Evaluation of the 2002
California Statewide Emerging Technologies Program

Submitted to

Southern California Edison Company

Submitted by

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The ETP is a statewide information-only program that seeks to accelerate the introduction of energy efficient technologies, applications, and analytical tools that are not widely adopted in California. The Program targets nonresidential and residential customers, and is composed of two parts: 1) Demonstration & Information Transfer, and 2) the Emerging Technologies Coordinating Council (ETCC). The Demonstration & Information Transfer portion of the Program focuses on near-commercial and commercial energy efficient applications with low market penetration. Demonstration projects, conducted at either customer sites or in a controlled environment, provide design, performance, and verification of energy efficient systems, helping to reduce the market barriers to their wider acceptance. Additionally, these projects help to measure and document the potential future energy savings of specific applications in different market segments.

The keystone of the statewide coordination effort is the ETCC. The ETCC includes program representatives from Pacific Gas & Electric, Southern California Edison, San Diego Gas & Electric, Southern California Gas, and the California Energy Commission (CEC) Public Interest Efficiency Research (PIER) Program. The objective of the ETCC is to seek opportunities to coordinate efforts between utilities within the statewide program as well as with the CEC PIER program. The ETCC coordination effort is designed to ensure that effective communication occurs among entities involved in either the development or delivery of new energy efficient technologies in California. If implemented as designed, the ETP can form a vital link in the commercialization of energy efficient emerging natural gas and electric technologies and applications.

1.2 Evaluation Objectives

The original evaluation objectives were to:

1. evaluate program success by measuring indicators of program effectiveness and test the assumptions underlying the program theory, and
2. provide ongoing feedback and corrective guidance regarding program design and implementation.

Due to insufficient data (see Section 3.2 for details), we concluded that while it was possible to examine some indicators of program effectiveness and provide ongoing feedback and corrective guidance, it was premature to test any of the assumptions underlying the program theory. Essentially this meant that we would only conduct a *process* evaluation, leaving the impact evaluation to a later date.

Thus, the main focus was on describing the activities of the Statewide ETP that occurred in the calendar year 2002, while reinforcing the notion that the various products developed, implemented, and evaluated by the ETP typically require more than a single year to complete. As a result, we were still able to measure some elements of program effectiveness by examining program inputs (e.g., program budgets, use of existing resources), program activities (e.g., technology screening, ETCC activities), and program outputs (e.g., demonstration projects, ET database, dissemination efforts, cross-program support). We were not able to examine any program impacts or outcomes (e.g., changes in awareness, knowledge, attitudes, and behavior with respect to emerging technologies).

1.3 Conclusions and Recommendations

1.3.1 The Emerging Technologies Coordinating Council (ETCC)

Based on interviews conducted, there is agreement both on the frequency of ETCC meetings and the relevance of the topics discussed. There was also agreement that the ETCC is an effective forum for sharing information among it members and a strategically sound mechanism for coordinating the statewide emerging technology effort.

1.3.2 Emerging-Technology Database

Overall, the Emerging Technologies (ET) database appears to have met its original purpose of serving as a repository for information about emerging technologies. With respect to the database, we recommend the following:

- The database should have a unique identifier for each project. The structure of the database should allow a unique project to have multiple technologies associated with it.
- Variables within the main tables for which all data are missing should be reviewed and updated to include relevant data as necessary.
- Full documentation of the database structure and definitions of the terms within the database should be prepared. This will improve the overall consistency of data entered by multiple users.

For the data from the database that are available in summary form as PDF documents on the ETCC website, we make the following recommendations:

- On the web site, describe the various files that are available and how they can be used to find information.
- Create the ability to email project managers regarding specific technologies and/or projects.
- Fully describe the variables that are used within the summaries so that interested parties can understand what is within the summary.
- Each project indicated within the report summaries should have a unique identifier.

More details on the ET Database can be found in Section 5.2.

1.3.3 Program-Tracking Database

The ET Database does not provide, and was never intended to provide, project-level information necessary to meet all of the basic accountability requirements of the CPUC *and* to support an evaluation. We recommend that a program-tracking (PT) Database be created by each utility that complements the data currently stored in the ET Database. The core variables collected and stored in the PT Database should satisfy the needs of the various stakeholders, including the CPUC, the program managers, and the EM&V staff within each utility. Full documentation of the PT Database structure and definitions of the terms within the database should also be prepared. Finally, the PT Database must be structured so that specific variables can be merged at the project level with the ET Database.

1.3.4 Regulatory Framework

CPUC requirements with respect to the types of technologies investigated and the duration of projects have changed over time. Moreover, the number and type of technologies and their duration have to some extent been affected, since 1998, by the year-to-year uncertainty regarding the very existence of the ETP and levels of funding. This uncertainty and changes in budget amounts very likely affected whether certain projects were initiated and decisions to terminate existing projects.The importance of multi-year funding necessary for long-term stability for such programs as the ETP cannot be over-emphasized.

Within this regulatory framework, there are three additional observations: 1) the current measures of ETP effectiveness, established by the CPUC and the four IOUs, ignore a number of critical ETP activities, 2) there are promising technologies available from the Public Interest Energy Research (PIER) Program and other research organizations that cannot be pursued by the ETP due to limited budgets, and 3) there are key ETP activities, such as comprehensive screening of candidate technologies and the dissemination of the results of technology assessments, that cannot be fully implemented due to limited budgets. These three problems might make it more difficult to achieve and even surpass the maximum achievable energy efficiency potential identified by Rufo and Coito (2003a and 2003b). Thus, we recommend that key stakeholders, prior to the implementation of the 2004-05 ETP, or prior to the end of the first quarter of 2004, adopt additional, measurable objectives related to a broader range of key ETP activities. These additional objectives could be added as an addendum to the 2004-05 Program Implementation Plans. We emphasize that all objectives should be established in light of the eventual budgets for 2004-05. If the budgets for 2004-05 are decreased, we recommend a proportional scaling back of all ETP activities and goals rather than completely dropping a key activity or activities.

Finally, given the aggressive resource acquisition goals set forth by the CPUC, we recommend that funding for the ETP be substantially increased so that all key ETP activities are adequately funded and that a larger number of promising technologies can be explored. See Section 6.4 for more detail regarding the regulatory framework.

1.3.5 ETP Projects, Technologies, and Transfer

The ETP has a multi-year focus and has extensive activities taking place in any one calendar year with budgets allocated in one program year that are spent in subsequent program years. On average, the duration of projects is 2.5 years. The majority of technologies within the program are considered to be in the commercial introduction stage. However, there are many projects in which a more mature technology is being introduced to a new market sector. The ETP covers a wide range of end uses, from HVAC to lighting to manufacturing processes. Within 2002, there were eleven projects completed. Over half of the completed projects were described as having been transferred to an energy efficiency incentive program or an information program. Only one of the eleven completed projects was not recommended as worth pursuing. With respect to sectors, 74 percent of the ETP projects cover the commercial sector while 36 percent cover the industrial sector.[1]

The type and number of projects, the time to complete them, and the rate at which they are being deployed into energy efficiency programs or into the market seem reasonable given the resources available. See Section 5.3 for more details.

1.3.6 Technology Selection and Information Dissemination

Project managers use a variety of strategies and sources to identify new ETP technologies and disseminate information. Of the six linkages in the program logic model that we investigated, all but two linkages received moderate or strong validation[2]. Those linkages receiving weak validation are concerned with the use of market-related primary and secondary research to identify potential demonstration projects and to disseminate the results of technology assessments through the use of strategic marketing campaigns. None of the project managers interviewed indicated that secondary data such as saturation studies, customer needs-and-wants studies, market potential studies, market-share tracking studies, and evaluation studies were used in reviewing candidate technologies. With adequate funding, these components could be strengthened.

In addition, the Internet is not used to its full extent as a tool for disseminating information about ETP. We recommend that the statewide ETP determine the best approach to using the various IOU websites and update these sites appropriately. This would minimally include information about the program projects, past projects, and contact information.

Finally, we have one key recommendation regarding the design of the ETP. The ETP focuses on providing utility-sponsored energy efficiency programs and the market with a steady stream of new technologies. This basic model should be modified so that third-party energy efficiency programs can benefit from the same information. A mechanism such as formal, regularly scheduled workshops could be established so that information can be shared about those technologies that are ready for deployment. See Sections 5.4 and 5.5 for more details regarding technology selection and information dissemination.

[1] Because there are projects that cover more than one sector, the percentages sum to greater than 100%.

[2] Weak validation means that the evaluation team observed that the ETP staff had allocated insufficient resources to certain activities that are critical elements in the ETP design.

1.3.7 New Evaluation Model

Key stakeholders have a need to know whether the ETP is effective. By focusing on only the two objectives listed in the utility Program Implementation Plans, other key objectives of the ETP are ignored. We recommend an approach for evaluating the ETP that is based on monitoring the full range of ETP activities, outputs, and outcomes combined with the use of a cost-effectiveness model that explicitly recognizes that the ETP benefits are difficult, if not impossible, to monetize. In addition, an evaluation of a multiple-year program should follow a program for at least one cycle (a cycle could be two to three years) in order to more consistently and accurately observe the implementation of the program and measure any impacts. In Appendix E, we provide an example of one possible method to evaluate the ETP.

2 Introduction

2.1 The Emerging Technology Program (ETP)

The ETP is a statewide information-only program that seeks to accelerate the introduction of energy efficient technologies, applications, and analytical tools that are not widely adopted in California. The Program targets nonresidential customers, and is composed of two parts: 1) Demonstration & Information Transfer, and 2) the Emerging Technologies Coordinating Council (ETCC). The Demonstration & Information Transfer portion of the Program focuses on near-commercial and commercial energy efficient applications with low market penetration. Demonstration projects, conducted at either customer sites or in controlled environments, provide design, performance, and verification of energy efficient systems, helping to reduce the market barriers to their wider acceptance. The ETP demonstration projects help to measure, verify, and document the potential future energy savings of specific applications in different market segments. ETP efforts disseminate project results, and are customized to the targeted market through a variety of means such as:

- Detailed project reports,
- Design documentation,
- Professional and industry forums,
- Technical and non-technical publications,
- Trade journals,
- Trade shows,
- New stories,
- Video documentaries,
- Case studies,
- Detailed project brochures and fact sheets,
- Newsletters,
- Site visits and tours,
- Internet web pages,
- Analytical tools,
- Community-based organizations,
- Workshops, seminars, conferences, and
- Mainstream energy efficiency programs such as the utilities' statewide Express Efficiency Program, the Standard Performance Contracting Program, and third-party offerings.

Central to the design and operation of the ETP is the definition of an emerging technology. The following definition, adopted by the ETP, served as the working definition for this evaluation.

> Emerging technologies range across the entire new product development cycle from early prototypes and demonstrations all the way through to commercially available equipment. Some are stand-alone products, or components, process improvements and software tools. They all have public interest benefits including energy efficiency improvements. However, they have not yet achieved adequate market penetration or acceptance. Note: Utilities are focused on products that have already been commercialized while the CEC is demonstrating products that are nearing the end of their product development cycle.

2.1.1 Demonstration & Information Component

Figure 2-1[3] shows many of the considerations that go into demonstration projects at customer sites. These demonstration projects may come about in one of two manners:

Customer pull. A utility account representative may approach the program staff on behalf of a customer interested in pursuing energy efficiency. The program staff will help the account representative address the customers' needs, and at the same time, consider a range of potential energy efficient emerging technology applications.

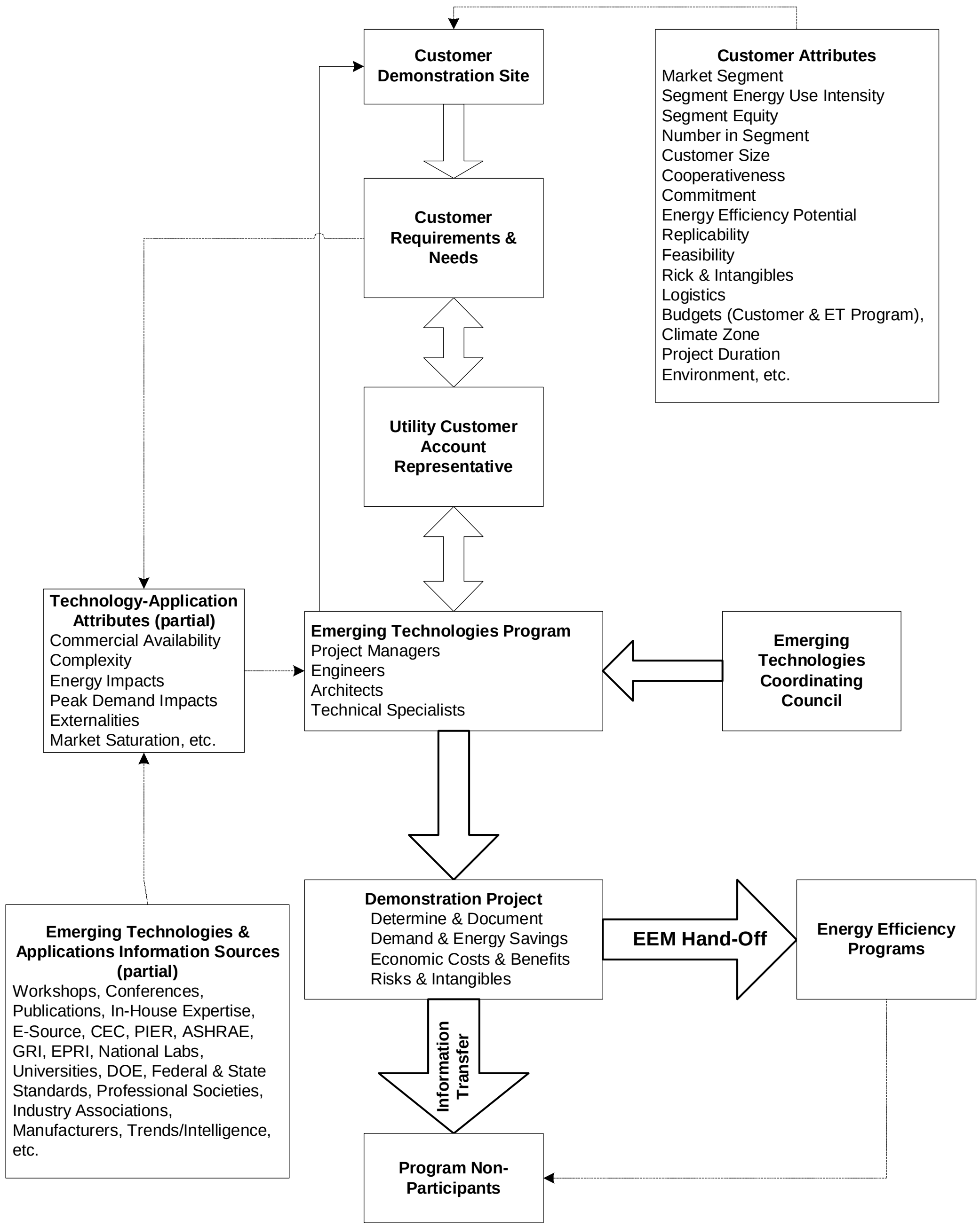
Technology push. The second manner that a project may come about is when a significant new technology application emerges. The program staff then approaches the utility account representative for a particular market segment, inform them about the new technology application, and ask them to help identify a potential demonstration site from among their customers.

Some projects may not require a field demonstration at a customer site to evaluate equipment performance. But even for those types of projects, the ET program staff seeks to understand customers' needs and requirements. This helps ensure that project objectives are aligned with customer needs and expectations.

While not obvious from Figure 2-1, the ETP has focused primarily on deploying new technologies to utility-sponsored energy efficiency programs or directly to the market. To date, there is no formal mechanism for deploying new technologies to the community of implementers of third-party and municipal programs.

[3] "2002 Energy Efficiency Programs R. 01-08-028 Implementation Plan: Statewide Nonresidential Retrofit Emerging Technologies." Submitted by the Pacific Gas and Electric Company, May 2002

Figure 2-1. ETP Demonstration Process

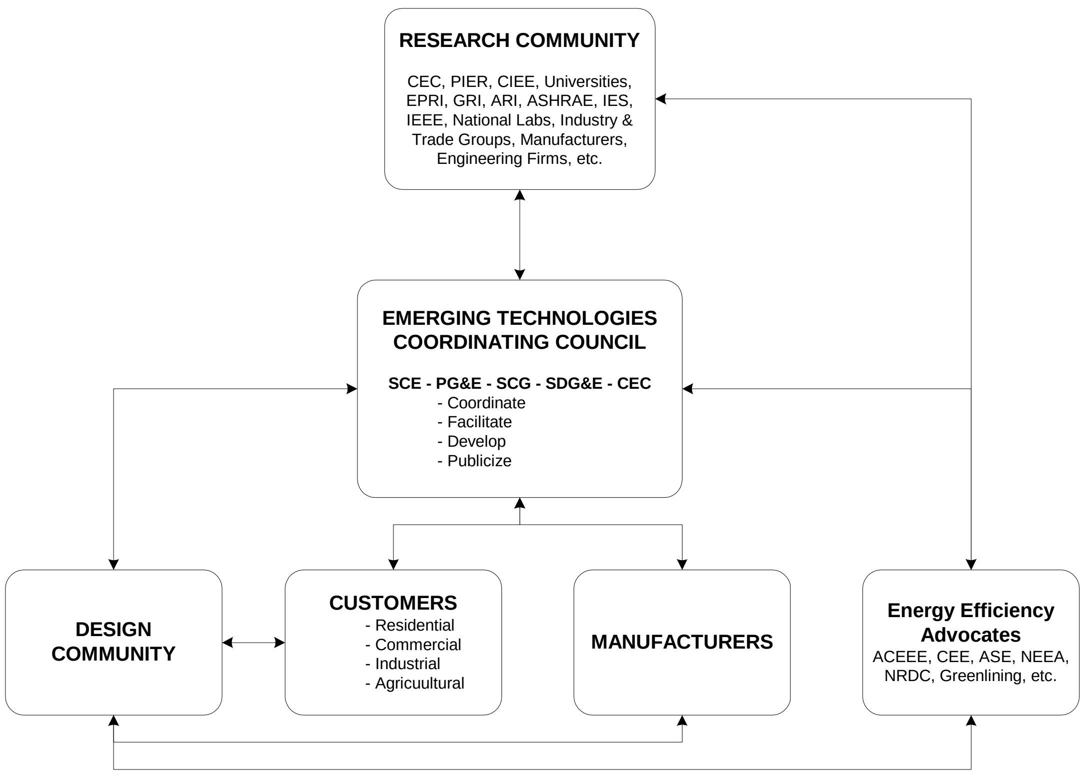


2.1.2 ETCC Component

The keystone of the statewide coordination effort is the ETCC. The ETCC includes program representatives from Pacific Gas & Electric, Southern California Edison, San Diego Gas & Electric, Southern California Gas, and the California Energy Commission (CEC) Public Interest Efficiency Research (PIER) Program. The objective of the ETCC is to seek opportunities to coordinate efforts between the utility-sponsored Emerging

Technologies program, as well as with the California Energy Commission's PIER program. Each utility sponsors activities that may be coordinated with other utilities and the CEC, as well as activities that are unique to their own service territory and customer base. The efforts that each utility undertakes as part of the statewide ETP are guided by the prioritization of their customer base needs, the coordinated ETCC activities, technology readiness, and their approved program funding level. In particular, the ETCC coordination effort is designed to ensure that effective communication occurs among entities involved in either the development or delivery of new energy efficient technologies in California. If implemented as designed, the ETP can form an important link in the commercialization of energy efficient emerging natural gas and electric technologies and applications. This coordination effort is illustrated in Figure 2-2.

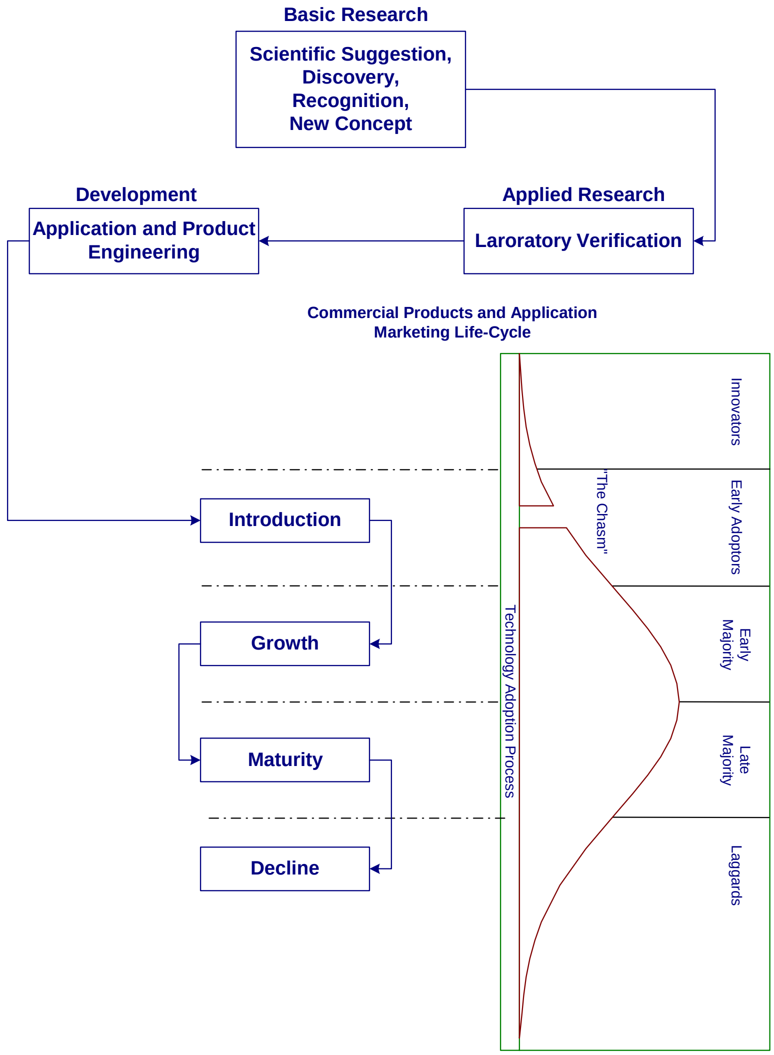
Figure 2-2. Emerging Technology Coordination



2.2 Program Theory

Those who designed and are implementing the ETP have placed it firmly in the *diffusion-of-innovation* theoretical framework. As shown in Figure 2-3, the program efforts form an important link in the commercialization of energy efficient emerging technologies and applications.

Figure 2-3. Typical Product Development and Commercialization Cycle[4]



The technology adoption life cycle involves five stages, each characterized by a particular type of consumer: 1) innovators, 2) early adopters, 3) early majority, 4) late majority, and 5) laggards. Each group represents a psychographic profile – a combination of psychology, demographics, and firmographics - that makes its marketing responses different from those in other groups. Each type of customer is briefly described below (Moore, 1991).

> **Innovators**. They pursue new technology products aggressively. They sometimes seek them out even before a formal marketing program has been launched. Their endorsement reassures the other players in the marketplace that the product does in fact work.

[4] Figure 2-3, taken from utility the 2002 Program Implementation Plans, is incorrect. As noted by Moore (2002), the chasm actually occurs between the early adopters and the early majority.

> **Early Adopters**. Like innovators, they buy into new product design concepts very early in their life cycle, but unlike innovators, they are not technologists. Rather they are people who find it easy to imagine, understand, and appreciate the benefits of a new technology, and to relate these potential benefits to their other concerns. They do not rely on well-established references in making these buying decisions, preferring instead to rely on their own intuition and vision.
>
> **Early Majority**. They share some of the early adopter's ability to relate to technology, but ultimately they are driven by a strong sense of practicality. They know that many of these new inventions end up being passing fads, so they are content to wait and see how other people are making out before they buy in themselves. They want to see well-established references before investing substantially. Because there are so many people/firms in this segment – roughly one-third of the whole adoption life cycle – winning their business is key to any substantial profits and growth.
>
> **Late Majority**. They share all the concerns of the early majority, plus one additional one: whereas people in the early majority are comfortable with their ability to handle a technology product, should they finally decide to purchase it, members of the late majority are not. As a result, they wait until something has become an established standard, and even then want to see lots of support and tend to buy, therefore, from large, well-established companies.
>
> **Laggards**. These are people who simply don't want anything to do with a new technology, for any of a variety of personal and economic reasons.

The "*chasm*" in Figure 2-3 represents the area of need regarding emerging technologies and the focus of the ETP efforts. The chasm is ". . .a discontinuity in the product life cycle that occurs from early adopter to the mass market." That is, the chasm separates the early adopters from the early majority. Crossing the chasm requires that those in the early majority receive something that the early adopters do not need, the needed assurances from trusted sources regarding new technologies. Many new products fail because they are not able to cross the chasm in terms of new product design and marketing strategy, from the early market (early adopter) to the mass market (early majority).

Customers who are among the first to install an emerging technology can be viewed as *innovators or early adopters.* Certainly, those active in professional associations, such as the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), American Institute of Architects (AIA), Illuminating Engineers Society (IES), and the Society of Commercial Kitchen Designers (SCKD), are often on the cutting edge and are perhaps more likely to be willing to carefully evaluate and try new technologies. As a result, they can be considered, for the most part, *innovators and early adopters*. Others who have requested information from the ETP, been exposed to the new technologies through the Internet, conferences, articles, etc. can also be considered as likely *early adopters or early majority*.

There are other market actors, such as energy managers and administrators of construction, who may be considered in the *early majority* (e.g., imitators) since they often do not have the time to explore and evaluate new technologies because they are preoccupied with the day-to-day operations of their organizations. They tend to wait until energy efficient technologies are shown by others to be reliable and cost-effective.

By working with both the innovators and early adopters, the ETP hopes to systematically collect compelling evidence about the performance of new technologies in order to influence either directly or indirectly (e.g., through lighting designers, engineers, architects) those in the early majority. The ETP has identified those major market barriers that are faced, they believe, by the early majority. These are discussed in the following section. We note that the goal of the ETP is not to transform the market, but to identify promising technologies and to accelerate their deployment into the market or into energy efficiency programs while avoiding the “chasm,” the most serious discontinuity in the product adoption cycle [5]. If the ETP accomplishes this goal, the chances that the market will be transformed through the efforts of a variety of market actors over time are increased.

2.3 Market Barriers

The following five market barriers have been identified by the ETP staff (Eto, Prahl, and Schlegel, 1996). Reducing these barriers will, it is hypothesized, accelerate the deployment of new technologies. It hopes to achieve these objectives by focusing on the early majority and reducing the following five market barriers.

2.3.1 Performance Uncertainty

Many designers, architects, engineers, contractors, and owners are skeptical about emerging energy efficient products and designs. These market actors do not readily accept unproven technologies and concepts, especially if the first costs are significantly higher than existing, proven equipment and methods. Further, these market actors are not sure if the emerging technologies and innovative designs will either work or perform as claimed. Through demonstration projects, emerging energy efficient technologies and designs may demonstrate their value to the various market actors, and the performance of the efficiency options under actual field conditions.

2.3.2 Information/Search Costs

One major barrier is the cost of identifying energy efficient products. Disseminating information about the technology demonstration projects through various means, including fact sheets, web sites, and journal articles, can significantly reduce this barrier.

2.3.3 Asymmetric Information

When shopping for new equipment, customers find it difficult to evaluate the veracity, reliability, and applicability of claims made by sales personnel. Sellers of energy efficient products typically have more and better information about their offering than do

[5] The fact that California has shifted the focus of its portfolio of energy efficiency programs from market transformation to resource acquisition does not affect the fundamental design of the ETP.

consumers and sellers can have an incentive to provide misleading information. By providing information on technology demonstrations to customers, the customers are at less of a disadvantage when interacting with sales personnel.

2.3.4 Organizational Practices

Within organizations, certain kinds of behavior or systems of practices discourage or inhibit cost-effective energy efficiency decisions. Through technology demonstrations, market actors can be convinced that the new technologies and designs perform well, are reliable over the long-term, and are cost effective. As a result, they may modify their standard practices and incorporate the new technologies and designs into future projects.

2.3.5 Split Incentives

In some cases, the incentives of an agent charged with purchasing energy efficient equipment are not aligned with those of the persons who would benefit from the purchase. For example, a contractor working for a school district, by focusing on first costs, may not purchase the somewhat more expensive, more energy efficient equipment for a given building. However, such a decision will result in a school district paying more in energy costs over the long term. The ETPs focus on the creation and performance of an optimal energy efficient design requires teamwork between designers, architects, engineers, contractors, and building owners to create, operate, and maintain an optimized system that accounts for the interactions between its components and the building. Making sure that all those involved understand the long-term costs and benefits of equipment and building decisions can reduce this barrier.

2.4 Program Logic

In this section, we discuss the reason for constructing a logic model of how the ETP activities and outputs are expected to produce near-, mid-, and long-term impacts. Building on the activities illustrated in Figure 2-1, we then go on to illustrate graphically this program logic model. Note that it was necessary to elaborate upon Figure 2-1 since only program *inputs* and resulting *outputs* were described; none of the impacts or *outcomes* and their relationships to prior program *inputs* and *outputs* were described.

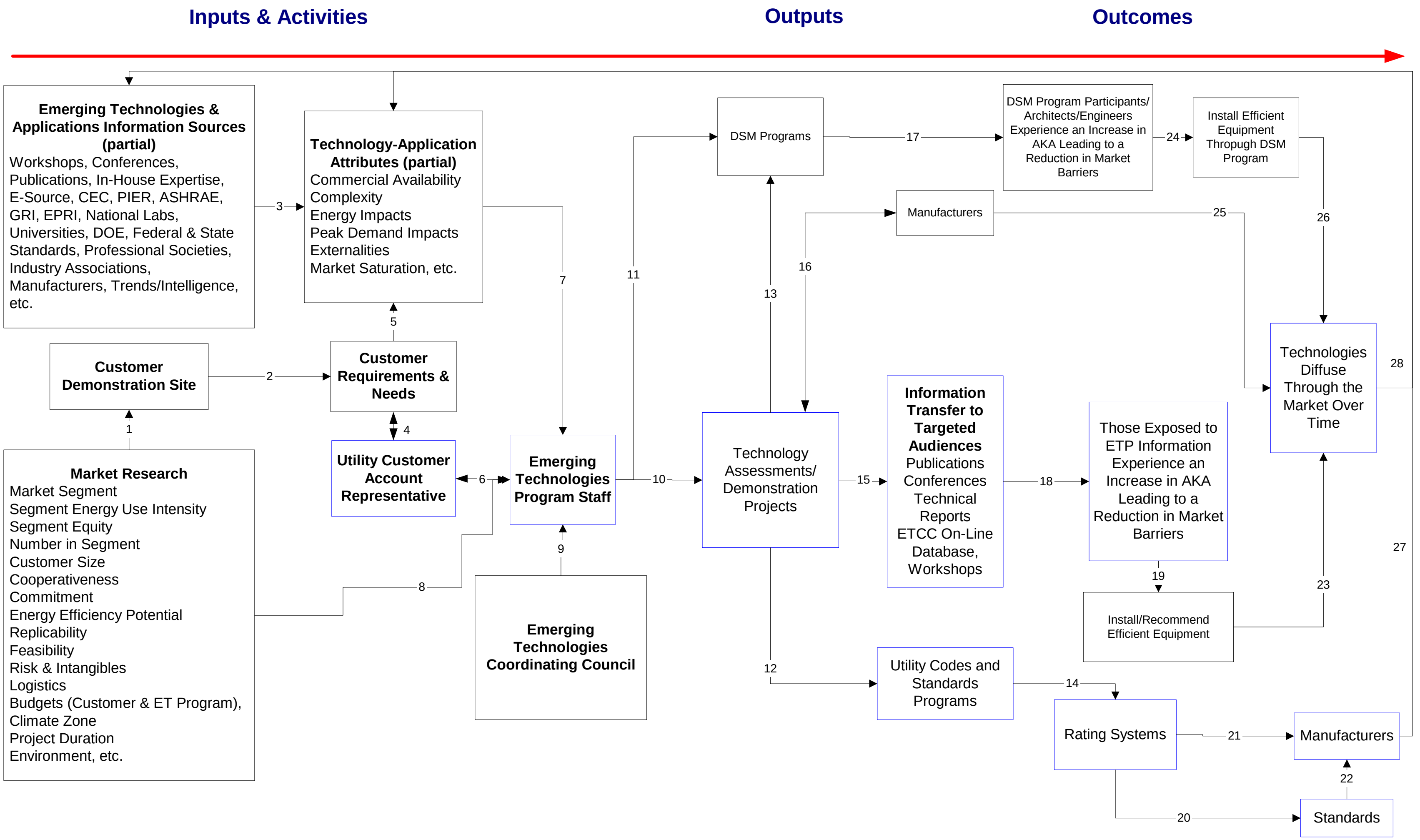
Weiss (1997) stresses that understanding the underlying logic of the program is essential to developing the most appropriate evaluation, and that a good evaluation is based on defining, testing, and analyzing the assumptions of the program logic. In general, the logic model consists of ETP activities and the hypothesized direct and indirect communication and causal linkages between these activities and the key market actors. There are many different areas in which programs can go astray, but, by focusing on program logic, evaluators can keep themselves on track.

Figure 2-4 illustrates the program logic model, i.e., the relationships between the ETP activities, the market actors, expected outputs, and the expected outcomes or impacts. As depicted in this diagram, the activities of the ETP are designed to influence members of the target audience both directly and indirectly. Those *directly* influenced include those who are exposed to the information disseminated by the ETP through such avenues as demonstration projects, fact sheets, journal articles, magazine articles, technical reports, a conference presentation, etc. Others are influenced *indirectly* through their participation in energy efficiency programs that have folded in technologies originally championed by the ETP.

The logic model depicted in Figure 2-4 was used to develop near-, mid-, and long-term indicators of the activities, outputs, and outcomes or impacts. The logic model has 28 program activity and causal linkages, each of which is described below in Table 2-1. Note that some of the linkages in Table 2-1 illustrate program activities and outputs while others describe the immediate, mid-term, and long-term outcomes or impacts that are hypothesized to be caused by these activities and outputs.

The most often cited summary of the diffusion of innovation theory is provided by Rogers' diagram as shown in Figure 2-5. Clearly, the ETP seeks to intervene among those on the other side of the "chasm," i.e., those in the early majority who are at Stages I, II, and III of the innovation-decision process by attacking what it perceives as the most significant market barriers. For example, the program seeks to provide information about efficient equipment (Stage I) as a way of addressing the information-cost market barrier. Eventually, the hope is that after ETP intervention, Stage V is reached in which the individual recognizes the benefits of energy efficiency, integrates the innovation into their on-going routine, and promotes the innovation to others. If others are appropriately influenced, then a sustainable change has been achieved.

Figure 2-4. Emerging Technologies Program Logic Model



Note: AKA = attitudes, knowledge, and awareness of emerging technologies.

Table 2-1. Logic Model Linkage Descriptions

Linkage	Linkage Descriptions
1	ETP staff, using market research, including information on individual customers and characteristics of customer segments, identify potential technology demonstration projects.
2	The characteristics of customer demonstration sites are expressed through a customer's requirements and needs.
3	Research community including such organizations as PIER, EPRI, and ASHRAE and the Emerging Technologies Coordinating Council engage in on-going dialogue regarding emerging technologies. Other sources of information, such as workshops in-house expertise can information on promising technology candidates. This information is organized in terms of technology-application attributes.
4	Customers' requirements and needs are communicated to the utility account representative.
5	A customer's requirements and needs can also contribute to the technology-application attributes.
6	A utility account representative may approach the program staff on behalf of a customer interested in pursuing energy efficiency. The program staff will help the account representative address the customers' needs, and at the same time, consider a range of potential energy efficient emerging technology applications. A second manner that a project may come about is when a significant new technology application emerges. The program staff then approaches the utility account representative for a particular market segment, inform them about the new technology application, and ask them to help identify a potential demonstration site from among their customers.
7	ETP staff are informed by the technology-application attributes.
8	ETP staff use information on customer segment attributes to create strategic marketing campaigns.
9	Emerging Technologies Coordinating Council and ETP engage in on-going two-way communications to better coordinate the statewide emerging technology effort
10	ETP staff select and pursue demonstration projects of emerging technologies.
11	Design consulting services made available to utility energy efficiency programs.
12	Results of demonstration projects made available to utility Codes and Standards Programs.
13	The results of demonstration projects are deployed to energy efficiency programs.

Linkage	Linkage Descriptions
14	Utility Codes and Standards Programs influence rating systems
15	Results of demonstration projects transferred to various target audiences though publications, technical reports, workshops etc.
16	The ETP develops a new technology in collaboration with selected manufacturers who may eventually decide to introduce it into the marketplace.
17	Energy efficiency program participants exposed to program information and/or who take advantage of design consulting services regarding emerging technologies will experience an increase in attitudes, knowledge, and awareness of emerging technologies leading to a reduction in targeted market barriers.
18	Members of target audience who are exposed to the results of demonstration projects will experience an increase in attitudes, knowledge, and awareness of emerging technologies leading to a reduction in targeted market barriers.
19	Those who experience a reduction in market barriers as a result of being exposed to results of demonstration projects will install efficient equipment.
20	Rating systems eventually contribute to the creation of efficiency standards
21	Rating systems affect the type of equipment manufactured
22	Standards affect the type of equipment manufactured
23	Those who install efficient equipment are more likely to continue recommending/investing in energy efficiency equipment and spreading information by word-of-mouth.
24	Those who experience a reduction in market barriers by participating in energy efficiency programs will install efficient equipment.
25	Manufacturers introduce the new technology to the market.
26	Energy efficiency program staff/participants more likely to continue recommending/investing in energy efficiency equipment and spreading information by word-of-mouth.
27	The fact that new rating systems and standards affect manufacturers is communicated to such market actors as professional societies, DOE, EPRI, and national laboratories.
28	As efficient technologies diffuse throughout the market, new technologies emerge and are developed and championed by such market actors as professional societies, DOE, EPRI, and national laboratories.

Note that the ETP operates in an environment that is also exposed to such state and federal emerging technology programs such as the U.S. Department of Energy's State and Community Programs operated by the Office of Building Technology and the CEC's Dairy Energy Project and the PIER Project. To the extent that the technologies promoted by these various state and federal programs overlap with those promoted by the ETP, attribution of any observed impacts to the ETP will be difficult.

2.5 The 2002 ETP

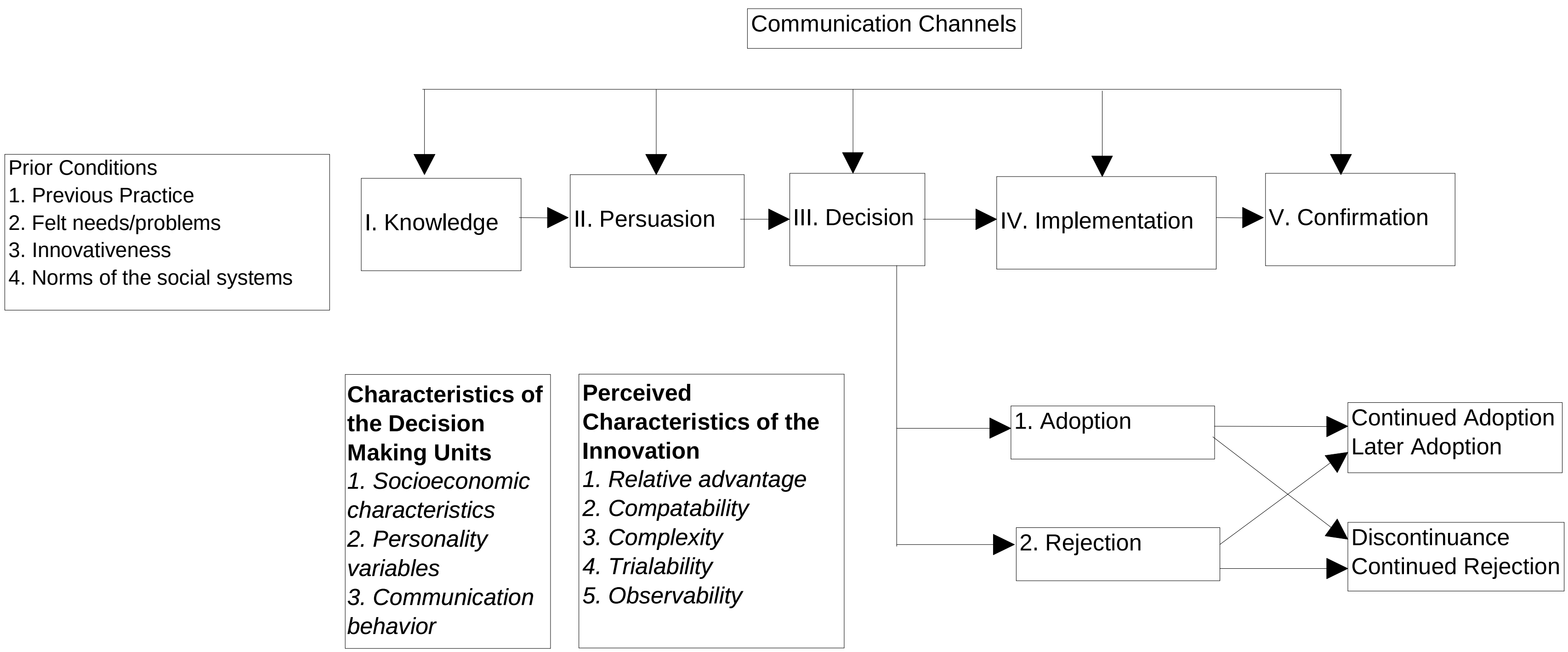
Within this general framework, each utility set the following objectives for conducting technology assessments[6] for program year (PY) 2002. Table 2-2 presents the number of assessments for each utility that were slated to occur in 2002.

Table 2-2. Technology Assessment Objectives, by Utility

Utility	Technology Assessments	Percent
PG&E	3	17%
SCE	8	44%
SDG&E	1	6%
SoCalGas	6	33%
Total	18	100%

[6] Technology assessments involve either an on-site *or* a laboratory demonstration of a particular technology.

Figure 2-5. Model of Stages in the Innovation-Decision Process



The utilities began multiple projects in 2002, as indicated in Table 2-3. They also completed projects that began both within 2002 and prior to 2002 (also shown in Table 2-3). Note that each utility was responsible for updating its portion of the database.

Table 2-3. Projects Initiated or Completed in 2002, by Utility

Utility	Projects Initiated	Projects Completed	Total Projects in 2002
PG&E	2	1	3
SCE	11	7	18
SDG&E	1	1	2
SoCalGas	11	2	13
Total	25	11	36

Based on data within the 4th quarter reports, the PY 2002 budgeted and expended amounts for each utility are presented in Table 2-4.

Table 2-4. PY 2002 ETP Budgeted and Committed Amounts, by Utility

Utility	Budgeted	Expended
PG&E	$ 300,000	$ 268,233
SCE	$ 650,000	$ 650,000
SDG&E	$ 91,800	$ 73,054
SoCalGas	$ 640,000	$ 676,831
Total	$ 1,681,800	$ 1,668,118

As one can see, there a fair amount of variation in the funding which is consistent with the level of ETP activity indicated in Table 2-3. Also note that funding for PY 2002 was not approved by the CPUC until June 2002. Funds for the first half of 2002 were provided by so-called bridge funding, a situation that affected previous years. Uncertainty regarding the availability and level of funding creates uncertainty regarding staffing and the initiation and completion of projects, especially for programs like the ETP that implements projects that typically require two to three years to complete. Such uncertainty might account for some of the gaps in implementation described later in this report.

3 Evolution of the Research Plan

3.1 Originally Proposed Plan

The original plan to evaluate the PY2002 ETP was based on the program theory. However, after an assessment of the data available and the program implementation (discussed in Section 3.2), we realized that this original plan had to be revised. For purposes of completeness, though, we present information from the initial plan. Our originally proposed evaluation plan contained two primary objectives that are contained in the "Energy Efficiency Policy Manual" (EEPM) prepared by the Energy Division of the CPUC in October 2001:

1. Evaluate program success by measuring indicators of program effectiveness and testing the assumptions underlying the program theory and approach[7].

   The general research hypothesis was that the ETP activities would cause an increase in awareness of targeted technologies. Any changes over time in the indicators could be considered as evidence of market effects, but only to the extent that other non-ETP activities in the market could be ruled out as explanations of this change. Therefore, the original goal of this evaluation was to evaluate the success of the program by measuring indicators such as awareness among the target audience of those emerging energy efficient technologies targeted by the ETP. We also planned to measure the degree to which behaviors of the target audience had changed regarding the adoption and use or commercialization of these emergent energy efficient technologies. An assessment of program performance would have provided a test of the program's ability to overcome barriers to the implementation and commercialization of energy efficient technologies by using a variety of methods to disseminate information about emergent energy efficient technologies.

2. Provide ongoing feedback and corrective guidance regarding program design and implementation.

   The goal was to assess the effectiveness of the different strategies the program employed to reach the target audience and to achieve program objectives and goals. Thus, the purpose was to assess the impacts of program activities such as coordination activities, project demonstrations, and information delivery mechanisms such as conferences, professional consultations, websites, journal articles, trade shows, and seminars, and ongoing interactions with professional associations and industry and trade groups.

[7] Note that the EEPM objective of "Assessing the overall levels of performance and success of programs" was considered to integral to this objective.

The general approach to achieving these two evaluation objectives was to have included telephone interviews with a random sample of 300 of the various market actors who chose to participate in the ETP in various ways. These included those who:

1. visited the web sites and request additional information,
2. attended workshops, seminars, conferences, and trade shows,
3. received professional consultation, and
4. were exposed to other dissemination efforts.

These interviews were to focus on a variety of topics including how they first learned of the ETP and the technologies that it promotes and the extent to which the traditional market barriers (performance uncertainty, information/search costs, asymmetric information, organizational practices, and misplaced or split incentives) were lowered as a result of their exposure to the ETP activities. We also planned to investigate any changes in attitudes regarding these technologies. Finally, we planned to estimate the diffusion of these technologies among the targeted population by measuring changes in:

1. attitudes toward energy efficiency,
2. awareness of the targeted technologies,
3. behavior of seeking additional information regarding these technologies,
4. plans to install these technologies in the next 12 months,
5. installation of these technologies,
6. demonstrating the benefits of these technologies to others, and
7. promoting permanent internal changes within organizations regarding these technologies.

We also planned to conduct 20 in-depth interviews with all relevant program stakeholders including members of the ETCC and ETP Program staff. These interviews were designed to determine the extent to which the ETP was faithfully implemented and to determine whether there were any variations across utility service territories. As a part of this effort, we also planned to conduct a comprehensive review of ETP Program documents.

Before implementing the original evaluation plan, we performed an assessment to determine whether that original plan was viable. The evaluability assessment is described next.

3.2 Evaluability Assessment

The first step in any comprehensive, systematic evaluation is an evaluability assessment (EA):

> Evaluability assessment is a diagnostic and prescriptive tool for improving programs and making evaluations more useful. It is a systematic process for describing the structure of a program (i.e., the objectives, logic, activities, and indicators of successful performance); and analyzing the plausibility and feasibility for achieving objectives, their suitability for in-depth evaluation, and

> their acceptability to program managers, policymakers, and program operators. (Smith, 1989, p. 1)

For the ETP, the EA involved the following steps:

1. Clarify the intended program from the perspectives of managers, staff and other key stakeholders.
2. Develop the underlying theories of the program.
3. Explore the program reality, including the plausibility and measurability of program goals and objectives.
4. Determine the evaluation design.
5. Finalize the research plan.

The results of the evaluability assessment were not encouraging with respect to carrying out the first evaluation objective. The data we received, which was to form the population of market actors who chose to participate in the ETP in various ways, did not support our original research plan. In general, few names and addresses were provided for those who had been exposed to information about specific technologies that are being promoted by the ETP. When we were provided with names and addresses, the level of exposure was either not substantial or the level of exposure was unclear. As a result, there appeared to be little point in interviewing this small group of customer since we expected that there would be only very modest (if any) increases in awareness and knowledge. In addition, while some customers have no doubt been exposed to these technologies via the IOU and ETCC websites, we had no way of contacting them since they were not asked to provide their telephone numbers or e-mail addresses.

We concluded that there were two primary reasons for this lack of data. First, this is the first time any of the ETP managers have been exposed to an independent evaluation required by the CPUC *and* shaped by the requirements of the Energy Efficiency Policy Manual. Second, 2002 was the first year that the ETP was to be implemented as a statewide program. For both of these reasons, ETP staff had limited understanding of the reasons for collecting the required data as well as the procedures to collect these data.

We also discovered other gaps in the data. The main purpose of the ET database was to disseminate basic information about an array of emerging technologies and it was never designed to serve as a program-tracking database. As a result, the database contained only a portion of the data needed to meet the basic accountability requirements of the CPUC *and* to support an evaluation. For example, such project-specific information as a project’s beginning, ending, and expected completion dates, annual expenditures, dissemination efforts with respect to targeted markets, as well as kWh and kW impacts were not in the ET Database. We concluded that the reasons for these gaps are the same as those described in the previous paragraph.

Finally, we learned that these utility-specific ETP efforts differ with respect to the types of projects and the strategies designed to study and promote the various emerging technologies. These differences mean that opportunities to collect data from participants also differed, with some having more opportunities than others.

3.3 Revised Plan

As a result of the data issues described above, we concluded that while it was possible to examine some indicators of program effectiveness and provide ongoing feedback and corrective guidance, it was premature to test any of the assumptions underlying the program theory. Essentially this meant that we would only conduct a *process* evaluation, leaving the impact evaluation until 2004 or 2005.

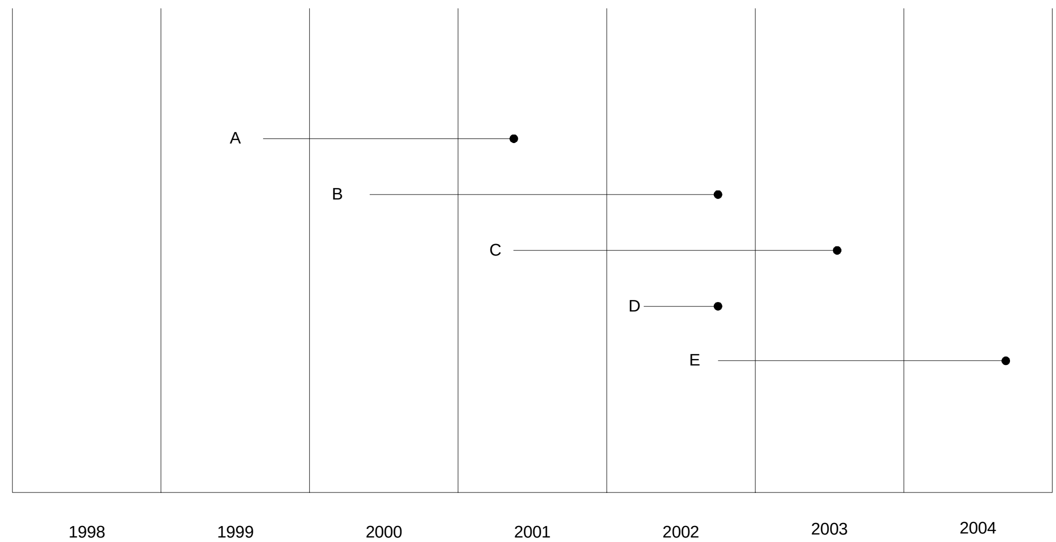
As a result, we were still able to measure some elements of program effectiveness by examining program inputs (e.g., program budgets, use of existing resources), program activities (e.g., technology screening, ETCC activities), and program outputs (e.g., demonstration projects, database, cross-program support). We were not able to examine any program impacts or outcomes (e.g., changes in awareness, knowledge, attitudes, and behavior with respect to emerging technologies).

One of our major concerns was to describe the activities of the Statewide ETP over the past three to four years, while reinforcing the notion that the various products developed, implemented, and evaluated by the ETP typically require more than a single year to complete. Even though this was an evaluation of the PY2002 program, to focus only on the application assessments begun in 2002 would yield limited information on the success of the ETP since many of the 2002 application assessments only began in late 2002 and would have very few if any substantive results to report. In order to provide the most relevant and useful information on the ETP in light of the limited evaluation budget, we chose to look at all the projects for which work was done in 2002 by the ETP staff, regardless of the specific program year in which they began. [8]

Figure 3-1 illustrates four types of projects. Type A is a project that began in 1999 and was completed in 2001. Type "B" is a project that began in 2000 and was completed in 2002. Type "C" began in 2001 and was completed in 2003. Type "D" began in 2002 but was terminated in 2002 due to termination of the project for various reasons. Type "E" began in 2002 and is expected to be completed in 2004.

[8] ETP managers reported that this approach fails to address a number of successful ETP projects that were completed in 1998 or 1999.

Figure 3-1. ETP Project Lifecycle



Thus, the approach used here for this evaluation was to focus on *all* the ETP work during 2002 that involved demonstration projects, application projects, software development, etc. (represented by B, C, D, and E in Figure 3-1). In this way, we were able to more fairly describe the ETP activities and how they fit into the theoretical framework that has been constructed.

The structure of this portion of the evaluation represents what is called a *retrospective tracer study*. Such a study attempts to reconstruct the sequence of main events and decisions in the innovation-development process. The sources of data are usually personal interviews with key investigators and other participants, research publications, and archival records (Rogers, 1995). Such studies can clarify the activities, their sequence, and timing for those unfamiliar with organizations such as the ETP, that conduct research, testing, development, and commercialization of emerging technologies.

3.4 Hypotheses and Indicators

Because this evaluation was exclusively focused on *process*, only 6 linkages having to do with inputs, activities, and outputs were inspected using all collected data (i.e., linkages 7, 8, 9, 10, 13, and 15 in Figure 2-4). Table 3-1 presents these 6 linkages from the program logic model in Figure 2-4, the related expectations, the indicators that were used to verify them, and their timing. Note that none of these linkages address any of the outcomes or impacts listed earlier in Figure 2-4.

It's important to recognize that the definition of the *statewide* ETP program should be defined by a common set of linked activities, outputs, and outcomes across all four IOUs. It will be those linkages that should receive most of the attention from evaluators. However, we recognize that the ETP should be allowed to vary somewhat in order to respond to the unique customer characteristics, customer mix, weather, and economics that characterize the four service territories. Subject to budget constraints, future evaluations should also examine those program design features that are unique to each utility program.

Table 3-1. Program Linkages, Expected Activities and Outputs, Indicators, & Timing

Linkage	Expected Activities & Outputs	Indicators	Timing of Effect
7	ETP staff are informed by the technology-application attributes.	Descriptions of the technology review process The extent to which the review process is systematic.	Near-Term
8	ETP staff use information on customer segment attributes to identify potential demonstration projects and to craft strategic marketing campaigns	Qualitative assessment of the extent to which ETP project managers rely on market research, saturation surveys, estimates of market size and energy potential, past studies, and interactions with others in the energy efficiency community etc. to identify promising technologies and to craft strategic marketing campaigns.	Near-Term
9	Emerging Technologies Coordinating Council and ETP engage in on-going two-way communications to better coordinate the statewide emerging technology effort	Frequency of meeting Information exchanged Degree of collaboration	Near-Term
10	ETP staff select and pursue demonstration projects of emerging technologies.	Number of technology assessments	Near-Term
13	The results of demonstration projects and related technologies are deployed to energy efficiency programs.	Number of technologies deployed to energy efficiency programs Frequency of contact between ETP staff and energy efficiency program staff	Near-Term
15	Results of demonstration projects are disseminated through various means.	Number of articles, on-site tours, technical papers, workshops, etc.	Mid-term

4 Methods

This section describes the methods used to carry out the revised evaluation plan. It covers data collection, the review of the ET database, and analysis.

4.1 Data Collection

Three data collection activities were implemented. The first involved a review of program documents and the database as a way of determining the extent to which the database had been updated, verifying the number of technology assessments initiated during 2002, and describing the full array of ETP activities in 2002. The second involved interviews (in most cases a series of unstructured interviews) with ETP *program* managers and members of the ETCC in order to better understand the ETP itself, to document all relevant program activities, and to identify data that could be collected in a cost-effective manner. The third involved surveys of all ETP *project* managers at each of the four utilities in order to fully describe all the ETP projects in which they were involved during 2002.

4.1.1 Review of ETCC Database

We requested and obtained the entire database with the intention of reviewing the structure and content of the database to better understand what data were being collected, how these data were stored, how and in what form they could be retrieved, and what data needed to meet the basic accountability requirements of the CPUC *or* to support an evaluation were present.

However, given the absence of basic documentation regarding the structure, contents, and definitions, we were forced to at least prepare a draft of this basic documentation for use in the analysis.

4.1.2 In-Depth ETP Staff and ETCC Member Interviews

Originally we planned to conduct in-depth interviews with the four IOU ETP program managers, a member of the ETCC, and the person responsible for updating the database. However, since, to some extent, we were breaking new ground, it was difficult to anticipate exactly what questions to ask in an in-depth interview. As a result, rather than conducting one in-depth interview with each person, we conducted a series of interviews with each over a six-month period. These interviews touched on a variety of topics including:

- the ETCC's role in statewide coordination,
- funding levels,
- linkage between the ETP and utility energy efficiency programs,
- efforts to disseminate information about emerging technologies,
- staffing,

- review and selection of technologies,
- the ETP Database,
- PY 2002 ETP objectives,
- deviations from the original ETP design, and
- ideas for improving the ETP.

As a part of this effort, we reviewed all program-related documents provided by ETP staff. The results of these interviews and document reviews are reflected throughout this report.

4.1.3 Surveys of ETP Project Managers

The first step in describing the 2002 utility-sponsored projects in the database was to identify the managers of these projects. Once managers were identified, we attempted to collect data for each project they managed (defined as an application of a specific technology). Surveys were sent electronically to each of the ETP project managers at the four IOUs. Table 4-1 presents the number of project managers, by utility, who were surveyed. It should be noted, especially in the case of SoCalGas, that ETP projects might have multiple individuals who are the point of contact for a project, but may not formally serve as the project manager. Additionally, there are known individuals at the utility who are involved with the ETP, yet are not reflected in Table 4-1 since they serve more as a *program* manager than a *project* manager. Therefore, the information in Table 4-1 and the number of employees formally employed in the ETP very likely do not match.

Table 4-1. ETP Project Manager Respondents, by Utility

Utility	Number
SCE	8
SoCalGas	6
PG&E	1
SDG&E	2
Total	**17**

The survey, presented in Appendix A, addressed a number of issues including:

- Project Name
- Project Index
- Application Index
- Technology Index
- Type of Project
- Objective of Project
- Project Status
- Name and Description of Technology
- End Use in which Technology Falls
- Status of the Technology Overall

- Status of the Technology In this Project
- Project Begin Date
- Project Completion Date
- Expected Project Completion Date
- Information Disseminated about Technology
- A Description of the Various Strategies Used to Disseminate Information about the Project
- Annual Project Expenditures
- Estimated kWh, kW, and Therm Impacts
- Market(s) Targeted
- Market Actor(s) Targeted
- A Listing of Reports and/or Fact Sheets Developed for the Project
- A Description of How Project Evolved over Time
- Utility Contact for Further Information
- If the project involved an installation at a customer site, all relevant information (phone number, address, account, contact name, and a summary of any measured results)

A series of briefer follow-up interviews were conducted with project managers. These interviews asked the following three questions:

1. With respect with your ETP job, how would you break down your time between managing the projects we are discussing, performing technical advice to other people within your company, and/or other tasks? What are those other tasks?

2. Which energy efficiency/conservation programs have you provided some technical support regarding ETP past or present technologies over the last three years? What was that support?

3. What is your background? Engineer? Architect? Other?

4.2 Early Feedback

As interviews, meetings, and surveys were completed, the R&A Team provided early feedback to key decision makers in a variety of telephone conversations, presentations, meetings, memos, and e-mails. This early feedback was critical in order for the ETP to make any mid-course corrections in the implementation of the PY2003 ETP and to modify the proposed design and implementation of the PY2004-2005 ETP.

4.3 Analysis

The data analysis relied mostly on descriptive statistics of the projects provided by the project managers. We also engaged in a fair amount of qualitative analysis of the interviews with the ETP program managers, CEC staff, and ETP project managers. The review of the database and assessment of the outreach through the Internet was, by its nature, qualitative. From these analyses, however, have emerged recommendations that we believe will facilitate a more quantitative analysis in future evaluations of the ETP.

5 Results

5.1 ETCC Activities and Coordination

During 2002, the ETCC met five times on 5/13, 6/25, 7/31, 9/25, and 12/13 with SCE, PG&E, SDG&E, SoCalGas, and the CEC as regular attendees. As one might expect, the meetings focused primarily on discussions of technologies, CEC and utility coordination and collaboration, and the database. A variety of technologies were discussed such as Compressed Air Central Plant Efficiency and Drag Reduction Fluid Additives. In addition, the members also reviewed a wide variety of CEC PIER Projects as potential candidates for utility emerging technology program collaboration. Examples of these projects include:

- Alternatives to Compressor Cooling
- Conceptual Design Energy Analysis Tool
- Air Handling Unit and VAV Box Diagnostics
- Power-Line Carrier Bi-Level Switch
- Next Generation Relocatable Classroom
- Benchmarking
- Commercial Kitchen Exhaust Systems
- Whole Building Diagnostician
- Night Breeze
- AHU/VAV diagnostics
- Bi-level light switch operating on PLC

Also considered were research proposals submitted by such organizations as American Council for an Energy Efficient Economy (ACEEE), the Consortium for Energy Efficiency and the California Institute for Energy Efficiency.

In addition, there was fair amount of discussion surrounding the roles of various market actors in promoting emerging technologies. Topics included the need to engage industry and other appropriate market actors in research and emerging technology projects and the need for the ETCC to take a step back and better define what it believes are the respective roles for the CEC and the utilities relative to research and emerging technologies.

Factors for evaluating PIER Buildings program portfolio balance were also discussed:

- Are the appropriate building types/vintages being addressed relative to the size of each sector and the opportunity in each?
- Are the best opportunities within the building life cycle being targeted (design/construction/operations)?

- Are there useful research products being produced (hardware, software, information products, etc.)?
- Are the right market audiences being addressed (owners, designers, standards, contractors, etc.)?
- Are there research results impacting the market? (The emphasis is more on applied research that has a shorter time to market than basic research).

Finally, a regular topic was the on-going development of the database.

Based on interviews conducted, there is agreement both on the frequency of meetings and the relevance of topics discussed. There was also agreement that the ETCC is an effective forum for sharing information among it members and a strategically sound mechanism for coordinating the statewide emerging technology effort.

5.2 ET Database

The responsibility for maintaining the database has historically resided with SCE. Together, the four IOUs and the CEC created the current database. Program managers at each of the utilities and the CEC are responsible for updating their respective projects in the database.[9] The original purpose of this database was to provide current information on specific technologies; it was not designed to provide a *history* of how technologies progressed through the ETP or other information typically found in a program-tracking database. The program managers and the public are the two main users of the ET Database. According to the program managers, the ET Database is mainly used as a communication tool among themselves. The public portion of the database consists of reports on the current information on specific technologies. These reports are in Adobe Acrobat PDF format and are available on the ETCC website.

We reviewed both the structure and contents of the database as part of this evaluation in order to assess how data was entered and used within the database and what data was currently available for the evaluation effort.

5.2.1 Documentation

No documentation was available on the database. The terms used within the tables and the correct way to input the data within each table have not been codified. This made it difficult to determine if the goals outlined in Table 2-2 were met. There was some confusion about the definition of a technology assessment, what data should be entered, and in which tables the data should be entered. However, we believe that the ETP technically met the goal of updating the database.

Complete and clear documentation of the database would minimize much of this confusion. Also, a full understanding of the structure and terms within the database would aid in creating a program-tracking database. The creation of the ETP as a statewide program in PY2002 and the need to conduct a more rigorous evaluation made the creation of a program-tracking database essential. However, since quite a bit of time

[9] It is noted that this updating is performed by providing relevant information to SCE who inputs the data.

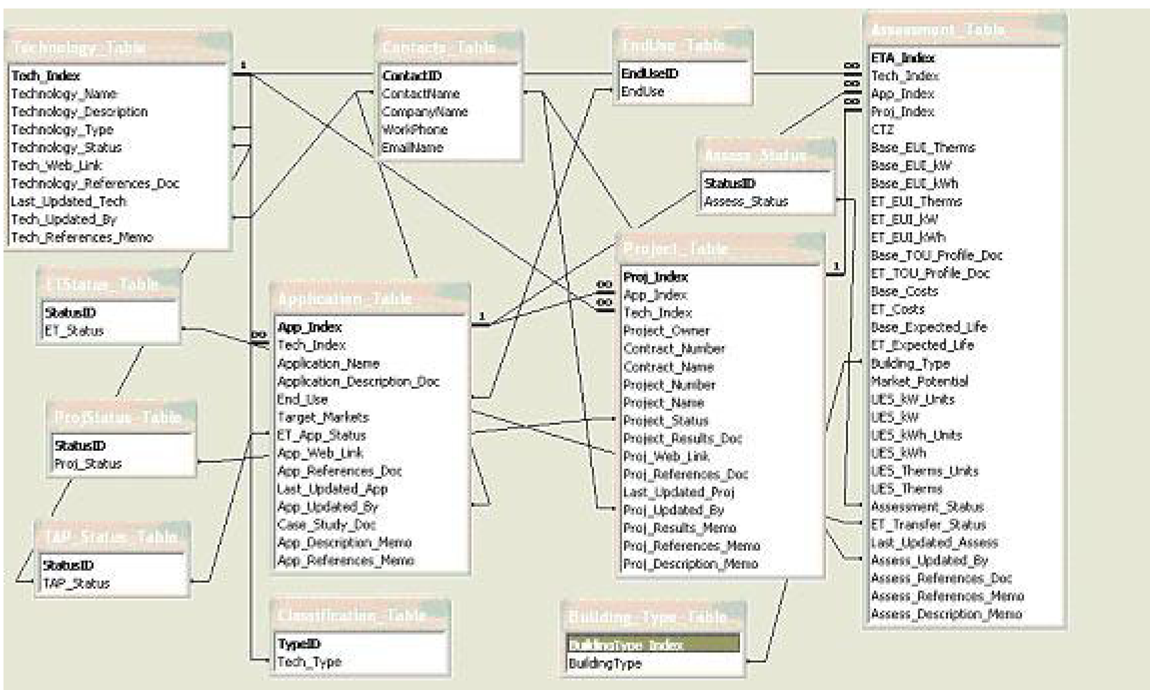
and effort has gone into the creation of the current database, we recommend that the tracking components be added to the current database and be fully documented.

We note that, at the time of the draft report, it was reported to the evaluation team that documentation of the database is currently underway. The next two sections provide our understanding of the database at the time of this evaluation.

5.2.2 Architecture

Microsoft Access was used to create the current relational database. Figure 5-1 provides a graphic view of the tables within the database and their relationships. In this figure, the variable in **bold** is a unique variable for that table. The lines indicate the relationships among the tables, which variables within a table are linked, and whether the relationship was one-to-many (1 to ∞) or simply a linked variable with no symbols.

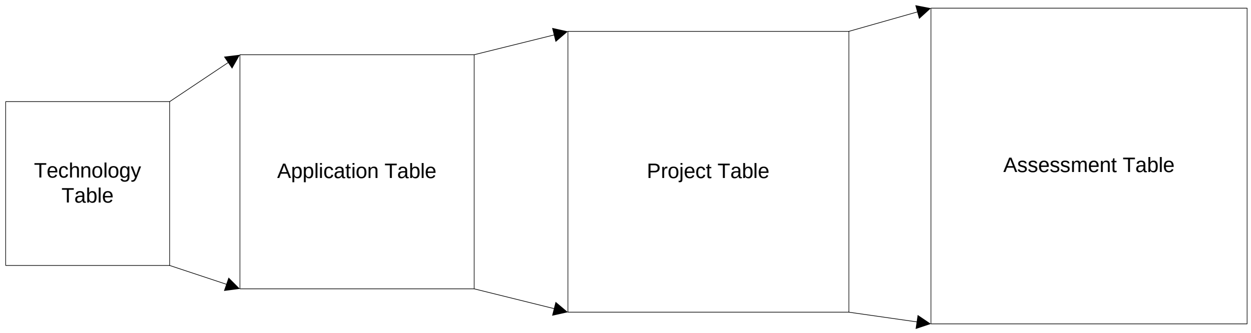
Figure 5-1. Current Database Structure



There are five main tables (Technology_Table, Application_Table, Project_Table, Assessment_Table, and Contact_Table) and seven supporting tables. The supporting tables provide the descriptions of the information contained in the main tables.

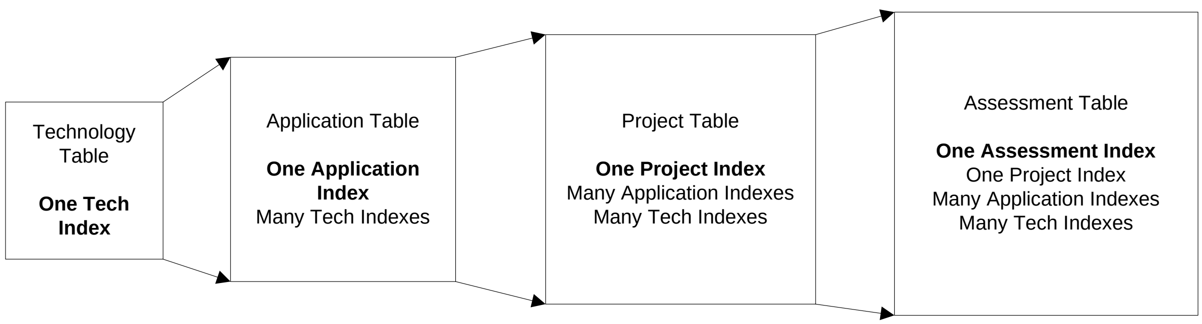
The contact table contains the information about program managers as well as those who are responsible for entering data. Other than this table, the database structure uses the technology table as the fundamental component in the database. Each successive table builds on by adding more information and referencing previous tables. This structure is illustrated in Figure 5-2.

Figure 5-2. Partial Database Structure



In order for the database to track which piece of information from the previous table is being referenced in the successive tables, each of the four tables has a unique identifier for a record in the table (e.g., each record in the technology table has a unique technology index that is referenced in later tables). The unique index follows a record wherever it goes. This is illustrated in Figure 5-3.

Figure 5-3. Partial Database Structure with Indexes



This allows for a very flexible database structure. For example, the program manager can input a technology once and use it multiple times across many different applications. However, because the database structure is complicated, difficulties can arise if the structure and definitions of terms are not well understood by all users.

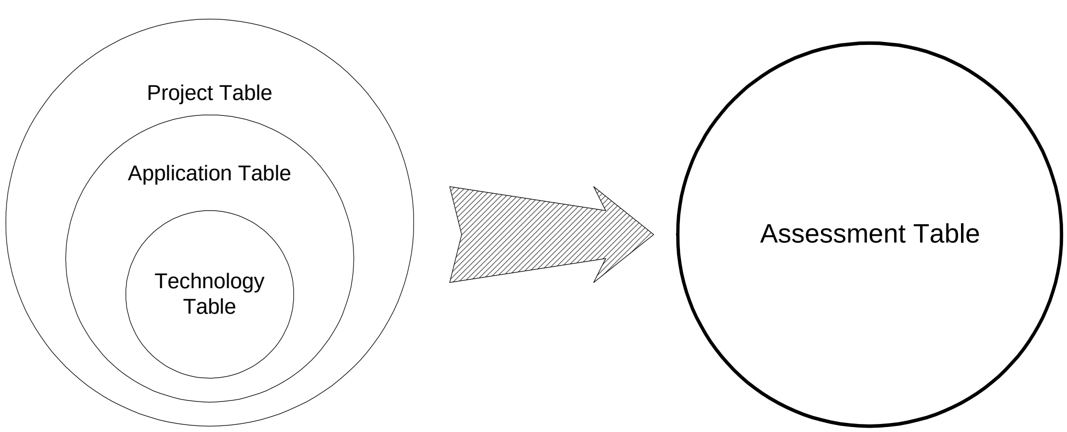
Based on conversations with SCE, Table 5-1 lists the current main tables and their purported use.

Table 5-1. Use of Main Tables

Table Name	Table Use
Technology Table	This table provides information about a technology at the most detailed level. It should not be duplicative. The technologies in this table have a certain level of development (shown by the Technology_Status).
Application Table	This table uses the different technologies from the technology table and assigns those technologies to end uses or markets (i.e., applications) that may be new or underserved. Each application record has only one technology associated with it. The technology, as specified by the end use or target market, may have a different level of development than shown in the Technology Table. Currently only one technology can be associated with an application. This should be changed to allow for an application to indicate that several technologies may be used.
Project Table	The ETP actually funds the program staff time to determine technologies and applications, but much of the annual funds go towards projects. It is at this level that program year funds are allocated for specific *projects* – not simply a technology or an application. For every project record within the table, some sort of report should follow the outcome of the project. As currently set up, a project has only one application and technology associated with it. This should be changed to allow for a single project to cover multiple applications if this is how funding occurs.
Assessment Table	After each project is completed, as assessment occurs the status of which is indicated in the ET_Transfer_Status variable. Each assessment should be unique to a project. The information in this table provides specific data that can be used by program planners to decide whether to include a given technology and application in their energy efficiency and/or information programs.

The assumed relationships among the tables are illustrated in Figure 5-4.

Figure 5-4. Main Tables Structure



The current structure of this database allows the program managers to input an application or a project with little differentiation. The fact that each record in each table must have a unique identifier does not allow them to group technologies under a single application or applications under a single project. This creates confusion with respect to where information should go within the table. This confusion was manifested when each utility updated their sections of the database, but chose to update different tables. What is needed is a clear structure that indicates that information is flowing from one table to the next based on where a technology is within the program.

Based on the data collected in this evaluation, there can be multiple technologies that are mapped to a single application. The structure of the tables must change to allow for a non-unique application index (i.e., multiple technology records applied to the same application index). A record identifier should be added that is a primary key and a form created to allow for ETP staff to input information to allow this (Note: a form with a sub-form is one possibility).

Since modification of the database was beyond the scope of this evaluation, there was no exchange between the evaluation team and the ETCC regarding possible modifications. This left certain questions unanswered. However, based on the current understanding of the data, it seems that there is a strong possibility that multiple applications are grouped beneath a single project, since funding is at the project level. The structure of non-unique project indexes appears to be required to create this ability in the database. However, in the assessment table, it seems like the project manager has used multiple avenues to test a single idea and there should be a 1:1 relationship between the assessment and project tables. This area needs further discussion within the ETCC if and when changes to the database occur.

5.2.3 Contents of Database

After surveying the project managers, we entered the survey data into the ETP database. The total number of original records and those added by the evaluation team is shown in Table 5-2. As indicated by the architecture of this database, a record under the project table is considered a unique record. We added 24 projects that were not in the original ETP database.

Table 5-2. Records in ETP Database Main Tables

Table	N Original Records	N Added by Evaluation Team	Total as of September, 2003
Technology	165	18	183
Application	211	22	233
Project	248	24	272
Assessment	40	0	40
Contacts	13	15	28

As stated earlier, this database was not originally created to track the program elements as they moved through time. As such, certain data such as when the project started, when it ended (or is expected to end), and the budget for the project were not included. However, there were data to support the descriptions of technologies and applications of those technologies. While, in general, the variables within each of the tables appear to have been thoughtfully selected, when over half of the content is missing for a variable, it is ultimately not very useful. There are a few cases in which the data for a variable is completely missing. These variables should be reviewed to determine if they should be dropped from the database, or, if the data are required and available, updated. If the data are required, project managers should not have the option of leaving it blank. We will cover each of the main tables next.

Technology Table. Currently, the technologies listed can be grouped by type (hardware, software, method) or where in the product development and commercialization stage they lie. These are eminently useful. If one wants to see how many technologies are within the program for a specific end use, then information from the application table is brought into play to provide this data (assuming that the technology has been stated to be within an application). Technology names such as “energy efficient lighting”, “agricultural energy efficient technologies”, “building envelope improvements”, or “high efficiency appliances” do not have the technology broken down into the most elemental piece. While this naming problem affects only a small number of technologies, it should be addressed. Finally, the variable, Technology_References_Doc, should be reviewed for inclusion or exclusion.

Application Table. We have no comments on the contents of this main table. However, the following variables should be reviewed for inclusion or exclusion: Application_Description_Doc, App_References_Doc, and Case_Study_Doc.

Project Table. This table should add a few more variables to enable the tracking of the project through time. At a minimum, a date started, date ended, and expected completed date should be added. Each project should have a budget included and the program should keep track of the project expenditures over time. The location of the project accounting details should be identified and documented by the IOUs. Finally, the following variables should be reviewed for inclusion or exclusion: Project_Results_Doc and Proj_References_Doc.

Assessment Table. This table had few inputs, and only from one utility. We suspect that this might be due to a misunderstanding regarding the structure of the database. The variables here appear quite useful for disseminating information on the application of the specific technology.

Contacts Table. We have no comments on this table.

Data from each of the main tables (except the contacts tables) have a summary in PDF format that is available to the public via the Internet (www.ca-etcc.com). As the data within the database change, the summaries can be easily updated. We reviewed the summaries as presented on this site. While the format is nicely laid out, there are areas of improvement that could help to improve the dissemination of information. For example, it is not clear how a person visiting the site should look at the data in the four files provided on the site. What does it mean to have something in the project table, but not in the assessment table? If a person is interested in finding out more about that particular project, whom do they contact? If a project has been transferred to an energy efficiency program, which program? It is difficult, if not impossible, to contact anyone associated with projects listed on this site. The links go to the main utility home page where one continues the search, a search that does not always end successfully.

We make the following recommendations for updating the website database summaries based on the reasonable presumption that the purpose of the website is to disseminate information:

- Within the site, describe the various files that are available and how they can be used to find information.
- Create the ability to contact project managers regarding specific technologies and/or projects.
- Fully describe and populate the variables that are used within the summaries.
- Each project indicated within the report summaries should have a unique identifier.

5.3 PY 2002 Project Activity

Recall that in Section 3.3, in order to provide the most relevant and useful information on ETP in light of the limited evaluation budget, we chose to look at all the projects for which work was done in 2002 by the ETP staff, regardless of the specific program year in which they began. We noted that this approach fails to address a number of successful ETP projects that were completed in 1998 or 1999. Of the 69 projects for which we originally requested data across all four utilities, there were a total of 53 projects for which project managers reported some ETP activity in PY 2002 and were therefore of interest to the evaluation team. Table 5-3 present these results.

Table 5-3. Projects in 2002, by Utility

Utility	N Requested	N Received	Comments
SCE	39	31	There were 8 requested projects requested by the evaluation team that did not have activity in 2002.
SoCalGas	16	16	SoCalGas actually provided 18 projects, but there were 2 projects that that did not have activity in 2002.
PG&E	9	3	There were 6 requested projects requested by the evaluation team that did not have activity in 2002.
SDG&E	5	3	There were 2 requested projects requested by the evaluation team that did not have activity in 2002.
Total	**69**	**53**	

There was a large amount of data provided in the 53 projects from the utilities. The next sections assemble much of that information and present it in tabular or graphic format

5.3.1 Estimated Start and Ending Times for Projects

Figure 5-5 and Figure 5-6 show the estimated start and end times for the projects. The figures are color coded by utility. For those viewing these tables in black and white, the leftmost column (*Task Name*) indicates the utility sponsor.

The average duration of a typical ETP project is about 2.5 years. Some of them are completed in less than a year while others *appear* to take over five years to be completed. The fact that some project managers reported durations of four or five years for some projects does not necessarily mean that the contracted period within which to conduct the project was four or five years. It might mean that, while the contracts officially last two or three years, the project manager was still responding to inquiries for an additional year or two. To verify that each project required no more time to complete than the time allowed by the CPUC was beyond the scope of this evaluation. ETP program managers reported that all projects have always been completed within the CPUC-specified timeframe.

Figure 5-5. Estimated Start and Ending Times for Projects

ID Pg 1	Task Name	Start	Finish
1	PG&E - Project 100	6/3/2002	1/31/2003
2	PG&E - Project 101	9/2/2002	8/1/2003
3	PG&E - Project 267	5/1/2001	8/30/2002
4	SDG&E - Project 96	12/3/2001	10/1/2003
5	SDG&E - Project 97	2/1/2002	10/1/2002
6	SDG&E - Project 99	12/3/2001	12/1/2004
7	SCE - Project 3	11/1/1999	11/1/2002
8	SCE - Project 35	8/1/2000	8/1/2003
9	SCE - Project 248	3/1/2002	3/1/2005
10	SCE - Project 249	6/3/2002	6/1/2005
11	SCE - Project 251	12/2/2002	3/1/2005
12	SCE - Project 253	12/2/2002	9/1/2004
13	SCE - Project 254	12/2/2002	10/31/2003
14	SCE - Project 256	12/2/2002	1/30/2004
15	SCE - Project 258	12/2/2002	1/30/2004
16	SCE - Project 259	12/2/2002	12/1/2004
17	SCE - Project 260	12/2/2002	12/1/2004
18	SCE - Project 261	6/3/2002	6/1/2005
19	SCE - Project 269	11/1/2000	10/31/2003
20	SCE - Project 270	11/1/2000	10/31/2003
21	SCE - Project 271	12/3/2001	12/1/2003
22	SCE - Project 273	10/1/2002	10/1/2003
23	SCE - Project 274	10/2/2000	7/1/2002
24	SCE - Project 275	11/1/1999	8/30/2002
25	SCE - Project 276	12/1/2000	12/1/2004
26	SCE - Project 278	12/1/2000	11/1/2004
27	SCE - Project 279	12/1/2000	12/1/2003

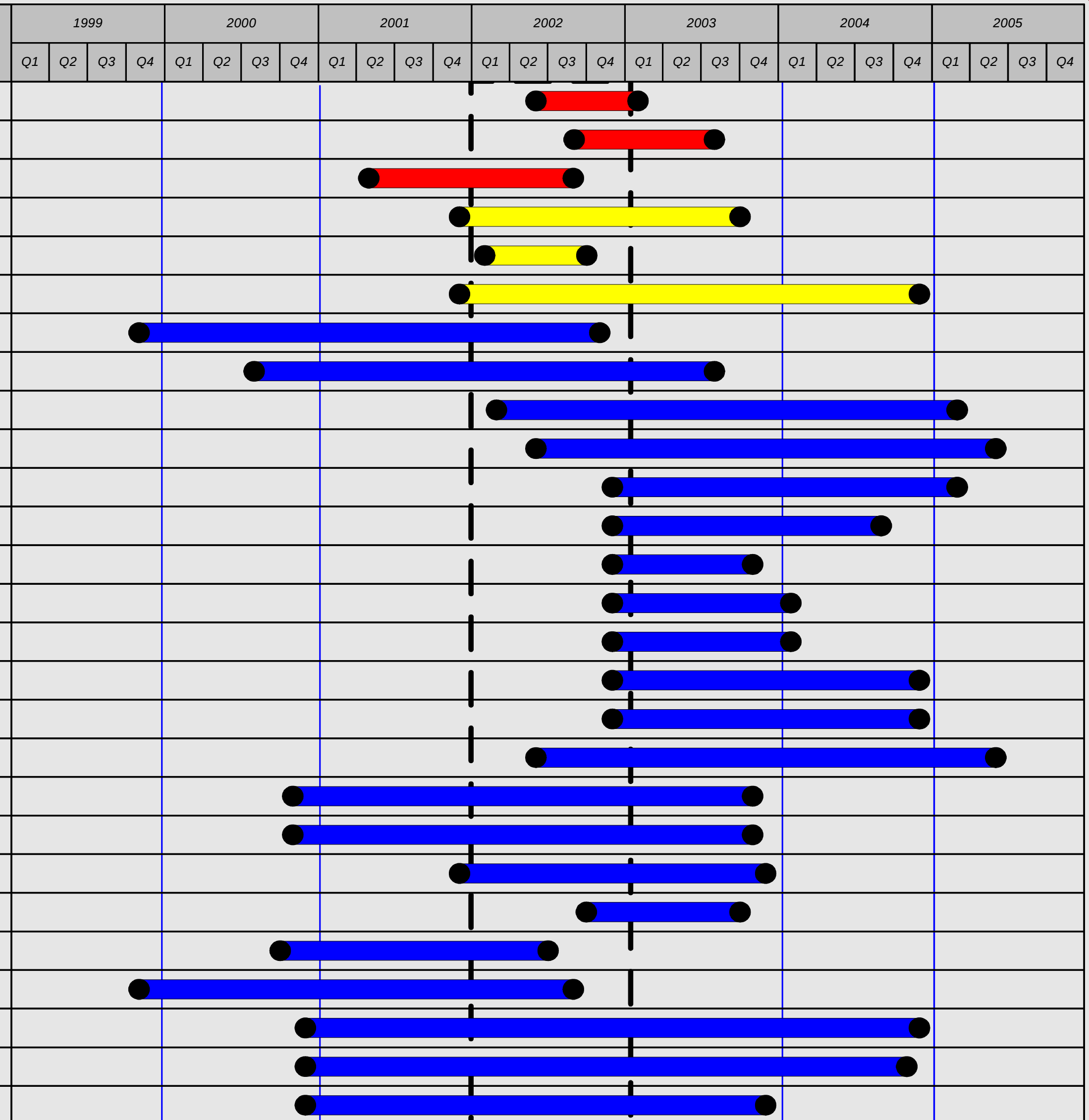
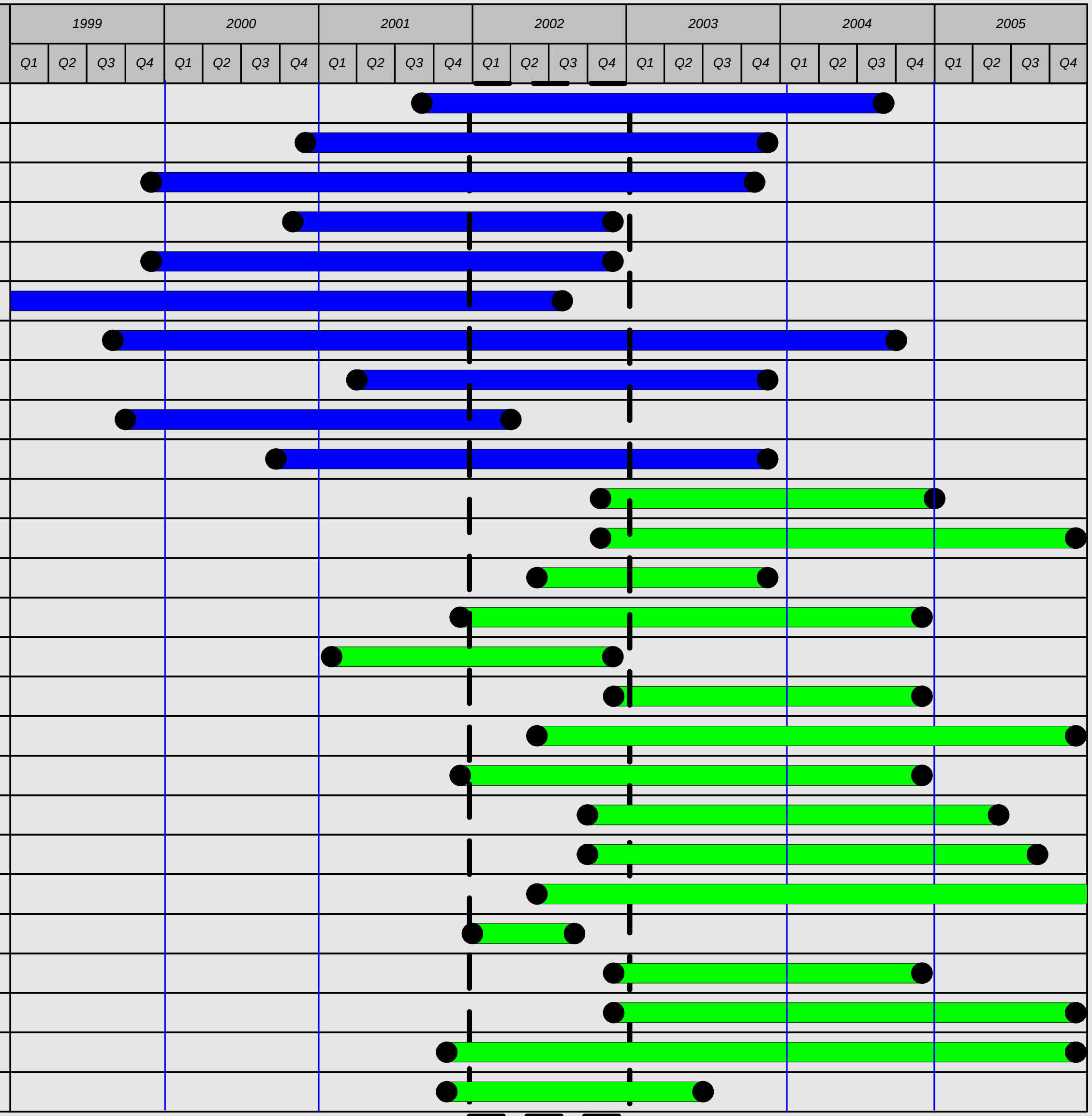


Figure 5-6. Continuation of Project Estimated Start and End Times

ID - Pg 2	Task Name	Start	Finish
1	SCE - Project 280	9/3/2001	9/1/2004
2	SCE - Project 281	12/1/2000	12/1/2003
3	SCE - Project 282	12/1/1999	10/31/2003
4	SCE - Project 283	11/1/2000	11/29/2002
5	SCE - Project 284	12/1/1999	11/29/2002
6	SCE - Project 285	8/1/1997	8/1/2002
7	SCE - Project 286	9/1/1999	10/1/2004
8	SCE - Project 287	4/2/2001	12/1/2003
9	SCE - Project 289	10/1/1999	4/1/2002
10	SCE - Project 290	9/22/2000	12/1/2003
11	SCG - Project 78	11/1/2002	12/31/2004
12	SCG - Project 79	11/1/2002	12/1/2005
13	SCG - Project 80	6/3/2002	12/1/2003
14	SCG - Project 81	12/3/2001	12/1/2004
15	SCG - Project 82	2/1/2001	11/29/2002
16	SCG - Project 83	12/2/2002	12/1/2004
17	SCG - Project 88	6/3/2002	12/1/2005
18	SCG - Project 89	12/3/2001	12/1/2004
19	SCG - Project 91	10/1/2002	6/1/2005
20	SCG - Project 92	10/1/2002	9/1/2005
21	SCG - Project 93	6/3/2002	12/29/2006
22	SCG - Project 94	1/1/2002	8/30/2002
23	SCG - Project 95	12/2/2002	12/1/2004
24	SCG - Project 291	12/2/2002	12/1/2005
25	SCG - Project 292	11/1/2001	12/1/2005
26	SCG - Project 293	11/1/2001	7/1/2003



5.3.2 Technology and Application Status

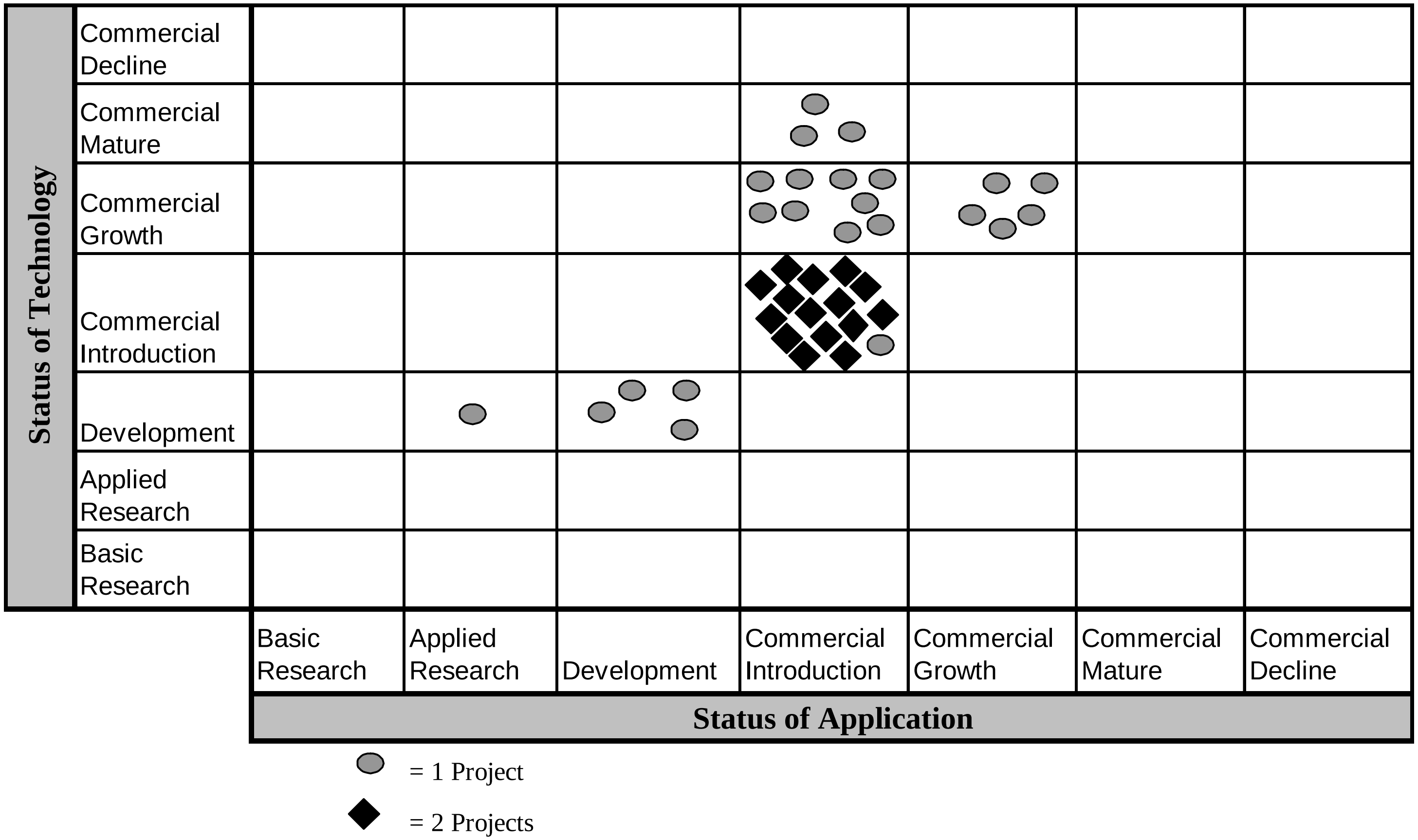
As shown in Figure 2-3, products typically go through several stages in their development and commercialization. Understanding the current stage of a particular technology can help determine when and how the ETP should become involved. Additionally, while a technology may be mature in one market, it may be virtually unknown in a different market. ETP has a part to play in this situation as well. Table 5-4 provides definitions of the status indicators that were used when surveying project managers. Each project manager was asked about the status of the technology *independent of the market* and well as the status of the technology *within the market of the current project application.* That is, a technology might have been commercially available for some time (i.e., it is mature) but it has achieved only very limited penetration within a given market segment, e.g. daylighting within the schools market segment.

Table 5-4. ETP Definitions of Status Indicators

Status	Definitions
Basic Research	The technology is a scientific suggestion or may be a new concept or an attempt to discover something about a process or technology.
Applied Research	The basic research is taken to the next step and an attempt is made to apply the basic research to actual problems within a controlled environment.
Development	The technology is being developed via engineering and industrial design prototypes at either labs or manufacturers.
Commercial Introduction	The technology is beyond the prototype stage, and the first versions have entered production. Technologies may vacillate between the development R&D stage and the commercial introduction stage until either it is accepted in the marketplace, or it fails and the development and production cease.
Commercial Growth	The technology is present in the market place. While it has achieved little penetration, its rate of penetration is increasing.
Commercial Mature	The technology is mature, but the market that is targeted is new to the technology or the application of that technology is new.
Commercial Decline	The technology has been adopted by the majority of the marketplace.

We used these definitions to help provide a framework as to where the projects exist within the ETP (shown in Figure 5-7).

Figure 5-7. Status of Technology and ETP Applications During 2002



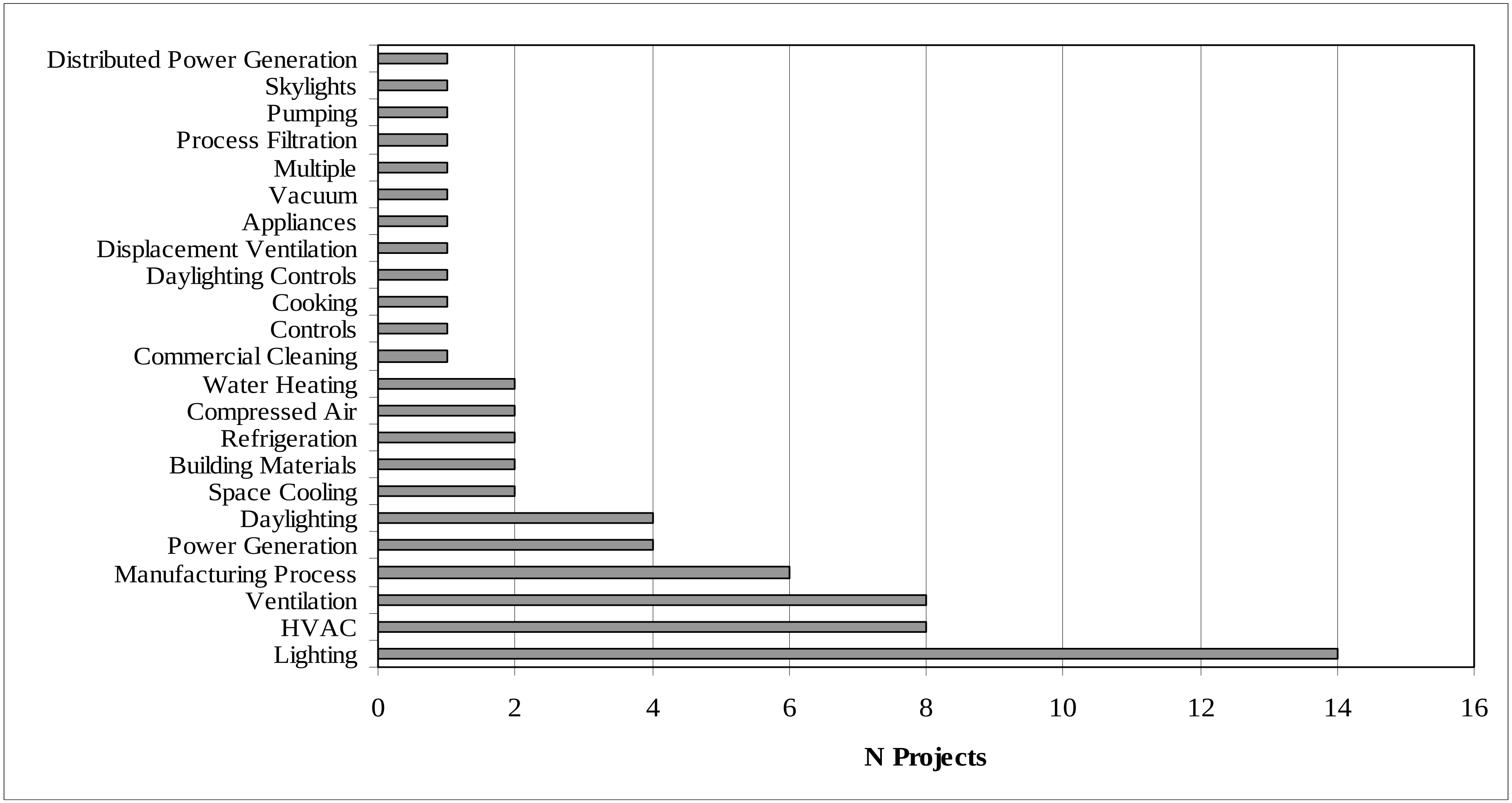
Slightly over half of all projects within ETP have a technology that is considered to be beyond the prototype stage, but not yet fully in production (i.e., those in which the technology is in the commercial introduction stage – 31 of the 53 projects). The majority of all *applications* within ETP cluster around the commercial introduction stage (43 of the 53 projects). This is expected given that the role of the ETP is to help these technologies move into the marketplace. There are 12 projects that involve technologies that are in the

Commercial Growth or Commercial Mature stages but are in the Commercial Introduction stage for the markets selected for the ETP applications.

5.3.3 End Uses Addressed

ETP covers a wide range of technologies. Based on data provided by the project managers (see Figure 5-8), the Program covers technologies that affect 23 different end uses. While 53 percent of the projects have the typical commercial end uses of lighting and HVAC, close to 20 percent of the projects cover non-standard end uses such as power generation and manufacturing process.

Figure 5-8. End Uses within ETP



5.3.4 Project Status

Of the 53 projects on which the ETP actively worked during 2002, there were 11 projects completed during 2002. As expected in this type of program, not all the technologies, or applications of those technologies, are successful in the market place. The ETP project managers might find that the potential for savings was less than expected. There may be indications that further work is needed to realize the savings potential. Conversely, projects may demonstrate savings and are ready for deployment to energy efficiency information and resource acquisition programs or directly to the market, sometimes with the collaboration of a specific manufacturer. Table 5-5 shows the status of the 11 projects completed within 2002.

Table 5-5. Status of Projects Completed in 2002

Completed Project Status	N	% of Total
Under Review	1	9%
Not Recommended	1	9%
Requires further development	1	9%
Requires further demonstration	2	18%
Transferred to Energy Efficiency Program	1	9%
Transferred to Information Program	3	27%
Market Adopted	2	18%
Total	11	

Over half of the projects have been transferred to energy efficiency programs or directly into the market. While not large in absolute numbers, this is a high percentage of new technologies or applications of mature technologies that are being deployed into the mainstream energy efficiency programs or the market.

An equally important concern, however, is whether the recent levels of funding are adequate to explore all promising technologies. In order to achieve the full energy efficiency potential, sufficient funding must be provided to minimize missed opportunities.

It is also worth noting that the ETP appears to be assuming a reasonable amount of risk given that only one completed project (less than 10 percent) was not recommended for further development of transfer. Assuming a reasonable degree of risk is a challenge and is a key performance indicator of the ETP that should be monitored on a regular basis[10].

[10] We understand that failures are a necessary fact of life when conducting emerging technology programs. If there are no failures, then emerging technology program staff are not taking enough risks, i.e. a certain number failures is not necessarily an indication that the program has failed but that it has not allowed a certain amount of uncertainty to dissuade them from pursuing promising technologies. Pursuing only sure bets might slow the identification and deployment of some of the more innovative and promising technologies, resulting in a number of missed opportunities for saving energy and reducing demand.

It is important to remember that the level of risk varies with the type of technologies selected by the ETP for assessment. For example, if a project consists of a new application of a product that is commercially available, there is probably less risk that it will be eventually deployed to an energy efficiency program than a technology that is not as yet commercially available and has no known successful applications in the market. Or, consider the case of a project that assesses how well an algorithm can control equipment. In such a project, the risk may be higher since there is no guarantee that the algorithm will eventually be adopted by manufacturers for use in their equipment.

5.3.5 Budgeted Amounts Over Time

To describe in great detail the expenditures of the ETP was not a goal of this evaluation. As a result, while we gathered data on project expenditures by year, we made no attempt verify these expenditures through the use of rigorous accounting methods. Nor did we attempt to ascertain how regulatory decision might have affected the allocation of money over time or the duration of projects. The sole purpose of our budgetary analysis within this evaluation was to provide a *sense* of the allocation of project resources over time. Figure 5-5 and Figure 5-6 provide graphic illustrations of the span of years over which projects occur. Table 5-6 shows how costs from a program year are allocated across multiple years as the projects evolve. We note that the budget allocation percentages in Table 5-6 could reflect spending across multiple phases of a project and not necessarily simply budgets from one program year.

Table 5-6. Budget Percentages Provided by Year and When Spent

Year*	1997	1998	1999	2000	2001	2002	2003
1997	0%	25%	35%	35%	5%		
1999			2%	29%	49%	20%	
2000				3%	53%	33%	11%
2001					55%	23%	22%
2002						18%	4%

*There is no year 1998 as none of the projects in our designated evaluation period included projects begun in 1998.

Except for 2002, all data we obtained to date were considered to cover 100% of the budget. As such, the percentages for years 1997-2001 add up to 100%. Program year 2002 only adds to 22% since only 22% of the budget for PY2002 has been reported to have been expended to date, although 100% of it may have been allocated.

5.3.6 Project Evolution

An important aspect of ETP is how the projects are chosen for inclusion into the program. Asking the project managers to explain how their projects were initiated helped us to identify possible improvements in technology selection. Based on the data collected, it became clear that there were several approaches being used to select technologies and applications. Among the approaches were:

- Using knowledge of the technology by engineering staff in combination with knowledge of specific customer sites.

- Using prior ETP research on a specific topic or technology leading to further investigation.
- Gathering intelligence from manufacturers to help determine the most promising technologies and working directly with manufacturers to demonstrate emerging technologies in various markets.
- Identifying Department of Energy (DOE) and CEC Public Interest Energy Research (PIER) projects that are moving from the research phase into the commercialization phase.
- Using previously published research on technology.
- Reading trade journals with articles about specific technologies, but with no references to specific energy savings potential.
- Collaborating among different entities to create an energy efficient outcome.
- Monitoring customer interest to reduce energy use within a specific application.
- Staying abreast of environmental issues that are being addressed within a market and determining the energy efficiency possibilities and ramifications within the area as more environmentally friendly technologies are investigated.
- Supplying additional funding to already existing research outside of ETP so that additional information on emerging technologies can be obtained.
- Disseminating research performed outside of ETP in order to expand the awareness of the technology.
- Applying knowledge of a technology within a specific market to similar use in a different market.
- Applying knowledge of an industrial process in which an emerging technology can increase the cost-effectiveness of the process.
- Through energy audits, identifying high use end uses for which there exists no known energy efficient technology.

As this list indicates, there are many avenues through which projects can be added to ETP. Having multiple avenues helps to insure that technologies from multiple areas are funneled into the pool of measures with potentially large savings.

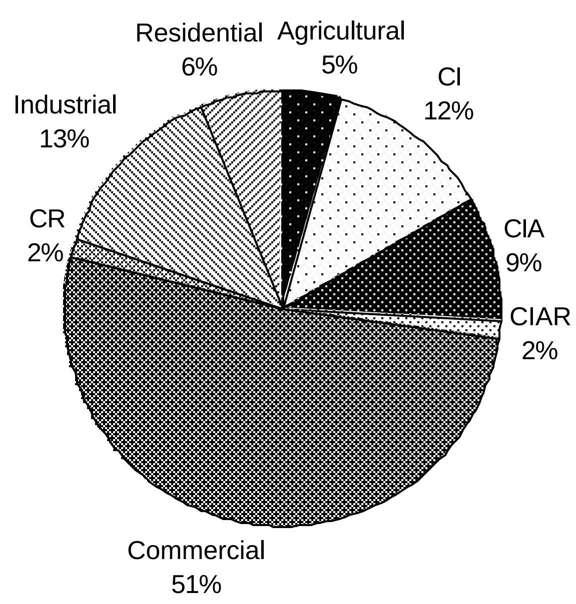
Looking through the list above provides some insight into how ETP staff allocate their efforts. All work does not go directly towards managing projects that demonstrate a technology. The project manager may be involved with meetings with manufacturers, research facilities, or customers to follow-up on various leads. They read relevant technical journals. They collaborate with other entities, including other managers within their utility. Project managers provide information through their involvement with outside committees such as the National Steering Committee of the Green Building Council or through their work with such programs as DOE’s Compressed Air Challenge.

However, we did discover what appears to be a significant gap in the information considered when reviewing candidate technologies. None of the project managers indicated that secondary data such as saturation studies, customer needs-and-wants studies, market potential studies, market share tracking studies, and evaluation studies were used in reviewing candidate technologies. In addition, it appears that estimates of the savings potential associated with possible projects within a targeted market were not routinely made. We will discuss targeted markets next.

5.3.7 Targeted Markets

The projects within ETP cover many market sectors. While some ETP staff defined their target market in a fairly detailed manner, we chose to present them in Figure 5-9 in their more familiar general terms: residential (R), commercial (C), industrial (I), and agricultural (A) sectors (see Appendix D for a detailed listing of markets). Also, note that projects can, and often do, cover more than one sector.

Figure 5-9. Market Sectors with ETP Projects



It is rare for projects to cover all sectors, but a few do (e.g., the 2% of CIAR). The commercial sector is targeted most often with 74% of the projects listed as covering this sector. The industrial sector is second with 36% of the projects.[11]

The targeted markets described by ETP staff ranged from very general to specific. In all 60 markets were mentioned, including plastics manufacturing, dry cleaners, as well as the entire commercial sector. Appendix D presents all 60 markets mentioned.

[11] There are projects that cover more than one sector. This causes single sector sums of greater than 100%.

The ETP project managers were also asked to list the market actors in each of these markets and estimate their numbers. This was done in order to provide an idea of how large the potential audience was for a given emerging technology and to identify which market actor would be the best to target. Of the 53 projects, 35 (66 percent) identified a market actor. Of these 35, project managers were able to estimate their numbers for 22 (62 percent). Put another way, of the 53 projects, 42 percent of the project managers were able to estimate their numbers.

The gap in market actor data, in conjunction with the general failure to consider those studies referenced in Section 5.3.6 on project evolution (e.g., saturation studies, customer needs-and-wants studies, market potential studies, market share tracking studies, market research studies, and evaluation studies), suggest that specific knowledge about target markets is difficult for the project managers to obtain. It is unreasonable to expect project managers trained in engineering, architecture, and business to have both the time and the necessary skills to identify, read, interpret, and apply such a broad range of studies. Therefore, we recommend that the expertise be acquired to assist in characterizing target markets, developing targeted marketing campaigns, and documenting all efforts.

5.4 ETP Dissemination Activities and Products

As an information program, the ETP, as should be expected, has multiple outreach efforts to disseminate information on emerging technologies. These efforts include:

- Fact sheets
- IOU Website
- Workshops / classes at the different technology centers throughout the state
- Conference papers
- Journal articles
- Brochures
- Reports
- Tours of demonstration sites
- Exhibit at technology center
- Account representatives
- Case studies
- Video Storytelling
- Presentation to other utility program planners
- Creation of design guidelines

The information regarding the type of activities and products listed above was obtained from the four utilities. Table 2 presents a summary of these efforts:

Table 5-7. PY 2002 Dissemination Activities & Products, by Utility

Activities/Products	PG&E	SCE	SDG&E	SoCalGas
Fact sheets		12		
Workshops/Classes (See Appendix C)	Three workshops on chillers and chilled water plants	Two workshops	Nine workshops on a variety of technologies	Ten workshops on a variety of technologies
Conference presentations				
Articles				
Brochures				
Reports	Two reports on the DualCool air conditioner demand reduction system One guidebook and accompanying CD ROM regarding design and analysis tools	Reports on: 1) High Pressure Blower, 2) Application of VSDs to a forging process, 3) Direct-Drive Injection Molding, and 4) Electric Power Saving Fan Options for Cow Cooling	One report on Cool Roofs	
Tours of demonstration sites				
Exhibits at technology centers				
Meetings with account representatives				
Case studies				
Video storytelling		One video titled "Better Brighter Schools"		
Presentation to other utility program planners		Regular & Informal		
Creation of design guidelines		CHPS*		

* School district construction guidelines established and promulgated through the Collaborative for High Performance Schools

From Table 5-7, one can see that, in light of the number of projects, there are relatively few efforts to disseminate information about these projects. There are two possible reasons for this. First, it might be due to a misallocation of resources. That is, perhaps the ETP could have launched fewer projects and, as a result, had more resources to devote to dissemination of information. A second reason might be that, given the expectation that a certain number of projects are launched each year, there was insufficient understanding of the costs associated with a good faith effort to disseminate information. At the very least, we recommend that the goal of conducting a certain number of technology assessments be established in light of the equally important goal of disseminating information.

As discussed in Section 3.2, there was little ability to contact customers who had been touched by any of these data dissemination efforts, as we had originally planned. While many of the projects currently covered in our evaluation of PY 2002 activities will be completed in 2003 or later, the dissemination of data and tracking of those dissemination efforts for future evaluations should become a high priority within ETP. Because the Internet can be an effective strategy for disseminating information, we address it next.

5.5 The Internet

We described the database data on the ETCC website within Section 5.2.3. In addition to that site, we reviewed the available ETP information at each of the IOUs Internet homepage (www.sce.com, www.pge.com, www.sdge.com, and www.socalgas.com). We searched each site for a reasonable period of time (approximately 15 minutes per site). If could not access the data in a relatively short period of time, we concluded that it was very likely unavailable to the average user as well. Of the four IOUs, only two had information that appeared related to ETP. The information of the two IOUs that did have ETP data appeared to be outdated with some with information dating back six years. One of the IOUs presented “Success Stories” about certain emerging technologies. However, because there were conflicting dates, it was difficult to know when the information had been added to the web site. At this point, the IOU websites are not reliable avenues for dissemination of ETP information. We recommend that each IOU create a link to a site that provides information about the ETP that, in turn, includes a link to the current ETCC website, which should probably be expanded and updated as well.

6 Conclusions and Recommendations

6.1 The Emerging Technology Coordinating Council

Both the frequency of ETCC meetings and topics discussed seem appropriate. In addition, the ETCC is an effective forum for sharing information among it members and a strategically sound mechanism for coordinating the statewide emerging technology effort.

6.2 Emerging-Technology Database

Overall, the Emerging Technologies Database (the database) appears to have met its original purpose of serving as a repository for information about emerging technologies. With respect to the database, we recommend the following:

- The database should have a unique identifier for each project. The structure of the database should allow a unique project to have multiple technologies associated with it.

- Variables within the main tables for which all data are missing should be reviewed updated to include relevant data as necessary.

- Full documentation of the database structure and definitions of the terms within the database should be prepared. A dictionary of each of the variables should be created along with a full description of the structure of the database and how records should be added. This information is mandatory for a database for which multiple parties have responsibility for updating. Written instructions will insure that all terms are being used correctly and that all information is correctly entered. This will improve the overall consistency with which multiple users enter data.

For the data that are available in summary form as PDF documents on the ETCC website, we make the following recommendations:

- On the web site, describe the various files that are available and how they can be used to find information.
- Create the ability to contact project managers regarding specific technologies and/or projects.
- Fully describe and populate the variables that are used within the summaries so that interested parties can understand what is within the summary.
- Each project indicated within the report summaries should have a unique identifier

6.3 Program-Tracking Database

To insure that the ETP is accountable to the CPUC and more easily evaluated in the future, we recommend that a Program Tracking (PT) Database be created by each utility. With respect to the program-tracking (PT) database, we recommend the following:

- The core variables collected and stored in the PT Database should satisfy the needs of the various stakeholders, including the CPUC, program managers, and the EM&V staff within each utility.
- Full documentation of the PT Database structure and definitions of the terms within the database should be prepared.
- The PT Database must be built so that specific variables can be merged at the project level with the ET Database.

6.4 Regulatory Framework

In this section, we address regulatory uncertainty and as well as the CPUC's definition of effectiveness.

First, the number and type of technologies and their duration have to some extent been affected, since 1998, by the year-to-year uncertainty regarding the existence and levels of funding. This uncertainty and changes in budget amounts very likely affected whether certain projects were initiated and decisions to terminate existing projects. The importance of multi-year funding necessary for long-term stability for such programs as the ETP cannot be over-emphasized.

With respect to effectiveness, we begin by noting that the Energy Efficiency Policy Manual (CPUC, 2001) provides only very general guidance regarding the evaluation of information-only programs. The two *evaluation* objectives that were relevant for information-only programs were to:

- evaluate program success by measuring indicators of program effectiveness and test the assumptions underlying the program theory, and
- provide ongoing feedback and corrective guidance regarding program design and implementation,

The best way to evaluate effectiveness is to focus on measuring the extent to which the agreed-upon program objectives have been met. If they are met, then the program is deemed successful.

The ETP program objectives negotiated by utilities with the CPUC and presented in their Program Implementation Plans were to:

- conduct a certain number of technology assessments (the number varied by utility), and
- update the ET database.

Thus, the only *official* indicators of ETP effectiveness were whether the utilities conducted the agreed-upon number of technology assessments and whether they updated the database[12]. Of course, by focusing only on these two objectives, one clearly risks ignoring the other equally important objectives of the ETP such as the systematic and comprehensive screening of candidate technologies, the dissemination of the results of demonstration projects, and changes in awareness, knowledge, and attitudes towards specific emerging technologies among the various target audiences. This failure to adequately consider all the objectives of the ETP has two important consequences.

The first consequence is that the nature of the ETP is often misunderstood, and as a result, its performance only partially documented. The second consequence is that while, on its face, the funds available for the ETP in 2002 were sufficient to achieve the *two* objectives stated in the implementation plans of the four IOUs, it becomes clear that the level of funding is inadequate when these other objectives are taken into account. By focusing on the two official objectives, one can lose sight of the fact that there are other equally critical activities and goals that also require adequate funding. For example, the dissemination activities that were necessary to adequately inform all the relevant targeted markets could not be fully implemented due to a lack of funds.

Another issue is that the number of technology assessments that should be conducted in any given program year should take into account both the energy policy goals of California and the number of promising technologies emerging from the PIER Program and other research organizations. In the current aggressive resource acquisition framework, for the ETP to be unable to explore all promising technologies is suboptimal. In-depth interviews indicate that there are additional PIER technologies that cannot be reviewed or investigated further by the ETP due to a lack of funds.

The extent to which such key activities are under-funded and promising technologies are left unexplored might make it more difficult to achieve and even surpass the maximum achievable energy efficiency potential identified in Rufo and Coito (2003a and 2003b)[13]. Capturing this potential requires a steady flow of new, more efficient technologies into the portfolios of energy efficiency programs. Failure to do this means that the savings associated with the current energy efficiency program technologies will shrink as the efficiency of the baseline technologies and efficiency standards rise.

Thus, we recommend that key stakeholders, prior to the implementation of the 2004-05 ETP or prior to the end of the first quarter of 2004, establish additional, measurable objectives that address the *key* linkages in the ETP logic model (see Figure 2-4). Some of

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[12] Of course, after the fact, one can, guided by the ETP program theory (see Figure 2-4), embrace other objectives. However, the only objectives that are likely to matter are those that are agreed-upon *a priori*. Failing to meet the agreed-upon objectives while at the same time arguing *ex post* that other objectives equally important objectives have been achieved is likely to be a quixotic exercise.

[13] We recognize that the Rufo and Coito (2003a and 2003b) did not explicitly consider emerging technologies due to the uncertainty about which and when certain technologies might emerge. They state: "In addition, our original scope was also limited to commercially available measures; thus, few emerging technologies are included. This is again appropriate for a medium-term view of potential, but as one forecasts further into the future, the effect of excluding emerging technologies is to underestimate long-term potential.

As a result, savings decline over time as the gap in energy use between standard equipment and efficient equipment narrows. In order for savings not to decline over time requires that a steady stream of emerging technologies be deployed into energy efficiency programs and into the market.

these new objectives could be related to activities currently carried out by the ETP such as the screening of new technologies, dissemination of information about emerging technologies to targeted audiences, and deployment of new technologies into utility, third-party, or municipal energy efficiency programs or directly into the market. This does not mean that evaluators should ignore other important linkages but that evaluators should focus most of the efforts on measuring progress towards meeting formally agreed-upon objectives. We emphasize that all objectives should be established in light of the eventual budgets for 2004-05. If the budgets for 2004-05 are decreased, we recommend a proportional scaling back of all ETP activities and goals rather than completely dropping a key activity or activities.

Second, we recommend that the number of promising technologies explored be expanded in order to avoid missed opportunities. A third recommendation that follows from the first two is to increase substantially ETP funding. All three recommendations are designed to increase the likelihood that all achievable energy efficiency potential will be realized.

6.5 ETP Projects, Technologies, and Transfer

Clearly, the ETP has a multi-year focus and has extensive activities going on in any one calendar year. Budgets allocated in one program year are spent across multiple years, with a typical project lasting 2.5 years. The majority of technologies within the program are considered to be in the commercial introduction stage. However, there are many projects in which a more mature technology is being introduced to a new market sector. ETP covers a wide range of end uses, from HVAC to lighting to manufacturing processes. Within 2002, there were eleven projects completed. Over half of the completed projects were described as having been transferred to an energy efficiency program (either within an incentive program or an information program). Only one of the eleven completed projects was not recommended as worth pursuing. With respect to sectors, 74 percent of the ETP projects cover the commercial sector while 36 percent cover the industrial sector.[14]

The type and number of projects, the time to complete them, and the rate at which they are being deployed into energy efficiency programs or into the market seem reasonable given the resources available.

6.6 Technology Selection and Information Dissemination

Project managers use a variety of strategies and sources to identify new ETP technologies and disseminate information. However, these efforts could be strengthened by improving market research and targeted marketing. Having such skills would assist the ETP in identifying such specific information as market potential and customer wants and needs regarding new technologies and crafting new-product marketing campaigns targeted at specific market segments/actors among the early majority, which is critical if the chasm is to be effectively bridged (Wiefels, 2002; Moore 1995; Moore, 2002). Having these skills would also assist the ETP in establishing mechanisms by which contact information

[14] Because there are projects that cover more than one sector, the percentages sum to greater than 100%.

for the various market actors targeted by the various ETP outreach efforts is collected and stored. Having this contact information will allow future evaluations to assess the various outreach efforts and their impact on awareness, knowledge, and attitudes regarding emerging technologies. We conclude by noting that the ETP and utility energy efficiency programs can collaborate on marketing to the extent that the latter possess the necessary new-product marketing expertise.

Currently, the Internet is not used to its full extent as a tool for disseminating information about ETP. We recommend that the statewide ETP determine the best approach to using the various IOU websites and update these sites appropriately. This would minimally include information about the program projects, past projects, and contact information.

Finally, we have one key recommendation regarding the design of the ETP. We noted earlier that the ETP focuses on providing utility-sponsored energy efficiency programs and the market with a steady stream of new technologies. This basic model should be modified so that third-party energy efficiency programs can benefit from the same information. A formal mechanism such as formal, regularly scheduled workshops could be established so that information about those technologies that are ready for deployment can be shared.

6.7 Program Logic Validation

In addition to addressing the extent to which the fours IOUs met the two main ETP objectives (conducting a certain number of technology assessments and updating the ET database), the evaluation team was also able to test 6 linkages from the program logic model. The data presented in the previous sections can now be used to validate 6 of the linkages in the program logic model illustrated in Table 3-1. Validation included the assessment of whether the activity or output was observed and the quality of the activity or output. The results are summarized below in Table 6-1.

Note that the hypothesis for each linkage is often tested using more than a single piece of information. Also, recall that this evaluation was focused on process rather than impact. As a result, it focused on activities and outputs rather than outcomes and impacts. The linkages that we attempted to verify are only process-related linkages.

Based on the available evidence, we were able to observe activities associated with 6 linkages, with all but two linkages receiving moderate or strong support. Those linkages receiving weak support are concerned with the use of market-related primary and secondary research to identify potential demonstration projects, to disseminate the results of demonstration projects, and to create strategic marketing campaigns.

Table 6-1. Validation of Program Logic

Linkage	Expected Activities & Outputs	Weak Validation	Moderate Validation	Strong Validation
7	ETP staff are informed by the technology-application attributes.			X
8	ETP staff use information on customer segment attributes to identify potential demonstration projects and to craft strategic marketing campaigns.	X		
9	Emerging Technologies Coordinating Council and ETP engage in on-going two-way communications to better coordinate the statewide emerging technology effort			X
10	ETP staff select and pursue demonstration projects of emerging technologies.			X
13	The results of demonstration projects are deployed to energy efficiency programs.			X
15	Results of demonstration projects are disseminated through various means.	X		

We repeat the point made earlier regarding utility-specific variation in ETP program design. It's important to recognize that the definition of the *statewide* ETP program should be defined by a common set of linked activities, outputs, and outcomes across all four IOUs. It will be those linkages that should receive most of the attention from evaluators. However, we recognize that the ETP should be allowed to vary somewhat in order to respond to the unique customer characteristics, customer mix, weather, and economics that characterize the four service territories. Subject to budget constraints, future evaluations should also examine those program design features that are unique to each utility program.

6.8 New Evaluation Model

We begin by noting that, because the ETP activities with respect to selected technologies require more than one year to complete, an evaluation of the ETP should cover at least one cycle. This would allow evaluators to more consistently and accurately observe the implementation of the program and measure any impacts.

Next, we address the issue of cost-effectiveness for information and education programs such as the ETP. In the PY 2002 Program Implementation Plans submitted by the four IOUs, it states:

> There is no estimate of energy, capacity, therm savings, or cost effectiveness for this information program. Although it is the intention of each energy efficiency program to encourage the efficient utilization of electricity and/or natural gas, the calculations performed for the 2002 program cost-effectiveness utilize energy, capacity, and therm savings estimates for measures and programs for which there is a lower degree of speculation. The lack of energy savings, capacity savings, therm savings, resource benefits, or a TRC ratio for any particular program (i.e., information programs) should not imply that a measure or program does not promote energy efficiency nor should it imply that there is not an impact to the customer's use of electricity or natural gas or a corresponding impact to the electricity or natural gas system. However, pursuant to the CPUC's approved Energy Efficiency Policy Manual, this proposal for an information-only program is not reasonably expected to provide an estimate of energy savings.

We suggest that this does not mean that some assessment of the effectiveness of the ETP, with its multiple objectives, as compared to its costs cannot be carried out and tracked over time. Key stakeholders need to know whether energy efficiency-related emerging technology demonstration and deployment activities are effective. Having an index, such as a cost-effectiveness ratio (Levin and McEwan, 2001), makes it possible to evaluate a program and compare it to an *a priori* standard or track its performance over time. In Appendix E, we describe one *possible* approach to evaluating the ETP.

We note that the recently-released draft of the protocols for the evaluation of information and education programs[15] recommends many of the evaluation strategies contained in our initial and final research plan for the ETP. The cost-effectiveness model presented in Appendix E is consistent with the draft protocols.

[15] Draft Information/Educational Program Evaluations. Prepared by TecMRKT Works Framework Team for the Southern California Edison Company as mandated by the CPUC, November 6, 2003

Appendix A

ETP Project Manager Survey

Emerging Technologies Project Survey

	Project Name:	«Project_Name»
	Project Index	«Proj_Index»
	Application Index	«App_Index»
	Technology Index	«Tech_Index»

1	**Please indicate the type of project. (Please check all that apply)**	
	«Technology_Type»	

2	**What is the objective of the project?**

3	**What is the project status?**
	«Project_Status»

4	**Please provide the name of the technology and describe it.**
	Technology Name: «Technology_Name» **Technology Description:** «Technology_Description»

5	**Please identify the end use(s)**
	«End_Use»

6	**What is the status of this technology overall?**
	«Technology_Status»

7	**What is the status of the technology in this project?**
	«ET_App_Status»

8	**When did this project begin? (Month & year)**	

9	**If the project has been completed, what was the date of completion? (Month and year)**	

10	**Please indicate the status of this completed project by putting an "X" in the appropriate cell**	
	Transferred to Energy Efficiency Program	
	Transferred to Information Program	
	Not Recommended	
	Under Review	
	Market Adopted	
	Requires further development	
	Requires further demonstration	
	Requires further testing	

11	**If the project has not been completed, what is the expected date of completion? (Month & year)**	

12	**Have you ever disseminated information about this project?**	
13	**Are you still disseminating information about this project?**	

14	**In no more than one page, please describe the various strategies used, or plan to be used, to disseminate information about this technology and project to the targeted audience(s).**

15	**Annual project expenditures:**	
	First Year *	$
	Second Year	$
	Third Year	$
	Fourth Year: $	$

* Note: First year is assumed to be the same as the year the project began as indicated in Q8 above. If different, please indicate which year.

16	**Estimated annual savings:**	**Savings**	**Unit of Savings (i.e. per square foot, per piece of equipment, etc.)**
16a	**kWh**		
16b	**Therms**		
16c	**Demand reduction: (kW)***		
16d	**Please state how the estimated savings were made (i.e., engineering calculations, metering, etc.)**		

*****This is the connected load. Peak demand reduction for various periods should be noted as such and the periods designated (i.e., average demand reduction from noon to 6 PM on weekdays)

17	**For which market(s) is this technology targeted?**	
17a.	Market #1:	«Target_Markets»
17b.	Market #2:	
17c.	Market #3:	
17d.	Market #4:	

18	Target market actor(s) and estimated number(s)	Name of Market Actor	Estimated Number of Market Actors
18a	Market actor #1		
18b	Market actor #2		
18c	Market actor #3		
18d	Market actor #4		

19	Please list any reports and fact sheets associated with this project	How to obtain this information electronically (Email or URL)
	«App_References_Doc»	«App_Web_Link»
	«Proj_References_Doc»	«Proj_Web_Link»

20	Please provide a description of one page or less of how the project has evolved over time, from identification of the technology, selection, research, to elimination or deployment.

21	Utility contact for further information:	
	Name	«ContactName»
	E-Mail	«Email_Name»
	Telephone	«Work_Phone»

23	If it is a demonstration project or showcase, please provide the following information:	
	Phone number:	
	Customer address:	
	Customer account:	
	Customer contact name:	
	Summary of any measured results:	

Appendix B

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Appendix C

Workshop Titles, Dates, and Number of Attendees, by Utility

SDG&E Workshops	Date	Attendees
The Lowdown on Hibay Lighting	24-Oct-02	13
The Lowdown on Hibay Lighting	18-Sep-02	42
Energy Management Systems, HVAC & DDC	17-Jul-02	99
The Latest in Advanced Lighting	6-Nov-02	19
Energy Management Systems, HVAC & DDC	24-Oct-02	22
Series of Seminars (Latest in Advanced Lighting	19-Jul-02	66
The Lowdown on Hibay Lighting	19-Sep-02	29
Energy Management Systems, HVAC & DDC	18-Jul-02	57
Series of Seminars (Latest in Advanced Lighting	20-Jun-02	44
SoCalGas Workshops	**Date**	**Attendees**
Steam Efficiency Workshop	3-Apr-02	81
Cost Effective, Low-Nox Technology BACT	5-Sep-02	34
Understanding Boiler Basics	17-Sep-02	65
On-Site Electric Generation: Is It Right For Your Bu	25-Sep-02	154
Facilities, Engineering & Healthcare Symposium	26-Sep-02	134
Air Compression Seminar	3-Oct-02	23
Building Commissioning: Who, What, When & Wh	7-Nov-02	45
High Performance Schools: The CHPS Program	August 29, December 12 & December 13, 2002	94
Designing & Operating Energy Efficiency Food Ser	6-Jun-02	59
Advanced Concepts in Kitchen Ventilation Systems	3-Dec-02	37
SCE Workshops	**Date**	**Attendees**
Fan Demonstration	6-Sep-02	25
Building Envelope and Daylighting	?	17
PG&E Workshops	**Date**	**Attendees**
Chiller Water Plant Retrofits	12-Sep-02	?
The Simulation of Chilled Water Plants	13-Sep-02	?
Chiller	1-Sep-02	?

Appendix D

Listing of Target Markets

Market Name
Academic Campus distributed power generation with heat recovery (BCHP)
Affordable housing
Air Compression
Air conditioned buildings with un-insulated flat roofs
All universities, college, and trade schools
Commercial
Commercial boiler market segment
Commercial kitchens
Commercial sit down restaurants
Commercial space conditioning
Commercial specifically chain stores with technical maintenance staff
Customer self-generation
Dairy
Dairy farm milking and freestall barns
Dairy Plants
Dry cleaners
Fast Food Restaurants
Full service restaurants
Fume Hood
Governmental, commercial, industrial kitchens – possibly large cooking schools
High end of commercial / industrial low bay
HVAC
Indoor high bay (above 25') governmental, commercial, industrial, retail warehouses, aerospace – indoor
Industrial
Industrial Boiler market segment
Industrial customer (load reduction and distributed power)
Institutional
Large Commercial
Large facilities with central chilled water systems

Market Name
Lighting
Low pressure compressed air systems
Manufacturing
Manufacturing with captive heat treatment
Medium bay retail
Medium bay warehouses
Medium to High bay Manufacturing plants, warehouses, and retail spaces
Multifamily housing
Offices, conference rooms
Outdoor floods and spot lighting (including multi-use fields) 25’ to 120’
Outdoor tower medium and high mast – 45’ to 120’
Parts Powder Coating
Plastics Manufacturing
Power Generation
Printed circuit board manufacturers
Quick Service Restaurants
Refrigeration
Residential
Residential / light Commercial
Residential and Commercial Building Space Conditioning
Residential and small office with electric hot water heater
Schools
Sit down restaurants
Small businesses that do PERC based dry cleaning
Small Commercial
Small commercial ‘green’ thinking businesses
Small commercial grocery stores
Small residential systems that are highly subsidized
Small to large commercial buildings
Small to Large Manufacturing
Thermography printing

Appendix E

Cost-Effectiveness Analysis for the ETP

In this Appendix, we describe one general approach to evaluating the ETP that is based on the monitoring of the full range of ETP activities, outputs, and outcomes. We begin by noting that the standard benefit-cost techniques, which require that the costs *and* the benefits be monetized, are inappropriate for the ETP, since its multiple objectives (its benefits) are difficult, if not impossible, to monetize. Because some type of valuation is needed for ETP, we describe a *cost-effectiveness* (C/E) technique that does not require that the benefits of the program be monetized *and* can address multiple objectives.

We begin with the simplest type of C/E evaluation involving a program that is attempting to optimize on a single goal or objective. For example, to conduct a cost-effectiveness evaluation of a program with the single objective of distributing energy efficiency literature to 200 ASHRAE members is easy. One simply divides the number of ASHRAE members reached by the dollars expended to produce a ratio.

How then does one calculate a C/E ratio for a program, which has multiple objectives that cannot be monetized? One popular technique is a version of the cost-utility analysis (Levin and McEwan, 2001) that involves utility transformations. This technique, called multi-attribute utility technique (MAUT), has been used for over 25 years in the evaluation of social action programs (Edwards, et al., 1973; Edwards and Newman, 1982). A simple example will illustrate this technique. Consider an emerging technology program with three objectives:

1. To review promising technologies,
2. To conduct technology demonstration projects, and
3. To disseminate information about successful projects.

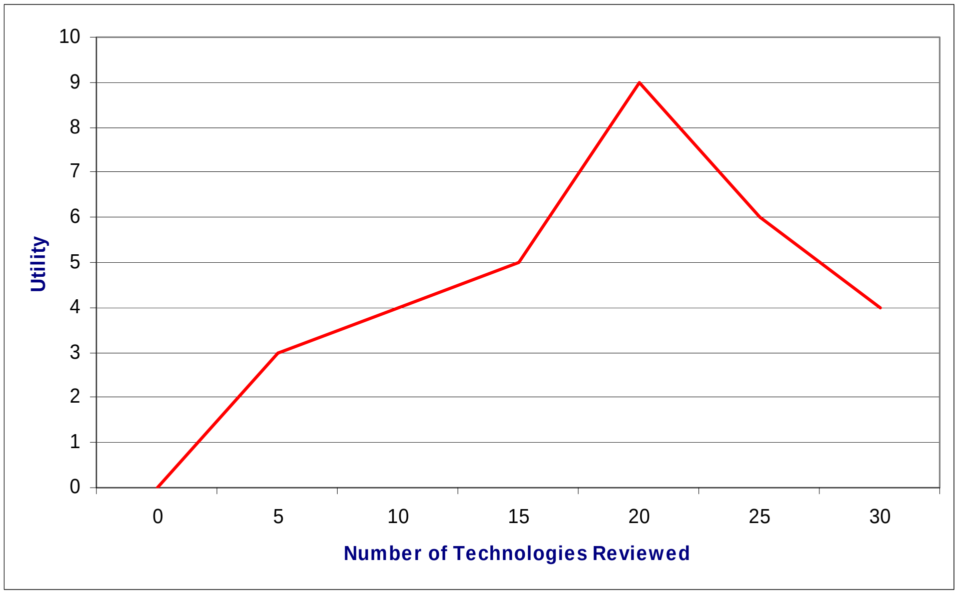
Also, suppose that in meetings with key stakeholders weights were assigned to each objective such that the total equaled 1.0. Table E-1 presents these hypothetical weights.

Table E-1.Objectives and Weights

Objective	Weight
1. To review promising technologies	0.2
2. To conduct technology demonstration projects	0.5
3. To disseminate information about successful projects	0.3

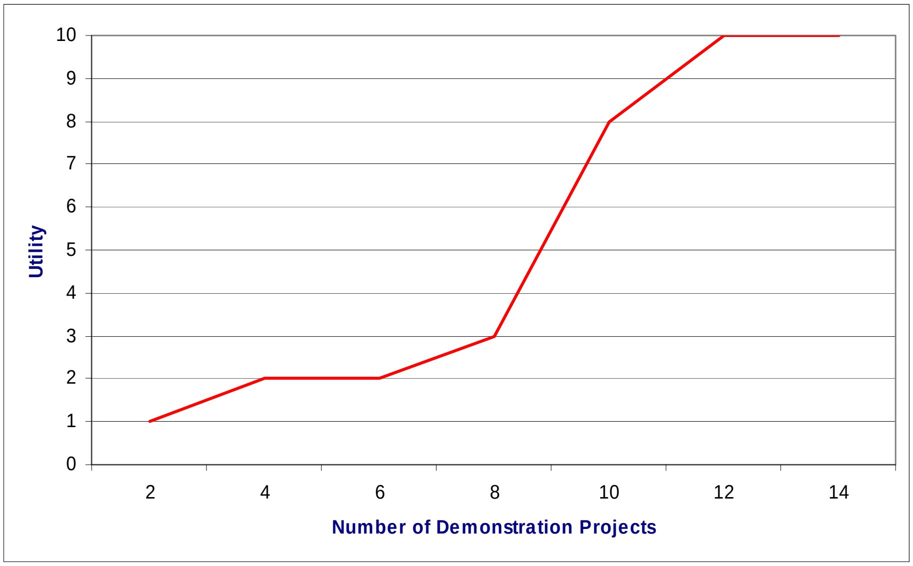
Next, again in meetings with key stakeholders, curves can be developed that describe, for each of the three objectives, the value or utility that is associated with different levels of achievement. Figures E-1 through E-3 illustrate these hypothetical curves. Note that a simplification of these utility curves would be to assume that they are all linear rather than nonlinear as in these three figures. This simplification would be acceptable as long as one's intuition is not severely violated.

Figure E-1. Utility As a Function of Number of Technologies Reviewed



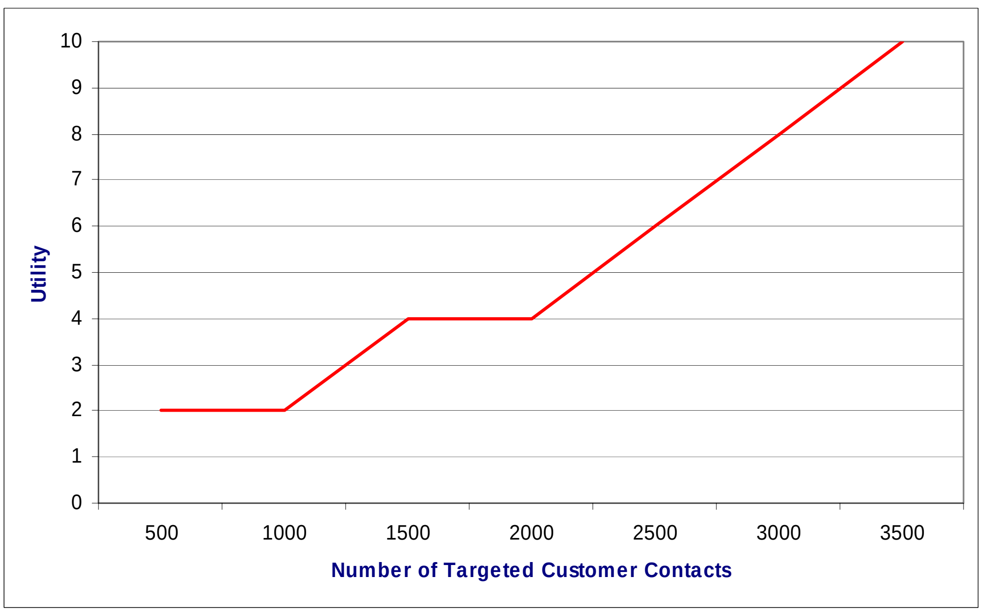
With respect to Figure E-1, we can see that until the number of technologies reviewed reaches 20, the utility or value to the decision makers increases, but decreases thereafter. This might be due to their concerns that given a limited budget to cover more than 20 technologies would mean that each technology would not receive the thoughtful attention it deserved.

Figure E-2. Utility As a Function of Number of Demonstration Projects



With respect to Figure E-2, the value associated with the number of demonstration projects does not increase very much until the number of projects reaches 9 and beyond. In other words, conducting less than 9 projects is considered inadequate.

Figure E-3. Utility As a Function of Number of Targeted Customer Contacts



With respect to Figure E-3, while where is some indifference as to whether 500 or 1,000 contacts are made and whether 1,500 or 2,000 contacts are made, in general, the number of customers contacted the greater the value or utility.

Let's assume that the program has been conducted and that progress towards each of the three objectives has been measured by the evaluation team. Let's assume that the program was able to review 15 technologies, conduct 12 technology demonstration projects, and disseminate information to 1,500 key market actors. These resulting measurements for each objective are then translated into a utility or value score. For example, by using the utility function in Figure E-1, one can translate the review of 15 technologies into a utility or value score of 5.0. Table E-2 presents all the essential information for our one hypothetical program.

Table E-2. Objectives, Weights, Measured Results, Value and Weighted Score

Objective	Weight	Measured Results	Value	Weighted Score
1. To review promising technologies	0.2	15	5	1
2. To conduct technology demonstration projects	0.5	12	10	5
3. To disseminate information about successful projects	0.3	1500	4	1.2

Using the equation below, the information in Table E-2 can now be assembled.

$$U = \sum_{i=1}^{n} w_i u_i \qquad \text{(E-1)}$$

where

U= The overall utility or composite utility for the program

w_i= Is the normalized weight assigned to the ith objective

u_i= Is the value or utility of the ith objective

The symbol $\sum$ means to sum the weighted utilities over all attributes from the first (1) to the last (n). Using Eq. E-1, the weighted score column can be summed to 7.2 out of a possible 10. In other words, one can think of this ratio of 0.72 as a realization rate with respect to multiple objectives. Or, one can divide the aggregated utility by the amount expended by the program to yield a utility-per-dollar ratio.

In summary, the five steps to carry out a MAUT evaluation of the ETP are listed below:

1. Identify (with ETCC help) a list of appropriate stakeholders for each program.
2. Develop a list of objectives that will be used to evaluate the ETP through iterative communications with stakeholders.
3. Develop and administer a survey for the stakeholder group to determine the relative importance of each objective (i.e., establish weights).
4. Assign utilities to varying levels of each objective.
5. Aggregate utilities and weights into a single index.

The use of MAUT, or some other cost-effectiveness tool, will enable stakeholders to better understand the cost-effectiveness of the ETP and to track it over time.