficiency Program
Integrated Design for New Children's Museum, and Underfloor Air Distribution	Terminated		
Integrated Design for Non-Residential Retrofit Buildings	Completed	11/1/05	SPC
Integrated Efficiency Improvements for Small Grocery Stores	Completed	5/1/05	SPC
Integrated Hood Exhaust Backwall Make-Up Air System for Commercial Kitchen Hood Exhaust	Ongoing		
Integration of Energy Efficiency Improvements in a Small Sit-Down Restaurant	Completed	6/1/05	
Low-E Pigment for Stucco and Paints for Residential and/or Small Commercial Buildings	Completed	12/31/06	
Perforated Supply Plenum Make-Up Air System for Commercial Kitchen Hood Exhaust	Completed	11/1/05	SPC
Spray-on Radiant Barrier for Existing Residential and/or Small Commercial Buildings	Completed	2/1/05	
T-5 High Output Lighting System for High Bay Workshop and Variable Geometry Reflector System for HID Lighting	Completed	11/1/05	Express Efficiency
Variable Frequency Drive for Commercial Kitchen Hood Exhaust and Make-Up Air System	Completed	11/1/05	SPC

Table 6 lists assessments that were initiated in 2000 and 2001, but continued into 2004 and 2005. Of the three assessments listed, only one was ongoing. Project descriptions for these assessments were not available and are not included in the Appendix.

Table 6: Assessments Initiated during 2000 and 2001 - SCE

Assessment	Status	Initiation Year	Completion Date Or Estimated Completion Date
National Resource Defense Council (NRDC) Santa Monica Headquarters Natural Ventilation, High Efficiency HVAC, Daylighting Control, Water Recovery System, Occupancy Sensors, and Photovoltaic System	Completed	2000	11/1/05
Pomona Unified School District – Portable Classroom	Completed	2000	10/1/05
Southeast Learning Center – Natural Ventilation, High Efficiency HVAC, and Daylighting	Completed	2001	12/29/06

Information Transfer Activities

According to SCE program staff, information about completed assessments is often communicated to other programs and organizations through person-to-person contact, and is therefore difficult to quantify. However, some formal information transfer activities did occur during 2004 and 2005. Following are descriptions of various information transfer activities that were described in SCE ETP monthly reports and in other information provided by program staff:

- In 2004, four papers submitted by SCE program staff were accepted by the 2004 ACEEE Summer Study.
- SCE program staff also participated in the 2004 Emerging Technologies Summit in San Francisco. As part of the summit, program staff chaired the panel on "LEED and ES: Drivers for Emerging Technology Adoption." Staff also made five separate presentations: 1) Development and Performance Evaluation of Advanced Rooftop Air Conditioning Units, 2) Leadership in Energy and Environmental Design (LEED) Rating – A Driver for Emerging Technology Adoption, 3) Showcasing Energy Efficient Emerging Refrigeration Technologies, 4) Compressed Air Supply Efficiency – CASE Index, and 5) Emerging Technologies Energy Efficiency Programs - Roles & Linkages.
- In March 2004 a Program Manager lectured on daylighting design at the 2004 Lightfair International in Las Vegas, Nevada.
- SCE program staff held a professional wet cleaning seminar and demonstration in October 2005 that was attended by 80 cleaners.
- SCE program staff organized and sponsored a seminar on Integrated Design for school district personnel and designers.
- SCE program staff helped to produce two award-winning movies on energy efficiency. The two movies, titled “Better Brighter Schools” and “Greener Buildings / Bluer Skies – The Story of NRDC’s Robert Redford Building In Santa Monica, CA” both received Telly Awards. In addition, the “Greener Buildings / Bluer Skies” movie was also the 2006 Emmy Special Environment

Program Winner for the National Academy of Television Arts and Sciences, Pacific Southwest Chapter.

- SCE staff attended four ETCC meetings in 2004 and four ETCC meetings in 2005. The meetings provided an opportunity for SCE to coordinate its activities and exchange information with the other utilities and PIER, and to discuss ETP changes.

In addition, SCE sponsored a number of seminars and workshops in 2004 and 2005. These activities were in direct response to findings in a previous EM&V report that SCE did not spend enough time transferring program information to the public. The seminars and workshops were designed to provide training to professionals and inform the industry about new energy efficiency equipment and practices. Some of these outreach activities were directed at specific end users such as hotels/motels, and designers. Table 7 lists the seminars that SCE sponsored during 2004-2005 (attendance for some of these events is not known).

Table 7: SCE Sponsored Seminars

Date	Number of Attendees	Seminars / Workshops Topic
01/22/04	33	Advanced Supermarket Display Case Workshop
03/23/04		Energy Efficiency Food Service Refrigeration CSBU Training Workshop - conducted for Business Solutions
03/23/04		EE Lighting, HVAC & Food Prep Strategies for Restaurants
03/25/04	43	Energy Answers: Hospitals, Healthcare & Assisted Living
04/06/04	42	CHPS Commissioning
04/27/04	41	CHPS Design Training
05/25/04		HVAC & Refrigeration Maintenance Workshop
06/02/04	35	EE Foodservice & Supermarket Refrigeration
06/02/04		Energy Efficiency Food Service and Supermarket Refrigeration - Food Sanitation and Advisory Council
06/17/04	31	Wireless Technology (Carlos Haiad)
06/17/04	18	Compressed Air Systems
06/17/04		Improvements with Wireless Sensors
06/17/04		Air Compressor System Efficiency
07/08/04		Maximize the Performance of Your Energy System
07/21/04	54	LEED Intermediate
07/23/04	9	Integrated School Building Design (LAUSD)
08/12/04	35	Classroom Lighting Guide Seminar (C. Magar)
08/12/04		Institutional Food Service
09/16/04		Hi-Bay Indoor Lighting Options

Date	Number of Attendees	Seminars / Workshops Topic
09/24/04	23	Integrated School Building Design (C. Magar)
09/29/04	22	Diary Energy Management
10/07/04	26	Classroom Lighting Guidelines
10/21/04	53	Hotel/Motel Emerging Technologies Seminar
10/27/04	26	Collaborative for High Performance Schools (CHPS) Design Training
10/28/04	18	Advanced Foodservice Refrigeration
11/04/04	27	Cleanrooms: Can They be Energy Efficient?
11/10/04	13	Energy Efficient Supermarket Refrigeration (Ramin Faramarzi)
11/17/04	20	Integrated School Building Design
12/16/04	11	LEED Advanced Training
03/10/05	23	LAUSD SPOT Daylighting
03/30/05	61	LEED NC
04/28/05	19	CHPS M&O
05/13/05		PAC- Hot Dry Air Conditioning Project
06/17/05	20	Hotels/Motels
07/15/05	65	Demand Response Technology Meeting
08/03/05		Ground Source Heat pumps
08/04/05	33	Title 24 Duct Training (D&ES Codes & Standards)
08/11/05	33	Title 24 Duct Training (D&ES Codes & Standards)
10/18/05		Energy Efficiency Opportunities in Inst. Foodservice Facilities
10/20/05	25	Cool Solutions - Refrigeration for Grocery Stores & Delis (Ramin Faramarzi)
10/25/05		Supermarket Refrigeration Opportunities
10/27/05		Tool Lending Library
10/28/05	30	Lighting Fixture Maintenance
10/31/05	85	Wet Cleaning - Stakeholder Seminar
11/09/05		Energy Efficiency Treatment of Dairy Lagoons and Wastewater Management
11/16/05	13	EE & Diagnostics Strategies for Packaged Rooftop A/C's
11/17/05	20	Compressed Air (Babu Joseph)
11/18/05	28	Lighting Fixture Maintenance
12/01/05	38	High Intensity Discharge Lighting
12/01/05		Energy Efficiency Opportunities for Rooftop Packaged Units

In addition to these workshops and seminars, SCE also produced a series of marketing fact sheets about some of the assessments that have been initiated. Each fact sheet briefly describes the project and expected benefits, and some fact sheets also summarize the assessment findings or conclusions. Printed copies of the fact sheets were distributed to account services representatives who pass the information on to relevant SCE customers.

Fact sheets have been produced on the following topics:

1. Vending Machine Energy Guide
2. Small Market Success Story
3. Energy Efficiency Solutions for Relocatable Classrooms - High Performance Relocatable Classrooms
4. Energy Efficiency Solutions for Schools – Integrated Design
5. Energy Efficiency Solutions for Small Office Buildings – Green Building
6. Energy Efficiency Solutions for the Classroom – Integrated Classroom Lighting

PG&E Program Activities 2004-2005

Table 8 shows the PG&E program budget for the ETP program. As shown in the table, the largest portion of the budget (56 percent) was allocated to direct implementation.

Table 8: 2004-2005 Budget – PG&E

Budget and Expenditures	Budget	Percent of Total Budget
Administration	$793,213	32%
Marketing	$201,200	8%
Direct Implementation	$1,387,600	56%
EM&V	$110,800	4%
Total	**$2,492,813**	**100%**

Assessments Initiated

The PG&E ETP program initiated a total of 29 assessments during the 2004-2005 program years. Of the 29 assessments, 13 were initiated during 2004 and 16 during 2005. According to PG&E's monthly reports, the goal was to initiate 20 total assessments during the two- year period, and thus PG&E exceeded its goal.

Assessments Initiated During 2005

Table 9 lists the assessments that were initiated during 2005 and their completion status in the summer of 2006. As shown in the table, all of the projects except for the 80

Plus Program assessment were still ongoing, which is to be expected since most ETP assessments are multi-year projects.

Table 9: Assessments Initiated During 2005 – PG&E

Assessment	Status	Completion Date Or Estimated Completion Date
80 Plus Program	Completed	Ended 2005
BreezeAir Evaporative Cooler Validation	Ongoing	Continuing
Energy Efficient Residential Advanced Windows	Ongoing	Ending 2006
Evaporative Cooler Market Penetration Study	Ongoing	Ending 2006
Freus Evaporative Condenser Testing	Ongoing	Continuing
Green Building Studio Evaluation	Ongoing	Continuing
High Density Data Center Air Management - Phase II	Ongoing	Ending 2006
Home Electronics Opportunity Study	Ongoing	Continuing
Impacts of Improved Daylight Metrics on CA Energy Use	Ongoing	Ending 2006
Indirect-Direct Evaporative Cooler	Ongoing	Ending 2006
Industrial Pumps & Fans	Ongoing	Ending 2006
Kitchen CFL Downlights	Ongoing	Continuing
Supermarket Kitchen Ventilation Control	Ongoing	Ending 2006
VAV Box Data Development	Ongoing	Continuing
Wet Cleaning	Ongoing	Continuing
Wireless Lighting Controls	Ongoing	Continuing

Assessments Initiated During 2004

Table 10 lists the assessments that were initiated during 2004 by PG&E. Of the 13 assessments initiated during 2004, four have been completed, seven were ongoing, and two were canceled. Two of the completed projects, Bi-Level Stairwell Lighting (Phase 1) and Relocatable Classroom Integrated Lighting have transferred to other energy efficiency programs.

Table 10: Assessments Initiated During 2004 – PG&E

Assessment	Status	Completion Date Or Estimated Completion Date
25 Watt T8 HCT Lighting	Ongoing	Continuing
Advanced Evaporative Cooler Media	Completed	Ended 2005
Bi-Level Stairwell Lighting (Phase 1)	Completed	Ended 2005
Bi-Level Stairwell Lighting (Phase 2)	Ongoing	Continuing
Commercial Kitchen Tankless Water Heater	Ongoing	Continuing
Data Center A/C Optimization	Ongoing	Ending 2006
Furnace Blower Test	Ongoing	Final Report in Progress
Indirect Evaporative Cooler Evaluation	Completed	Ended 2005
Kitchen Ventilation - Gas Control	Cancelled	Abandoned
Modular Skylight Validation	Cancelled	Abandoned
Relocatable Classroom IDEC	Ongoing	Continuing
Relocatable Classroom Integrated Daylighting	Ongoing	Continuing
Relocatable Classroom Integrated Lighting	Completed	Ended 2006

Continuing Assessments

Assessments Initiated During 2003

The assessments listed in Table 11 were initiated in years prior to 2004, but work continued on these projects during the 2004-2005 program years. As shown in Table 11, PG&E staff worked on a total of eight assessments that were initiated during 2003. Of these eight assessments, seven were completed during 2004 and 2005 and one was still ongoing. One project - Verified A/C Refrigerant Charge & Airflow - was transferred to a customer energy efficiency program. Another project - Data Center Scoping Study - was used to define key issues for subsequent data center evaluations in 2004 and 2005.

Table 11: Assessments Initiated During 2003 – PG&E

Assessment	Status	Completion Date Or Estimated Completion Date
Advanced Evaporative Coolers vs. Baseline Testing	Complete	Ended 2004
Commercial Kitchen Ventilation (CKV)	Complete	Ended 2004
Data Center Scoping Study	Complete	Ended 2004
Diagnostics and Commissioning	Complete	Ended 2005
High Color Temperature Lighting	Ongoing	Ending in 2006
Relocatable Classrooms Daylight Dimming and Simulation	Complete	Ended 2004
Tankless Residential Water Heaters	Complete	Ended 2004
Verified A/C Refrigerant Charge & Airflow	Complete	Ended 2004

Information Transfer Activities

According to PG&E program staff, information about completed assessments is often communicated to other programs and organizations through person-to-person contact, and is therefore difficult to quantify. However, some formal information transfer activities did occur during 2004 and 2005. Following are descriptions of various information transfer activities that were described in PG&E's ETP monthly reports and in other information provided by program staff:

- The PG&E ETP Program presented the first bi-annual public conference on Emerging Energy Efficiency Technologies, which was co-sponsored by the statewide investor-owned utilities (IOUs), the CEC, and the American Council for Energy Efficient Economy. The conference took place in San Francisco on October 14 and 15, 2004 and had 231 registered attendees. Of the attendees, 167 were from California, 59 were from other states, and four others were from Canada or the UK.
- PG&E staff attended four ETCC meetings in 2004 and four ETCC meetings in 2005. The meetings provided an opportunity for PG&E to coordinate its activities and exchange information with the other utilities and PIER, and to discuss ETP changes.

PG&E program staff organized a total of 11 training courses in 2004 and 2005. Table 12 lists the trainings and provides a brief description along with the number of attendees and location.

Table 12: Training Courses Organized By PG&E During 2004-2005

Description Of Training	Delivery Method	Materials Provided To Attendees	Number Of Attendees	Date And Location Of Training
Optimizing VAV System Design from Box Selection to Controls	Full Day Class	Handouts	33	4/13/04 – PEC, SF
Optimizing VAV System Design from Box Selection to Controls	Full Day Class	Handouts	13	4/15/04 – San Jose
The Digitization of Lighting Controls: Making Lighting Systems Responsive	Half Day Class	Handouts	96	4/29/04 – PEC, SF
Controls for Daylighted Spaces: A Case Study Approach	Half Day Class	Handouts	113	4/29/04– PEC, SF
Tankless Water Heaters Training	On-site class	Handouts	32	11/8/04 ETC - Stockton
Tankless water heater training	Classroom training	Handouts	53	3/3/05 ETC Stockton
California Kitchen Downlighting System Training	Full day class	Handouts	20	5/24/05 - Energy Training Center, Stockton
Tankless Water Heaters Training	Full day class	Handouts	51	4/6/05 - Energy Training Center, Stockton
California Kitchen Downlighting System Training	Full day class	Handouts	33	4/27/05 - Energy Training Center, Stockton
Tankless Water Heaters Training	Full day class	Handouts	34	10/11/05 - Energy Training Center, Stockton
California Kitchen Downlighting System Training	Full day class	Handouts	26	10/26/05 - San Jose

In addition, PG&E also produced a series of one-page marketing fact sheets about some of the assessments that were initiated. Each fact sheet briefly describes the project and expected benefits, and some fact sheets also summarize the assessment findings or conclusions. Electronic versions of each fact sheet are located on the ETCC website. Printed copies of fact sheets are distributed to internal audiences within various utility departments/groups and to external audiences at energy conferences and workshops or through account service representatives who meet with PG&E customers. Fact sheets have been produced for the following assessments:

1. 80 Plus Program
2. Bi-Level Stairwell Lighting

3. Residential Air Conditioner Charge and Air Flow Verification Study
4. Commercial Kitchen Ventilation Study
5. Data Center Air Management Technology Assessment
6. Data Center Assessment Scoping and Feasibility Study
7. Evaluation of Dual Cool Evaporative Air Conditioning
8. Advanced Evaporative Coolers
9. Emerging Technologies Program Overview
10. Demonstrating and Modeling Solar Tube Skylights in Relocatable Classrooms
11. Residential Feasibility Assessment of Tankless Gas Water Heaters
12. Feasibility Assessment of Tankless Gas Water Heaters

SDG&E Program Activities 2004-2005

Table 13 shows the 2004-2005 budget for SDG&E's ETP Program. The largest portion of the total budget (66 percent) was allocated to direct implementation.

Table 13: 2004-2005 Budget - SDG&E

Budget and Expenditures	Budget	Percent of Total Budget
Administration	$115,254	26%
Marketing	$1,506	<1%
Direct Implementation	$293,240	66%
EM&V	$32,500	7%
Total	$442,500	**100%**

Assessments Initiated

The SDG&E ETP program initiated five assessments during the 2004-2005 program years, one less than its goal of six total assessments for the two years. Of the five assessments, two were initiated during 2004 and three during 2005.

Table 14 lists these assessments along with their status and initiation year. As shown in the table, the two assessments that were initiated in 2004 have both been completed. The remaining three assessments were ongoing, which is to be expected since most ETP assessments are multi-year projects.

Table 14: Assessments Initiated in 2004-2005 - SDG&E

Assessment	Status	Initiation Year
Camp Pendleton - Ground-coupled Heat Pump Demo	Ongoing	2005
Evaluation of UVc on HVAC coil performance	Completed	2004
Expansion of PERC Cleaner Evaluation to SDG&E territory	Ongoing	2005
Hybrid Solar Lighting Product Demo	Ongoing	2005
Thermal Displacement Ventilation Demo	Completed	2004

Information Transfer Activities

SDG&E program staff indicate that information about completed assessments is often communicated to other programs and organizations through person-to-person contact, and is therefore difficult to quantify. SDG&E staff also attended four ETCC meetings in 2004 and four ETCC meetings in 2005. The meetings provided an opportunity for program staff to coordinate their activities and exchange information with the other utilities and PIER, and to discuss ETP changes.

SCG Program Activities 2004-2005

Table 15 shows SCG's 2004-2005 budget for the ETP program. As shown in the table, the largest portion of the budget (68 percent) was allocated to direct implementation.

Table 15: 2004-2005 Budget - SCG

Budget and Expenditures	Budget	Percent of Total Budget
Administration	$320,000	20%
Marketing	$128,000	8%
Direct Implementation	$1,058,000	68%
EM&V	$55,500	4%
Total	$1,561,500	**100%**

Assessments Initiated

The SCG ETP program initiated a total of 12 assessments during the 2004-2005 program years, and therefore met its two-year goal of initiating 12 assessments as stated in their monthly reports. Of the 12 assessments, six were initiated during 2004 and six during 2005.

Assessments Initiated During 2005

Table 16 lists the assessments that were initiated during 2005. As shown in the table, none of these assessments have been completed, which is to be expected since most ETP assessments are multi-year projects.

Table 16: Assessments Initiated in 2005 - SCG

Assessment	Market Segment	Status
Advanced Multiple Boiler Control System by Autoflame	Industrial	Ongoing
Advanced System controls with ultra-low NOx Alzeta Burner	Industrial	Ongoing
Commercial Condensing Boiler Demo	Commercial	Ongoing
Commissioning process - LAUSD ES-1 Cahuenga	Commercial	Ongoing
Solar Thermal Water Heating - City Pool Demo	Commercial	Ongoing
Tankless Water Heater Assessment @ Fitness Complex	Commercial	Ongoing

Assessments Initiated During 2004

Table 17 lists the assessments that were initiated during 2004. As shown in the table, none of these assessments were completed, although two projects were expected to be completed in 2006 after the data for this report was collected.

Table 17: Assessments Initiated in 2004 - SCG

Assessment Identifier	Market Segment	Status
Advanced FIR Burner Application in a Fluid Heater	Industrial	Ending 2006
CSUN (Ca State Northridge) BCHP	Commercial	Ending 2006
Engine-driven Chiller @ UCSB	Commercial	Ongoing
IC Engine drive Refrigeration w/Heat Recovery	Industrial	Ongoing
Industrial CHP Assessment with Bowman MT's	Industrial	Ongoing
Industrial Engine CHP with Adsorption Chiller	Industrial	Ongoing

Continuing Assessments

The assessments listed in Table 18 were initiated in 2003, but work continued on these projects during the 2004-2005 program years. SCG staff worked on a total of eight assessments that were initiated during 2003. Of these eight assessments, four were completed during 2004 and 2005, three were continuing, and one was terminated. One of the projects that was completed - Trend Offset Printing - was transferred to the energy efficiency planning group to be incorporated in industrial energy efficiency programs.

Table 18: Assessments Initiated During 2003 – SCG

Assessment	Technology Area	Market Segment	Status
Adsorption Chiller - Mission Plastics	Heat Recovery Adsorption Chiller	Industrial	Completed
Capstone MT on blended fuel at Cal Poly SLO	Bio-fuel recovery to Dist. Power production	Industrial	Terminated
Cummins-Westport demo at Anaheim Convention Center	Advanced combustion control for emissions and efficiency	Industrial	Continuing
FIR Burner - Reinhold Industries	Low NOx advanced burner system	Industrial	Completed
Guidant Air Compressor	Engine-driven Air Compressor w/heat recovery	Industrial	Continuing
Occidental (PERC - II)	Non-PERC cleaning alternatives	Commercial	Continuing
PACRAT Demonstrations - at USC, UCSB and Cedars Sinai	Automatic Fault Detection & Diagnosis	Commercial	Completed
Trend Offset Printing	Regenerative Thermal Oxidizer	Industrial	Completed

Information Transfer Activities

SCG program staff indicated that information about completed assessments is often communicated to other programs and organizations through person-to-person contact, and is therefore difficult to quantify. SCG staff also attended four ETCC meetings in 2004 and four ETCC meetings in 2005. The meetings provided an opportunity for the PG&E to coordinate their activities and exchange information with the other utilities and PIER, and to discuss ETP changes.

3. PROCESS EVALUATION

This report describes the results of a series of in-depth interviews that were conducted during the fall of 2006 for the evaluation of the Emerging Technologies Program (ETP). To assist in the interview process, interview guides were developed for ETP staff and for staff from other programs to help ensure that topics of interest were covered during the interviews. The purpose of the interviews was to gain an understanding of how different components of the ETP function in practice. Specifically, the process evaluation and the interviews focused on:

- How the ETP identifies new technologies
- How technologies are screened and selected for assessment, and
- How results of the assessments are disseminated, including the use of assessed technologies in other energy efficiency programs.

A total of 18 in-depth interviews were conducted with the following people:

- ETP Program Managers
- ETP Project Managers[1]
- Program Managers from Express Efficiency
- Program Managers of the Standard Performance Contract program (SPC)
- Program Manager for residential energy efficiency
- Program Manager for the Account Services Group
- And a representative for the Public Interest Energy Research Program (PIER).

The 2004-2005 program years were a period of transition for the ETP, with significant changes from the previous program years. The fundamental rationale for the changes was to better align the ETP with other energy efficiency programs and with PIER. Whereas previously the ETP's focus was to "assess and showcase" technologies, during 2004 and 2005 the program began to shift its focus with the goal of accelerating the arrival of new energy efficiency technologies into other energy efficiency programs and the marketplace. Although it has always been the goal of the ETP to accelerate energy efficiency technologies into the market, the new focus put a much larger emphasis on specifically getting new technologies into energy efficiency programs to expand the potential sources of energy savings to customers. Parts of this transition occurred during the 2004-2005 program years, while other changes came later or are still ongoing. Funding for the ETP also began to ramp up during the 2004-2005 program years, from about $4.5M in 2002-2003 to almost $8.2M in 2004-2005. Funding for the 2006-2008 funding years is set at $11.2M. These changes have affected many aspects of the ETP, including how technologies are selected and how assessment results are disseminated to relevant parties.

[1] Project Managers may also be referred to as Portfolio Managers at some utilities. It should also be noted that SCG and SDG&E do not have dedicated ETP project manager staff due to limited resources.

It should also be noted that while this report generally refers to the ETP as a single program, each of the four IOUs administers the program independently. Since each utility has its own unique structure for delivering energy efficiency programs, this report attempts to highlight general concepts that can be applied to all programs. Another difference between the utilities is the funding allocated to the ETP, which determines both the financial resources available to fund projects and the human capital available to manage assessments and effectively coordinate with other entities.

The remainder of this report discusses the findings from our interviews with ETP staff and other individuals who interact with the ETP. The results are organized into three main sections: Technology Identification, Technology Selection, and Coordination and Information Dissemination. In each section we will describe the processes used by the ETP during the 2004-2005 program years and how they have changed since then. We will also make recommendations where appropriate about how certain processes could be improved.

TECHNOLOGY IDENTIFICATION

Overview

The ETP has no problem identifying potential technologies for the program. Program managers from the ETP all stated that they have an inventory of viable technologies to choose from that exceeds the ETP's capacity. SCE and PG&E each have project managers who are responsible for identifying new technologies for the program within a specific market segment or technology type (such as lighting). Due to limited staff for the ETP implemented by SDG&E and SCG, the program managers at these utilities are responsible for basically all of the aspects of program, including the identification and selecting of technologies.

An advantage of having project managers responsible for a particular market segment is that it helps ensure a certain amount of equality among the markets segments. At the beginning of a funding cycle each project manager is essentially allocated a portion of the funds for ETP assessments, and it is up to each individual to identify technologies in his/her specified market segment. If a project manager were unable to find any viable technologies for assessments the funds could be transferred to other project managers who have a greater demand. It should be noted that the budgets for each project manager are not formally separated, in that funds can easily be shifted to any project that requires funding in any market segment.

ETP project managers use a variety of resources to identify technologies, including personal networking, independent research, PIER, ET conferences, and utility account representatives. Below we discuss the various ways that the ETP identifies technologies.

Personal Networking and Industry Contacts

ETP staff stated that personal networking within the industry is one of the most important sources for identifying new technologies. As the ETP has developed over the past few years it has established itself as an important member of the emerging technology community and has made many contacts throughout the industry. The increased awareness of the ETP among manufacturers, vendors, and others involved in

the industry has resulted in large numbers of solicitations by individuals who would like the ETP to look at a specific technology. Project managers are in frequent contact with manufacturers, research organizations, and other industry experts. Manufacturers and vendors frequently approach the ETP to share information about their products and to look for partnerships. ETP Project managers will also contact manufacturers if they have an interest in a particular technology.

As the ETP gains visibility in the emerging technologies industry it has the ability to provide indirect assistance to manufacturers as well as technology assessments. For example, manufacturers will often approach the ETP about technologies that are still in the product development stage and are therefore not yet far enough along in their development to be used in an ETP assessment. Although the ETP cannot use the technology as a project, they are able to provide some initial feedback about what the manufacturer will need in order for the ETP to take the technology seriously. The ETP will also occasionally refer the manufacturer to different organizations who work with technologies in the R&D phases, such as PIER. One way for the ETP to continue to provide assistance in such cases without spending excessive resources could be to create a screening form for manufacturers, vendors, and other individuals that clearly outlines the ETP's selection criteria and requires applicants to provide summary information about the technology. ETP could then use this to quickly screen a new technology. The form could also serve to provide a list of other potential resources for the interested party if it is clear that the technology is not appropriate for the ETP.

Many ETP program and project managers stated that they would like more opportunities to exchange information with individuals throughout the emerging technologies industry. Currently, their main opportunity to do this is at the emerging technology summit that is held biannually. This conference provides a valuable opportunity for the industry to share ideas and experiences across fields, markets and geographic areas. ETP staff all stated that these conferences are an important source of new ideas for assessments. The ETP should continue to look for opportunities to exchange information with people in the emerging technologies industry both inside California and outside the state.

Market Knowledge and Experience

The ETP managers' in-depth knowledge of how customers use energy and their experience working with energy efficient technologies are also important factors for identifying new technologies. This is particularly true for the industrial market. Large industrial customers rely on many energy intensive processes. ETP staff who understand customer needs and also have experience working with industrial energy efficient technologies have the ability to identify inefficient processes and apply more appropriate technologies that may already be used in different markets. This idea of transferring proven technologies from one market and assessing their viability to another market has gained traction in the ETP. These types of assessments can typically be completed in a shorter time frame because they require less background research and shorter monitoring periods. Transferring proven energy efficient technologies from one market to another therefore helps the ETP provide near-term energy efficient solutions to other energy efficiency programs.

PIER and Other R&D Organizations

ETP staff from electrical utilities said that PIER has been a valuable resource in identifying technologies for the ETP, and that a significant number of PIER projects have resulted in ETP assessments. During the 2004-2005 program years, coordination between the ETP and the PIER was generally informal. According to ETP project managers, they would periodically check to see what PIER projects were in the pipeline. If one of the project managers was interested in a particular project, he/she would work with PIER to get any necessary information. Towards the end of 2005 and the beginning of 2006 the ETP began to formalize its communication channels with PIER.

In general, the relationship between the ETP and PIER has strengthened considerably in the last two years, with increased coordination and understanding of program needs between the two programs.

Along with informal contact between the two programs, PIER and the ETP now hold periodic meetings where PIER has an opportunity to present a list of their projects to the ETP. The meetings also allow ETP staff, along with representatives from other energy efficiency programs, to give feedback to PIER. As one ETP program manager stated, "[whereas] before there was more of a push from PIER, now utilities are asking for more of what they are looking for and PIER seems to be listening." The ETP and PIER have since worked together to ensure that results for PIER projects effectively address the ETP's needs. This has made it easier for ETP staff to transfer PIER projects into the ETP.

PIER was originally conceived as an electricity research organization, and it was not until 2004 that the CPUC decided to make funds available for public interest natural gas research and development projects. During 2004-2005 most of PIER's work was not relevant to gas technologies and was therefore a less significant resource for SCG than for PG&E, SDG&E, and SCE. Public Interest Natural Gas Research Program (PINGR), which is the new gas research component of the PIER program, should help bring in a new infusion of gas technology research. ETP staff from SCG stated that their relationship with PIER has already intensified in the last year due to the addition of gas funding. As the PINGR program ramps up, it will be important for ETP staff from SCG, SDG&E and PG&E to continue to effectively coordinate with the PINGR program.

Many project managers are also involved with R&D organizations other than PIER. ETP staff frequently sit on review and advisory committees of organizations such as Lawrence Berkeley National Laboratory (LBNL), American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), and the Environmental Protection Agency (EPA). These relationships allow project managers to keep an eye on the latest technology developments and also enable ETP representatives to share their knowledge and influence the R&D.

Energy Efficiency Programs and Utility Account Executives

Although part of the ETP's value is to find technologies that the EE programs were not aware of, EE programs do play a role in the identification of new technologies. EE program managers are always on the lookout for new measures to include in their program, and frequently learn about new technologies from customers, vendors, and

account executives. EE program managers have increasingly used the ETP as a resource when they have a question about a new technology, bringing new ideas to the ETP in the process. This increase in communication is really part of a general trend towards increased coordination between the ETP and other entities. This will be discussed further in the "Coordination and Information Dissemination" section.

Account executives assigned to specific large utility customers have also played a role in identifying technologies for the ETP, though most ETP project managers said they were not a primary source of new technologies. Account executives occasionally approach the ETP if they have a customer who is interested in a technology that they are not familiar with. Although account executives did not have a formal role in the technology identification process for the 2004-2005 program, their in-depth knowledge of the market could provide a valuable resource for the ETP. Account executives know what the newest technologies to hit the market are, what kinds of technologies customers are interested in, and what concerns customers have about new technologies. It appears that the ETP has begun to recognize this wealth of information, as they have started to bring account executives into their selection process. We recommend that the ETP continue to look for opportunities to incorporate account executives into the technology identification and selection processes. This will help the ETP stay in touch with the markets in which it operates.

Technology Identification Challenges

Although the ETP has no shortage of potential technologies to assess, certain market segments do pose more of a challenge; specifically, ETP staff stated that it has been more difficult to find technologies geared towards the mass market for small commercial and residential customers. One of the reasons for this difficulty is that the longer R&D and adoption phases that are typical of technologies in these markets (as compared with larger commercial and industrial markets) are significant market barriers that limit the number of new energy efficient technologies that enter these markets.

Energy efficient gas technologies also present a challenge. According to ETP program managers, R&D related to efficiency gas technologies has been significantly more limited than R&D for efficiency electrical technologies. This has resulted in a deficiency of new energy efficient gas technologies entering in the market place. The addition of the Public Interest Natural Gas Research Program (PINGR), which is the gas equivalent of the PIER program, should help bring a new infusion of gas technologies into the ETP.

TECHNOLOGY SELECTION

Selection Overview

Because the number of available technologies exceeds the number of assessments the ETP can conduct, it is essential that the program create a formal and rigorous selection process. To be effective, the ETP needs to be able to quickly filter through the list of potential technologies and select technologies that are not only appropriate for the ETP, but also offer the maximum potential impacts. The ETP did not broadly implement a formal selection process until 2005, and in some cases into 2006.

- One of the reasons why the ETP did not have a formal selection process before 2005 was the smaller scale of the program. Since the ETP had fewer staff and was engaged in fewer assessments the staff were able to manage the program effectively without the more rigorous formal process.
- Another reason for the lack of a formal selection process was that the ETP did not have a clearly defined audience, but was more focused on the technology itself. If it looked like the technology had the potential to save energy compared to the baseline and was cost effective, then it was worth assessing. The assessments were not necessarily targeted for a specific energy efficiency program. This meant that different assessments might have had substantially different purposes. The shift of focus towards feeding EE programs with new technologies gave the ETP a certain amount of coherence by specifying the ultimate target audience for all assessments. This has helped the ET to develop a targeted selection process with the purpose of selection technologies that have the maximum potential to impact energy efficiency programs.

Much of the restructuring of the ETP in the last two years has dealt with issues pertaining to technology selection. The fundamental principle behind the changes was to realign the ETP so it would be more relevant to EE programs. Specifically, processes began to be established so that the ETP could effectively deliver new technologies to EE programs. In response to this objective, the ETP has made considerable progress towards establishing an effective and systematic approach to selecting technologies.

ETP program staff recognized the importance of having a formal process that allows the program to efficiently sort through the large numbers of potential technologies and then select those with the maximum potential to impact energy savings for energy efficiency programs. As one ETP project manager put it, "[the question now is] how do you get the most effectiveness out of the technology assessment selections?" To help address this issue, the ETP has established a formal selection process that was first put into general use during 2005 and the beginning of 2006.[2]

- After sorting through their lists of potential technologies, project managers select technologies that they believe to be the most promising.
- They are then required to complete a pre-proposal form for each of these technologies that essentially serves as an initial screen, using a series of metrics that include initial estimates of the potential market size, energy savings, timeframe, and cost of the assessment. They also provide a description of the technology and its market alternatives, potential market barriers, and how the technology can fit into existing energy efficiency programs. The different metrics are then weighted to produce an overall project rating.
- Potential technologies are also presented to program managers from other energy efficiency programs and account executives, who then help the ETP

[2] The four utilities are at different stages of implementing their selection processes. PG&E and SCE, having considerably larger ETP programs began to implement their new processes during 2005. SCG and SDG&E, which are both essentially one-man programs, are reportedly in the process of developing a formal selection process.

prioritize the potential according to their perceptions of the market's interests and needs.

- Once the technologies have been prioritized, project managers then write a full proposal, which must be approved by the ETP and energy efficiency (EE) program managers before the assessment can proceed.

This process represents a significant improvement over the methods used to select technologies during the 2004-2005 program years. Specifically, if the ETP is going to succeed in its goal to accelerate the adoption of energy efficient products in the market and move new technologies into energy efficiency programs, they will need to carefully consider the market potential and savings impact of each technology. The new selection process addresses these issues early on by putting an increased emphasis on the market and savings potential of a technology. Getting the utility program managers and account executives involved in the selection process represents another important shift from prior years. As one EE program manager stated, "if the ETP wants to use the energy efficiency programs as a delivery channel for their technologies, it is critical that they include us in their selection process." Specifically, getting buy-in from the energy efficiency programs greatly increases the probability that the technology will actually be incorporated into the program. It also serves to inform the program managers about what technologies are in the pipeline in the ETP. This subject will be discussed further below in the Information Dissemination and Coordination section.

Selection Challenges

While the program and project managers interviewed have generally found the development of a formal selection process beneficial to the ETP, they note that the pre-proposal forms require project managers to spend significantly more time conducting background research. Although this research is critical in determining the value of a potential assessment, it also puts considerable strain on the project managers' resources. ETP staff typically stated that the biggest barrier to identifying and selecting viable technologies for assessments is a lack of time and money needed to conduct the background research. Going forward, the ETP should plan on allocating sufficient time to allow project managers to conduct a thorough selection process, as this is an essential process for the ETP. This could mean hiring additional ETP staff or enabling the ETP to retain consultants to assist in the technology review.

One issue that came up during discussions with both ETP staff and staff from energy efficiency programs is how the number of manufacturers who produce a given technology can affect its success in an EE program. If only a single manufacturer produces a technology, this can create a number of problems for energy efficiency programs. One issue is that the utilities have strict CPUC guidelines prohibiting them from endorsing any specific company. This in essence makes it very difficult for an energy efficiency program to promote a product if it has only one manufacturer. Another problem with having a single manufacturer – particularly for mass markets -- is that it sends a message to customers that the product is not very established, which causes them to shy away from the technology.

While the formalized selection process and criteria do address many of the challenges associated with selecting viable technologies, there are other issues that still should be

considered. A specific challenge for the ETP in the upcoming years is going to figure out in which markets the ETP can have the greatest impact. In other words, the ETP will have to think strategically about which technologies to select. The best way to do this is to ensure that ETP staff have a thorough understanding of the markets in which they work and that they are able to keep track of changes in the market as they occur. To do this, the ETP will need to effectively coordinate with groups both within the utilities, such as other EE programs, account executives, and PIER, and with groups outside the utilities such as vendors, research organizations such as LBNL and the Gas Research Industry Institute, and other industry players.

INFORMATION DISSEMINATION AND COORDINATION

Overview

Effectively transmitting information regarding its assessments to relevant parties is a critical function of the ETP. Since the ETP is technically an "information only" program, its function is to disseminate information that will accelerate the adoption of new technologies into utility energy efficiency programs. It is important to define what is meant by "information dissemination." For the purpose of this report, information dissemination is meant to include the communication of any ETP activity, at any stage of an assessment, which will help accelerate the adoption of a technology into an energy efficiency program. This idea differs from the two step process that has been typical of the ETP in previous years, where an assessment was completed and then results were disseminated. Information dissemination is therefore a continuous process that goes hand in hand with the ETP's coordination activities.

There are three key components to the dissemination of assessment results.

- First, it is important to define to whom the ETP should and should not be providing information. While it is outside the scope of the ETP to market information directly to customers, the ETP is responsible for making sure that the parties who market directly to customers receive the information they need in order to move the technology to the market place. More specifically, since the ETP's goal is to move new products into energy efficiency programs, it must effectively disseminate its results both to the individuals responsible for adopting new technologies into these programs and to the individuals responsible for informing customers about these new opportunities. These individuals may include program managers of other energy efficiency programs, account representatives and vendors.
- It is also important to understand at what stage of the assessment the ETP should begin to coordinate with these various parties. Some individuals may not need to know much about an assessment until it is completed. Others may need to be included at an earlier stage so that they can have a better understanding of the technology and plan accordingly. For example, EE program managers expressed the need to have up-to-date information about technology assessments so they can stay informed about the market choices that their customers are faced with. This is discussed further below.

- Lastly, individuals must receive the types of information that they need, and in a form that is useful to them. This could be anything ranging from a full engineering white paper, to a simple one- or two-page marketing fact sheet that describes the benefits of the technology.

The diverse range of projects, people, and market segments that the program works with makes coordination between the ETP and other entities challenging. There is no "one size fits all" process for coordinating the ETP with energy efficiency programs, account executives, and other entities. This makes it particularly difficult to create a formal process that ensures information provided by the ETP is getting into the hands of the people who need it and that people who have a stake in ETP activities have an opportunity to provide their input. The ETP has put a lot of effort into improving its coordination efforts over the last two years and has made significant improvements. Still, there is room for improvement, as we will discuss below.

The following sections provide an analysis of the ETP's coordination and information dissemination activities, along with how they have evolved since the 2004-2005 program years. The findings are presented by audience type, and focus only on the primary ETP audiences.

Coordination with Energy Efficiency Programs

One of the key messages conveyed by EE program managers during our interviews was that, in general, they wanted relatively consistent and up-to-date feedback about ETP assessments. According to the EE program managers, the products that their customers are exposed to in the market change very rapidly, and it is important for the EE programs to keep up with these technologies. EE program managers believe that the ETP can help them do this by keeping them informed about what technologies are in the ETP pipeline. Due to the rapidly changing market, and also to the amount of time that many ETP assessments take, EE program managers stressed that it is important to them to receive up-to-date feedback about the status of assessments as well as the final results.

Initially, during the 2004-2005 program years much of the coordination between the ETP and EE programs was done in an ad-hoc fashion, with the timing and extent of the coordination varying from assessment to assessment. For some assessments the ETP would begin to collaborate with EE programs during the early stages of the assessment, and the EE program would stay involved throughout the process. For other assessments, the ETP would not contact the targeted EE program until the assessment was complete and they had favorable results. Since different assessments require different levels of coordination and are geared towards different kinds of EE programs, this type of ad-hoc coordination was appropriate for the ETP to a certain extent, but it prevented the ETP from fully leveraging its results. Specifically, the ETP was able to transfer assessment results to EE programs, which is the ETP's goal, but this kind of ad-hoc coordination also left EE program managers in the dark about many of the ETP's activities. Consequently, EE program managers were generally unaware of the list of technologies that the ETP had tested or what technologies were in the ETP pipeline. Since EE program managers were unaware about many of the ETP's activities, potentially useful ETP assessment results may not have been getting into their hands.

While the ETP has successfully coordinated with EE programs on certain assessments, it has taken time for the ETP to gain visibility with EE program managers. This is in part due to the ad-hoc form of communication with EE programs that the ETP used in the past. Since EE program managers were unaware of many ETP activities, the ETP seemed much more limited to them than it may have been. It is also clear that in the past, EE program managers did not have a clear understanding of how the ETP was supposed to fit in with their program or how they could leverage the ETP to benefit their programs. This lack of understanding led EE program managers to turn a blind eye to the ETP. Another reason for the limited visibility in the past was simply because the ETP did not have a large presence in any particular area. Even though the ETP had conducted many assessments, the assessments themselves were spread among many different markets, and thus the ETP has not had an obvious presence in any individual market.

Beginning in 2005, the ETP began to implement more formalized procedures for coordinating with the EE programs. The basic principle behind many of the procedures was to integrate the ETP with the EE programs to facilitate a smooth handover of the technology from one program to the other. One step that the ETP implemented was to formally include EE program managers early on during the assessment - typically as early as the technology selection process. EE program managers are now invited to go over a list of potential ETP assessments and help prioritize them, and in some cases EE program managers are required to sign off on each proposal before it can become an assessment. Getting the EE program managers involved in the selection serves to inform them, at least initially, about what ETP assessments are in the pipeline. This is an important first step in the coordination process. Program managers reported that, in general, they were happy with this process and believe it is important for them to be able to provide guidance as to what technologies the ETP chooses to assess.

As mentioned previously, it is important for EE program managers to get up-to-date information regarding ongoing assessments. Although including the EE program managers in the selection process is important, it does not ensure that EE program managers continue to stay informed about the assessments. One of the findings from our interviews with EE program managers was that even when they are included in the selection process, the assessments will sometimes fall into what one program manager called a “black hole.” In other words, there may be good communication at the beginning of the process, but once the assessment gets going the EE program managers lose touch with it.

A similar problem was reported for technologies that are recommended by EE program managers to the ETP for assessments. One EE program manager we spoke with was discouraged because he had provided the ETP with technologies that he was interested in investigating, but he never heard back from the ETP. This issue highlights both a possible disconnect, and a possible misunderstanding. Many EE program managers often go directly to their organization’s engineering group when they need information about a technology, and they typically receive consistent and timely feedback. Although this kind of feedback may be outside the scope of the ETP, if an EE program manager expects this kind of feedback but the ETP cannot provide it, the EE program managers will become discouraged – which could have a negative impact on the way the program manager leverages the ETP. Indeed, during our interviews with EE program managers

we found some evidence that this has been happening. To resolve this issue, the ETP and EE program managers need to clearly explain their expectations of each other and how they can best work together., It is also important that the ETP provide some response to an EE program manager if a request is made. For example, the initial request should be acknowledged and, if the program is unable to investigate a technology that an EE program manager requests,, this should be communicated to the EE program manager. It is important that the ETP have some kind of consistent feedback loop any time an EE program manager submits a request.

Regular meetings (usually quarterly) with program managers from the ETP and EE programs have served as one method of communicating ETP activities to EE program managers, but they may not be the best tool for this purpose. These meetings allow program managers from different programs to present information pertaining to their activities, and to discuss issues that may cut across multiple programs. According to the EE program managers that we spoke with, however, these meetings were not an effective way of providing updates about specific ETP activities. Since these meetings typically are used as a forum to discuss many issues pertaining to multiple programs, it is not always clear what pertains specifically to the ETP and what does not. In other words, since many different issues are discussed at these meetings, what the ETP does can get lost in the noise.

PG&E has adopted a technique that, at least initially looks promising. PG&E's ETP has a number of project managers responsible for specific market segments. During the selection process the project managers must get an EE program manager to sign off on each project proposal before it can become an assessment. The ETP project manager then serves as a direct link between the assessment and the EE program manager for the remainder of the assessment. Since the project manager focuses on a particular market, they tend to work with the same EE program managers repeatedly, which helps them form a direct relationship. This relationship serves as an important link between the ETP and the EE program by providing a single point of communication for the EE program manager. The EE program manager then learns how to leverage the ETP as a resource for his/her program. For example, at PG&E, when an EE program manager makes a recommendation for an assessment to the ETP, the ETP will typically complete a pre-proposal form (discussed in the Technology Selection section previously) for this technology. The Emerging Technology Opportunity Summary (ETOS) form provides enough initial information that the ETP project manager and the EE program manager can then decide how to proceed forward with the technology. This kind of consistent feedback plays an important role in building stronger relationships between the ETP and energy efficiency programs.

Energy efficiency program managers provided a number of recommendations for how they thought communication could be improved between their programs and the ETP. To help keep EE program managers up-to-date on ETP activities, one recommendation was for the ETP to provide regular email updates to EE program managers. These updates would include a list of technologies that the ETP is considering, along with the list of ongoing ETP assessments and their status. EE program managers also expressed interest in a database that would basically provide the same information. In order to for this database to be useful, it would need to be updated frequently (at least once a month) as new information about ETP activities becomes available.

With regards to the dissemination of final assessment results, the ETP provides information that is tailored towards a specific EE program. For example, SPC program managers typically need resources that help them calculate savings on a project-specific basis. For a deemed measure program such as Express Efficiency, the ETP must provide a full engineering white paper that demonstrates a per measures savings value that can be submitted to the CPUC to qualify for a rebate. During the 2004-2005 program years the ETP began to develop marketing materials for completed assessments that show the potential benefits of the technology. These marketing materials are an important tool for EE programs, and should be developed and distributed for all successful ETP assessments.

Coordination Between Utilities

Coordination between utilities has been, and continues to be implemented primarily through the quarterly ETCC meetings. These meetings provide an opportunity for ETP program staff to discuss relevant issues and to share program results. In general, ETP staff thought that the ETCC meetings provide sufficient coordination between the utilities. ETP project managers stated that between these meetings and informal communication, they are able to keep up with activities at different utilities. One ETP project manager recommended that more time should be spent discussing ETP processes at these meetings. Specifically, the utilities should spend more time trying to answer the question of "how do you get the most out of an ETP assessment." The ETCC meeting could provide a valuable forum for discussing what processes seem to really have a positive influence on the outcomes of assessments. This is especially important at this stage in the ETP, since the utilities are still refining their processes to use the ETP as a pipeline of new measures for their EE programs.

There is another layer of communication between utilities that is relevant to the ETP, but thus far seems to be overlooked. We did not find any clear way that EE program managers from one utility can find out about ETP activities at another utility. Although some ETP assessments may be specific to a utility's service territory, many of the assessments have the potential for much broader applications. Since the ETP is a statewide program it makes sense that their activities should be reported somewhere in a single coherent form. It would therefore be of use to the EE program managers to have access to a list of ETP activities conducted by all four of the IOUs, including up-to-date information about the status of assessments and who they can contact to get more information about an assessment. The ETCC online database begins to address this issue, but its content is neither extensive enough nor current enough to be of great use to EE program staff (this will be discussed further in the "database" section).

Coordination With The PIER Program

There are two primary components to the coordination between ETP and the PIER Program (PIER). The first primary component takes place during the technology identification processes. As discussed previously in the Technology Identification section of this report, the level of coordination between ETP and PIER has intensified in the last two years. Instead of relying on informal communication between the two programs, PIER now comes to the ETP and presents a list of PIER projects that could be transferred to ETP assessments. In order to facilitate a smooth transition from PIER to

the ETP, the ETP has provided PIER with their pre-proposal forms so that PIER knows what information ETP needs in order to easily assess whether or not a technology is appropriate for an ETP assessment.[3] Both PIER and ETP seem satisfied with these changes, which represent significant improvements from prior years.

The second component to the coordination between ETP and PIER is the feedback that ETP provides back to PIER during and after assessment. This feedback allows PIER to determine what additional R&D may be needed for a certain technology. The feedback also provides information to PIER that allows it to evaluate how effective its own R&D efforts are at helping to accelerate viable technologies into the market. PIER has received good feedback on certain assessments, but in general this feedback loop has been and continues to be a weakness in the coordination between ETP and PIER. Specifically, PIER would like to be viewed as one of ETP's primary audiences, at least for assessments that originated from PIER research. In addition, PIER would like a section in ETP assessments to be directed towards R&D to help guide further research.

Coordination With Account Executives

Account executives are one of the primary drivers that bring commercial and industrial customers into utility EE programs, and are therefore an important link between ETP and the adoption of ETP technologies by utility customers. Excluding mass market customers, account executives are typically the customers' primary link with the EE programs, and are also their main source of information regarding EE technologies. In fact, EE programs often do not promote specific technologies, but instead just promote the program in general. In these cases the account executives may be a primary source of information about specific technologies, along with vendors who are selling the products. It is therefore critical that any information regarding a new EE technology get into the hands of account executives. The timing at which the account executives receive information is also important. According to EE program managers and also an account executive supervisor, the products available in the market have the potential to change very quickly. As soon as a new technology comes out in the market, vendors are out there selling it directly to customers and promoting it to the account executives. When a customer learns about a new product from a vendor, they typically will ask their account executive about the merits of the technology. Since it is the account executive's job to help their customers make smart choices regarding their energy use, they must keep up with all of the latest products and know what is a viable energy efficiency technology and what is not.

One issue brought up by an account executive supervisor was the length of the ETP assessment process; by the time the assessment is complete and the results are published and ready to be disseminated, vendors may have already been selling the technology in the market for some time. Providing account executives with up-to-date feedback on relevant assessments should therefore be a priority for the ETP.

There are a number of ways that account executives typically learn about ETP assessments. Occasionally, when one their customers is used as a demonstration site for

[3] PIER advised the ETP on enhancing their pre-proposal forms.

an ETP assessment, the account executive has a hands-on role. Account executives more commonly become aware of an assessment after the technology is included in an EE program, but this depends on how active the EE program is at educating the account executives about new measures. Account executives can therefore be up to two steps removed from the ETP, with EE programs being the intermediary. This presents a possible disconnect between information flowing from the ETP to the people who are actually on the ground promoting the technologies to customers. Better use of the ETCC (or similar) program database may help facilitate better communication and coordination with the account executives and allow for more information exchange on effective approaches in the field.

More recently, the ETP has begun to make quarterly presentations to account executives to update them about ETP activities and discuss assessment results, but currently this is not implemented consistently across the IOUs. In order to keep account executives up-to-date on ETP activities, we recommend that this practice be adopted throughout the ETP. Along with the quarterly presentations, we recommend that the ETP email a monthly list of ETP activities for all the utilities to the account executives, similar to the list we recommend that the ETP provide to EE program managers. Also, when an assessment is completed, it should be a priority of the ETP to provide account executives with marketing materials that they can use to promote the technology to their customers.

Other Coordination Issues

ETCC Database

Currently the ETCC database is of little value to the ETP and individuals involved with energy efficiency programs. During our interviews, we found no evidence of anybody who has used the database. According to ETP staff, they do not use it because they are able to keep up with ETP activities through informal activities and the ETCC quarterly meetings. None of the energy efficiency program managers that we spoke with knew the database existed. This is not to say that the database should be discontinued, but if it is to be continued it needs to provide the information desired by its target audience and it must be diligently maintained.

Since ETP program staff already have established communication channels across utilities, it seems that the database could best serve as a way for EE program staff to stay up-to-date on ETP activities across utilities. EE program staff were unaware of the current ETCC database, though they did express an interest in having a database to access ETP information. For the database to be of use to EE program staff, it would need to include additional technical information beyond what is provided in the current summaries. In addition, it would need to be updated consistently to provide up-to-date information about the assessment status and preliminary results. The database could also facilitate communication between the EE programs and the ETP by providing a way for EE program staff to connect directly to the people involved with implementing the assessment. If it is decided that EE program staff should be the primary audience of the ETCC database, we recommend that the ETP consult with EE program managers to ensure that the content in the database meets their needs.

Partnerships

On a number of occasions the ETP has partnered with other groups on projects. ETP project managers said that they generally try to get multiple groups together on projects. According to ETP project managers, getting more people to have a stake in an assessment helps the project's chance of success. For example, the ETP has had a number of successful partnerships with the SPC. By pooling their resources, the programs are able to offer a better project to their customer in terms of program support and financial resources. This model has a number of advantages. First, it gets the SPC program manager involved early on in the assessment. It also makes the project more attractive to the customer. If a customer is going to try a relatively new technology, they like the idea of the utility doing a thorough assessment of the technology's benefits. This also reduces the risk to the customer, both by providing technical support through the ETO and by offering an incentive through the EE program.

Vendors sometimes approach the ETP to do an assessment on a technology for which the vendor has already found a buyer. If the ETP is interested in assessing this technology, this situation provides a number of benefits. The demonstration site has essentially been handed to the ETP, since the customer has already agreed to purchase the technology. Also, by getting "buy-in" from both the customer (the customer has committed its own resources to purchase the technology) and the vendor (who originally approached the ETP), both parties will generally be more enthusiastic about the assessment and therefore be more willing to provide enhanced project support.

CONCLUSION

By all accounts, the 2004-2005 program years for the ETP were a period of transition. This transition was really a kind of identity shift for the program. Where previously the ETP's focus was to "assess and showcase technologies," the new focus became "accelerate the adoption of new technologies into energy efficiency programs." To make this transition the ETP had to re-evaluate how it could integrate itself with the EE programs and how it should fit into the larger picture of delivering valuable services to the utility customers.

Since 2004 the ETP has overhauled many of its processes. Some of the changes were implemented during the 2004-2005 program years while others came later, or are still in the process of being implemented. This overhaul made it difficult to specifically pinpoint which processes were used during 2004 and 2005 and which processes came later. In response to this challenge, we found it most useful to focus on how processes have changed since 2004. What we found is that the ETP has made many significant improvements in its processes, especially with regard to aligning itself with the focus of delivering technologies to energy efficiency programs. As the ETP settles into its current from, it will be important for the ETP to have a period of stability to enable it to refine its processes and build secure relationships with other industry players.

4. PROGRAM LOGIC AND CASE STUDIES

INTRODUCTION

This document presents a logic model and program theory for the 2004-2005 Statewide Emerging Technologies Program (ETP). Based on the logic diagram and program theory, indicators of program activities and progress are derived. These indicators (when measured properly) can help confirm the underlying program logic by demonstrating that key linkages between planned activities and expected outcomes are in fact working according to expectations. To demonstrate this, several case studies for technology assessments performed during the 2004-2005 analysis period are presented and used to show program progress based on the indicators linked to the logic model. For each assessment, the case study identifies strengths of the assessment (i.e., aspects that worked in accordance with the logic model), weaknesses, and recommendations for improvement.

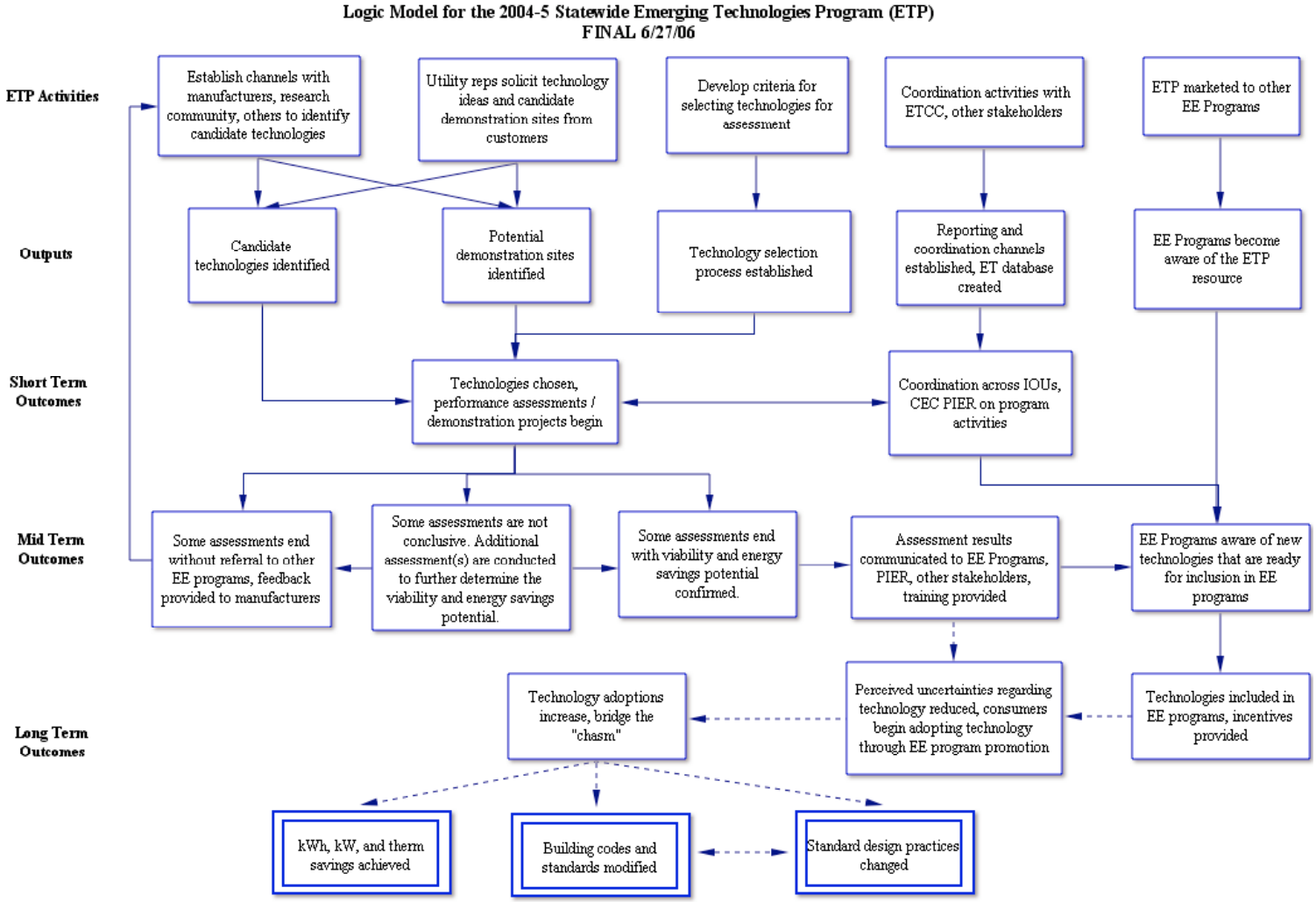
In addition to affirming the program logic for the 2004-2005 ETP, the logic model and case studies are presented together to highlight an evaluation approach that conforms to the 2006-2008 ET Evaluation Protocols developed by the CPUC Energy Division. Through the case studies we have identified simple metrics that we believe should be routinely tracked as part of any assessment done through the ETP. These metrics can be easily combined across all assessments to show program progress. This approach is consistent with the "Standard Rigor" evaluation approach described in the 2006-2008 Evaluation Protocols.

The remainder of this document is organized as follows. The next section presents a logic model diagram and program theory for he 2004-2005 ETP. Based on this diagram, a series of progress indicators are identified for each output and outcome discussed in the program logic and theory. A series of case studies of individual ETP technology assessments is then used to demonstrate the program logic by presenting information on the various metrics linked to key activity-outcome linkages in the logic model. Following the case studies, a method for building on these case studies is discussed that can be used in future evaluations to conform to the 2006-2008 ET Evaluation Protocols instituted by the CPUC Energy Division.

LOGIC MODEL AND PROGRAM THEORY

The diagram below is the logic model diagram for the 2004-2005 ETP and shows the linkages between activities, outputs and outcomes. A more detailed discussion of ETP activities, outputs, and outcomes is presented in the pages following the logic model.

Figure 1: Logic Model for the 2004-2005 Emerging Technologies Program



Dashed lines indicate induced outcomes that are outside of the direct program influence

The following program theory for the ETP builds on the program logic model and provides additional detail on program activities, outputs, and outcomes.

When assessing the underlying program logic, it is important to distinguish between outputs and outcomes. For this report, outputs are defined as the immediate results from specific program activities. These results are typically easily identified and can be counted, often by reviewing program records. Outcomes are distinguished from outputs by their less direct result from specific program activities. Outcomes represent anticipated impacts associated with ETP activities and will vary depending on the time period being assessed. On a continuum, program activities will lead to immediate outputs that, if successful, will collectively work toward achievement of anticipated short-term, mid-term, and long-term program outcomes.

ACTIVITIES

Establish channels to identify candidate technologies

The ETP works with manufacturers, California Energy Commission (CEC) Public Interest Energy Research (PIER) program, research design and technical communities, energy efficiency advocates, and other public agencies to identify technologies that have concluded the R&D phase and may be good candidates for assessment through the ETP.

Utility reps solicit technologies

Utility reps work with their customers to identify technologies and customers that may be willing to host a Assessment project. The customer may approach the utility rep with an idea (customer pull) or the rep may pitch the idea to the customer (technology push).

Develop selection criteria and process

Technologies are selected based on multiple criteria, including the market and energy savings potential of the innovation, market barriers, incremental cost, life expectancy, assessment cost, and time required for the assessment. Technologies will also be chosen to achieve a mix of market sectors covered by the technologies being assessed.

Coordinate ETP activities

Each IOU has its own version of the ETP and program implementation efforts are coordinated through regular meetings between utilities, joint meetings with the Emerging Technologies Coordinating Council (ETCC), discussions with the CEC PIER program, the ETCC database, and the monthly program workbooks each IOU files with the California Public Utilities Commission (CPUC).

Market ETP to energy efficiency programs

The target audiences for the ETP are other energy efficiency programs and utility account representatives. Other energy efficiency programs include those programs sponsored by the IOU's along with other third-party programs. The ETP markets the results of the assessments through fact sheets, workshops, trainings, and the ETCC database so that these programs are aware of the ETP as a source for new technologies.

SHORT-TERM OUTCOMES

Technologies chosen, assessments and demonstration projects begin

Using the ETP selection process, technologies are selected and the assessments are initiated. Most assessments are done at customer sites for those customers that are interested in being among the first to apply a new solution, or who want to showcase/promote a technology. Other assessments may be performed at test centers under controlled environments.

Activities coordinated

Assessment activities are coordinated across utilities through regular meetings and dissemination of information on assessment progress through multiple channels.

MID-TERM OUTCOMES

Some assessments end without referral to other EE programs

Some assessments show that a technology will have limited market potential in its current state and is therefore not ready to be included as an eligible technology in an energy efficiency program. Although the assessment does not result in a technology moving into an efficiency program, the process does provide valuable information on the technology that is communicated to manufacturers and other stakeholders so that the product can be improved.

Technology receives additional assessment(s) to determine viability and energy savings potential

Completed assessments may show energy savings potential, but by themselves are not conclusive. In theses cases, follow-up assessments may be necessary to determine the energy savings potential of the technology.

Some assessments completed and energy savings and equipment viability are confirmed

When assessments are completed the potential energy savings and viability of the technology are confirmed for some technology assessments.

Assessment results communicated to EE programs and other stakeholders

For those technologies that have successfully completed assessments and are ready for wider promotion, the assessment results are communicated to other EE programs and ETP stakeholders. The assessment results are disseminated via fact sheets, workshops, trainings, demonstrations, Energy Centers, and person-to-person contact with IOU EE program managers.

Energy efficiency programs aware of new technology options from ETP

As the ETP increases the number of technologies it recommends to the energy efficiency programs, awareness of the ETP program increases and the ETP is given greater consideration as a resource by the energy efficiency programs.

LONG-TERM OUTCOMES

Consumers begin adopting technologies through energy efficiency programs

With the greater exposure of established EE programs, their reputation of promoting proven technologies, and the availability of financial incentives the adoptions of the ETP technologies will increase. In the language of the diffusion of innovation literature, through the assistance provided by these programs, demand for the ETP technologies will eventually bridge the "chasm" between the "Early Adopters" and the "Early Majority".

kWh, kW, therm savings achieved

As adoptions of ETP technologies increase over time as a result of ETP activities, savings are achieved that would not have occurred without the ETP.

Building codes and standards modified

As the ETP technologies become mature, building codes and standards are modified to reflect higher efficiency levels.

Standard design practices changed

As adoptions increase and consumers become more confident in the technology performance, the technologies will be incorporated into customers' standard design practices.

Indicators of Program Progress

The tables below show potential indicators for each of the outputs and outcomes included in the logic model.

Table 19: Outputs and Possible Progress Indicators From the ETP Logic Model

Outputs	Possible Indicators
Candidate technologies identified	Number of technologies identified Number of end uses covered Number of measures covered
Potential demonstration sites identified	Number of sites identified Ratio of candidate identified to all sites reviewed
Technology selection process established	Technology application / proposal forms Formal selection criteria / protocol instituted
Reporting and coordination channels established, ET database created	Regular coordination meetings scheduled Number of database users Reporting requirements / format established Number of assessments with complete and current information in the ETP database.
EE Programs become aware of the ETP resources	Awareness of ETP by EE program managers Number of regular meetings between ETP and EE Program managers Number of assessment requests brought to the ETP by EE Program managers EE Program managers involved in assessments

Table 20: Short-term, Mid-term, and Long-term Outcomes and Indicators

Outputs	Possible Indicators
Short-term Outcomes	
Technologies chosen Technology assessments / demonstrations begin	Number of technologies chosen Ratio of technologies chosen to all technologies considered Energy savings and market potential of selected technologies Number of assessment started Number of end uses covered Number of market sectors covered Number of assessments started
Coordination across IOUs, CEC PIER on program activities	Coordination Funding leveraged from other sources
Mid-term Outcomes	
Some assessments end without referral to other EE programs, feedback provided to manufacturer	Number of assessments ending without referral and with information provided to manufacturer Ratio of non-referral assessments to all total assessments Type and quantity of information provided to manufacturer

Outputs	Possible Indicators
	Actions taken by manufacturer in response to assessment information provided
Some assessments are not conclusive. Additional assessment(s) are conducted to further determine the viability of energy savings potential	Number of assessments that are not conclusive Ratio of inconclusive assessments to all assessments Changes made to technology by manufacturer based on information provided on the ETP. Number of "repeat" assessments with the same technology.
Some assessments end with viability and energy savings potential confirmed	Number of assessments completed with savings potential confirmed Ratio of viable assessments to total assessments Savings values calculated
Assessment results communicated to EE Programs, PIER, other stakeholders, training provided	Reports Presentations Savings calculations, other data provided to EE Programs Number of trainings provided
EE Programs aware of new technologies that are ready for inclusion in EE programs	Awareness of new ET technologies among EE Program managers Information provided (savings and cost calcs) that is needed for EE Program inclusion
Long-term Outcomes	
Technology adoptions increase, bridge the "chasm"	Change in number of adoptions Change in market share Change in market penetration in new market sectors originally targeted by the ETP Change in number of end uses, market sectors using technology
Perceived uncertainties regarding technology reduced, consumer begin adopting technology through EE program promotion	Change in participant adoptions Change in non-participation adoptions Number of repeat purchases of the same technology (replacements with the same technology)
Technologies included in EE Programs, incentives provided	Number of programs listing technology as eligible measure Amount of incentive dollars provided
kWh, kW, and therm savings achieved	Net kWh, kW, and therm impacts
Building codes and standards modified	Changes in building codes and standards
Standard design practices changed	Changes in number of design firms using technology Share of new buildings using technology Share of retrofits using technology

The following case studies are designed to highlight some of the key metrics shown below as well as show the success of key links in the logic model. Note that not all

metrics are demonstrated in each case study, but enough are shown in the small case study sample to generally confirm the program logic and demonstrate the value of the ETP.

CASE STUDIES

The following are case studies examined as part of the 2004-2005 ETP Evaluation. These case studies were chosen based on conversations with ETP staff at each utility. They were chosen to show a range of technologies, end uses, and utilities during the 2004-2005 program period. They include two industrial processes (dust collection, dry cleaning), one commercial end use (refrigeration), one commercial/residential end use (desktop computers), and three lighting applications (bi-level stairwell lighting, integrated classroom lighting system, Super T8s).

Case Study 1: Variable Speed Dust Collection System

Technology Overview

The Ecogate Variable Speed Dust Collection System (Ecogate System) is a dust collection system that is designed to save energy by supplying the dust collection vacuum only to stations that are in operation. The standard practice in woodworking facilities is to use one or more large electric motors that are always running at full power to supply a dust collection vacuum. This dust collection vacuum is connected via elaborate duct systems to all woodworking stations. In most facilities, however, not all work stations are in use at all times and consequently a significant amount of energy is wasted from powering the dust collection vacuum when it is not needed.

The Ecogate system operates with a series of sensors that are controlled with a master control box (greenBOX). When a woodworking machine is in operation, a sensor signals the greenBOX controller to open the corresponding gates on the vacuum vents used to collect dust. When the woodworking machine is not operating, the greenBOX closes the gates to those vents that supply the dust collection vacuum to that station. Since the gates are only open when a machine is in use, the dust collection vacuum is supplied when needed to active workstations. The Master Controller System monitors usage of all workstations in the operating facility and uses a variable speed drive (VSD) to optimize the amount of power supplied to the dust collection vacuum at all times based on the number of workstation in use at any given moment.

The Ecogate system has the potential to achieve energy savings of 80 percent over the standard practice of running the dust collection system at all times for all workstations. Although 80 percent is a maximum savings, Ecogate claims that the technology will achieve a 68 percent energy savings on average with a payback period of less than two years. One of the purposes of the technology assessment completed through the ETP was to verify the manufacturer's savings claims.

SCE estimates that most of the market barriers to variable speed dust collection systems center around customer economics. Woodworking facilities typically have restrictions on capital investments and technologies like the Ecogate system must compete with other capital equipment purchases. In addition, customers are hesitant to purchase new

equipment (especially unproven technologies) that will require a significant amount of downtime to install.

Technology Selection

In 2004, the process used by SCE to identify potential assessment technologies relied on ETP project managers to find sectors or market niches that may have significant untapped energy savings potential. ETP project managers and SCE account reps were also continuously looking for new technologies that may be able to provide savings in these areas. While this process was somewhat informal in 2004, it did result in the ETP identifying the Ecogate system as a candidate technology for an assessment.

In the assessment proposal, SCE estimates that there are 1,200 woodworking businesses in its service territory. To estimate potential savings in this market, SCE assumes that these firms operate using 500 HP motors (on average), 25 percent of energy use is devoted to dust collection, and that 10 percent of these firms may adopt the Ecogate system. Given these assumptions, SCE estimates that there is potentially 72,000,000 kWh in savings annually that could be obtained with a wider adoption of the variable speed dust collection system. If this estimate is extended to the entire woodworking market in California (3,200 firms) and assuming a 10 percent market penetration rate, this technology has the potential to save 192,000,000 kWh annually.

During this period, the Vice President of Manufacturing from Oakwood Interiors requested a meeting with SCE to identify ways that they could reduce their energy use. The Oakwood Interiors facility is located in Ontario, CA and manufactures furniture (mostly bedroom) with a mid to upper end quality level. As a result of the meeting with SCE, Oakwood Interiors agreed to host the technology assessment for the Ecogate System.

Assessment Implementation

The Oakwood Interiors production facility is located on a 10-acre site in Ontario, CA with 200,000 square feet of space that is used for both furniture production and shipping. Energy is a significant component of Oakwood's O&M costs and annual energy use is estimated at 2.7 million kWh with peak demand of 1,100 kW. Furniture production at Oakwood utilizes four large motors that power the dust collection system. Of these, three of the motors are 100 HP and the fourth is 150 HP. SCE paid $50,000 for the installation of the Ecogate system, which covered almost all of the $52,000 installation cost.

The ETP had three specific tasks for the assessment:

1. **Baseline evaluation and analysis.** The energy use was monitored for a period prior to installing the Ecogate system. This provided a baseline energy use against which the energy consumption using the Ecogate system was compared.
2. **Ecogate system installation.** Once an adequate amount of baseline energy usage was collected, the Ecogate system was installed on one of the four motors used at Oakwood Interiors.

3. **Field monitoring and evaluation.** Field monitoring was conducted to measure energy use with the new system and to compare it with baseline usage. Monitoring was also done to ensure that the equipment was operating properly and to identify any problems with technology.

The combined results of these three tasks were used by the ETP to develop reliable kWh and kW savings for the variable speed dust collection system.

The original assessment plan called for installing the Ecogate system with a VSD on the 150 HP motor. Upon examination it was determined that the 150 HP motor was too old to be compatible with the VSD operation. As an alternative, one of the 100 HP motors was chosen for the assessment to demonstrate the Ecogate system. However, the 100 HP motors installed at Oakwood do not run at capacity[4], making them less ideal for the assessment than the 150 HP motor. To address this, the ductwork was redesigned in order to utilize a fuller load from the motor. In the new duct configuration, two systems were combined via the ductwork to be served by a single 100 HP motor. Even with this new configuration, the motor was still oversized.

In addition to the Ecogate system, energy monitoring equipment was installed to track energy usage with and without the Ecogate system in place. The monitoring equipment was installed inside one of the electrical panels at Oakwood where it was readily accessible. Data logging occurred at six-second intervals to provide a high level of resolution for the consumption data. The data were downloaded weekly and spot checks were done after each download to ensure that the equipment was functioning properly. Multiple sets of weekly consumption data (5-day intervals, Monday-Friday) were collected during the assessment.

One of the observed benefits of the Ecogate system was reduced energy usage during the motor startup. As discussed above, the original motors were installed to provide additional power required during motor startup and shutdown. Once the desired motor speed is reached after startup, the motor maintains its speed and energy consumption remains at a fairly constant level.

The amount of energy required at startup is very sensitive to the number of dust collection gates open during startup. As a result, the installation of the Ecogate system that optimizes the use of these gates resulted in a significant lowering of energy required during system startup. This benefit occurred even though the motor was oversized for the application and the energy savings would likely be greater if the Ecogate system were installed on a properly-sized motor.

In addition to savings during startup, the Ecogate system also delivered savings during normal operations by opening and closing gates to supply dust vacuuming only when needed. Overall, the monitoring showed that the system was able to save on average about 50 to 60 percent over baseline usage without the Ecogate system. For the 100 HP motor that was monitored, this meant that the average weekly kWh usage decreased from 3,394 kWh to 1,346 kWh with the addition of the Ecogate system, resulting in energy savings of 60 percent over normal usage. Similar results were found for the

[4] The 100 HP motors were intentionally oversized by Oakwood to provide additional power needed during system startup and shutdown.

hourly consumption comparisons, but the weekly results were judged to be more representative of savings that should be expected due to their lower variability relative to the daily numbers.

The data collection phase of the assessment ended in November 2006 and a draft report was completed in December 2006. This report has not been finalized but the SCE project manager expects that it will receive final approval in early 2007.[5]

The final report concludes that the Ecogate system is a sound technology and SCE should begin promoting it more to the woodworking industry through its other energy efficiency programs. The assessment was also able to support the manufacturer's claims that the technology will achieve energy savings of 68 percent on average. In the Oakwood assessment, savings of 50 to 60 percent were achieved even though the Ecogate system was installed in a facility using an oversized motor and improperly sized ductwork. The report also recommends further testing of the Ecogate System in other related industrial applications such as metal fabrication and finishing and commercial dental laboratories.

Following the release of the final report, the following information dissemination activities are planned:

- A fact sheet summarizing the results of the technology assessment;
- Verified kWh and kW savings estimates for use in other efficiency programs;
- Presentations to other energy efficiency programs to inform them about the technology's energy saving potential; and
- A presentation of the assessment results at a conference (one that is attended by representatives from the furniture industry).

Assessment Strengths and Weaknesses

The strengths and weaknesses of the Variable Speed Dust Collection System assessment are summarized below, followed by recommended actions for this assessment or for similar assessments in the future.

Strengths:

- Customer-initiated site selection
- Energy savings confirmed
- Planned dissemination of results
- Planned hand-off to energy efficiency programs
- Possible application in other industries

Weaknesses:

- No systematic site selection process

[5] Most of the technology assessment description and analysis results included in this case study were taken directly from the draft assessment report provided by SCE. Since this case study relies on a draft version of the report, the final assessment results may differ from this case study description once the assessment report is finalized.

Recommendations:

- Systematic screening with comparison to alternatives
- Follow up testing with properly sized motor
- Follow up testing in other target industries

Indicators of Progress from the Logic Model

The table below links specific metrics taken from this case study and relates them to the indicators from the program logic model for the short and mid-term outcomes. (Note that the long-term outcomes are excluded as they are generally beyond the time horizon of the case studies and outside the scope of the ETP.)

Table 21: Relationship of VS Dust Collection Case Study to ETP Logic Model

Outputs	Possible Indicators	Indicators Observed in Case Study
Short-term Outcomes		
Technologies chosen Technology assessments / demonstrations begin	Number of technologies chosen Ratio of technologies chosen to all technologies considered Energy savings and market potential of selected technologies Number of assessments started Number of end uses covered Number of market sectors covered	Technology and demonstration site successfully selected Assessment begun Energy savings and market potential estimated at 3,200 facilities with potential savings of 77,760 kW and 468.5 million kWh annually.
Coordination across IOUs, CEC PIER on program activities	Coordination Funding leveraged from other sources	No involvement with PIER or other IOUs on this case study
Mid-term Outcomes		
Some assessments end without referral to other EE programs, feedback provided to manufacturer	Number of assessments ending without referral and with information provided to manufacturer Ratio of non-referral assessments to all total assessments Type and quantity of information provided to manufacturer Actions taken by manufacturer in response to assessment information provided	N/A
Some assessments are not conclusive. Additional assessment(s) are conducted to further determine the viability of energy savings potential	Number of assessments that are not conclusive Ratio of inconclusive assessments to all assessments Changes made to technology by manufacturer based on information provided on the ETP. Number of “repeat” assessments with the same technology.	N/A
Some assessments end with viability and energy savings potential confirmed	Number of assessments completed with savings potential confirmed Ratio of viable assessments to total assessments Savings values calculated	Assessment ends with savings claims confirmed. Savings calculations developed by the ETP based on assessment results, ready for use in EE Program.
Assessment results communicated to EE Programs, PIER, other stakeholders, training provided	Reports Presentations Savings calculations, other data provided to EE Programs Number of trainings provided	Final report is being completed Savings calculations being completed Fact sheet is being developed Plans to have results presented at a conference
EE Programs aware of new technologies that are ready for inclusion in EE programs	Awareness of new ET technologies among EE Program managers Information provided (savings and cost calcs) that is needed for EE Program inclusion	Some awareness by EE Programs, technology already used before in the SPC program

Case Study 2: Professional Wet Cleaning

Technology Overview

Professional wet cleaning is a non-toxic, energy saving alternative to the traditional use of the toxic chemical perchloroethylene (perc) as a dry cleaning solvent. For more than 50 years, perc has been the preferred dry cleaning solvent because it can be used without risk of shrinkage, fading of dyes, or otherwise harming sensitive or delicate fabrics. However, used perc must be recycled through filtration and/or distillation and disposed of as hazardous waste. The use of perc in dry cleaning operations in California is subject to regulation and oversight by local (fire departments, sanitation districts), state (California Air Resources Board — CARB), and federal agencies. CARB has classified perc as a Toxic Air Contaminant (TAC), while the United States Environmental Protection Agency (EPA) established standards in the 1980s to regulate perc as a water, land, and air contaminant, and in 1993 implemented regulations to reduce emissions of perc from dry cleaners in response to requirements in the 1990 Clean Air Act.

Since the 1990s a number of alternatives to perc dry cleaning have emerged as regulation has increased. Some of these alternatives are:[6]

- *Petroleum Solvent Dry Cleaning*: The most widely used alternative to perc, petroleum solvents are not currently classified as hazardous air pollutants, but they do emit smog-producing volatile organic compounds (VOC), generate hazardous waste, and are highly flammable. Equipment costs are slightly higher than perc machines,
- *Silicone Solvent Dry Cleaning*: Increasingly popular, silicone solvent equipment costs are slightly higher than perc machines. Although silicone solvent has been marketed as non-toxic by GreenEarth Cleaning L.L.C., toxicity testing has not been completed and safety concerns remain. Silicon solvent is less flammable than petroleum solvents, but is subject to the same fire codes and regulations.
- *CO2 Dry Cleaning*: Liquid CO2 solvent used in this method is pressurized carbon dioxide gas, and is non-toxic and non-flammable. The equipment cost of a CO2 dry cleaning system is substantially higher than a perc dry clean machine.
- *Professional Wet Cleaning*: Developed in Europe over 10 years ago, professional wet cleaning is the most commercially available *non-toxic* alternative to dry cleaning. It is a water-based process that uses computer-controlled washers and dryers, biodegradable soaps, and specialized tensioning finishing equipment to restore shape and form. Both equipment and operating costs are lower in wet cleaning compared to perc dry cleaning, and cleaners that have switched to professional wet cleaning have been able to

[6] Ibid.

process the same garments they had previously dry cleaned. A number of features enhance the efficiency of professional wet clean systems:[7]

- A horizontally mounted cleaning drum enables the use of low water levels.
- Minimal agitation is used during the wash cycle.
- High-speed extraction removes moisture from garments and shortens dry times.
- Precision garment-sensitive moisture sensors in the dryer prevent over-drying.
- Tensioning finishing equipment maximizes the use of steam and lowers pressing times.

Technology Selection

Because of persistent compliance problems and the growing availability of non-perc systems, the South Coast Air Quality Management District (SCAQMD) ruled in December 2002 to phase out perc dry cleaning in the greater Los Angeles region by 2020. In addition, cleaners in the region will not be permitted to operate older primary-control only perc dry clean machines after November 2007[8]. At the time of the ruling, about 90 percent of the dry cleaners in SCAQMD's jurisdiction used perc during the cleaning process, and about 2,100 dry cleaners in Southern California will need to comply with the perc phase-out. In addition, two-thirds of cleaners in the region were estimated to have primary-control only machines. For the City of Los Angeles, approximately 270 of 400 perc dry cleaners will need to purchase new cleaning technology by November 2007.[9]

In response to the perc phase out, Southern California Edison (SCE) conducted outreach through its Hard to Reach (HTR) program to learn how its dry cleaning customers planned to comply with the rules and how the utility could potentially help them transition technology.[10] Based on input from the dry cleaning community, an HTR account representative subsequently contacted the ETP project manager to see if a demonstration/assessment project could be implemented to prove that professional wet cleaning is effective and saves energy.

Previous studies by Occidental College (the assessment implementer) had suggested that electrical and perhaps natural gas and water savings were achievable by switching from perc to wet cleaning, even though the studies had data collection problems that limited the precision of the comparisons. The first problem was the ability to effectively

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[7] Ibid.

[8] A "primary control" or third-generation system uses a refrigerated condenser instead of a conventional condenser. Fourth and fifth generation machines have improved primary control machines by adding a carbon adsorber as a secondary control, and a door lock that prevents the cylinder door from opening before the perc absorption cycle has been completed. Ibid.

[9] Ibid.

[10] About two-thirds of SCE's dry cleaning customers are Korean immigrants.

separate out resources used in processing laundry items (e.g. dress shirts, khaki pants, etc.) from resources used in the professional cleaning system for sensitive textiles (e.g. wool, silk, etc), since both systems use the same finishing pressing equipment simultaneously. The second problem was a lack of accurate record keeping by operators in characterizing each load of garments cleaned during the tests (load weights, load time, and cleaning program used) [11].

Because potential energy and gas savings were evident, SCE's ETP program manager and project manager jointly decided to contribute funds to a new garment cleaning study that would more systematically measure energy consumption (i.e., there would be low cost/risk to expand an already planned study). In this case, the ETP project manager did not truly select the technology to study (professional wet cleaning), but rather "approved" it for additional study and funding. SCE's HTR account representative was the assessment's main supporter.

Regarding potential market barriers, the SCAQMD rules effectively force perc dry cleaners to choose another system, and SCAQMD has proactively awarded grants to cleaners that change technologies. Hazardous site insurance is also becoming a driver of technology change, as landowners worried about exposure to legal claims are telling dry cleaners they can no longer use perc when their lease is renewed. Because a few wet cleaning systems had already been installed in the south coast region, the ETP project manager was not concerned about the technology working.

On the other hand, hydrocarbon and silicon solvent systems use machines very similar to perc machines (they are made by the same company that makes perc machines), and these two technologies were taking about 75 percent of the market for new equipment. In contrast, wet cleaning uses new machines, requires different techniques, and is the most challenging system for owners to adapt to (i.e., there is a significant knowledge barrier).

Assessment Implementation

To account for a range of solvents and machine configurations, the assessment was designed to characterize the energy and water use of the five professional garment cleaning technologies described above: Perc dry cleaning, professional wet cleaning, petroleum dry cleaning, silicone dry cleaning and CO2 dry cleaning.

To isolate the energy and water use of the professional cleaning process from other water and energy uses (e.g., air conditioning, laundry) and to use standardized wash loads, a new data collection protocol was developed in conjunction with engineers from the Los Angeles Department of Water and Power, SCE, Southern California Gas Company (SCG), and a member of Occidental College's Professional Wet Cleaning Commercialization Project Advisory Board. The main components of the testing protocol were:[12]

[11] SCE Phase I Report.

[12] Ibid.

- Test facilities would process (wash, dry, and finish) between two and four loads of garments in their professional cleaning system before operating any other cleaning process (e.g. laundry machines).
- Tests would be conducted on two specified test days.
- Data would be collected by Occidental College staff prior to processing on load characteristics, including load weight, number of pieces, garment type (e.g., jacket, pants, etc.), care label, fiber type, and cleaning program used.
- Test facilities would be sub metered for water, electricity, and natural gas.

Test procedures were refined at two beta sites to develop specific procedures that could be used at any professional cleaning facility. SCE agreed to sub meter the two facilities for electricity usage and SCG agreed to sub meter them for natural gas use and water use. After beta testing, resource use of perc dry cleaning and professional wet cleaning was measured at a single plant (Del Rey Cleaners) that switched from perc to professional wet cleaning during the assessment. The three other dry cleaning technologies were measured at three different cleaning facilities. Except for Del Rey Cleaners, the sites used existing equipment that was between one and two years old.[13] The test sites were paid $500 to $1,000 to participate and were recruited by Occidental College.

After SCE and SCG installed the data logging equipment at each facility, communications were mainly between the site operator and Occidental College staff. After completing two or three half-day tests, SCE and SCG would remove the logging equipment, download the data, and transmit it to the implementer (e.g., one minute demand data). If, during the assessment, a test site expressed an interest in receiving energy efficiency incentives, the ETP project manager would inform SCE's HTR account representative.

The tests at Del Rey Cleaners revealed that electricity use, natural gas use, and water use were all significantly lower for the professional wet cleaning system compared to the perc dry cleaning system:

- Electricity use was reduced by 60 percent
- Natural gas use was 19 percent lower
- Water use was 52 percent lower

Electricity use in professional wet cleaning at Del Rey Cleaners was also lower compared to the other dry cleaning technologies:

- 48 percent lower than petroleum
- 59 percent lower than liquid CO2
- 65 percent lower than silicone

Natural gas and water use were higher at Del Rey Cleaners, for both perc dry cleaning and professional wet cleaning, compared to the three other technologies. The higher

[13] On average a new professional cleaning system costs $50,000 and the typical usage life is 15 years.

natural gas use for both systems was attributed to a highly inefficient boiler system, and the higher water use rate in perc dry cleaning was attributed to a broken cooling tower float valve. The lower natural gas use at Del Rey Cleaners after switching technologies suggests that there are natural gas savings in professional wet cleaning compared to other garment care technologies.[14]

The final assessment report includes the following recommendations:[15]

- *Additional testing*. Each of the five technologies studied has different machine manufacturers and configurations that use varying amounts of energy and water. Additional research is recommended to provide more stable estimates of energy use.
- *Research on the prevalence of "once through water use."* The assessment identified a cleaner that uses a "once through cooling" system, and a prevalence study would help quantify the amount of water lost at dry cleaners from malfunctioning cooling towers. The study could quantify potential water savings if cleaners switched to systems that do not require cooling towers, such as professional wet cleaning.
- *Develop a rebate program*. A rebate program for professional wet cleaning should be developed due to the electricity savings documented in the assessment.
- *Educational outreach*. To publicize a rebate program, existing professional wet cleaning sites located in the City of Los Angeles should be used as venues for workshops targeted to cleaners who need to purchase new cleaning equipment.

Several of the assessment recommendations have been or are being implemented.

- Wet cleaning systems are eligible to receive incentives of 8 cents per kWh saved per year through SCE's Standard Performance Contract (SPC) program. As professional wet cleaning is estimated to save more than 5,000 kWh per year on average, the average incentive equals $500 to $1,000.
- SCE has prepared and distributed outreach materials in English and Korean to describe the energy savings and health benefits of professional wet cleaning.
- An 850 square foot professional wet cleaning demonstration site has also been established at SCE's Customer Technology Application Center (CTAC), paid for with contributions by SCAQMD and industry vendors (some cleaning equipment is also leased). In 2004 and 2005, 10 scheduled professional wet cleaning demonstrations were conducted, and two major industry workshops were conducted in 2005 and 2006. The workshops were organized by Business Solutions staff at SCE (which has a small business focus) in conjunction with SCG, SCAQMD, CARB, the City of Los Angeles, and the

[14] Ibid.

[15] Ibid.

Greater Los Angeles Area Dry Cleaners Association. The demonstrations and workshops have an education focus and also inform cleaners of available incentives and grants. Fact sheets are available at CTAC in English and Korean, and the equipment can be reserved for cleaners to test different wet cleaning soaps, which have a significant impact on the quality of the end product.

- Going forward, SCE and SCG are currently implementing a joint research plan, again administered by Occidental College, to develop more comprehensive estimates of electricity and natural gas use savings for the five garment care technologies evaluated in this assessment. The study will evaluate twenty-two test sites that are using the most efficient designs in the market: five professional wet cleaning, five petroleum, five perc, five silicone, and two CO2. The study will use the same data collection protocol, but will only measure electricity and natural gas use savings. The report is expected to be published in the third quarter of 2007.

According to the ETP project manager, this professional wet cleaning assessment was the first to systematically study electricity and natural gas consumption in the garment cleaning process in the United States. The assessment leveraged an existing study plan and funding to improve and broaden the scope of research to better serve a significant customer group (professional dry cleaners) in need of technology education and financial assistance. As professional wet cleaning technology has been used successfully in other parts of the world for 10 years, the objective was not to identify or recommend changes to equipment manufacturers. Rather, the primary goals of the assessment were to validate a new incentive program for dry cleaners and establish a body of knowledge to disseminate and build upon. Both of these goals were accomplished.

Assessment Strengths and Weaknesses

The strengths and weaknesses of the professional wet cleaning assessment are summarized below, followed by recommendations for this assessment or similar assessments in the future.

Strengths:

- Coordination with Occidental College
- Market/regulation-driven opportunity
- Built on previous research
- Comparison of technologies in the assessment
- Adopted by SPC program

Weaknesses:

- Equipment problems affected gas usage
- Different equipment manufacturers and configurations at test sites affected energy use

Recommendations:

- Additional research in a controlled setting to validate savings

Indicators of Progress from the Logic Model

The table below links specific metrics taken from this case study and relates them to the indicators from the program logic model for the short and mid-term outcomes. (Note that the long-term outcomes are excluded as they are generally beyond the time horizon of the case studies and outside the scope of the ETP.)

Table 22: Relationship of Professional Wet Cleaning Case Study to ETP Logic Model

Outputs	Possible Indicators	Indicators Observed in Case Study
Short-term Outcomes		
Technologies chosen Technology assessments / demonstrations begin	Number of technologies chosen Ratio of technologies chosen to all technologies considered Energy savings and market potential of selected technologies Number of assessments started Number of end uses covered Number of market sectors covered	Technology and demonstration chosen successfully selected Assessment begun For 2,100 dry cleaners in Southern California who must comply with the perc phase-out, energy savings are estimated at 10.5 million kWh annually.
Coordination across IOUs, CEC PIER on program activities	Coordination Funding leveraged from other sources	Data collection protocol developed in conjunction with Los Angeles Department of Water and Power and Southern California Gas Company ETP leveraged existing study and expanded scope so that reliable estimates of energy and gas savings could be developed
Mid-term Outcomes		
Some assessments end without referral to other EE programs, feedback provided to manufacturer	Number of assessments ending without referral and with information provided to manufacturer Ratio of non-referral assessments to all total assessments Type and quantity of information provided to manufacturer Actions taken by manufacturer in response to assessment information provided	N/A
Some assessments are not conclusive. Additional assessment(s) are conducted to further determine the viability of energy savings potential	Number of assessments that are not conclusive Ratio of inconclusive assessments to all assessments Changes made to technology by manufacturer based on information provided on the ETP	N/A Results used to recommend an additional study to further refine savings values and develop a separate

Outputs	Possible Indicators	Indicators Observed in Case Study
potential	provided on the ETP. Number of "repeat" assessments with the same technology.	program for these cleaning technologies
Some assessments end with viability and energy savings potential confirmed	Number of assessments completed with savings potential confirmed Ratio of viable assessments to total assessments Savings values calculated	Assessment ends with savings calculations for electricity, gas, and water savings Savings calculations developed by the ETP based on assessment results, ready for use in EE Program.
Assessment results communicated to EE Programs, PIER, other stakeholders, training provided	Reports Presentations Savings calculations, other data provided to EE Programs Number of trainings provided	Final report completed 10 wet cleaning demonstrations conducted; Fact sheets available in English and Korean Demonstration site established at CTAC
EE Programs aware of new technologies that are ready for inclusion in EE programs	Awareness of new ET technologies among EE Program managers Information provided (savings and cost calcs) that is needed for EE Program inclusion	Wet cleaning systems eligible to receive incentives of 8 cents per kWh through SPC program.

Case Study 3: Optical Demand Defrost

Technology Overview

Optical Demand Defrost technology is designed to reduce the amount of energy used to melt the frost that builds up on the coils of refrigerated cases in grocery stores and supermarkets. Because these coils typically operate at below-freezing temperatures, moisture in the air will condense and create frost on the coil. The frost hampers heat transfer effectiveness and air circulation, which results in inefficient operation and higher in-case product temperatures, so that the evaporator coils of refrigerated display cases must be periodically defrosted. This is done by turning off the compressor and applying electric resistance heat to the exterior of the coil. Typically, the defrost cycle is initiated by a time clock, regardless of the amount of frost accumulation or need for defrost, with four or more defrost cycles programmed in a 24-hour day. However, frost accumulation is not consistent, but is influenced by conditions such as ambient temperature, humidity and product load. Initiating defrost before significant frost accumulates wastes energy. If defrost could be initiated only when it is in fact needed, energy could be saved without affecting performance of the refrigerated cases.

Optical Demand Defrost (ODD) would trigger the defrost cycle only when the build-up of ice requires it by detecting the amount of light reflected off the frost buildup. The greater the frost buildup, the greater the amount of light reflected, with defrost initiated when a threshold associated with a predetermined thickness of ice is reached. As with conventionally scheduled defrost, the defrost cycle ends when the temperature of the discharge air indicates that cooling should resume.

Triggering defrost only when needed rather than on a fixed schedule is not a new concept, since the potential energy savings are significant. Alternative demand defrost technologies have relied on delicate instruments or indirect measurements that estimate the amount of ice buildup to initiate and terminate defrosting periods.

Technology Selection

Because this assessment was initiated in 2004, before a more formal technology selection process was initiated, the ODD technology was chosen based on the market knowledge and contacts of the Southern California Edison (SCE) Refrigeration and Thermal Test Center (RTTC) staff. Before this assessment was initiated, RTTC staff had long been aware of the potential energy savings offered by demand defrost and of the fact that several demand defrost technologies had been offered in the marketplace. They noted, however, that none of these technologies have been extensively adopted by the supermarket industry. The lack of acceptance, they found, had been primarily because these systems are perceived to lack mechanical and/or operational reliability. That is, the systems either do not function properly under real world conditions or they operate in a way that causes the temperature of food stored in the case to rise above desired (and government-mandated) levels. For store owners, potential energy savings from reductions in defrost cycles are far outweighed by concerns about equipment reliability and product quality.

From their interaction with the Energy Efficiency program managers, the RTTC staff knew that there was substantial interest in Demand Defrost if the technology could be made reliable. When the manufacturer of the Optical Demand Defrost technology approached the RTTC in 2004, the SCE engineers thought this technology offered the potential to implement demand defrost more reliably because of its relative simplicity. Optical Demand Defrost uses multiple strands on a single multi-core fiber optic cable to shine light on the coil and other strands on the same cable to transmit reflected light back to a photo detecting element on the controller. In contrast, other ODD technologies use a variety of methods of determining the time of defrost initiation.

As part of the selection process for the ODD technology, the Refrigeration Center conducted a thorough review of these other available DD options, including:

- Infra-red optical sensor
- High frequency acoustic wave attenuation
- Indirect measurements of frost buildup through temperature and/or pressure differential
- Previous defrost history
- Heat flux (rate of heat transfer from a heat exchanger fin)
- Data transmission
- Change in frequency of vibration caused by ice buildup.

While some of these technologies have been on the market for years, none have been formally assessed by the ETP process, and none are considered reliable enough to be accepted into the Statewide Express Efficiency Program, although all are potentially eligible for the SPC program if pre- and post conditions are adequately documented to

confirm energy savings. If the reliable operation of the ODD technology and the associated energy savings could be documented, the technology might also qualify for the Express Efficiency Program – as many other refrigeration measures have done. Refrigeration is a major end use among commercial customers, yet refrigeration measures have typically accounted for less than 5 percent of impacts from the Express Efficiency Program.

The expected energy savings from ODD are related to a direct reduction in the amount of energy required to maintain display case temperature. The primary energy savings are achieved by reducing the run time of the electric heating source. Secondary savings are achieved by reducing the amount of heat introduced into the case during the defrost process, also known as pull-down load.

Customers that could use ODD technology comprise all those who use refrigerated cases, including supermarkets, smaller independent grocery stores, convenience stores and liquor stores. Supermarkets and grocery stores are by far the largest market. There are about 3,000 large supermarkets and some 4,000 smaller grocery stores in California, representing more than 230 million square feet of commercial space. A typical supermarket is equipped with an assortment of open and closed medium and low temperature cases. RTTC reports that based on its own limited survey, a typical supermarket is equipped with 0.011 feet of medium temperature (refrigerated) cases per square foot of floor space and 0.005 feet of low temperature (freezer) cases per square foot of floor space. These estimates are confirmed by audit data from the 2003-05 EnergySmart Grocer Program, which found that larger supermarkets averaging 42,000 square feet in floor space are equipped with an average of about 0.011 feet of medium temperature (refrigerated) cases per square foot and 0.005 low temperature (freezer) cases per square foot. On average, smaller stores averaged about 10,500 square feet and were equipped with relatively more medium temperature cases (0.015 feet per square foot) but fewer low temperature cases (0.0045 feet per square foot).

The RTTC estimates that the energy saving potential of a successful demand defrost application – whether ODD or another technology – could amount to roughly 1,655 kWh per store annually for low temperature cases alone. This estimate does not include savings in pull down energy – that is, the energy required to bring the case back down to the desired operating temperature after the defrost interval where no cooling takes place – which is said to amount to some 25-30 percent of the direct defrost wattage.

With total savings per store conservatively estimated at 4,000 kWh (both low temperature and medium temperature cases, including pull down load) per store, the 3,000 large supermarkets in California could save 12,000 MWh of energy through the use of demand defrost.

Assessment Implementation

Assessment of the ODD technology was conducted in-house, at the SCE Refrigeration & Thermal Test Center (RTTC). While the manufacturer provided information on the installation and operation of the system, the testing protocol was designed and implemented by RTTC staff. The ODD unit was installed on an open vertical display case and testing was carried out according to ASHRAE Standard 72-98. Results were compared to a similar test where the case operated with a conventional time-initiated,

temperature-terminated defrost scheme. All other parameters remained identical between the two test scenarios.

A first-generation sensor was provided to the RTTC in June 2004 and installed according to the test design, but repeated efforts to establish satisfactory operation were unsuccessful. The ODD system would work for a few days, then something would happen to trigger a very long defrost cycle, after which there would be no defrost cycles for several days. RTTC staff attributed these problems to issues with the optical detector sensitivity and water droplet adhesion problems were observed and shared with the manufacturer. The manufacturer redesigned the hardware and provided a second generation sensor in February 2005.

The new sensor was installed in the case and a second round of testing was attempted. Several problems similar to those encountered with the first unit continued to prevent proper operation of the ODD system. The system was allowed to operate continuously for 24 hours, but the results were unsatisfactory. Early in the ODD test, the sensor began toggling rapidly between calling and not calling for defrost.[16] Towards the end of the test, no defrost cycles at all were initiated, and the coil became completely frozen. Air flow through the coil was restricted by frost formation, resulting in product temperatures consistently exceeding acceptable levels and thereby failing to meet the most fundamental operational requirements of the potential user. When the ODD system consistently failed to meet these requirements, testing was terminated.

Despite frequent interaction between the product manufacturer and RTCC staff, it was impossible to make the system operate reliably. As a result, there were no demonstrations of the technology or discussions with other potential users of the technology while the assessment was under way.

The final report submitted for this assessment concluded that while ODD appears to be an innovative solution to the defrost problems, its repeated operational failures resulted in unacceptable product temperatures. Coupling high product temperature with ODD's unreliable operation proves that this technology is not yet ready for adoption by supermarket operators and cannot currently be recommended to customers or energy efficiency programs.

Because this technology clearly was not ready for market, little additional information dissemination was pursued beyond submission of a final report to the ETP Program Manager. PIER and the EE program managers were informed of the negative results through the normal reporting and information sharing process. The manufacturer of the technology was provided with a copy of the report and strongly encouraged to find robust solutions to mitigate basic failures and reliability concerns. To date, the manufacturer has not developed a new version of the technology for consideration by the RTTC.

Despite the failure of this particular technology to meet expectations, the RTTC staff say they learned a great deal from this project about the issues surrounding demand defrost

[16] This was believed to have been caused by water droplet adhesion to the sensor head. As the water droplet was blown around by the evaporator fan, reflectivity of the sensor target changed and altered the amount of light seen by the detector.

and the challenges associated with testing, evaluating, and implementing this technology. They remain very interested in the opportunities offered by DD and are currently pursuing the review of another promising DD technology, which may become an assessment during the current program cycle.

RTTC staff say they have used the findings of this assessment to demonstrate to EE program staff that they are actively monitoring opportunities offered by DD and are able to answer questions about the technology. In addition, findings of this assessment have been incorporated into training classes for SCE program staff and account reps. "This helps them know we are aware; that we know about it but that we haven't seen anything promising. We try to stay frank and honest."

Assessment Strengths and Weaknesses

The strengths and weaknesses of the optical demand defrost assessment are summarized below, followed by recommendations for this assessment or for similar assessments in the future.

Strengths:

- Other demand defrost technologies were reviewed as part of selection process
- Weaknesses in technology were identified
- SCE staff became more knowledgeable about DD technologies in general

Weaknesses:

- System never operated reliably to assess energy usage
- Limited dissemination of results

Recommendations:

- Require further evidence of basic operational reliability before initiating assessment

Indicators of Progress from the Logic Model

The outcome of the assessment, while not positive in terms of validating the technology, provided valuable feedback to the manufacturer and to other potential suppliers of similar demand defrost approaches. The table below links specific metrics taken from this case study and relates them to the indicators from the program logic model for the short and mid-term outcomes. (Note that the long-term outcomes are excluded as they are generally beyond the time horizon of the case studies and outside the scope of the ETP.)

Table 23: Relationship of Optical Demand Defrost Case Study to ETP Logic Model

Outputs	Possible Indicators	Indicators Observed in Case Study
Short-term Outcomes		
Technologies chosen Technology assessments / demonstrations begin	Number of technologies chosen Ratio of technologies chosen to all technologies considered Energy savings and market potential of selected technologies Number of assessments started Number of end uses covered Number of market sectors covered	Informal process used to identify promising demand defrost technology ODD technology selected Assessment begun Energy savings and market potential estimated at 3,000 supermarkets with potential savings of 12,000 MWh annually.
Coordination across IOUs, CEC PIER on program activities	Coordination Funding leveraged from other sources	No involvement with PIER or other IOUs on this case study
Mid-term Outcomes		
Some assessments end without referral to other EE programs, feedback provided to manufacturer	Number of assessments ending without referral and with information provided to manufacturer Ratio of non-referral assessments to all total assessments Type and quantity of information provided to manufacturer Actions taken by manufacturer in response to assessment information provided	Two version of technology failed to meet performance requirements Test results provided to manufacturers After first failure, manufacturer provided new equipment; after second failure, went back to product development
Some assessments are not conclusive. Additional assessment(s) are conducted to further determine the viability of energy savings potential	Number of assessments that are not conclusive Ratio of inconclusive assessments to all assessments Changes made to technology by manufacturer based on information provided on the ETP. Number of "repeat" assessments with the same technology.	N/A
Some assessments end with viability and energy savings potential confirmed	Number of assessments completed with savings potential confirmed Ratio of viable assessments to total assessments Savings values calculated	N/A
Assessment results communicated to EE Programs, PIER, other stakeholders, training provided	Reports Presentations Savings calculations, other data provided to EE Programs Number of trainings provided	Final report completed Results used in presentations to customer reps and program staff
EE Programs aware of new technologies that are ready for inclusion in EE programs	Awareness of new ET technologies among EE Program managers Information provided (savings and cost calcs) that is needed for EE Program inclusion	N/A

Case Study 4: Integrated Classroom Lighting System in Relocatable Classrooms

Technology Overview

The integrated classroom lighting system (ICLS) was developed by Finelite with the assistance of the Public Interest Energy Research (PIER) program, the Collaborative for High Performance Schools (CHPS), and Architectural Energy Corporation to produce a lighting system offering enhanced performance and comfort for teachers and students while exceeding Title 24 standards for energy efficiency. Specifically, the ICLS was designed to provide optimal light quality for classroom activities such as reading and writing, whiteboard use, and digital and overhead projector use. It was also designed for "plug-and-play" installation, with integrated, easy-to-install components to reduce installation costs. Furthermore, all of the components are available from a single manufacturer, which enables easy procurement and allows the entire system to be covered under a single manufacturer warranty.

The ICLS uses suspended luminaires with parabolic louvers and energy efficient Super T-8 lamps. The luminaries are designed to provide glare-free light and also reduce shadows in the class. The luminaires are constructed from a 96 percent reflective plastic, compared to standard white pre-painted steel fixtures with 86 percent reflectivity. Since light is reflected multiple times before exiting a fixture, the increased reflectivity has a multiplied effect on the fixture's efficiency. The material can also be manufactured using injection molding, which reduces its cost compared to other materials with high reflectivity.

To adjust the lighting for various classroom tasks, the ICLS has simple controls at the front of the classroom, readily accessible by teachers. Although the system has a variety of optional controls, the basic control allows the teacher to switch between audio/video (A/V) mode, with lower light intensity to let students comfortably read and take notes without interfering with the presentation, and general mode, with higher light intensity for reading, writing, and other activities where low contrast materials are used. The ICLS also has an occupancy sensor, with both passive infrared and ultrasonic technologies to prevent false shut-offs. An innovative addition to the sensor that was a result of the original PIER study is a "quiet-time" switch that allows the teacher to easily shut off the sensor for a set period of one hour.

In a study conducted before the ETP assessment, PIER installed and monitored the ICLS in 19 regular classrooms, and found that the ICLS produced substantial energy savings and also provided superior light quality compared to the current practices used to light classrooms. PIER's final report, titled "Project 4.5: Integrated Classroom Lighting System – Final Report," states the following key results:

- Reduced energy usage by 30 to 50 percent
- Maximum lighting power densities of about 0.95 W/sq. ft -- 20 percent less than 2005 Title 24 limit of 1.20 W/sq. ft and half as much as the existing lighting in some classrooms
- Improved flexibility for setting light levels for general teaching and A/V presentations

- Perceived reduction in eye strain and glare and improved quality of light by teachers
- Documented ICLS component and installation costs that are less than that of typical layouts using 15 parabolic reflectors for new construction.

Technology Selection

In 2004, PG&E's School Resources Program (SRP) initiated a project to test a variety of technologies designed to improve the environment and performance of relocatable classrooms (RCs). It was estimated that there were around 90,000 existing RCs in California and that an additional 2,500 to 4,000 were expected to be built each year. With an average life span of 30 to 40 years, RCs in California present a significant retrofit market.

RCs typically have a lighting configuration consisting of 48 lamps in 12 recessed troffers – a design that provides poor light quality with high glare, is energy intensive, and provides little flexibility for changing lighting to accommodate classroom activities such as A/V presentations. Furthermore, a report titled "Environmental Health Conditions In California's Portable Classrooms" by California's Air Resources Board and the Department of Health Services found that nearly 40 percent of California's RCs do not meet the Illuminating Engineering Society of North America's (IESNA) guidelines of 50 foot candles for low contrast materials.

The original intent of the SRP project was to test technologies that already had deemed savings and rebates available though the utilities energy efficiency programs, but it was decided that the ICLS, which had recently been developed by Finelite and tested by PIER, had the potential to offer greater energy savings potential and better light quality than other lighting technologies being offered through the energy efficiency programs at the time.

Although the PIER project had concluded that the ICLS was a success in regular classrooms, it was not clear how the system would perform in RCs, which have different characteristics than regular classrooms. Specifically, RCs have a ceiling height of 8' to 8'6", compared to 10'6" to 12'0" for regular classrooms. The SRP wanted to modify the ICLS to meet the specific needs of RCs and demonstrate the system's applicability in the RC environment.

As a new technology that had not been adopted by any energy efficiency program or tested in the RC environment, the ICLS provided an ideal opportunity to collaborate with the ETP. When the SRP approached the ETP about collaborating on the project, the ETP requested that the SRP complete an Emerging Technologies Opportunities Summary (ETOS) and provide additional background materials. The ETOS was developed by PG&E's ETP as a part of the technology selection process to provide the necessary background information about the prospective technology in order to determine whether it has the potential to be a viable ETP assessment. Specifically, the ETOS includes background information about the technology, estimated project costs, target market size, energy saving potential, a project description, and a summary of risks.

In summary, there were a number of key factors that influenced the ETPs decision to participate with the ICLS assessment, including:

- PIER had already concluded that the ICLS was a success in regular classrooms
- RCs presented a large target market
- The ICLS was readily available in the market
- Finelite had already agreed to participate in the assessment and provide discounted equipment and free installation oversight and technical assistance
- The assessment had the potential to result in a new deemed savings measure applicable to PG&E's mass-market energy efficiency program

Assessment Implementation

The SRP managed the implementation of the entire RC project, including the ICLS component, for which the ETP provided the necessary funding and project management oversight. During the first stage of the assessment the ICLS was tested at Finelite's testing center, where they could manipulate the characteristics of the room to match the environment of an RC. When the ICLS developed for regular classrooms with higher ceilings was found to produce significant glare in the lower-ceiling RCs, Finelite modified the ICLS to accommodate the lower ceiling by using a 2-lamp suspended luminaire instead of the 3-lamp luminaire used for regular classrooms. The new design used both lamps simultaneously to provide 80 percent uplight and 20 percent downlight, providing high quality light while eliminating the glare.

The two-lamp system created an additional challenge to the system design. In the original ICLS, the A/V mode was achieved by using only the middle of the three lamps, which would not be possible with the 2-lamp luminaire. After experimenting with different configurations, the A/V mode in the new 2-lamp luminaire system was achieved by using only four lamps in the rear perimeter of the classroom. This provided enough reflected light to illuminate students' desks while not interfering with A/V presentations.

In the next stage of the assessment the ICLS was installed in 4 RCs, each in a different climate zone. In addition, test sites were to be a combination of elementary schools and high schools, since it was assumed that classroom activities differ between the two. The SRP approached school districts that they had worked with in the past , thereby helping facilitate the needed agreements between the SRP, school districts, principals, teachers, and facility managers. The lighting systems, provided by Finelite at a discount, consisted of two rows of suspended luminaires with high efficiency Super T8 lamps. The controls were the same as those used in the PIER study, which allow teachers to switch between general lighting and A/V mode and also control each row of lighting independently. A dual technology occupancy sensor was also installed along with the "quiet-time" switch that was developed in response to PIER findings.

Light levels and energy loads were then monitored 24 hours a day, seven days a week for an entire academic year. Monitoring equipment was also installed in RCs adjacent to the test RCs, but not retrofitted with the ICLS. These sites served as the baseline to determine the impacts of the system. The assessment also included an occupancy survey

completed towards the end of the assessment to allow teachers to provide feedback about their satisfaction with the ICLS.

An additional 6 ICLS systems were installed following the successful installation and monitoring of the 4 originally installed systems. These additional installations were strictly for demonstration purposes. No monitoring equipment was associated with these installations.

Although the final report has not yet been completed, the results of the assessment show that the ICLS offered both substantial energy savings and performance benefits compared to the baseline lighting equipment in RCs. The ICLS resulted in energy reductions of 60 to 65 percent compared to the existing lighting equipment. In addition to the energy savings, teachers provided positive feedback about the quality of the new lighting system.

Due to the positive results from the ICLS assessments in both regular classrooms and RCs, PG&E is incorporating the ICLS as a deemed savings measure with a rebate to be adopted by the mass markets energy efficiency program. The ICLS is currently in the planning review stage of PG&E's new service development process. The ETP and others involved with the ICLS assessments continue to be involved as decisions are made on moving the ICLS into a deemed savings program. The ICLS has presented a unique challenge in this regard because it is actually a system rather than a single piece of equipment like most other deemed savings measures. Nevertheless, PG&E hopes to have a rebate in place for the ICLS by mid-2007.

The ICLS assessments have also gained attention from other interested parties. The Los Angeles Unified School District is reportedly in negotiations with Finelite to retrofit a number of their classrooms. Finelite has also begun to work closely with the New York State Energy Research and Development Authority (NYSERDA) to assess opportunities in their territory. A number of organizations have also approached the project manager of the RC assessment to present the results of the ICLS assessment, including the Consortium of Energy Efficiency, the Coalition of Adequate School Housing (CASH), and the Community College Facilities Coalition (CCFC).

In addition, four major lighting manufacturers have approached PG&E to learn more about the ICLS assessments. It is expected that some of these manufacturers will be coming out with their own version of the ICLS in the near future.

Assessment Strengths and Weaknesses

The strengths and weaknesses of the ICLS in relocatable classrooms assessment are summarized below, followed by recommendations for this assessment or similar assessments in the future.

Strengths:

- Coordination/synergy with PIER and School Resource Program
- Built on previous research
- ETOS submitted as part of selection process
- Rebate being developed for ICLS as deemed savings measure

- Broad dissemination of results

Weaknesses:

- Final report not yet completed
- Only one vendor of system to date

Recommendations:

- Encourage other vendors to develop similar systems
- Complete and disseminate final report

Indicators of Progress from the Logic Model

As shown in the table below, this assessment validates several key links in the ETP program logic model, including the link between both utility representatives (through SRP) and the research community (through PIER) and technology and site identification. The ETP was also able to leverage program dollars by working with an existing study and expanding the scope of the study to include an emerging technology. In addition, assessment results have been communicated to energy efficiency programs and other stakeholders in order to move the technology to an energy efficiency program. (Note that the long-term outcomes are excluded as they are generally beyond the time horizon of the case studies and outside the scope of the ETP.)

Table 24: Relationship of Integrated Classroom Lighting System Study to ETP Logic Model

Outputs	Possible Indicators	Indicators Observed in Case Study
Short-term Outcomes		
Technologies chosen Technology assessments / demonstrations begin	Number of technologies chosen Ratio of technologies chosen to all technologies considered Energy savings and market potential of selected technologies Number of assessments started Number of end uses covered Number of market sectors covered	Technology and demonstration successfully selected with input from School Resources Program Assessment begun Market potential estimated at 90,000 existing Relocatable Classrooms in California and 2,500 to 4,000 expected to be built each year with potential savings of 60-65 percent compared to existing lighting equipment, or about 1.6 million kWh/year.
Coordination across IOUs, CEC PIER on program activities	Coordination Funding leveraged from other sources	Assessment followed up on previous PIER study in regular classrooms PG&E's School Resources Program (SRP) managed overall study

Outputs	Possible Indicators	Indicators Observed in Case Study
Mid-term Outcomes		
Some assessments end without referral to other EE programs, feedback provided to manufacturer	Number of assessments ending without referral and with information provided to manufacturer Ratio of non-referral assessments to all total assessments Type and quantity of information provided to manufacturer Actions taken by manufacturer in response to assessment information provided	N/A
Some assessments are not conclusive. Additional assessment(s) are conducted to further determine the viability of energy savings potential	Number of assessments that are not conclusive Ratio of inconclusive assessments to all assessments Changes made to technology by manufacturer based on information provided on the ETP. Number of "repeat" assessments with the same technology.	N/A
Some assessments end with viability and energy savings potential confirmed	Number of assessments completed with savings potential confirmed Ratio of viable assessments to total assessments Savings values calculated	Assessment showed ICLS offered energy savings and performance benefits Savings calculations developed by the ETP based on assessment results, ready for use in EE Program.
Assessment results communicated to EE Programs, PIER, other stakeholders, training provided	Reports Presentations Savings calculations, other data provided to EE Programs Number of trainings provided	Final report is being completed Results presented to Consortium of Energy Efficiency, Coalition of Adequate School Housing (CASH), Community College Facilities Coalition (CCFC). Four major lighting manufacturers have approached PG&E to learn more about the ICLS assessments
EE Programs aware of new technologies that are ready for inclusion in EE programs	Awareness of new ET technologies among EE Program managers Information provided (savings and cost calcs) that is needed for EE Program inclusion	PG&E is incorporating the ICLS as a deemed savings measure with a rebate to be adopted by the mass markets energy efficiency program

Case Study 5: Bi-Level Stairwell Lighting

Technology Overview

Most building and electrical codes require that stairwells be illuminated at all times for emergency and exit purposes. Because of this, traditional stairwell lighting fixtures

normally provide high and consistent levels of illumination 24 hours a day, every day of the year, consuming a lot of energy to illuminate mostly unoccupied stairs, alcoves and landings. In contrast, newly emerging bi-level fixture technology incorporates integral occupancy sensor motion detectors to monitor stairwell occupancy. This technology is designed to provide more efficient lighting by providing high illumination during occupied periods and reduced illumination when stairwells are vacant. In general, the energy savings for bi-level fixtures depend on stairwell occupancy patterns, the illumination step-down settings (i.e., the "low" illumination level, how long the area must be vacated before stepping down), and the type of technology that is used.

Currently there are two types of luminaires that are used with occupancy sensors to provide variable lighting levels.

- A luminaire manufactured by Wellmade Products provides a low level of illumination by using a low wattage CFL lamp that remains on at all times. When occupancy is detected in the stairwell, a main lighting source (typically a 4-foot T8 lamp) turns on to provide full light. The main light source then turns off after the stairwell has been vacant for a programmed period of time.
- A second type of luminaire system manufactured by LaMar Lighting also uses an integral occupancy sensor , but uses a bi-level *dimming* ballast to dim the luminaire when the space is unoccupied, instead of shutting it off. Different models can dim to 5 percent, 10 percent or 33 percent of normal, and battery packs can be added for emergency lighting[17]. The lamp never goes out completely and there is no need for an additional CFL light to provide reduced illumination. One significant advantage of this system is that the lamps tend to last for a long time, and thus reduce maintenance costs, because they are not turned off and on frequently.

New requirements for stairwell lighting from the American National Standards Institute (ANSI) have increased the required amount of light in occupied stairwells from 1 foot-candle (fc) to 10 fc. To mitigate the higher energy costs that will result, the codes also allow the use of bi-level lighting technology to reduce stairwell light levels back to 1fc during unoccupied periods. Bi-level lighting is therefore expected to be an attractive option for commercial, residential and public buildings in jurisdictions that are adopting the new ANSI codes for facilities that want to reduce energy consumption and costs generally.

Technology Selection

This assessment built upon earlier bi-level lighting research conducted under the PIER program (Project 5.1, Contract #500-01-041). The PIER study evaluated energy usage and occupancy patterns in four California buildings, including a 10-story university classroom/office building, a five-story office/research building, an 11-story county government building and a 10-story federal office building. The buildings were selected based on the level of stairwell use, and different models of the LaMar dimmable ballast

[17] All LaMar dimming fixtures are contained in the Occu-smart® product line.

lighting were installed at different sites. The study found that the four installations saved between 38 and 49 percent of lighting energy on 24-hour weekdays and between 47 and 67 percent on weekend days. The percentage of time that was "dimmed" ranged from 62 to 82 percent during weekdays and from 85 to 97 percent on weekends. Overall, the energy savings at the four test sites ranged from 40 to 60 percent.[18]

The PIER project and earlier research by NYSERDA provided preliminary evidence that cost and energy savings can result from bi-level lighting, the dimming ballast technology works well and can be introduced into the market, and lighting codes and standards are not barriers to acceptance by California building owners.[19] Noting these findings, PG&E's ETP commercial portfolio/project manager chose to conduct another bi-level lighting study to test a different technology (the Wellmade CFL product) in a different setting (a residential high-rise). According to the ETP project manager, "We knew one form of the technology worked through PIER, but every building is different, and you can't fully understand the technology and energy savings until you conduct more tests. We wanted more information so that hopefully we could justify reducing the product price to building owners." PG&E commercial account services representatives also supported the decision to conduct additional tests, noting that some commercial and residential building owners were aware of the PIER results and were looking for ways to reduce lighting energy costs.

Assessment Implementation

The assessment was conducted by PG&E at the Fillmore Center complex in San Francisco, which had recently upgraded the lighting in several of its stairwells. The complex includes 20-story towers with upscale residential apartments, each of which has centrally located elevators and two stairwells located at opposite corners of each building. The new stairwell lighting system in the residential towers consisted of Wellmade luminaires with integral occupancy sensors. Each fixture contained a switchable 30-watt primary T-8 fluorescent lamp, and an integral five-watt CFL that remained on all the time to maintain a low level of light in the stairwell. According to the lighting vendor, the fixtures were installed at a cost of $185 per luminaire, which includes the equipment cost, the labor for removal of the old equipment, and installation of the new fixtures. In comparison, standard four-ft. one-lamp corridor fixtures that are most commonly specified in stairwells typically cost $50-$100 installed.

TMT Associates (the assessment implementer) measured the performance of the new lighting installation and installed lighting data loggers on 99 fixtures in two different residential stairwells. The loggers measured the total time that the lights were on over a fourteen-day period. Data from the loggers was then downloaded into spreadsheets and extrapolated to estimate annual energy and cost savings from the bi-level lighting. TMT

[18] California Lighting Research Program. *Project 5.1 Bi-level Stairwell Fixture Performance Final Report*. Prepared for California Energy Commission Public Interest Energy Research Program. October 2005.

[19] Research conducted in 2003 by the Lighting Research Center at Rensselaer Polytechnic Institute (RPI) installed dimming fixtures in a residential high-rise on Roosevelt Island and a high-rise office tower in Manhattan. Due to security restrictions the stairwells were not used often in either building, and the resulting energy savings were 53 to 60 percent.

Associates proposed the assessment design based on a scope of work developed by the ETP project manager, and no changes were made to the study methods due to intermediate results.

The study found that the stairwell lights in the frequently used lower levels of the facility were on 35 percent of the time. In the less frequently used areas on the intermediate and higher floors (where most lights are located), the luminaires were on for less than 3 percent of the time. The average on time for all luminaires was only 3.3 percent. Overall, the occupancy sensor controls created stairwell lighting energy savings of 66 percent and coincident peak demand savings of 50 percent. The simple payback for the retrofit lighting project was estimated to be 6.4 years. The study notes that the results for other buildings could vary greatly by application.

The assessment also found that frequent switching of the luminaires causes lamps to burn out at a higher rate than normal. The luminaire manufacturer usually supplies fixtures with instant start electronic ballasts, which is one of the most energy efficient starting methods available for F32T8 lamps. Starting the lamp in this way, however, often shortens the lamp's service life by 25 percent or more. Rapid switching cycles, such as those that occur when controlling luminaires with occupancy sensors, can exacerbate this problem. This was observed at the Fillmore Center, where many of the stairwell lights were burned out. As a result, facility staff reported that they spend much more time relamping luminaires than previously. In addition, the 5W CFL lamp has a rated lamp life of only 10,000 hours, so it must also be replaced often.

The final assessment report is accessible on the ETCC website. Internally, PG&E has distributed fliers and fact sheets for account services representatives to provide to interested building owners. The ETP project manager has also made internal presentations to PG&E staff as part of multi-topic workshops.

PG&E now considers both bi-level lighting technologies, with dimming or CFL ballasts, to be viable and acceptable to building owners, and moved quickly to make bi-level lighting a rebatable product through its standard adoption process:

- ETP project manager makes a recommendation to create an incentive
- A PG&E engineer or analyst applies ETP project findings in technical work papers justifying incentive (ETP project manager provides study results and reviews work paper)
- Planning Group conducts cost effectiveness calculations
- The new service development core team, with input from the Strategic Research and Evaluation Group, considers customer needs, makes go/no go decision, and determines appropriate incentive level
- Senior level management approves incentives that serve multiple customer sectors

The technology is now included in PG&E's energy efficiency programs with a rebate of $25 per installation. According the to the ETP project manager, "It is critical to have good evidence that new rebates are defensible, and in this case the ETP process achieved this. Good evidence of savings is critical for customers too, and without real case studies it is hard to convince prospective buyers."

The ETP project manager says there is anecdotal evidence of increasing installations of both technologies, mostly in offices, schools and government buildings. In addition, bi-level lighting systems have recently been installed at eight university campuses as part of the UC/CSU PIER Demonstration Project, and are the most popular lighting application in the demonstration program. At PG&E's Pacific Energy Center and SCE's Customer Application Technology Center, single bi-level lighting fixtures are mounted and operate on a "fast" cycle for demonstration purposes.

Going forward, the ETP is concluding a second bi-level lighting study at the Trans America commercial building in San Francisco. The potential for energy savings is expected to be even greater in office buildings where stairwell usage is mostly limited to high traffic times. The study will be similar to the Fillmore study (a retrofit application using Wellmade technology) with the following exceptions:

- Commercial v. residential building (will result in different stairwell usage patterns)
- 5W CFL ballasts were replaced with 3W cold-cathode lamps

No additional research is expected after the Trans America study, as the two completed studies will have provided a thorough field test of the technology. At that point the primary issue for PG&E will be to make the cost of bi-level lighting acceptable to customers which may involve increasing the incentive levels.

Assessment Strengths and Weaknesses

The strengths and weaknesses of the bi-level stairwell lighting assessment are summarized below, followed by recommendations for this assessment or similar assessments in the future.

Strengths:

- Assessment built on previous PIER and NYSERDA research
- Energy savings confirmed with a different bi-level lighting technology
- As a result of the assessment, incentive offered for the measure

Weaknesses:

- High burnout levels with instant start ballasts

Recommendations:

- Require rapid (rather than instant) start ballasts on T8s for bi-level lighting rebate

Indicators of Progress from the Logic Model

The table below links specific metrics taken from this case study and relates them to the indicators from the program logic model for the short and mid-term outcomes. Early information sharing with the PIER program (i.e., established information channels) caused PG&E to learn that bi-level lighting was a viable technology, while the ETP assessment demonstrated that energy savings were also achievable using a different product in a different setting. The assessment results were used to make the technology

eligible for fixed rebates through PG&E's incentive programs and were also communicated to PIER and the broader research community. (Note that the long-term outcomes are excluded as they are generally beyond the time horizon of the case studies and outside the scope of the ETP.)

Table 25: Relationship of Bi-Level Stairwell Lighting Case Study to ETP Logic Model

Outputs	Possible Indicators	Indicators Observed in Case Study
Short-term Outcomes		
Technologies chosen Technology assessments / demonstrations begin	Number of technologies chosen Ratio of technologies chosen to all technologies considered Energy savings and market potential of selected technologies Number of assessments started Number of end uses covered Number of market sectors covered	Technology and demonstration chosen successfully selected Assessment begun Stairwell lighting energy savings of 66 percent and coincident peak demand savings of 50 percent for multi-story commercial buildings, particulary high rise offices.
Coordination across IOUs, CEC PIER on program activities	Coordination Funding leveraged from other sources	Assessment built upon earlier bi-level lighting research under the PIER program
Mid-term Outcomes		
Some assessments end without referral to other EE programs, feedback provided to manufacturer	Number of assessments ending without referral and with information provided to manufacturer Ratio of non-referral assessments to all total assessments Type and quantity of information provided to manufacturer Actions taken by manufacturer in response to assessment information provided	N/A
Some assessments are not conclusive. Additional assessment(s) are conducted to further determine the viability of energy savings potential	Number of assessments that are not conclusive Ratio of inconclusive assessments to all assessments Changes made to technology by manufacturer based on information provided on the ETP. Number of "repeat" assessments with the same technology.	N/A
Some assessments end with viability and energy savings potential confirmed	Number of assessments completed with savings potential confirmed Ratio of viable assessments to total assessments Savings values calculated	Assessment ends with savings claims confirmed. Savings calculations developed by the ETP based on assessment results, ready for use in EE Program.
Assessment results communicated to EE Programs, PIER, other	Reports Presentations	Final report is on the ETCC website Presentations to PG&E staff as part of

Outputs	Possible Indicators	Indicators Observed in Case Study
Programs, PIER, other stakeholders, training provided	Savings calculations, other data provided to EE Programs Number of trainings provided	multi-topic workshops Fliers and fact sheets distributed to account services representatives to provide to interested building owners
EE Programs aware of new technologies that are ready for inclusion in EE programs	Awareness of new ET technologies among EE Program managers Information provided (savings and cost calcs) that is needed for EE Program inclusion	The technology is now included in PG&E's energy efficiency programs with a rebate of $25 per installation.

Case Study 6: 80 Plus Program

Technology Overview

All computers and servers use a power supply that converts AC power to DC. Currently, typical power supplies have efficiencies of around 65 to 70 percent, meaning that 30 to 35 percent of the electricity used by the computer is lost just by converting the power from AC to DC. Given the widespread use of computers, any improvement in the efficiency level of this conversion process could result in significant energy savings.

In 2004, Ecos Consulting started a program called "80 Plus." The purpose of 80 Plus is to develop more efficient standards for computer power supplies and encourage manufacturers to produce power supplies to these standards. The 80 Plus program is a utility funded program that currently has 12 program sponsors throughout the country. According to the program website, over 20 power supply manufacturers have submitted products for certification[20].

The 80 Plus specification requires power supplies to be at least 80 percent efficient at 20, 50, and 100 percent of the rated load of the computer or server. To encourage manufacturers to adopt the 80 Plus specification, the program offers a $5 incentive per desktop computer and $10 incentive per desktop server that includes a qualifying power supply. These incentives are designed to cover a portion of the incremental cost to the manufacturer of meeting the 80 Plus specification.

More recently, EPA's ENERGY STAR program has been working to update its own specifications for desktop computer and server power supplies. EPA set this previous specification in 2000, and today nearly all desktop computers and servers qualify as ENERGY STAR under this existing standard. The EPA's new specifications are expected to take effect during 2007 and will be complementary to 80 Plus. In fact ENERGY STAR and 80 Plus worked closely together to develop the new ENERGY STAR specifications. As a result, ENERGY STAR adopted the 80 Plus test specifications verbatim as one of the elements in their upcoming release.

Technology Selection

Ecos Consulting originally approached PG&E to solicit their participation in the 80 Plus program in 2004. At the time, PG&E did not have any other alternatives that would

[20] 80 Plus website. http://www.80plus.org/80what.htm. January 7, 2007.

allow them to substantially influence the computer market. In addition, Ecos had already conducted extensive research on the power supplies and provided the ETP with background information, including market size estimates, energy savings calculations, and program and product cost estimates. Ecos calculated that an 80 Plus desktop computer would result in annual savings of 85 kWh and peak demand reduction of 19 W. Desktop servers would result in annual energy savings of 301 kWh and peak demand reductions of 39 W.

Although it was clear that the program had the potential to save a significant amount of energy, PG&E was unsure of whether or not the rebate offered through 80 Plus was appropriate for the incremental cost incurred to the manufacturers for their participation in 80 Plus. The ETP also consulted with managers of the mass-market energy efficiency programs to determine if and how 80 Plus would fit into PG&E's mass-market portfolio. Energy Efficiency program managers provided their cost effectiveness criteria that 80 Plus would need to satisfy in order to be a viable program within PG&E.

With buy-in from the mass-market program managers, the ETP set out to conduct an assessment designed to provide the necessary information that would enable the utility to make a decision regarding their participation in 80 Plus.

Assessment Implementation

The primary objective of the assessment was to produce an internal report that would provide enough information to determine if 80 Plus would be a viable and cost effective program that could be added to PG&E's mass market portfolio. Specifically, the assessment was designed to provide the following information:

- The current state of the technology
- The availability of the product
- The market size for the product in PG&E's territory, and
- The cost effectiveness of product and rebate from the standpoint of the utility.

The ETP 80 Plus assessment was conducted in-house at PG&E. Since Ecos had already done extensive engineering analysis related to desktop computer and server power supplies, further engineering analysis was not a component of the ETP assessment. As a result, the assessment did not require the testing of any equipment but did review the savings calculations.

Information needed to assess the current state of the technology and energy saving potential was in large part provided by Ecos. Ecos had already been in contact with various manufacturers, and through discussions with the ETP, provided information regarding manufacturer adoption of the 80 Plus specification. Ecos also provided the ETP with background information that described their energy savings calculations. As part of the assessment, the ETP evaluated the assumptions and methods used by Ecos. The ETP found no significant problems with these calculations and concluded that they could accept the deemed energy savings as calculated by Ecos.

In order to calculate the potential market share in the PG&E territory, the ETP relied on secondary research on computer and server sales data. Using this information, and taking into account the market share of manufacturers participating in 80 Plus, the ETP

was able to develop market penetration estimates for the number of desktop computer and server sales in PG&E territory, including those that would qualify as 80 Plus. The ETP concluded that first-year savings in PG&E territory from computer and server sales would be approximately 8,455,3232 kWh, and lifetime savings (assuming a 4-year EUL) would be 33,821,287 kWh. Demand savings were estimated to be approximately 1,052 kW.

Using these savings numbers, and taking into account the costs of participating in 80 Plus, the ETP estimated that the levelized cost of the savings would be around 0.026 $/kWh.

The results of the 80 Plus assessment were presented to the program managers of the mass-market energy efficiency programs. It was concluded that the 80 Plus did provide a significant opportunity for PG&E and that PG&E should therefore participate in the program. PG&E is now a sponsoring member of 80 Plus.

The ETP worked with the energy efficiency program managers to decide how to structure the program within PG&E and how to market the program effectively to customers and manufacturers. The ETP initially engaged the utility's communication and outreach staff before the assessment had concluded in order to let them know that it was in the pipeline so that they could begin to prepare accordingly. Once PG&E made the decision to participate in 80 Plus, the ETP began to work more closely with the outreach staff by providing them with content for their marketing materials. Initial marketing materials include a one-page fact sheet created by the ETP that provides a simple and clear summary of the technology and description of the 80 Plus program. Customers also received bill inserts describing the program.

To date, there has been almost no activity with 80 Plus in PG&E's territory. Ecos has been working with manufacturers to begin making the product and they are still in the product development phase. According to an Ecos program manager for 80 Plus, a number of manufactures are expected to come out with their first 80 Plus qualifying products during 2007. The program manager stated that he expects the 80 Plus to make significant gains in 2007. As further evidence of the program picking up speed in 2007, HP has announced that it will begin to provide 80 Plus certified power supplies with select desktop computers and servers during 2007.

Assessment Strengths and Weaknesses

The strengths and weaknesses of the 80 Plus Program assessment are summarized below, followed by recommendations for this assessment or similar assessments in the future.

Strengths:

- Effective leveraging of ETP resources by piggy backing on another program
- Coordination with ENERGY STAR
- Manufacturer rebate offered

Weaknesses:

- Limited activity with 80 Plus in PG&E's territory to date

Recommendations:

- Disseminate results to create demand for 80 Plus computers

Indicators of Progress from the Logic Model

The table below links specific metrics taken from this case study and relates them to the indicators from the program logic model for the short and mid-term outcomes. The 80 Plus program was brought to the ETP by an outside organization, highlighting the link between the outside energy community and the ETP. The ETP also had discussions with energy efficiency program managers to determine their interest and criteria in bringing the 80 Plus into PG&E's energy efficiency portfolio as part of the selection process. Lastly, this assessment highlights the hand-off of the technology from the ETP to the energy efficiency programs. (Note that the long-term outcomes are excluded as they are generally beyond the time horizon of the case studies and outside the scope of the ETP.)

Table 26: Relationship of 80 Plus Program Case Study to ETP Logic Model

Outputs	Possible Indicators	Indicators Observed in Case Study
Short-term Outcomes		
Technologies chosen Technology assessments / demonstrations begin	Number of technologies chosen Ratio of technologies chosen to all technologies considered Energy savings and market potential of selected technologies Number of assessments started Number of end uses covered Number of market sectors covered	Technology and demonstration chosen successfully selected PG&E did not have any other alternatives to influence the computer market First-year savings in PG&E territory from computer and server sales estimated at approximately 8.5 million kWh, and demand savings estimated to be about 1,052 kW.
Coordination across IOUs, CEC PIER on program activities	Coordination Funding leveraged from other sources	ENERGY STAR and 80 Plus worked together to develop new ENERGY STAR specifications, which include the 80 Plus test specifications verbatim.
Mid-term Outcomes		
Some assessments end without referral to other EE programs, feedback provided to manufacturer	Number of assessments ending without referral and with information provided to manufacturer Ratio of non-referral assessments to all total assessments Type and quantity of information provided to manufacturer Actions taken by manufacturer in response to assessment information provided	N/A
Some assessments are not conclusive. Additional assessment(s) are conducted to further determine the viability of energy savings	Number of assessments that are not conclusive Ratio of inconclusive assessments to all assessments Changes made to technology by manufacturer based on information	N/A

Outputs	Possible Indicators	Indicators Observed in Case Study
potential	provided on the ETP. Number of "repeat" assessments with the same technology.	
Some assessments end with viability and energy savings potential confirmed	Number of assessments completed with savings potential confirmed Ratio of viable assessments to total assessments Savings values calculated	Assessment ends with savings claims confirmed. PG&E is now a sponsoring member of 80 Plus.
Assessment results communicated to EE Programs, PIER, other stakeholders, training provided	Reports Presentations Savings calculations, other data provided to EE Programs Number of trainings provided	Final report completed Savings calculations completed Fact sheet created that provides a simple and clear summary of the technology and description of the 80 Plus program. Customers also received bill inserts describing the program.
EE Programs aware of new technologies that are ready for inclusion in EE programs	Awareness of new ET technologies among EE Program managers Information provided (savings and cost calcs) that is needed for EE Program inclusion	To date, almost no activity with 80 Plus in PG&E's territory, but manufactures are expected to come out with their first 80 Plus qualifying products during 2007.

Case Study 7: Super T8 Assessment

Technology Overview

Few technologies have contributed as much to energy efficiency improvements in the commercial sector as T8 fluorescent bulbs and electronic ballasts, which have been a mainstay of energy efficiency programs. In California, replacements of T12s with T8s have accounted for as much as a third of the Express Efficiency and SPC program impacts. In fact, lighting retrofits are so popular that the CPUC has placed restrictions on the percentage of SPC impacts that can be accounted for by lighting installations. Moreover, T8s have become the market standard for new buildings subject to Title 24 requirements (currently 1.1 watts per-square foot for office buildings[21]) that generally can only be met with T8s. For "commodity" T8s, the price premium over T12s is said to be modest – as little as 5 percent according the final report of the Super T8 technology assessments.

As T8s have made market inroads, lighting technology has continued to evolve, with potential gains in efficiency (and other measures of performance such as light output, expected life, and color rendering) coming from improvements both in the lamps themselves and in the ballasts that control them. Advances in the past several years in what are commonly termed third and fourth generation T8s have comprised both lamps and ballasts. "Super T8s" fall into both the third and fourth generation. Super T8

[21] *2005 Title 24 Nonresidential Compliance Manual*, p. 5-36, Table 5-2

lighting systems combine high-lumen, extended-life T8 lamps with a reduced-power electronic ballast, resulting in a system with wattage 15-20 percent less than a standard T8 system.[22] The Super T8 system lamps have lighting outputs rated at 3100-3200 lumens rather than the 2850 for a standard T8. With the higher light output, a reduced-power electronic ballast can be used that has a lower ballast factor and lower wattage. Super T8 lamps also have improved lumen maintenance, retaining from 88-92 percent of their initial lumens at the end of their product life.[23]

The electronic ballasts associated with Super T8 systems can be either what are called instant start or programmed start (sometimes known as rapid start).

- Programmed start ballasts use a micro-controller based circuit to apply a precise amount of cathode heat prior to starting the lamp. This ensures that the cathodes have reached optimum temperature before the lamp is started. Once the lamp is ignited, the ballast reduces the amount of cathode heat to the optimum level, to assure long lamp life. This advanced starting process drastically reduces the amount of cathode sputtering, resulting in increased lamp life, especially for short start cycles,
- In contrast, instant start (IS) ballasts apply high-voltage across the lamp with no reheating of the cathode. This is the most energy efficient starting method for fluorescent lamp ballasting. Instant start ballasts use 1.5 to 2 watts less per lamp than rapid start ballasts. Other IS ballast benefits include longer remote wiring distance, easier installation due to less complicated wiring and parallel lamp circuitry (which means that if one lamp fails the remaining lamps still burn.)

Compared to a system made up of energy-efficient magnetic ballasts driving 34W fluorescent lamps, Super T8 systems can produce energy savings as high as nearly 40 percent. These energy savings are said to represent virtually the same opportunity as existed when standard T8 systems began to be used for retrofit of magnetic ballast/F40T12 lamp systems.[24]

Technology Selection

Now that the California market has accepted commodity T8s as the standard for large commercial buildings and for new construction, there is strong interest from Energy Efficiency Program managers at all the utilities for new technologies that can continue to improve the efficiency of commercial lighting by setting higher standards for fluorescent systems to receive incentives. From their interaction with Energy Efficiency program managers, lighting engineers with SCE's Design and Engineering Services Customer Business Unit knew in 2003 and 2004 that there was a pressing need for additional lighting technologies.

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[22] *Commercial Lighting Retrofits: A Briefing Report for Program Implementers*, April 2003, American Council for an Energy-Efficient Economy (ACEEE).

[23] ACEEE, ibid.

[24] DiLouie, Craig, *The Next Generation of Electronic Lighting Systems: Smaller, Smarter and Greater Energy Savings*, Lighting Controls Association, 2003

Even before the two Super T8 assessments were initiated, the share of T8s in the marketplace was estimated at more than 75 percent in California, according to the Project Manager for the assessments (he says it has since topped 85 percent.) At that time – and even now -- almost all of the T8s installed would be considered first or second generation technologies. The goal of the two Super T8 assessments was to demonstrate some of the more advanced technologies and potentially recommend them for inclusion in the Express Efficiency and SPC programs.

Because these assessments were initiated in 2004, before a more formal technology selection process was initiated, the Super T8 technology was chosen for two test sites based on the market knowledge and contacts of the SCE Lighting Engineers. At the time the Super T8 assessments were being considered, third generation T8 systems (and a few of the fourth generation) had been introduced to the marketplace, but were still difficult to find, with a significant price premium and low awareness among facility managers and buyers. To gain experience with these systems, lighting engineers in the SCE Design and Engineering Services Customer Service Business Unit proposed assessments with two different versions of the Super T8 technology:

- Super T8 systems consisting of 2-lamp, instant start electronic ballasts coupled with F32T8 instant start (IS) lamps linear fluorescent lamps with a catalog rating of 30W per lamp and a connected load of 46W per 2-lamp/1 ballast system.
- A third generation Super T8 system consisting of 4-lamp (32W per lamp nominal, 92W per 4-lamp system connected) linear fluorescent fixtures with high efficiency, low power/lower light output program start ballasts.

In addition to energy efficiency, non-energy criteria were important in the selection of Super T8 technologies for these specific sites. The third generation programmed start system offers improved light quality and longer bulb life, while the fourth generation instant start system allows for longer wiring distances, parallel lamp circuits, less complicated wiring, and a somewhat lower initial investment (because fewer fixtures are needed).

The potential market for advances in T8 technology is, of course, enormous, since it comprises all commercial and many industrial buildings. As noted in one of the assessment reports for the Super T8 systems, "Lighting industry experts estimate that if all 4-foot T12 lamps and commodity T8s in the U.S. were replaced with the newest generation of fluorescent products, the electricity consumed by all light sources in the U.S. would be reduced by almost 10 percent and total electricity consumption would be cut by more than 2 percent.[25]"

There are, however, barriers to the ability of the two assessed Super T8 technologies to achieve their potential. The programmed start ballasts are relatively flexible and can be matched with a number of different types of lamps, but that can lead to less than optimum light output or energy savings over time because of spot-relamping. The fourth generation instant start systems are prone to significantly reduced life when used in

[25] *Energy Savings Potential of Super T8 Lighting Systems at First Presbyterian Church of Covina*, Design and Engineering Services Customer Service Business Unit, Southern California Edison, December 2004

combination with occupancy sensors that lead to frequent on-off cycles. Since California's Title 24 mandates the use of occupancy sensors (or other control strategies) in new commercial buildings, the fourth generation Super T8 technology does not appear to be suitable for any installation where occupancy sensors will be used and frequently triggered.

Assessment Implementation

Assessment of the Super T8 technology was conducted at two sites: the First Presbyterian Church in Covina and the Los Padrinos Juvenile Hall in Downey. The new lighting systems were installed by contractors under the direction of the SCE Project Manager. Interaction with the customers whose sites were being retrofitted were handled by both the Project Manager and by SCE account representatives. There was no explicit coordination with PIER or with other utilities.

- At the Presbyterian Church in Covina, 40 watt T12 lamps with magnetic ballasts in the church assembly, dining, and classroom areas were retrofitted with a fourth generation instant start Super T8 system having a rated load of 28W per lamp. Because of the higher light output of the new systems, the total number of fixtures was reduced by 43 percent.
- At the Los Podrinos facility, 21 incandescent 500 W pendant fixtures in the boiler/chiller room were replaced one-for-one with Super T8 4-lamp (32W per lamp nominal, 92W per 4-lamp system connected) linear fluorescent fixtures. The post-retrofit connected load per 2-lamp/1 ballast system was 46 W. The electronic ballast factor (the relative light output as compared to a reference ballast) was 0.71, which represent a high efficiency, low power/lower light output ballast choice. The lamp selection was F32T8 rapid start lamps. This lamp/ballast combination was the most energy and light efficient available for use in this application at the time of this project.

At both sites, pre- and post-retrofit connected loads were measured on-site, while lighting levels were measured in foot candles (fc) using a light meter. The customers provided information on operating hours: for the mechanical room at Podrina, and for individual facility spaces (sanctuary, classrooms, etc.) for the church – which was then used to calculate annual energy savings from the retrofit. Each of the new systems was monitored for several months for satisfactory operation. Because of potential concerns regarding proper lamp selection in case replacement was required, both sites were encouraged to remain in touch with the installing contractor. In addition, the church was provided with a case of Super T8 lamps to provide for any replacement needs.

Both assessments verified the practicality and efficiency of the third and fourth generation Super T8 lighting systems under the operating conditions where they were installed, and facility owners and managers at both sites were very pleased with the results of the lighting retrofits. While concerns about the effects of occupancy sensors for the fourth generation system installed at the church were not relevant in that situation, they have subsequently surfaced in other installations. For the third generation system assessed at the Downey facility, there were no concerns other than the potential difficulty site maintenance staff may face in finding replacement lamps and ballasts at traditional vendors. It was suggested that the customer go back to the

installer for future lamp and ballast replacements, although it was recognized as a possibility that the supplier may not exist when a group relamping is undertaken.

The final reports submitted for the two assessments concluded that the Super 8 technology successfully met the operational requirements of both facilities, while providing both significant energy savings and additional non-energy benefits. Energy savings were estimated at 72 percent per year relative to the existing T12 system at the church, and 82 percent compared to the previous incandescent system at the Juvenile Hall in Downey, although neither existing technology represents an accurate "current practice" baseline.

In addition to the energy savings, the assessment identified non-energy benefits for Super T8 systems at both sites. At the church, the fourth generation instant start system provided the following benefits:

- Lighting quality as measured by the color rendering index (CRI) increased dramatically, improving by 32 percent
- The number of fixtures was reduced from 310 to 178, providing an annual reduction of 43 percent in maintenance cost
- From an average 21 horizontal foot-candles (FC) for the old system, the post-retrofit systems produced 26 average horizontal FC, for a net light increase of 23.8 percent.

At the Los Padrinos Juvenile Hall facility, benefits included:

- From an average of 18 measured horizontal footcandles (FC) for the old system, the new post-retrofit systems produced 26 average horizontal FC, for a net light increase of 44 percent.
- The retrofit addressed persistent bulb failure problems that had been experienced with an old incandescent system, with bulbs that cost $15 and lasted only an average of 150 hours being replaced by Super T8 lamps that are projected to last about 3 years at the site usage rate of 6570 operating hours per year before group relamping is recommended

For both these assessments, little additional information dissemination was pursued beyond submission of a final report to the ETP Program Manager. PIER and the EE program managers were informed of the results through the normal reporting and information sharing process. Whether it was a direct result of these assessments is not clear, but Super T8 systems were subsequently added to the SCE SPC program as well as the SPC programs offered by the other utilities, with the requirement that these systems be evaluated with the calculated savings approach. Like other T8 systems with electronic ballasts, Super T8 lamps and ballasts are eligible for the Express Efficiency program, but currently receive no additional incentive for their added energy savings.

Assessment Strengths and Weaknesses

The strengths and weaknesses of the Super T8 lighting assessment are summarized below, followed by recommendations for this assessment or similar assessments in the future.

Strengths:

- Two advanced T8 technologies demonstrated in two different settings

Weaknesses:

- Energy savings measured against installed equipment which does not necessarily reflect the market baseline
- Weakness in instant-start technology not addressed by assessment
- No separate Super T8 measure in any energy efficiency programs

Recommendations:

- Use appropriate baseline for estimating energy savings
- Quantify lifetime reductions associated with instant start ballasts

Indicators of Progress from the Logic Model

The table below links specific metrics taken from this case study and relates them to the indicators from the program logic model for the short and mid-term outcomes. The technology selection process, while relatively informal, used a wide network of contacts and relationships to identify technologies that directly addressed a pressing need identified by energy efficiency program managers. The outcome of the assessment validated both versions of the Super T8 technology in these two applications, helping reduce perceived uncertainties surrounding the technology so that customers were able to begin adopting the technology. (Note that the long-term outcomes are excluded as they are generally beyond the time horizon of the case studies and outside the scope of the ETP.)

Table 27: Relationship of Super T8 Case Study to ETP Logic Model

Outputs	Possible Indicators	Indicators Observed in Case Study
Short-term Outcomes		
Technologies chosen Technology assessments / demonstrations begin	Number of technologies chosen Ratio of technologies chosen to all technologies considered Energy savings and market potential of selected technologies Number of assessments started Number of end uses covered Number of market sectors covered	Two separate T8 technologies chosen for two sites Assessments begun If all 4-foot T12 lamps and commodity T8s in the U.S. were replaced with Super T8s, the electricity consumed by all light sources in the U.S. would be reduced by almost 10 percent and total electricity consumption would be cut by more than 2 percent.
Coordination across IOUs, CEC PIER on program activities	Coordination Funding leveraged from other sources	No involvement with PIER or other IOUs on this case study
Mid-term Outcomes		
Some assessments end	Number of assessments ending without	N/A

Outputs	Possible Indicators	Indicators Observed in Case Study
without referral to other EE programs, feedback provided to manufacturer	referral and with information provided to manufacturer Ratio of non-referral assessments to all total assessments Type and quantity of information provided to manufacturer Actions taken by manufacturer in response to assessment information provided	
Some assessments are not conclusive. Additional assessment(s) are conducted to further determine the viability of energy savings potential	Number of assessments that are not conclusive Ratio of inconclusive assessments to all assessments Changes made to technology by manufacturer based on information provided on the ETP. Number of "repeat" assessments with the same technology.	N/A
Some assessments end with viability and energy savings potential confirmed	Number of assessments completed with savings potential confirmed Ratio of viable assessments to total assessments Savings values calculated	Assessment confirms reliable operation and energy savings (relative to existing systems) confirmed. Savings calculations developed based on assessment results not enough for deemed savings value and inclusion in Express
Assessment results communicated to EE Programs, PIER, other stakeholders, training provided	Reports Presentations Savings calculations, other data provided to EE Programs Number of trainings provided	Final reports completed and made available to PIER, program managers Savings calculations completed No other information dissemination
EE Programs aware of new technologies that are ready for inclusion in EE programs	Awareness of new ET technologies among EE Program managers Information provided (savings and cost calcs) that is needed for EE Program inclusion	Super T8s eligible for SPC program, but only through calculated savings approach

Case Study 8: Fiber Optic Lighting in Low Temperature Reach-in Refrigerated Display Cases

Technology Overview

Fiber Optic Lighting is a lighting system designed for low temperature reach-in refrigerated display cases typically found in grocery stores. These display cases need to display food to customers while storing the food at below freezing temperatures to avoid spoiling. Typical display cases rely on fluorescent lights that create additional heat

within the display cases. The cooling system then needs to work that much harder to keep food from spoiling.

Grocery store owners have been actively looking for ways to reduce energy costs and refrigeration is a key source of potential savings as it accounts for almost of half of supermarket energy consumption. Groceries and supermarkets have been generally reluctant to adopt lighting measures for refrigerated cases and freezers due to their higher capital cost and uncertainty around the savings potential.

The Fiber Optic Lighting is designed to provide adequate lighting for these display cases while using less energy. For this assessment, a Fiberstarts EFO-ICE system was used. The system is installed on the exterior of the refrigerated part of the display case. The light is then delivered to the display case through the fiber optic distribution system. Since the lighting source is located externally, less heat is introduced into the food area that is being cooled.

With Fiber Optic Lighting, energy savings can be achieved directly by utilizing a more energy efficient lighting source. The Fiber Optic Lighting system allows the light to be projected where it is most needed (on the food) rather than on the floor and glass doors where it is wasted. Since the light is directed more efficiently, the Fiber Optic Lighting system require less light overall. In addition, the component that produces heat for lighting is located externally, which provides additional savings as the amount of cooling needed inside the display case is reduced relative to the standard equipment.

SCE estimates the primary market for this technology as supermarkets, grocery stores, and convenience stores (SIC code 5411). SCE estimates that there are 10,260 buildings in these classifications with a potential of 315,800 freezer doors that could use the Fiber Optic Lighting.

Technology Selection

The Albertsons grocery store chain was approached by a manufacturer to use the Fiber Optic Display technology. Albertsons was interested but had several reservations about the technology, including concerns about light quality, energy savings claims, and the potential long-term costs of maintaining the technology.

To address these issues, Albertsons approached SCE to do a technology assessment at one of its stores. For this assessment, Albertsons paid to have the Fiber Optic Lighting system installed on 43 display case doors at one of its stores. SCE installed the monitoring equipment and conducted the analysis for the assessment.

Assessment Implementation

The data collection phase began in late 2005, with data on the existing lighting systems collected from October 10, 2005 to November 6, 2005. When the baseline data collection was completed, the Fiber Optic Lighting was installed and new data were collected from November 9, 2005 until January 10, 2006.

Each of the display cases had existing lighting consisting of 5 ft T-8 lamps with electronic ballasts. There was one 40 W lamp per door with an additional lamp at the end of each set of consecutive doors. The lamps were “overpowered” to 58 W to avoid flickering in the cold temperatures. With the Fiber Optic Lighting, the power per door

decreased from 60 W to 30 W. According to manufacturer data, the lighting efficacy was 90 lumens/W for the florescent lighting and 45 lumens/W for the fiber optic lighting, but the design of the Fiber Optic Lighting allowed the light to be directed more efficiently.

The assessment concluded that Fiber Optic Lighting system did reduce energy demand by 49 percent, with savings estimated at 1.28 kW or 11,200 kWh annually for the 43 doors assessed. Additional savings were also confirmed in the refrigeration system (compressor), as cooling loads had been reduced with the addition of the new lighting. For the refrigeration system, an additional savings of 11,800 kWh was achieved, which represents a reduction of 16.7 percent over standard equipment.

Taking the savings from lighting and compressor combined, the Fiber Optic Lighting achieved savings totaling 23,000 kWh annually, a reduction of 24.5 percent.

The assessment report also provided pictures to compare the lighting quality in the display cases with and without the Fiber Optic Lighting. Although determining an "adequate" level of lighting is highly subjective, it appeared that there was little or no loss of light quality with the Fiber Optic Lighting.

Although the results of this assessment were promising, the installation within an active supermarket prevented controlling for all the potential influences on energy demand. Consequently, SCE conducted additional tests of this technology in its Refrigeration and Thermal Test Center (RTTC) to compare several different lighting systems (T-8, LED, and fiber optic) and develop more precise estimates of the refrigeration energy savings. These additional tests were funded by SCE's Education, Training, and Outreach funding. Experts from the California Lighting Technology Center and the Southern California Lighting Technology Center are participating in the follow-up study to conduct a lighting quality analysis. These tests are still ongoing.

In addition to the final assessment report, anticipated information dissemination activities include:

- A fact sheet summarizing the results of the technology assessment will be created;
- Presentations of the results has been done at several conferences
- The assessment results have been reported in a supermarket trade publication
- The manufacturer has incorporated the assessment results into its marketing materials
- Albertsons installed the technology in the remaining display case doors at the test site.

Assessment Strengths and Weaknesses

The strengths and weaknesses of the display case fiber optic lighting assessment are summarized below, followed by recommendations for this assessment or similar assessments in the future.

Strengths:

- Assessment responded to customer need
- Both direct (lighting) and indirect (refrigeration) energy savings
- Assessment led to follow-up tests being conducted

Weaknesses:

- No formal screening/selection process
- Installation in an active supermarket prevented controlling for all the potential influences on energy demand

Recommendation:

- Pending successful follow-up test, include measure in Energy Efficiency program

Indicators of Progress from the Logic Model

The table below links specific metrics taken from this case study and relates them to the indicators from the program logic model for the short and mid-term outcomes.

Table 28: Relationship of the Fiber Optic Lighting Case Study to ETP Logic Model

Outputs	Possible Indicators	Indicators Observed in Case Study
Short-term Outcomes		
Technologies chosen Technology assessments / demonstrations begin	Number of technologies chosen Ratio of technologies chosen to all technologies considered Energy savings and market potential of selected technologies Number of assessments started Number of end uses covered Number of market sectors covered	Technology and demonstration chosen successfully selected Assessment begun Market potential estimated at 315,800 refrigerated display case doors at 10,260 stores.
Coordination across IOUs, CEC PIER on program activities	Coordination Funding leveraged from other sources	No involvement with PIER or other IOUs on this case study
Mid-term Outcomes		
Some assessments end without referral to other EE programs, feedback provided to manufacturer	Number of assessments ending without referral and with information provided to manufacturer Ratio of non-referral assessments to all total assessments Type and quantity of information provided to manufacturer Actions taken by manufacturer in response to assessment information provided	N/A
Some assessments are not conclusive.	Number of assessments that are not conclusive	Additional testing being done by SCE under more controlled lab setting in the

Outputs	Possible Indicators	Indicators Observed in Case Study
Additional assessment(s) are conducted to further determine the viability of energy savings potential	conclusive Ratio of inconclusive assessments to all assessments Changes made to technology by manufacturer based on information provided on the ETP. Number of "repeat" assessments with the same technology.	Refrigeration and Thermal Test Center
Some assessments end with viability and energy savings potential confirmed	Number of assessments completed with savings potential confirmed Ratio of viable assessments to total assessments Savings values calculated	Assessment ends with savings claims confirmed. Savings calculations developed by the ETP based on assessment results, ready for use in EE Program.
Assessment results communicated to EE Programs, PIER, other stakeholders, training provided	Reports Presentations Savings calculations, other data provided to EE Programs Number of trainings provided	Final report completed Fact sheet is being developed Presentations in several conferences Results included in super market trade publication Manufacture has incorporated results in its marketing materials Albertsons installed technology in remaining display cases at the test store
EE Programs aware of new technologies that are ready for inclusion in EE programs	Awareness of new ET technologies among EE Program managers Information provided (savings and cost calcs) that is needed for EE Program inclusion	Some awareness by EE Programs. Lighting Technology Centers aware of technology Inclusion of technology will be determined by the results of the follow-up assessment

INDICATOR AGGREGATION

The 2006-2008 ET Protocols list a series of indicators that could be used for an "aggregation analysis" of the ETP activities, where accomplishments and other progress metrics are summed over the number of assessments completed during the analysis period. We believe that the indicators provided above are good candidates for the aggregation and have the advantage of linking directly to the program logic model. The results of the case studies show the type of information that can be obtained that can be used for the aggregation. We recommend that this information start being routinely tracked by the ETP for all its assessment so that in future evaluations the aggregation can be done directly from the program tracking data.

The example of the aggregation analysis based on the 8 completed case studies is shown in Table 29.

Table 29: Example of Metric Aggregation From the Case Studies

Outputs	Possible Indicators	Indicators Observed in Case Studies
Candidate technologies identified	Number of technologies identified Number of end uses covered Number of measures covered	8 technologies identified 5 end uses covered 9 measures included in assessments
Potential demonstration sites identified	Number of sites identified Ratio of candidate sites identified to all sites reviewed	22 sites identified 20 Considered for these case studies.
Technology selection process established	Technology application / proposal forms Formal selection criteria / protocol instituted	3 assessments had formal project applications 3 technologies went through a formal review process established by the utility 6 of the 8 case studies for which potential was estimated had a combined savings potential of 659 million kWh a year.
Reporting and coordination channels established, ET database created	Regular coordination meetings scheduled Number of database users Reporting requirements / format established Number of assessments with complete and current information in the ETP database.	4 assessments have information in the ETCC database
EE Programs become aware of the ETP resources	Awareness of ETP by EE program managers Number of regular meetings between ETP and EE Program managers Number of assessment requests brought to the ETP by EE Program managers EE Program managers involved in assessments	1 assessments were initiated by EE Programs 2 assessment had EE Program managers involved during the assessment

Strengths and Weaknesses Aggregation

Analysis of the strengths and weaknesses of individual assessments examined in the case studies reveals several underlying themes that can be linked to indicators used to track the ETP. Strengths and weaknesses are summarized in Table 12.

Table 30: Strengths and Weaknesses Aggregation From the Case Studies

Assessment	Strengths	Weaknesses	Recommendations
Variable Speed Dust Collection System	Customer-initiated site selection	No systematic site selection process	Systematic screening with comparison to alternatives
	Energy savings confirmed	Less than ideal application for technology (because of oversized motor)	Follow up testing with properly sized motor
	Planned dissemination of results		Follow up testing in other target industries
	Planned hand-off to EE programs		
	Possible application in other industries		
Professional Wet Cleaning	Coordination with Occidental College	ETP Manager approved rather than selected assessment	Additional research in a controlled setting to validate savings
	Market/regulation-driven opportunity	Equipment problems affected gas usage	
	Built on previous research	Different equipment manufacturers and configurations at sites affected energy use	
	Comparison of alternate technologies in the assessment		
	Adopted by SPC program		
Optical Demand Defrost	Other demand defrost technologies were reviewed as part of selection process	System never operated reliably to assess energy usage	Require further evidence of basic operational reliability before initiating assessment
	Weaknesseses in technology were identified	Limited dissemination of results	
	SCE staff became more knowledgeable about DD technologies in general		
ICLS in Relocatable Classrooms	Coordination/synergy with PIER and School Resource Program	Final report not yet completed	Encourage other vendors to develop similar systems
	Built on previous research	Only one vendor of system to date	Complete and disseminate final report
	ETOS submitted as part of selection process		

Assessment	Strengths	Weaknesses	Recommendations
	Rebate being developed for ICLS as deemed savings measure Broad dissemination of results		
Bi-Level Stairwell Lighting	Assessment built on previous PIER and NYSERDA research Energy savings confirmed with a different bi-level lighting technology Incentive offered for the measure	High burnout levels with instant start ballasts	Require rapid (rather than instant) start ballasts on T8s for bi-level lighting rebate
80 Plus Program	Effective leveraging of ETP resources Coordination with EnergyStar Manufacturer rebate offered	No primary research conducted (but previous results reviewed) Limited activity with 80 Plus in PG&E's territory	Disseminate results to create demand for 80 Plus computers
Super T8s	Two advanced T8 technologies demonstrated	Energy savings measured against installed equipment, not market baseline Weakness in instant-start technology not addressed by assessment No separate Super T8 measure in EE	Use appropriate baseline for estimating energy savings Quantify lifetime reductions associated with instant start
Fiber Optic Lighting in LT Cases	Assessment responded to customer need Both direct (lighting) and indirect (refrigeration) energy savings Follow-up tests being conducted	No formal screening/selection process Installation in an active supermarket prevented controlling for all the potential influences on energy demand	Pending successful follow-up test, include measure in Energy Efficiency program

Among the strengths identified for the studied assessments, synergies with other programs or studies were among the most common. Several assessments built on previous PIER research (which meant that at least some aspect of the underlying technology had already been proven) so that the assessment helped broaden the applicability of the technology or measure in question. Similarly, several assessments utilized synergies with other programs or organizations, including ECOS Consulting, ENERGY STAR, Occidental College, and PG&E's School Resource Program. This effective use of synergy with other research efforts and organizations is captured through indicators that note the involvement of PIER and other organizations.

Another aspect of the reviewed assessments identified as a strength was the successful dissemination of research findings and the incorporation of those findings into energy

efficiency programs in a way that would encourage adoption. Several case study technologies have already been incorporated into EE programs, while others are in the process of becoming part of the SPC or Express Efficiency Programs. These assessment strengths can be captured in indicators relating to the awareness of assessed technologies among EE program managers and, over the longer term, indicators of measure adoption through one or more programs.

It was also considered a strength when an assessment screened or analyzed multiple technologies, either as part of the selection process or as part of the assessment itself. This strength is reflected both in the number of technologies identified and in the use of a formal application/screening process that ensures alternative technologies were identified for a specific end use or application.

Among the weaknesses identified in the case studies were the lack of a formal selection process, limited dissemination of assessment results, difficulties in accurately measuring energy savings in uncontrolled conditions, technical problems with a technology, and limited numbers of vendors for the assessed technology.

The lack of a formal selection process and limited dissemination of results would be captured in the indicators discussed above. The difficulties in accurately measuring energy savings (which arose to varying degrees for the variable speed dust collection system, professional wet cleaning, and fiber opting lighting in low-temp cases) appear to require an indicator that measures the appropriateness of the assessment site selected. While any real world test site is likely to pose some measurement challenges, an indicator should be used to provide a measure of whether these problems were encountered during the assessment. Such an indicator is included in the list of suggested indicators in the Implications for Future Evaluations section below.

Similarly, while uncovering previously unknown technical problems with a technology would be seen as a positive outcome of an assessment, failing to address known technical issues (such as high burnout rates for instant-start T8s) would be a shortcoming of the assessment approach and should be captured by an appropriate indicator, such as: known technical problems addressed (Y/N).

Finally, while it will often be the case that new technologies emerge as a result of the efforts of an individual firm, the value of an assessed technology would be somewhat diminished by its availability from only a single source. Therefore, an additional indicator should be used to note whether the tested technology is available from more than one source.

IMPLICATIONS FOR FUTURE EVALUATION

A review of the case studies shows that these eight assessments represent a cross-section in the types of technologies assessed, the processes used to identify and assess them and the assessment outcomes. For example, the case studies represent technologies and applications gathered from a wide range of sources.

- The ETP Program Manager and SCE account reps identified the Ecogate Variable Speed Dust Collection System as a technology of interest, and the assessment site was identified as a result of an individual customer's interest in saving energy.

- The wet cleaning assessment was championed by the program manager for SCE's hard-to-reach population in response to a specific regulatory issue that created an opportunity for an alternative cleaning technology.
- Optical Demand Defrost was selected by ETP and SCE's Refrigeration and Thermal Test Center (RTTC) staff after a review of other demand defrost technologies.
- Building on an earlier bi-level stairwell lighting study conducted under the PIER program, PG&E's ETP commercial portfolio/project manager, working with PG&E's School Resources Program (SRP), chose to conduct another bi-level lighting study to test a different technology in a different setting.
- Similarly, the integrated classroom lighting system (ICLS) assessment for relocatable classrooms grew out of previous research conducted through PIER, which had confirmed the viability of the technology in a regular classroom setting.
- The 80 Plus assessment was conducted in response to a request by an outside entity to support a national initiative for more efficient computer power suppliers, with the objective of producing an internal report that would determine if 80 Plus would be a viable and cost effective program that could be added to PG&E's mass market portfolio
- The SuperT8 technologies were assessed in response to program manager needs for new lighting technologies to supplement or replace the standard T8s, which have become baseline technology.
- The Fiber Optic Lighting technology was assessed at the request of a commercial customer that was considering installing the technology.

Similarly, the assessments vary widely in terms of the success of the technologies and their eligibility for inclusion in energy efficiency programs:

- Rebates have been established for the bi-level stairwell lighting measure, while a deemed savings rebate is expected later this year for the ICLS technology for Relocatable Classrooms.
- The Ecogate, Commercial Wet Cleaning, Super T8, and Fiber Optic Lighting technologies had electricity use/savings estimates verified, and are eligible for the SPC and/or Express Efficiency programs.
- The 80 plus standard for computer power supplies will offer a manufacturer rebate, and is also being incorporated into the EnergyStar specification for desktop computers and servers, with the first compliant models expected to reach the market later in 2007.
- Only the Optical Demand Defrost technology was proven to be not ready for commercialization.

All of the case study examples show the various metrics that can be used to track program progress as discussed in the 2006-2008 ET Protocols. One way to facilitate this would be to make sure a consistent set of metrics are tracked with each assessment. Then the aggregation could be done more efficiently using program data (with follow up

discussions and interviews as needed) rather than relying on the more time consuming case studies. Note that this list does not include all information that we believe should be tracked but focuses on those items that will specifically help link the ETP activities with the logic model and that appear to be linked to assessment strengths and weaknesses identified through the case studies.

Information we recommend tracking for each assessment to facilitate this includes the following:

- Formal application form used for technology assessment (Y/N)
- Formal review process used to approve technology for assessment (Y/N)
- Estimated savings potential (kW, kWh, therms)
- Estimated market size
- End uses covered
- Measures covered
- Target market sector
- Number of sites considered for the assessment
- Number of sites used for the assessment
- Number of technologies included
- More than one source of assessed technology (Y/N)
- EE program brought the technology to the ETP (Y/N)
- Assessment completed & technology recommended to EE programs (Y/N)
- Problems encountered during assessment related to site characteristics (Y/N)
- Assessment completed, technology referred back to manufacturer for additional work (Y/N)
- Known technical issues addressed (Y/N)
- Follow up assessment being done on technology used in previous assessment (Y/N)
- EE Program involved with assessment implementation (Y/N)
- Assessment done in conjunction with other IOUs (list which ones)
- Other collaboration with assessments (universities, national labs, etc.)
- PIER involved (Y/N)
- PIER funding ($)
- Co-funding from other sources? (Source and $ amount)
- Assessment results in ETCC database? (Y/N)
- Final report completed (Y/N)
- Fact sheet produced (Y/N)

- Other information dissemination (Specify)

By examining each step in the screening, selection, testing and information dissemination process in detail, case studies help validate or raise issues surrounding each aspect of the ETP. These initial case studies demonstrate how during the 2004-2005 program year, relatively informal processes were used to identify and screen technologies and sites, yet these processes appear to have brought into the ETP a number of promising technologies targeting a variety of end uses and customer sectors. More recently, the process by which technologies are screened has become more structured and the volume of technologies considered has increased as the need for new measures to feed into the EE program pipeline has grown. As a result, future evaluations will need to systematically review the overall process against the program logic, but it will also be necessary to continue to look at individual case studies to gain a better understanding of the application of the process to specific technologies, including the effectiveness of the program tracking metrics described above.

5. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Based on these evaluation activities, the following general conclusions are drawn from the data sources and analyses presented in the report:

The 2004-2005 program years were a period of transition for the ETP. Where previously the ETP's focus was to "assess and showcase technologies," the new focus became "accelerate the adoption of new technologies into energy efficiency programs." This change was stimulated by the need of EE programs to incorporate new technologies to meet increasingly higher energy savings goals. To compound the necessity for new energy efficient technologies, past technologies that EE programs have depended on are, or will be phased out as energy efficiency Codes and Standards are made increasingly stringent. In response to this shift, many of the processes and coordination efforts implemented by the ETP were also in a period of transition during the 2004-2005 program years. In general, the changes made to ETP processes were designed to encourage greater integration between the ETP and other EE programs.

Coordination between the ETP, EE programs, and parties that deliver the EE programs to customers is essential for successful commercialization of emerging technologies. According to the current program logic for the ETP, successful technologies are brought to commercialization by being passed from the ETP to EE programs where they are promoted directly to customers. Coordination between the ETP, EE programs, and other entities that help deliver programs to customers, such as account executives, is therefore critical for achieving the goal of accelerating new energy efficiency technologies into the market.

The current ETCC website contains inconsistencies. One problem that was encountered is that the ETCC database does not always contain the most current information on program activities. Many of the assessment initiation dates in the database were not correct, and few of the completed assessments had an ending date in the database, making it difficult to know the true status of many assessments. In addition, few of the completed projects included final reports in the database. In some cases the report was finished but had not been added to the website. In other cases the report had not been finalized, sometimes several months after the project work had been completed. That said, most of the assessments that program staff confirmed were active during the 2004-2005 program years were able to be located in the database.

One of the reasons for the database inconsistencies is that the website was launched in the last quarter of 2005, and all projects entered into the old database prior to 2005 had to be imported into the new database using an automated program. This problem was compounded by the fact that each utility uses different internal tracking mechanisms, and assessment names sometimes varied across reports (final report vs. monthly progress reports, for example). Staff at all of the utilities also agreed that a major obstacle preventing them from cleaning up the database was a lack of time and resources.

The redesign of the ETCC website and database needs further refinement to deliver relevant content to its target audience. The website currently provides

summary information about the ET program and its activities, results of various projects, and allows for information exchange between the outside entities and the ET program. Although the website does a successful job at making this information easily accessible, it is of little use to key audiences of the ETP, such as EE program staff, account representatives, and ETP staff themselves. We found no evidence that the database is used by ETP staff, EE program staff, or account representatives. ETP staff have little use for the database because they can get more detailed and up-to-date information through personal communications and ETCC quarterly meetings. EE program staff and account executives were generally unaware of the database, but indicated that they would be interested in such a resource if it contained up-to-date information such as project contact information mid-term status reports. In addition, the ETCC database does not always contain the most current information on program activities. Many of the assessment initiation dates in the database were not correct, and few of the completed assessments had an ending date in the database, making it difficult to know the true status of many assessments. Also, few of the completed projects included final reports in the database. That said, most of the assessments that program staff confirmed were active during the 2004-2005 program years were able to be located in the database.

The ETP has been successful at identifying numerous candidate technologies for its assessments. Personal networking, industry contacts, and research were commonly cited as the most important methods for identifying new technologies. ETP project managers typically have relationships with many manufacturers, vendors, and R&D organizations. Through these relationships the ETP project managers learn about new technologies that are entering the market.

The ETP and PIER have made significant improvements in their coordination. To keep ETP staff up-to-date on PIER program activities and discuss future activities, the PIER program now makes formal presentations to the ETP. PIER has also tailored the way information is presented to make is more user friendly for ETP staff. In addition, the programs have worked together to help guide the PIER program's research so that is more applicable to ETP projects.

Residential and mass markets present a challenge for the ETP. Although technology identification and selection in general are going well, the ETP's ability to identify and select technologies for the residential and mass markets was limited in 2004-05. Program managers indicated that this is due in part to the longer development period required for technologies targeting these markets. While the reasons for this were not explored further in the evaluation, it is possible that the more custom technologies have shorter development periods as they are designed to fit very specific needs and/or customer groups. Conversely, mass market and residential technologies must appeal to a broader range of customers and applications. This requires longer development periods (and results in more commercialization uncertainty) as multiple needs and groups must be considered. These products are also more reliant on popular tastes and advertising to be successful, which increases the challenge to the ETP.

The ETP has adopted a strategy of identifying broader markets for proven energy efficiency technologies. This strategy allows the ETP to provide new resources for EE programs in a shorter timeframe. It also allows the program to increase

its success rate, as it is working with technologies that have demonstrated that they are beyond the R&D stage as they are being adopted in some market sectors.

During the 2004-2005 program years, ETP's selection process was revamped in order to help better align the program with energy efficiency programs. One of the major changes that has occurred was the development of a formal technology selection process. The selection process now evaluates technologies based on specific criteria that have important implications for the technologies' potential impacts on the market (this is discussed in more detail in the main report). It should be noted that some of the IOUs are just now implementing this process (SCG and SDG&E), while others (PG&E and SCE) began to use their new process during 2005. In any case, the more structured selection process is an improvement over the more informal and inconsistent process that was used previously.

The ETP has begun to include EE program managers and utility account executives in the technology selection process. In some cases EE program managers are required to endorse each proposal before it can become an assessment. In other cases EE program managers help the ETP to prioritize a list of assessments based on their needs. By providing an endorsement or prioritizing the assessments, EE program managers indicate that based on preliminary information, the given technology could be a viable addition to an EE program depending on the final results of the ETP assessment. Energy efficiency program managers are pleased with their involvement in the selection process and stated that it will have a significant impact on the chances of ETP technologies being included in their programs.

During the 2004-2005 program years the ETP also began to implement more formalized coordination processes with EE programs and account executives. Previously, coordination between the ETP, energy efficiency program staff, and account executives was done on a project-by-project basis. ETP staff and EE program managers reported that on the projects that they coordinated on, results were transferred successfully.

During 2004-2005 the ETP began to create marketing pieces for their successful assessments. EE program managers and account executives stated this kind of summary information is valuable to them with regards to promoting the technologies to customers.

Awareness of the ETP on the part of EE program managers has been limited in the past, but is improving. EE program managers had limited knowledge about ETP activities during the 2004-2005 program years. They also did not have a clear understanding of how the ETP functioned and therefore how ETP was supposed to be integrated with their program. This is due in part due to the fact that ETP processes were previously not designed to specifically feed technologies to EE programs. Another factor that contributed to the limited awareness ETP activities by EE program managers is that since ETP assessments are spread out in essentially all markets, the number of assessments relevant to any particular market has not been large. Awareness should increase as the ETP grows and conducts more assessments. In addition, many of the recommendations below involve greater coordination between the ETP and other entities such as EE program staff and account executives. Greater coordination with these should also serve to increase awareness among these parties.

Communication between the ETP and EE program managers will sometimes lag during the implementation of assessments. EE program managers reported that while coordination has improved during the initial stages of an assessment, it has a tendency to drop off as the assessment progresses. As one EE program manager put it, "sometimes it seems like ETP projects disappear into a black hole."

Energy efficiency program managers and account executives need to be able to keep up with a rapidly changing market, and believe that the ETP can play a role in these efforts. To leverage the ETP, these individuals would like to be to be kept informed about which ETP assessments that are in the pipeline and receive updated information about the statuses of the assessments.

It should be noted that EE program managers have been invited to quarterly briefings where performance and technical information related to ETP results are presented, but few EE program managers have attended these meetings.

RECOMMENDATIONS

Based on the study findings discussed above, we offer the following recommendations for the ETP:

Coordination between the ETP and other entities should be considered an essential aspect of the program implementation. The ETP should therefore budget sufficient time and resources for ETP staff to conduct necessary coordination activities. Specific recommendations for improving coordination and information sharing include the following:

- Consider using market-specific ETP project managers as point people for communication with relevant EE program managers.
- Set clear expectations by clearly communicating the role that the ETP plays within the utility and the services it can and cannot provide to various groups. Also set expectations on when the timing of this communication should occur and during which phases of the technology assessment.
- Develop a consistent process for providing timely feedback to EE program managers when they submit a request to the ETP.
- Provide regular assessment updates and results to EE programs and account representatives in the form of monthly emails, a database dedicated to this purpose, or both. If both an email and database are used to coordinate ETP and EE program activities, the emails could be used to provide more up-to-date information and notify parties about updates to the database, while the database contains information pertaining to certain benchmarks, mid-term results, and final reports.
- ETP results should be shared with EE programs and account executives across utilities. It would be helpful if EE program managers and account executives had access to a single coherent list that included ETP assessments from all four IOUs. The ETCC database could serve this purpose, but since it currently

designed to provide limited information to the public, it is not adequate to serve this purpose in its current form (see database recommendation below).

- The four IOUs should work together to share best practices in order to maximize the success of ETP assessments.

Write and complete final reports for all assessments in a timely manner. This includes those assessments that find that the technology is not yet ready for inclusion in the EE programs. All reports should be readily available to any interested reader. When appropriate, include a section in the final reports that addresses future R&D opportunities regarding the specific technology. This section should be directed towards PIER. Marketing materials (such as fact sheets) should be developed for all completed assessments that are ready for EE programs.

Refine ETCC website to meet the needs of a target audience. Since ETP program staff already have established communication channels across utilities, it seems that the database could best serve as a way for EE program staff to stay up-to-date on ETP activities across utilities. EE program staff were unaware of the current ETCC database, though they did express an interest in having a database to access ETP information. For the database to be of use to EE program staff, it would need to include additional technical information beyond what is provided in the current summaries. In addition, it would need to be updated consistently to provide up-to-date information about the assessment status and preliminary results. The database could also facilitate communication between the EE programs and the ETP by providing a way for EE program staff to connect directly to the people involved with implementing the assessment. If it is decided that EE program staff should be the primary audience of the ETCC database, we recommend that the ETP consult with EE program managers to ensure that the content in the database meets their needs.

The ETP should continue to develop a strong relationship with PIER. This includes having a formal process to ensure that PIER results are being transmitted effectively to the ETP. The ETP should also work closely with the Public Interest Natural Gas Research program (PINGR) as it develops its gas research program.

Continue developing a formalized technology selection process. Sufficient time should be budgeted to allow ETP staff to conduct a thorough selection process. The program should consider using contractors to perform this work if ETP staff do not have the capacity. Each IOU should have a formalized selection process that specifically takes into account key market metrics, including market size, potential savings, alternative technologies, and other barriers and opportunities. In addition, EE program managers and account executives indicated that customers are more likely to adopt a technology if it is produced by multiple manufactures and vendors. Some technologies that are earlier in the commercialization phase will likely have only one manufacturer. Although these technologies may have higher risks, they could also have a higher potential payback and should not be disregarded by the ETP. The decision regarding risk versus payoff is a policy decision that each IOU will need to make on its own.

By the end of 2005, the IOUs were at different stages in regards to developing their selection process. SCE and PG&E had created technology selection forms and had already begun to use the forms and implement a more formalized selection process by

the end of 2005. SCG and SDG&E had not yet created such forms, but were reportedly working on developing their selection process.

The ETP should continue to look for opportunities to incorporate EE program managers and account executives into the technology identification and selection processes. The commercialization of emerging technologies ultimately depends on the coordination between the ETP, EE programs, and the people who help deliver the EE programs to customers. Incorporating these entities into the ETP selection process will help stimulate high-level coordination between the various groups. In addition, account executives have intimate knowledge of customer needs, and can therefore help the ETP stay in touch with the markets in which it operates.

Case studies of individual technology assessments can be a useful exercise for demonstrating the program logic. The case studies done as for this evaluation were useful for demonstrating parts of the program logic and evaluating the program implementation processes. Due to the long timeline for these assessments, however, the case studies are only applicable to the short-term activities, outputs and outcomes. Long-term effects by definition require a longer time horizon to track. In addition, the current data tracking procedures used by the ETP are not adequate for tracking program effects of individual assessments over time, which limits how much of the logic model can be tested with existing data sources. While the case studies did highlight some elements of the ETP logic model, tracking a series of metrics for each assessment over time will likely provide a more useful evaluation tool, as discussed in the next recommendation.

To aid with future evaluation work for the ETP, we recommend that a set of common metrics be tracked and clearly documented for every assessment. These metrics are designed to facilitate the 'aggregation analysis' discussed in the Evaluation Protocols. Many of these metrics can easily be incorporated into the formal selection criteria, as some utilities have already done. Other criteria could be incorporated into the final project reports, provided that the reports are completed for all projects.

Specific metrics that we recommend formally tracking for each assessment include:

- Formal application form used for technology assessment (Y/N)
- Formal review process used to approve technology for assessment (Y/N)
- Estimated savings potential (kW, kWh, therms)
- Estimated market size
- End uses covered
- Measures covered
- Target market sector
- Number of sites considered for the assessment
- Number of sites used for the assessment
- Number of technologies included

- More than one source of assessed technology (Y/N)
- EE program brought the technology to the ETP (Y/N)
- Assessment completed & technology recommended to EE programs (Y/N)
- Problems encountered during assessment related to site characteristics (Y/N)
- Assessment completed, technology referred back to manufacturer for additional work (Y/N)
- Known technical issues addressed (Y/N)
- Follow up assessment being done on technology used in previous assessment (Y/N)
- EE Program involved with assessment implementation (Y/N)
- Assessment done in conjunction with other IOUs (list which ones)
- Other collaboration with assessments (universities, national labs, etc.)
- PIER involved (Y/N)
- PIER funding ($)
- Co-funding from other sources? (Source and $ amount)
- Assessment results in ETCC database? (Y/N)
- Final report completed (Y/N)
- Fact sheet produced (Y/N)
- Other information dissemination (Specify)

APPENDIX A: ETP PROGRAM ACTIVITY DETAIL

SCE ASSESSMENTS INITIATED DURING 2005

Wet/Dry Cleaning Equipment

Customer name: Occidental College

Description: This assessment project is the second phase of a 2003 project. In this phase, the energy consumption of four types of clothes cleaning systems will be monitored based on the protocol developed under the earlier phase. Tests will be conducted at about eight sites. The four clothes cleaning systems are: 1) Professional Wet Cleaning; 2) Petroleum Dry Cleaning; 3) Silicone Dry Cleaning; and 4) Carbon Dioxide Dry Cleaning. SoCalGas is also providing funding to monitor natural gas consumption. These alternative clothes cleaning systems are proposed to replace the typical Perchloroethylene Dry Cleaning system that has been in use for the last 50 years.

Status - Professional Wet Cleaning: Program staff continue to interview potential test sites. Three test sites have been selected, and a data logging system was installed at two test sites. Testing at two cleaners was completed in December 2005. A professional wet cleaning seminar and demonstration was held in October 2005 and was attended by 80 cleaners.

Status - Petroleum Dry Cleaning: Program staff continue to interview potential test sites. One test site has been selected and arrangements have been made for monitoring.

Status - Silicone Dry Cleaning: Potential test sites are being screened.

Status - Carbon Dioxide Dry Cleaning: There are only a few potential CO2 test sites in southern California and discussions are under way to confirm their participation.

Hybrid LED Pathway Light

Customer name: Antelope Valley Fairgrounds

Description: The hybrid pathway lights consist of four LED lights and an incandescent lamp. The fixture has a photocell that turns the lights on at sunset and turns off the lights at sunrise. The fixture also has an occupancy sensor that turns off the incandescent lamp when nobody is present, leaving only the LED lights on.

Status: The light distribution and sensitivity of the occupancy sensor was tested in the Southern California Lighting Technology Center at Irwindale, California. The pathway is currently under construction at the facility, and the consultant is waiting for the pathway design from the fairgrounds. Once he receives it, he will determine the lighting design. Two potential manufacturers have been found to produce LED hybrid pathway lights, Hunter and Omni.

Fiber Optic Display Case Lighting System

Customer name: Albertson's, Inc.

Description: This technology relies on plastic optical fibers to guide beams of light where the light source is located outside of the refrigerated display case. The fiber optic system will replace the very high-output fluorescent lamps that are found in low-temperature reach-in refrigerated display cases. The instrumentation equipment for pre-monitoring is fully installed, and data for the first 10 days of pre-monitoring has been downloaded.

Status: ADM is currently analyzing the data. The fiber-optic system has been fully installed and post monitoring is nearly completed.

Pumps and Fans Initiative

Customer name: ACEEE

Description: This initiative is a collaboration with PG&E to investigate emerging technologies on pumps and fans that are suitable for the major industries served by each of the utilities.

Status: ACEEE continues to work on the project.

Compressed Air System Index

Customer name: Jazz Semiconductor

Description: The purpose of this assessment is to develop an indexing system to determine the performance of a compressed air system in extreme dry conditions (around -200F). A 2000 hp compressed air system will be monitored to determine the system efficiency. The results will be normalized so that the index can be applied to all systems that require extreme dry conditions.

Magnetic Suspended Refrigerant Compressor

Customer name: Macy's West Inc.

Description: Unlike conventional compressors, the rotor shaft and impeller of this compressor are levitated during operation by a digitally controlled magnetic bearing system. With friction, the compressor does not require lubricating oil. The VSD allows fluctuations in compressor capacity to match the load and condensing temperatures.

LED Taxiway Lights

Customer name: March Inland Port Airport Authority

Description: Conventional airport taxiway lights use incandescent 45-watt light bulbs. These can be replaced with blue LED lights that only require 5 watts, resulting in an 89 percent energy efficiency improvement. LED lights also have a much longer life and lower maintenance costs.

Desuperheater for Ammonia Refrigeration System

Customer name: Rockview Farms

Description: The efficiency of a refrigeration system can be improved by lowering the condensing temperatures using ground water around 50-60 degrees F. In this project, a plate heat exchange will be installed between the compressor and the condenser to act as a desuperheater. Heat will be removed by the plate heat exchanger and used to augment hot water needs within the plant.

Variable Speed Dust Collection System

Customer name: Oakwood Interiors

Description: A considerable amount of energy can be saved by converting a constant volume dust collecting system to a variable volume system. The Ecogate System is a fully automated electronic control system with built-in sensors and controller, used primarily in industrial commercial dust collection. A constant vacuum is maintained throughout the system by controlling the fan speed with variable speed drives. When a machine is turned on, a sensor signals the controller to open the appropriate gates. When the machine stops, the gate closes.

LED Street Lights

Customer name: SCE

Description: White LED street lights consume approximately 60 watts compared to 70 - 100 watt high-pressure sodium streetlights. White LED lights also have a longer life of 70,000 hours compared to 20,000 hours for high-pressure sodium lights.

Bi-Level Control of Area Lights

Customer name: SCE

Description: This assessment uses occupancy sensors to control area lights. When no one is near the lighted area, the occupancy sensor reduces the power to the lamp by 50 percent. When the occupancy sensor detects people in the area, the lamp returns to full power.

SCE Assessments Initiated During 2004

Portable Office Floor Lamp

Customer name: SCE Corporate Headquarters

Description: This assessment project will test the benefits and impacts of a prototype office floor lamp developed under the PIER program. SCE will deploy several floor lamps within SCE's own offices and measure both the energy and user impacts.

Status: Fourteen portable office floor lamps have been ordered and received. The project manager has located a test site and is preparing a work plan for the evaluation. A MOU has been approved by Real Property at SCE.

Plastics Resin Dryer

Customer name: SCE CTAC Center

Description: This assessment project will investigate the demand and energy consumption of resin dryers used in the plastics manufacturing sector. The assessment will identify the different equipment that is available, and compare product costs and potential demand and energy savings. Among the alternative dryers that will be considered are rotating desiccant dryers.

Status: A project plan is under development. Five resin dryer manufacturers have been contacted and technical information has been collected from these manufacturers. A detailed spreadsheet is being developed to document resin dryer models, manufacturers, and claimed energy efficiency.

Wireless Residential Energy Monitoring System

Customer name: Low Income Housing Units, LA County

Description: In collaboration with the 2004-2005 SCE/SCG/County of Los Angeles Energy Efficiency Partnership Program, this assessment project will install 350 EMS-2020 wireless energy-monitoring systems in low-income residential housing units. The main contractor, USCL, will provide, install and connect the equipment and data telemetry capability to a host computer with associated software to allow individual tenants, the LA County Housing Department, and SCE to monitor the energy use and generate reports.

Status: Of the 200 sites already selected, 100 sites are scheduled to receive the wireless energy monitoring system (EMS-2020).

Residential Variable Speed Swimming Pool Pumps

Customer name: Various

Description: This assessment project will investigate the use of variable frequency drives to control the speed of residential swimming pool pumps. The project will compare the VFD benefits and impacts to single-speed and two-speed pool pumps, note equipment modifications that are required, and identify ways to overcome market barriers. The project will document deemed savings and load profiles for the single-speed, two-speed, and VFD pool pumps in residential single family homes in California.

Status: Project staff continue to research the details and scope of the new Title 20 requirements for pool pumps and incorporate them into the project plans.

Optical Demand Defrost

Customer name: SCE RTTC Lab

Description: In open vertical display cases, infiltration of warm and moist air into the cabinet is responsible for a significant portion of the case-cooling load. The air curtain is often severely impacted by the buildup of frost on the coil, thereby increasing the amount of infiltration to the refrigerated case.

When display cases go into defrost the product temperatures increase significantly. In theory, the shorter defrost cycles of a demand defrost system will result in greatly reduced temperature swings. This should lead to longer shelf life and enhanced product quality for items merchandised in display cases.

This assessment determined the potential energy savings of using optical sensors and computer software to control the defrost cycle of a refrigeration system. The report presents laboratory test data about the operation of an optical demand defrost system in a medium temperature open vertical refrigerated display case.

Status: A 2nd generation ODD unit was obtained and evaluated in the RTTC's lab under the same ambient conditions as the baseline and 1st generation ODD. The 2nd generation ODD exhibited reliability problems similar to its predecessor. Subsequently, further evaluations of the ODD were halted. Program staff has completed the data analysis and final report.

Wireless Power Meters & Sensors

Customer name: Multiple Sites

Description: This assessment project assisted in the development of wireless power meters and remote sensors for use in energy management systems (EMS) for monitoring and control of HVAC, lighting, and process systems. The project collected and published customer needs and wants for wireless EMS components. The project was a partnership with the U.S. Department of Energy and the Pacific Northwest National Laboratory in the development and evaluation of both hardware and software systems.

Status: The wireless communication protocol was selected and software for the communication/setup of the loggers and for data acquisition, reduction, and analysis was tested. Beta testing of the software has been completed and the final report has been completed.

Light Emitting Diode (LED) Outdoor Lights

Description: This assessment project will determine both the demand and energy savings of LED outdoor lights. Part of the testing will be performed at SCE's CTAC facilities in Irwindale. This assessment complements ongoing CEC PIER work on LED luminaries for exterior, porch, and perimeter applications.

Status: Project staff continue to evaluate two exterior, wall mounted LED light fixtures at the Southern California Lighting Test Center in Irwindale. Luminance mapping of the light fixtures has been completed.

LED Task Lights

Customer name: SCE Corporate Headquarters

Description: This assessment project will determine the performance, demand and energy savings of LED task lamps. The assessment follows ongoing PIER development work and other RD&D sources on LED task lighting.

Status: Project staff have worked on the plans for this assessment and have investigated available products.

Residential Economizer Cycle Retrofits

Customer name: Mark Davis & Duro Dyne West Corp

Description: This assessment project will retrofit residential economizer cycles onto existing air conditioning units to document potential energy savings, performance, costs, and market barriers. A variety of hardware configurations are under consideration.

Status: Project staff continue to collect data at both test sites.

Advanced Heuristic Thermostatic Control System for Hotels

Customer name: Wyndham Palm Springs

Description: A new type of advanced thermostat, with an embedded heuristic control function wired to one or more occupancy sensors, may be used to control a room's cooling and heating demand. An agreement to test the technology was signed with a hotel in the Palm Springs area, and several conference rooms and guest rooms will be retrofitted and monitored during separate project phases.

Status: Project staff is preparing the final report for peer review.

Occupancy Sensor Nightlight Wall Switches for Hotel Guest Room Bathrooms

Customer name: Marriott & Hilton

Description: This assessment project will determine the potential demand and energy savings of replacing existing bathroom wall switches with wall switches with a built-in occupancy sensor and LED nightlight. The project will retrofit and monitor forty guest rooms divided among four hotel facilities in Southern California.

Status: Project staff has completed the data analysis and is preparing the final report.

California Kitchen Down-Lights

Customer name: Habitat For Humanity

Description: This assessment project will measure the usage and load profile of a downlight compact fluorescent lighting system for residential kitchens. The lighting system was developed through the CEC PIER program. The system is designed for quick connection during construction and uses a single ballast to drive two separate recessed cans.

Status: The end-use performance monitoring and testing phase of the project has been installed in ten homes. Project staff continues to monitor the load profile of the kitchens.

SCE Assessments Initiated During 2003

Rapid Start "Super" T-8 Fluorescent Lamp/Ballast

Description: Although program staff confirmed that this assessment was initiated in 2003 and had work completed during the 2004-2005 program years, we were unable to locate a project description.

Status: The final report and fact sheet have been completed.

Instant Start "Super" T-8 Lamp/Ballast

Description: Although program staff confirmed that this assessment was initiated in 2003 and had work completed during the 2004-2005 program years, we were unable to locate a project description.

Status: The final report and fact sheet have been completed.

Network Management of Computer Power Option Settings

Description: The purpose of this assessment was to determine the demand and energy savings potential of managing the power management settings of networked personal computers through both local and wide area networks.

Status: The final report has been completed.

Electrochromic Glazing

Description: This assessment builds upon research from PIER Contract No. 500-01-023. Electrochromic windows can be darkened or lightened electronically allowing the windows to be used as energy-saving devices.

Status: Project staff selected and gained access to a location to install and assess the electrochromic glazing. The glazing will be retrofitted into a portion of a southern facing window wall at SCE's Southern California Lighting Technology Center in Irwindale. A CO has been issued to Sage, and monitoring and instrumentation planning has started.

Displacement Ventilation

Description: A displacement ventilation was installed in the Daylighting Center classroom in SCE's CTAC Facilities in Irwindale in November 2005. The classroom was completed during the fourth quarter of 2003 with a standard packaged air conditioning that will establish the comparison baseline.

Status: The final report has been completed.

Advanced Classroom Lighting System

Description: A PIER-developed advanced T5 HO fluorescent lighting system with dimmable ballasts and daylighting controls was installed in the Daylighting Center demonstration classroom at SCE's CTAC facilities in Irwindale.

Status: The final report is in progress.

Anti Corrosion Coatings for Condenser Coils

Description: New inorganic coatings and cleaning processes for air conditioner condensers and evaporators have become available. The coatings, cleaning, and application processes are reported to significantly restore the operating efficiency of existing air conditioning units, and reduce the rate of their future degradation. This assessment will verify and expand upon the test results from the Florida Solar Energy Center. The assessment will establish an initial set of deemed savings estimates, as well

as time-of-use profiles, measure cost and life, for potential use in energy efficiency program planning.

Status: The final report is in progress.

Salt Reduction of Waste Water Precipitation of Salts for Fluid Bed/Lime Process

Description: Based on a recent Kennedy/Jenks pilot project, UHLA softening in a pellet softening fluidized bed configuration was performed to treat brackish groundwater for the City of Oxnard. The Oxnard pilot study included evaluation of a large diameter RO process, UHLA treatment to remove hardness and sulfate from the RO reject stream, and pellet softener process for hardness removal from the brackish groundwater. The various issues evaluated included i) characteristics and stability of the pellets during lime precipitation, ii) field verification of laboratory and computer model findings of the Ultra High Lime Aluminate (UHLA) process, iii) potential for crystallization of UHLA sludge on the pellets, and iv) volume of sludge produced from pellet processing.

Status: Final report has been completed

Voltage Reducer System for Dimming Control

Description: The voltage reducer system for dimming control was designed to save energy, and achieved 15 to 25 percent voltage reductions for fluorescent and HID lighting. At the same time, the system also reduces light levels 25 to 40 percent. The system requires additional assessment regarding how it can work with underlying lighting systems.

Status: The preliminary analysis demonstrated that additional performance tests are needed and planning for the additional work is underway.

Professional Wet Cleaning

Status: The final report has been completed.

Cold Storage Refrigeration Control

Description: Food processing plants use refrigerated storage facilities to preserve foods for processing, and the efficiency of the refrigeration system depends on many variables including the outside air temperature. This assessment project used advanced controls to reduce refrigeration system operating hours during the day. The strategy allows the indoor temperature to float, relying on the facility's and product's thermal mass during the hottest part of the day to sub-cool the facility and product at other times. The lower ambient air temperatures for heat rejection should improve the refrigeration system's operating efficiency.

Status: The final report has been completed.

Petroleum Dry Cleaning

Status: The final report has been completed.

Silicone Dry Cleaning

Status: The final report has been completed.

Carbon Dioxide Dry Cleaning

Status: The final report has been completed.

Advanced Control for Plastic Granulators

Description: Rejected parts and trimmings from the plastics molding process are often reground to be used again. The grinders that are used are typically 7.5 to 10 HP and are idling most of the time. This project was to study all grinders available in the market and also the controllers for these grinders to see if save energy savings could be realized.

Status: The final report has been completed.

SCE Assessments Initiated During 2002

Integrated Design for New Children's Museum, and Underfloor Air Distribution

Description: SCE was working with the Orange County Children's Museum to design a new facility. SCE facilitated a design charrette for the project and published a report summarizing the energy efficiency options that could be considered in the project. The options that were reviewed included envelope options, daylighting, lighting and controls, space conditioning, building materials, and indoor environmental quality improvements.

Status: In May 2004 the customer for this assessment project lost their rights to the proposed property and is seeking a new site. This project was terminated.

T-5 High Output Lighting System for High Bay Workshop and Variable Geometry Reflector System for HID Lighting

Description: The purpose of this assessment project was to determine whether T5 HO lamps can improve the overall area lighting and reduce energy consumption for a high bay workshop area for LA County.

Status: The final report has been completed.

Integrated Efficiency Improvements for Small Grocery Stores

Description: This project was to evaluate an integrated approach to improving the energy efficiency of the principal electrical end-uses in small grocery stores. As part of the project, the facility's lighting was to be retrofitted, possibly with T5 lamps and electronic dimming ballasts. The refrigeration system was to be retrofitted with a high efficiency condenser, a multiplex compressor rack, and an advanced energy management system.

Status: The final report was completed.

Integration of Energy Efficiency Improvements in a Small Sit-Down Restaurant

Description: This field assessment was formerly the "Multiplex Refrigeration in Small Sit-Down Restaurant" project. Due to roof structural concerns at the site and lack of other adequate equipment space, program staff recommended a new package of measures in lieu of the multiplex refrigeration system. Specifically, the project evaluated the combined use of over-sized condenser coils with PSC motors, ECM evaporator fan motors, electronic expansion valve, environmentally friendly refrigerants (R-404a and R-134a), and liquid-to-suction heat exchangers at the site. In addition, PVC wrapped and sealed insulation, used primarily in industrial refrigeration applications, was used in this project.

Status: The final report has been completed.

Integrated Hood Exhaust Backwall Make-Up Air System for Commercial Kitchen Hood Exhaust

Customer name: Applebee's Restaurants

Description: This project was one of three SCE technology application assessments that were part of a statewide, coordinated effort between the utilities to build upon the ongoing work in PIER Contract No. 500-98-031, "Improving Energy Efficiency of Commercial Kitchen Exhaust Systems."

Status: A test site has been located and an agreement has been signed. Project staff is working with the design team to design the kitchen exhaust hood. An extension for the project funding has been filed with the CPUC staff.

Perforated Supply Plenum Make-Up Air System for Commercial Kitchen Hood Exhaust

Customer name: Applebee's Restaurants

Description: This project was one of three SCE technology application assessments that were part of a statewide, coordinated effort between the utilities to build upon the ongoing work in PIER Contract No. 500-98-031, "Improving Energy Efficiency of Commercial Kitchen Exhaust Systems."

Status: The final report has been completed.

Variable Frequency Drive for Commercial Kitchen Hood Exhaust and Make-Up Air System

Customer name: Applebee's Restaurants

Description: This project was one of three SCE technology application assessments that were part of a statewide, coordinated effort to build upon the ongoing work in PIER Contract No. 500-98-031, "Improving Energy Efficiency of Commercial Kitchen Exhaust Systems."

Status: The final report has been completed.

Integrated Design for Non-Residential Retrofit Buildings

Description: SCE worked with the customer's design team to optimize the overall facility's energy usage using an integrated design approach during the design phase of a retrofit project.

Status: The final report has been completed.

Low-E Pigment for Stucco and Paints for Residential and/or Small Commercial Buildings

Description: Low-e pigment for stucco and paints was applied to building structures to reduce cooling loads and energy usage.

Status: The final report has been completed.

Spray-on Radiant Barrier for Existing Residential and/or Small Commercial Buildings

Description: A low emission coating was sprayed onto the underside of roofs to form a radiant barrier. The radiant barrier is supposed to reduce attic air temperatures, and consequently reduce a structure's cooling load.

Status: The final report has been completed.

PG&E Assessments Initiated During 2005

Green Building Studio Evaluation

Summary: The Green Building Studio is a web service application intended to support designers who wish to model the energy implications of building and systems designs. It will accept files from 3D CAD software or manual inputs of building designs and produce files compatible with several leading energy simulation and HVAC design software packages. This tool will help designers convert their designs to input data for compliance and design parametric runs, and will encourage designers to make earlier and more frequent efforts to comply with or exceed Title 24 requirements.

Status: The contractor is addressing cross-platform compatibility issues.

Energy Efficient Residential Advanced Windows

Summary: This project is a study of residential window technologies that are currently available or will become available to residential consumers. The study includes an analysis of measures to determine possible rebate levels and savings estimates, and was expected to be completed in 2005. However, recent technology changes and shifts in market availability required an update to the report.

Status: The final report is being updated.

Kitchen CFL Downlights

Summary: This project is an assessment of the energy-efficient CFL downlight fixture developed by the California Energy Commission's Public Interest Energy Research (PIER) program. The technology is a packaged downlighting kit, complete with can,

high performance lamp, and ballast. The unit includes unique thermal management for electronic ballasts, master/remote ballast geometry for reduced cost, high performance optics for reducing glare, and options for plug-and-play components to reduce installation time, site errors, and related costs. The fixture was jointly developed by the California Lighting Technology Center (CLTC) and Lithonia Lighting. The project is being conducted in partnership with homebuilders to demonstrate the viability of using the technology in the residential new construction sector.

Status: Kitchen lighting systems have been installed and test plan is being drafted for thermal performance evaluation.

Wet Cleaning

Summary: Perchloroethylene (also known as perc or PCE) is the solvent used by the vast majority of more than 5,000 dry cleaners in California and more than 30,000 dry cleaners operating in the United States. Evidence of the toxic nature of PCE and related health and environmental impacts began to emerge in the 1980s. This project is designed to jumpstart the diffusion of professional wet cleaning by converting two dry cleaners in the San Francisco Bay Area to professional wet cleaning and thereby serve as demonstration sites for other dry cleaners in the region.

Status: An agreement with BAAQMD has been executed to coordinate energy metering and analysis and market introduction at three sites. The first site has been selected and monitoring planning is underway.

Industrial Pumps & Fans

Summary: Pumps and fans are responsible for about 40 percent of motor energy use and account for more than a quarter of industrial electricity consumption nationally. The potential savings are more significant in pump and fan systems than for motors alone because pump energy use varies as approximately the cube of motor speed. The primary requirements to realize these savings are cost-effective methods to evaluate applications, methods to identify potential savings, and delivering the engineering solutions to customers. All of these requirements are being developed and piloted in applications under this project.

Status: Contract time extension needed in order to complete the assessment.

Impacts of Improved Daylight Metrics on CA Energy Use

Summary: Daylit buildings, combined with automatic photocontrols, have great potential to deliver substantial energy and peak demand savings. The current guidance for designing daylit buildings, however, is simplistic, static, and can even mislead designers into creating buildings that consume more energy, rather than less. As a result, the industry has set a goal to develop a new set of daylighting design criteria that are based on a dynamic analysis of varying solar position and climate relative to building design. These new metrics should establish acceptable criteria for visual and thermal comfort and facilitate faster market penetration for the use of daylighting. This project, co-funded by SCE, will develop a three-year plan for establishing new daylighting metrics and get these metrics adopted in appropriate design standards.

Status: The final report is under review.

The following four projects are part of the evaporative cooling suite of projects within the Mass Markets portfolio:

Indirect-Direct Evaporative Cooler

Summary: Two-stage or indirect-direct evaporative cooling technology offers the best opportunity for replacing air conditioning in California. The existing two-stage evaporative cooler on the market does not achieve maximum potential energy savings, and previous lab testing has shown an achieved evaporative effectiveness of 88 to 98 percent. The OASys product, however, appears to be able to improve performance. Lab and field monitoring has indicated that the OASys technology can achieve evaporative effectiveness from 104 percent to 111 percent.

Status: Internal work agreement is in place and expecting equipment delivery mid-August 2006.

BreezeAir Evaporative Cooler Validation

Summary: The BreezeAir single-stage advanced evaporative cooler is an Australian product that has recently been introduced into the U.S. market. This product differs from U.S. advanced technology in that it uses 4-3.5 inch thick pads rather than 1-8 or 12 inch thick pad, resulting in twice the surface area and half the static pressure loss. BreezeAir also uses variable speed fan technology, which in other applications reduces power draw. The purpose of this lab test is to determine unit evaporative effectiveness and compare the performance with single inlet advanced evaporative coolers.

Status: Internal work agreement is in place and the equipment is being prepared for evaluation.

Freus Evaporative Condenser Testing

Summary: Residential water-cooled condenser air conditioning technology has been available for several years. Water-cooled condenser technology can reduce electric demand by up to 46 percent at 1100F and can produce energy savings of 32-34 percent. However, the technology has also suffered from reliability issues, a limited product line and a weak distribution network. The manufacturer of this technology, Freus, appears to have resolved some of these issues. Their product is carried by at least two mid-sized HVAC distributors, and they have introduced several new models including a gas and electric package unit. Freus also offers a Demand Response option with a claimed 65 percent reduction in peak electric demand. This project is to determine if the energy and demand savings for the new models meets the manufacturer's claims.

Status: Project data collection is nearing completion; draft project report due mid-August.

Evaporative Cooler Market Penetration Study

Summary: The largest energy and demand savings opportunities in the residential and light commercial sectors are in cooling. The use of air conditioning continues to grow in California due to increases in income, and in inland regions such as CEC Climate Zones

11, 12, and 13 where evaporative cooling could save significant energy. Improving California's energy efficiency therefore depends on increasing the market penetration of new and existing cooling technologies. This project will investigate cost-effective ways to increase market penetration of evaporative cooling.

Status: Reviewing final report draft.

Supermarket Kitchen Ventilation Control

Summary: Commercial kitchen ventilation systems are critical to maintaining indoor air quality and improving fire safety. Ventilation systems also account for a large portion of facility energy use, particularly when other air systems are used (air conditioning in interior climate zones; heating for some coastal areas). Adjusting ventilation rates to reflect actual demand has already been shown to improve energy efficiency in large institutional kitchen and full-service restaurant settings. This project will implement ventilation demand control in a supermarket food service application where ovens are the predominant equipment.

Status: Reviewing final report draft.

Home Electronics Opportunity Study

Summary: This is a market and technology scoping study of emerging electronics technologies targeted to the mass consumer market (e.g., home video and audio systems, office electronics). The project is investigating the technologies emerging into the marketplace and seeks to identify opportunities to influence their energy efficiency and demand.

Status: Reviewing final report draft.

VAV Box Data Development

Summary: The commercial sector uses variable air volume (VAV) systems to provide more efficient heating, cooling, and ventilation than constant volume systems. To function properly and efficiently, these systems must balance fan and VAV box controls to supply only the needed air and heat to the building HVAC zones. VAV boxes, however, are generally not set to operate efficiently in low flow conditions due to a lack of information about the interaction of the box and its controller. This project is intended to evaluate how VAV boxes can be controlled and stabilized at low flow rates.

Status: Contract extension has been executed and work is continuing.

Wireless Lighting Controls

Summary: The intent of the Wireless Lighting Controls project is to bring wireless lighting controls out of the R&D stage and implement them on a large scale in existing commercial buildings. ET funding is being combined with manufacturer product funding and customer installation funding at the early commercialization stage for this technology.

Status: Contract has been executed. Verifying if technology is ready for testing. Expected to begin installation in last quarter of 2006.

80 Plus Program

Summary: The 80 Plus Program is a national program to develop and accelerate into the market higher-efficiency desktop computers and servers. The program offers rebates to computer manufacturers who incorporate power supplies with a minimum efficiency of 80 percent.

Status: Project completed. A kickoff meeting was held in January 2006 to transfer the project to customer programs.

High Density Data Center Air Management – Phase II

Summary: An initial Scoping & Feasibility project showed that data centers continue to be a high energy demand/consumption sector. Furthermore, industry surveys and brainstorming sessions with key industry staff provided good information regarding promising technologies for assessment. This Phase II technology assessment implemented one case study technology at a high-density data center.

Status: Site work is complete; final report draft expected in last quarter 2006.

PG&E Assessments Initiated During 2004

Advanced Evaporative Cooler Media

Summary: The first phase of an evaporative cooler technology evaluation project conducted in 2003 tested the performance of advanced evaporative coolers (AECs) that used eight-inch thick rigid media. The results showed that advanced coolers are 68-70 percent more efficient than conventional coolers. However, the achieved evaporative effectiveness was lower than the expected .85 effectiveness. This project determined if 12 inch thick rigid media can achieve a .85 or better evaporative effectiveness.

Status: The final report has been approved for distribution.

Indirect Evaporative Cooler Evaluation

Summary: An indirect evaporative cooling technology has been developed and produced on a small scale under the brand name Coolerado Cooler. This project purchased a single unit equal to the average size installed in CA homes and conducted performance testing under laboratory conditions that simulate the hot dry California climate. The testing determined if the indirect technology can deliver the claimed cooling capacity and energy efficiency and can potentially replace conventional refrigerant air conditioning.

Status: This project is complete, and the final report is under review in preparation for distribution.

Furnace Blower Test

Summary: Currently there is no uniform, single method of testing and comparing airflow and efficiency of competing furnace blower and motor technologies that answers all the questions of utilities and manufacturers. This collaboration of PG&E and LBNL compared the performance of furnaces and motors, and also make suggestions for modifying test procedures to accommodate the new equipment. Two furnaces and five

different blowers and blower motors were used, including: two standard permanent split capacitor (PSC) motors with forward curved impellor blades, a brushless permanent magnet (BPM) motor with forward curved impellor blades, and two prototype BPM motors with reverse inclined impellor blades.

Status: The final report is being revised to meet ET Program requirements.

Relocatable Classroom IDEC Evaluation

Summary: This project retrofit two existing relocatables with IDEC systems to assess ease of installation, equipment performance, impacts on energy usage and demand, and general impressions of classroom users.

Status: Monitoring has been performed through June 2006. The final report is in review.

25 Watt T8 HC*T* Lighting

Summary: This technology assessment is testing the performance and reliability of the new Philip's 24-Watt T8 four-foot fluorescent when used with standard instant-start ballasts designed to operate 32-Watt T8 lamps. The lower wattage lamps have reduced light output that should eliminate brightness concerns in previous HCTL demonstrations.

Status: This project is in progress. A host site has been identified and the project manager is working with the new property managers to secure installation.

Data Center A/C Optimization

Summary: This project demonstrated technologies in the area of air management, operation strategy, and/or heating, ventilation and air conditioning ("HVAC") air-side economization.

Status: The site work is complete and the draft final report is being prepared.

Relocatable Classrooms Integrated Lighting

Summary: This project will demonstrate and assess a new integrated lighting system for relocatable classrooms for K-12 schools in the PG&E service territory. The project is being undertaken in partnership with the School Resources Program (SRP) under Richard Flood.

Status: The project has been completed and the technology has been transferred to the SPC program.

Bi-Level Stairwell Lighting (Phase 1)

Summary: The bi-level stairwell lighting project determined the energy usage and cost impacts of a retrofit stairwell lighting system in a multi-family residential building in San Francisco. The building installed a new type of stairwell lighting fixture that reduces the lighting level for stairways in commercial buildings by reducing the lighting levels when there are no occupants in the stairway. This project made measurements and evaluated 1) the pre-install energy usage, 2) post-install energy usage, 3) impacts on

building occupants and visitors, and 4) impacts of local building or fire codes on installation in these two applications.

Status: The final report has been approved for distribution, and the project manager is worked with PG&E program managers on program adoption of this technology as a deemed measure for 2006. The technology has not been incorporated as part of the Express Efficiency program.

Bi-Level Stairwell Lighting (Phase 2)

Summary: This bi-level stairwell lighting project will determine the energy usage and cost impacts of a retrofit stairwell lighting system in a commercial building in San Francisco. PG&E is assisting the commercial building manager in a similar retrofit to the multi-family residential project by installing a new type of stairwell lighting fixture that reduces the lighting level for stairways by reducing the lighting levels when there are no occupants in the stairway. This project will make measurements and evaluate 1) the pre-install energy usage, 2) post-install energy usage, 3) impacts on building occupants and visitors, and 4) impacts of local building or fire codes on installation in these two applications.

Status: The stairwell lighting fixtures have been installed, and the contractor has performed an initial site review and developed a monitoring plan.

Commercial Kitchen Ventilation (CKV) - Gas Control

Summary: This project is an evaluation of a CKV demand control system at Skates restaurant. The system controls ventilation hood fans based on the amount of natural gas feeding the cooking equipment line. This project will analyze performance and compare the results to the results from a previous PG&E ET project that evaluated the Melink system that uses temperature and an infrared control strategy.

Status: This project was halted as the control system provider has abandoned the technology and market.

Relocatable Classroom Integrated Daylighting

Summary: This project will design, demonstrate, monitor and evaluate improved sidelighting, skylights, solar tubes, and lighting controls installed in relocatable classrooms (RCs) in three different climate zones in the PG&E service territory. ET funding is being combined with funding from the School Resources Program (SRP) to maximize and accelerate the energy and demand savings of RC technologies.

Status: The final report is in progress and is expected to be reviewed at the end of the summer in 2006.

Modular Skylight Validation

Summary: This project targets the new construction retail/commercial sector to reduce the lighting load in large properties with suspended ceilings. Previous field evaluations showed significant potential for reducing energy use and peak demand for such establishments. Work was done previously under CEC-PIER to identify packaged,

modular skylights that facilitate such installations. This project will demonstrate and qualify packaged skylights to accelerate application in the retail sector.

Status: The project was halted due to an inability to identify an appropriate host site.

Commercial Kitchen Tankless Water Heater

Summary: This project includes the design, installation and performance evaluation of water heating systems at a full-service restaurant, including high-efficiency tank water heaters, tankless water heaters, recirculation pump controls, and standard efficiency measures such as pipe insulation. The assessment will document energy, demand and cost savings and system performance, and the results will be used to plan potential rebate and/or codes and standards programs.

Status: The project had a change of scope and was granted a time extension. Testing is currently in progress.

PG&E Assessments Initiated During 2003

Relocatable Classrooms Daylight Dimming and Simulation

Summary: The objective of this project was to quantify the savings from the use of solar tubes as day lighting sources in relocatable classrooms. Specifically, the classrooms were retrofitted after baselining to determine the extent to which the use of solar tubes can cut the use of lighting power in the classroom. Monitored data was used to analyze the savings and to calibrate computer models that allow the determination of impacts around the state and on the HVAC system of the classroom.

Status: This project is complete, and the final report is being prepared for distribution.

Verified A/C Refrigerant Charge & Airflow

Summary: This study identified, evaluated, and examined market readiness for all existing residential air conditioner charge and air flow verification services. Verification service companies train, certify, list and collect testing data for independent contractors who agree to participate in charge and airflow verification. The verification service provides charge and airflow data which can be used to document energy savings.

Status: This project is complete, and the final report is being prepared for distribution.

Commercial Kitchen Ventilation (CKV)

Summary: This project designed and installed an optimized Commercial Kitchen Ventilation (CKV) system at one project site. The system was comprised of a variable air volume exhaust hood; backwall supply makeup air; side panels on hood; perforated diffusers; and evaporative cooling of makeup air (dependent on project location/climate). The assessment determined the energy, demand, and cost saving benefits, and the results will be used to plan potential rebate and/or codes and standards programs.

Status: The final report has been approved for distribution.

Tankless Residential Water Heaters

Summary: This project investigated opportunities for and barriers to tankless (i.e. instantaneous) natural gas water heaters in residential single family and multi-family buildings (initially for new construction applications, and subsequently retrofit applications).

Status: The final report has been approved for distribution.

High Color Temperature Lighting

Summary: This project includes the design, installation, energy usage monitoring, and user/visitor satisfaction measurement for a High Color Temperature Lighting System at a demonstration site with significant target market visitor traffic. The design will demonstrate best lighting design practices utilizing High Color Temperature Lighting in a real working environment. The intent of the project is to confirm user acceptance of High Color Temperature Lighting and provide a venue where the target market can view the energy-saving benefits of the technology.

Status: This project is ongoing. Data is being compiled and customer satisfaction surveys are being collected.

Diagnostics and Commissioning

Summary: This project utilized the results of the PIER LBNL and PIER ACE projects to develop an assessment/demonstration plan for the most promising diagnostics and commissioning technologies. The project demonstrated commissioning and diagnostic procedures and developed cost savings estimates.

Status: The draft final report has been approved for distribution.

Advanced Evaporative Coolers vs. Baseline Testing

Summary: This project evaluated and compared the performance of two types of advanced evaporative coolers to the traditional evaporative cooler. The results allow validation of energy savings and other manufacturer performance information.

Status: This project is complete, and the final report is being prepared for distribution.

SDG&E Assessments Initiated During 2005

Expansion of PERC Cleaner Evaluation to SDG&E territory

Description: This assessment will introduce alternatives to PERC dry-cleaning by way of demonstration stores for several technologies. The results of this assessment will strengthen the data being collected by the SCG/SCE collaboration already underway.

Status: Contracts have been signed, and collaboration with the San Diego APCD and regional EPA is anticipated.

Hybrid Solar Lighting Product Demo

Description: This product development was sponsored by DOE and is ready for trial. The site chosen will be at San Diego State University and will be evaluated throughout next year.

Status: The installation is pending.

Camp Pendleton Ground-coupled Heat Pump Demo

Description: The Trane Co., FEMP, and SDG&E are partnering in the evaluation of a new product offering energy savings through space conditioning with a ground-couple heat pump system. If successful, an application in commercial office buildings will be evaluated.

Status: Ongoing.

SDG&E Assessments Initiated During 2004

Evaluation of UVc on HVAC coil performance

Description: This assessment evaluated the use of UVc as a treatment for HVAC ducts to improve efficiency performance and mitigate bio-growth (CEC-PIER project continuation in a school classroom HVAC system).

Status: Reports from the consultant in mid-2006 found no changes of any significance to airflow or any improvement in EER. The study could make no conclusion connecting the UVc treatment with improved IEQ by way of a statistically significant improvement in ADA (average daily attendance).

Thermal Displacement Ventilation Demo

Description: This assessment evaluated a field test of thermal displacement ventilation in a K-12 school classroom application (CEC-PIER project continuation toward commercialization of a new OEM product specially optimized for this space and duct system).

Status: This assessment has been completed. There are strong prospects that thermal displacement ventilation can provide thermal comfort, adequate mixing and CO2 removal with significant energy savings (both heating and cooling). Additional ET assessments are recommended once the HVAC "product" is released for general distribution, or other systems are available for evaluation.

SCG Assessments Initiated During 2005

Advanced Multiple Boiler Control System by Autoflame

Customer name: Edna Pagel Boiler Control

Description: Autoflame, a British Company, is introducing a controller made to handle the operational integration of multiple boilers over complex and varying steam load demands throughout the production day. This effort will test the effectiveness of one system at a food-processing manufacturer.

Status: Multiple large boilers at a food processor are being “coordinated” by the Autoflame System controllers. The installation is completed and data is being collected.

Commissioning process - LAUSD ES-1 Cahuenga

Customer name: Los Angeles Unified School District

Description: The process of 'commissioning' new school facilities (and all commercial and government buildings) is underutilized but has the potential to ensure tremendous energy savings. This project collaborates with the LAUSD in attempting to ensure their ‘next generation' K-12 facilities are Collaborative for High Performance Schools (CHPS) rated. This project will help identify and calibrate the market barriers currently encountered with 'state-of-the-practice' commissioning services.

Status: The Contractor (Farnsworth Group) is documenting the Cx process, hurdles encountered with LAUSD and its contractors, and challenges to the incorporation of Cx as a normal component of the school construction process. ES-1 has encountered many delays and personnel changes. The general contractor was let go. It is a project that is over 1 year behind initial completion. Cx is expected to be completed by the end of 2006.

Commercial Condensing Boiler Demo

Customer name: Koinonia

Description: Hamilton Engineering has introduced an advanced hot water boiler whose applicability to the laundry service business is being evaluated. As gas prices increase and very low NOx emissions are required, these higher priced technologies are becoming more economical. The performance and reliability of this product in a laundry service application will be tested.

Status: Two deployments of the EVO-99 condensing boiler are being evaluated in this effort. The installation is completed and data collection has begun at one site.

Advanced System controls with ultra-low NOx Alzeta Burner

Description: Most new burner systems that strive to comply with extremely low NOx emissions standards struggle to maintain previous efficiency performance. Alzeta has developed a novel control strategy marrying re-circulated and combustion air management to optimize fan power savings while maintaining low emissions targets with extremely tight excess O2 control. Applied to large boilers this could lead to significant operational savings. This strategy improves on the efficiency performance of a low NOx burner system for a boiler by optimizing fan power consumption with careful control of flue gas recirculation and combustion air control.

Status: After many unanticipated delays at the food processor facility site, the “system” is expected to be fully operational by Aug. 2006, with data collection continuing through the end of the year.

Tankless Water Heater Assessment @ Fitness Complex

Customer name: Extreme Fitness, Inc. Center

Description: The newer generations of tankless water heater products are entering the market and various niches and application options are being demonstrated and evaluated for energy savings. This project addresses an opportunity at a Fitness Center near Toronto, Canada. Comparison with a conventional system involving a hot water boiler and storage tank system will reveal performance differences and potential energy savings.

Status: This project is collaborating with several Canadian gas utilities that are also interested in the performance of tankless water heating products in several market segments. The system is under construction and contracts are being executed among utilities for support funds.

Solar Thermal Water Heating - City Pool Demo

Customer name: Sierra Madre City Pool

Description: This project will evaluate the performance, installation issues, dependability and economics of a solar thermal system. A SunTrek system was placed in service at a municipal pool and will be observed for several seasons. The conservation of boiler fuel will be recorded/estimated.

Status: The installation is complete and data collection will begin following installation of critical metering equipment.

SCG Assessments Initiated During 2004

Advanced FIR Burner Application in a Fluid Heater

Customer name: Onyx Environmental

Description: The high efficiency, ultra-low NOx FIR burner system developed by GTI and introduced in fire-tube boilers by Johnston Boiler Co. was modified for use in a thermal fluid heater (@400HP) used to destroy toxic waste materials. This effort represents a significant market expansion opportunity and confirmation of the robust design and adaptability of the burner concept.

Status: This unique application in a 350hp thermal fluid (oil) heater had many challenges, but eventually stabilized and seems to be performing at the required levels of emissions. The project will continue to take data and review burner modulation for another year.

CSUN (Ca State Northridge) BCHP

Description: A cluster of six Capstone 330's with two heat recovery units (HRUs) is sited at the central facility in CalState Northridge as part of an evaluation of the efficiency and performance of this system.

Status: The installation is complete, and the data collection is almost complete for an initial review of system performance.

Industrial Engine CHP with Adsorption Chiller

Customer name: Styrotek

Description: A manufacturer of plastic parts has purchased and installed a 1 MW on-site generation system (3 rich burn engines). The project is evaluating the coupling of this system with a Nishiyodo adsorption chiller, driven by heat recovered from the engines.

Status: The installation is complete and data is being collected.

Industrial CHP Demonstration with Bowman MT's

Description: This project is an industrial CHP assessment at a brick manufacturer (Higgins Brick) and will install three Bowman microturbines with heat recovery to the brick kiln (in collaboration with DOE).

Status: The installation is complete. One microturbine failed and was replaced. Data is now being collected and analyzed, and the operation is not consistent or routine yet. The analysis will likely extend into next year.

IC Engine drive Refrigeration w/Heat Recovery

Description: A beverage manufacturer (Cott Beverage) is adding a three-engine (160hp ea.) refrigeration system with heat recovery that should offset between 75,000-100,000 th/yr of boiler fuel. The project is trying to assess the durability, performance and general economics of this type of system.

Status: The installation is complete and the performance assessment is underway.

Engine-driven Chiller @ UCSB

Description: This project will demonstrate an engine-driven chiller at UCSB with heat recovery and the performance will be evaluated. Therm savings of about 50,000 therms/yr. are expected depending on how the system is integrated with other university operations. Engine dependability and reliability will be assessed.

Status: The installation was delayed by other priorities at the Santa Barbara campus. Completion and commissioning is expected by the end of the year.

SCG Assessments Initiated During 2003

Guidant Air Compressor

Description: This project is a general assessment of the durability of gas-firing engine-driven air compressor systems in critical manufacturing service. Heat recovery is included to improve system efficiency and project operating economics.

Adsorption Chiller - Mission Plastics

Description: A plastics manufacturer sited a 1 MW cogeneration system at his facility (owned and operated by an ESCO) and the project evaluated the heat recovery equipment, which was a new AD-sorption chiller from Japan (the first known application in the service territory).

FIR Burner - Reinhold Industries

Description: Following the first successful deployment of the FIR burner at Fullerton CC, this and other assessments were planned to continue the evaluation of the scale-up of the technology.

Occidental (PPERC - II)

Description: Phase II of this collaboration with SCE involved the unique development of simplified, less invasive measurement strategies/protocols for developing consistent, credible data at these small cleaning businesses. No protocols had been developed before this project.

Capstone MT on blended fuel at Cal Poly SLO

Description: An attempt was made to work with a professor at SLO who had other DOE government grants to explore renewable energy from dairy waste. The project was interested in assessing blends of renewable fuels and natural gas in microturbine (and other prime mover) power generation.

Trend Offset Printing

Description: This project was a demonstration and assessment of a regenerative thermal oxidizer at a large lithographer/printer with multiple presses. Older conventional gas-firing oxidizers were replaced and significant gas savings were achieved.

Status: This result has been handed off internally to the EE planning group for industrial projects. Other customers who can use this product are being sought.

PACRAT Demonstrations - @ USC; @ UCSB; @ Cedars-Sinai

Description: The purpose of these three trials of PACRAT was to judge the commercial readiness of a software-product-business model for continuous building commissioning. Cedars-Sinai, UCSB, and the USC campuses were the willing participants. Diagnostics and recommendations were derived and checked.

Status: This technology still has a large potential to save significant energy in buildings. The findings from this work will be used to steer further research toward a business model that has a better chance to succeed.

Cummins-Westport demo @ Anaheim Convention Center

Description: This project was an advanced proprietary combustion scheme to combine liquid and gaseous fuel to achieve efficiency and low emissions in large, lean-burn cogeneration Cummins engines. This technology is being evaluated at Anaheim Convention Center, and the project is collaborating with the City Engineers to test and review results.

APPENDIX B: INTERVIEW GUIDES

ETP PROGRAM MANAGER IN-DEPTH INTERVIEW GUIDE

Interviewees (Phase 1)

ET Program Managers

Interviewees (Phase 2, Contacts collected from Phase 1 Interviews)

Utility customer reps

EE Program managers

Manufacturers

Demonstration site customers

Big picture issues:

- How does the program staff identify potential technologies? To what extent are the program managers pro-active and/or reactive with regard to identifying or seeking out new technologies?
- Overall, is it a bigger problem to find qualifying technologies or to narrow down a list of potential candidate technologies?
- What percentage of the technologies selected have already been demonstrated in other countries/regions/markets and are being tried in California (as opposed to not having been proven in any markets?)
- What criteria does the program use to screen potential technologies?
- What percentage of the technologies come from established manufacturers, and what percentage comes from entrepreneurial startups that might need further funding? How do these differences between the owners of the intellectual property (technologies) affect the ability of the technology to reach greater commercialization?
- To what extent is the selection/screening process formalized and documented?
- How does the program make sure that it is addressing the needs of its customers?
- How are the assessment results used?
- What entity or organization has the main responsibility for commercializing ETs? How does the ETP work with that entity?
- How does the program communicate with other key stakeholders? e.g. other EE programs, R&D organizations, customers, and manufacturers

Candidate Technology Selection

1. Can you describe the initial steps you take to identify a new technology? About how many new technologies do you screen per year? And how many of those end up being selected?

2. Can you explain how the following groups are in involved with the technology selection process?

   a) Manufacturers (Probe for sources of manufacturer awareness. Do manufacturers ever approach the ETP or does ETP usually approach manufacturers? What are the communication channels? Are you more likely to work with manufacturers in your service territory? In California? Or is location not an issue?)

   b) Research organizations (e.g. PIER, LBNL, others? Probe to see if there is a push/pull relationship here, i.e. does the ETP influence the R&D orgs to pursue technologies that are relevant to the utility customers' needs? What are the communication channels?):

c) Customers (Industrial? Commercial? Institutional?):

   d) Other energy efficiency programs (within your utility; in state; out of state):

   e) Utility customer reps

3. What have been the biggest barriers to identifying new technologies?

4. What resources/techniques have proven effective?

5. What else would help you to identify new candidate technologies?

6. How often do you have contact with customers and/or their reps?

7. How many of your projects originate from "customer pull?" If possible, can you please provide 3 examples of assessments that were initiated during 2004-2005 that are "customer pull" projects?

8. How are customers made aware of the ETP and the resources it presents?

9. When a customer expresses a need for a certain technology (customer pull), how does the ETP program able to influence the research community to pursue technologies that meet these needs?

10. How many of your projects originate from "technology push?" ?" If possible, can you please provide 3 examples of assessments that were initiated during 2004-2005 that are "technology push" projects?

11. How are the needs of customers considered?

Technology Selection Criteria

12. Can you describe any formal or informal selection criteria that you use to select technologies (e.g., technology maturity, market potential, savings per unit, ROI)?

13. How does the selection process balance higher-potential technologies that have greater risks and market barriers against less risky technologies that are less likely to have a major impact? Can you give some examples of each technology type currently in the program?

14. How is equity across different customer groups addressed in the selection process?

15. How are other funding channels utilized and does this affect the selection process? (Ask for examples: what funding channels, what percentage of the cost)

16. Of the technology assessments, what percentage of the technologies come from established manufacturers and what percentage are from smaller research labs?

17. How do differences between the owners of the intellectual property (technologies) affect the technologies ability to reach broader commercial markets? How does this influence which technologies are chosen for assessments?

Demonstration Site Selection

18. How are test sites determined?

19. How willing are customers to be used as a test site? What are the customer's responsibilities and risks in agreeing to serve as a test site?

20. What have been the challenges associated with finding appropriate test sites and working with the customers and technology suppliers?

21. How satisfied have customers been with the demonstrated technologies at their sites?

22. To what extent have demonstration sites been visited/used in technology promotion?

Assessment Implementation

23. How do assessment goals vary between projects?

24. During the implementation of a technology assessment, what are the responsibilities of the following participants?
    a) Interviewee:

    b) The ETP:

    c) Contractors:

    d) Demonstration site customer:

25. How does the program adapt to new information and feedback during an assessment? (Probe to see if the program allows for sufficient flexibility to change project scope as necessary during an assessment.)

26. How much time (FTE) is typically devoted to a given project by ETP staff?

Information Dissemination

27. When an assessment is completed, how are results reported?

28. How are results shared with:
    a) Manufacturers: Does the ETP work with manufacturers to incorporate the assessment results in order to improve products or guide development of new projects?

    b) The research community? Does the ETP work with the research community to incorporate the project results in new research?

    c) Pertinent customers?

    d) Different energy efficiency programs? If a technology is recommended for inclusion in an energy efficiency program, how does the ETP staff work to get the technology incorporated in the given program? Are there ways that this process could be improved?

29. Does the ETP continue to be involved with promoting and disseminating assessment results after the results are initially disseminated?

30. Do you have any other suggestions on how information dissemination could be improved? How do you think assessment results could be better leveraged to maximize the program impacts?

31. What entities or organizations are responsible for bringing successful technologies to commercialization? How does the ETP work with these organizations?

32. When a technology is deemed to be inappropriate for CA, how are the results reported and to whom? What are the challenges in reporting about technologies

that do not pass the assessment? (THIS IS SOMETHING THAT MAY NOT BE APPROPRIATE FOR THE PUBLISHED STUDY REPORT).

33. Who is responsible for keeping your program's activities up-to-date on the database?
    a) How often does your program update the database?
    b) How has the database proved useful for your program?
    c) How do you think the database could be improved?

Coordination

34. Please describe how you coordinate ETP activities with the following (For each, probe on how things are going, how it can be improved, etc.):
    a) ETP staff at the other utilities
    b) Other EE programs
    c) CEC / PIER
    d) Demonstration site customer:
    e) Others?

35. For our next round of interviews, we are going to talk to other stakeholders involved with the program. Can I get your suggestions for people to talk to within the following groups? (Get contact info for each)
    a) EE Program managers that work with the ETP
    b) Customer reps
    c) Manufacturers
    d) Demonstration site customer:
    e) Others?

36. For each of those groups, what key issues do you think we should address in the interviews?

Conclusions

37. As an ETP program manager, what are your greatest challenges?

38. Do you have any other comments that you would like to make about issues that were not covered thus far in the interview?

ETP IDI GUIDE – OTHER EE PROGRAMS

Interviewees (Phase 2, Contacts collected from Phase 1 Interviews)

EE Program managers

Candidate Technology Selection

1. Does your program have, or do you expect it to have a deficiency in eligible energy efficiency technologies making it difficult to meet program goals? [What specific markets or kinds of technologies are needed most? What challenges do you expect in the future in terms of the availability of technologies appropriate for your program?]
2. Where do you typically look to find new technologies to incorporate into your program?
3. How does your program interact with the ETP? [How frequently is there communication? What are the communication channels? What are the issues you discuss with the ETP?]
4. How do you leverage the ETP as a resource for your program?
5. Do you help the ETP identify technologies for assessments? How? Which ones?
6. Do you help the ETP to select technologies that are chosen for assessments? How Which ones?
7. How do you communicate your program's needs to the ETP?
8. How has the ETP been able to meet your needs?
9. What type of information and/or support from the ETP would be most valuable for your program?
10. Do you believe that the ETP has been effective at choosing technologies that have the potential to substantially impact your program? Do you see any problems with the kinds of technologies that the ETP chooses for assessments?
11. Are there certain types of technologies that you believe the ETP should put a greater focus on?
12. Are there particular market sectors that the ETP should be focusing on?
13. Are there particular end uses that the ETP should focus on?

Information Dissemination

14. Are you aware of technology assessments that are in the pipeline? How are you made aware? Is this knowledge helpful for your program?
15. When the ETP completes an assessment of a technology that is relevant to your program, how do you learn about the results?
16. When an assessment concludes that a technology is appropriate for your program, what steps are then taken to incorporate this technology into your program?
17. How long does it typically take to incorporate a technology from a successful assessment into your program?
18. Is there anything about this process that you believe could be improved?

19. Once a technology is in the program from the ETP, what steps does your program take to promote the technology? (Very important question) [If they are unaware of technologies accepted through the ETP, prompt them with examples. If still don't know, ask them how their program would promote a new technology that came out of the ETP.]
20. Can you give me any examples of technologies that came to your program from the ETP that customers have started adopting through your program?

Conclusions

21. Do you have any other comments on the ETP that we haven't covered yet?