Government Funded RD&D Program for Industrial Energy Efficiency: California Perspective & Experience

Pramod Kulkarni, California Energy Commission

ABSTRACT

Since 1996 the California Energy Commission has managed a Public Interest Energy Research (PIER) program. Achieving public policy objectives by enhancing industrial energy efficiency through research, development and demonstration (RD&D) projects is one of the major objectives of this program. To date the program has invested $35 million in RD&D projects that provide improved energy efficiency, cost savings and reliability for California industries. This paper discusses the program's rationale and structure, the regulatory background and the funding mechanisms for the program. The paper also analyzes the criteria for developing the RD&D portfolio, reviews the challenges faced in implementation of the program, and presents a sample of projects from the portfolio that have resulted in varying degrees of success.

Introduction

In 1996 the California Energy Commission initiated a unique research, development and demonstration (RD&D) program for increasing energy efficiency in the industrial sector. The Public Interest Energy Research (PIER) program has an explicit requirement that it meet multifaceted public policy objectives that are pegged to California's energy issues. The state's unique blend of cutting age and traditional industries creates an additional complexity in the program design. This paper discusses the specific challenges in implementing the program and gives a few examples of successfully developed technologies that provide a public benefit and that are currently being adopted by the market without government aid because of the economic benefits delivered to the industrial users.

Rationale for Government Funding for Industrial Energy Efficiency RD&D

California industrial users, combined with the water treatment and irrigation sectors, spend $10 billion annually and consume 30 percent of the electricity in the state. The enormity of the energy usage provided through an integrated electricity supply chain requires that efficiency be achieved not only at the customer's side of the meter, but also throughout the supply system that encompasses the generation, transmission, distribution and consumption continuum. Rewards of increased energy efficiency, such as lower energy bills, are not limited to consumers alone. The rewards permeate the entire electricity system. The reduced need for electric generation assets, in turn, reduces fossil fuel use and pollution and results in less congestion on transmission and distribution lines. Often the micro-level benefits of industrial energy efficiency translate into macro-level public benefits, which justify an active government support for industrial energy efficiency through development and demonstration of new energy efficiency technologies and processes.

The public benefits of energy efficiency measures implemented at the user level were clearly manifest after California's energy crisis in 2000-2001. Among measures adopted to help avert a repeat of such a crisis, the state legislature authorized extensive financial incentives for implementing energy efficiency measures. An independent evaluation established that these efforts effectively reduced the peak demand for electricity by 600 mega-Watts (California Energy Commission 2004). This reduction directly translated into the scaling back of inefficient and polluting peaking plants and a reduced load on the congested grid and, in turn, restored the electrical system to a level that was not as easily susceptible to imbalance. Besides benefiting energy users, concerted energy efficiency unequivocally delivered public benefits.

The Regulatory Background.

Prior to the electric industry restructuring in 1996, the independently-owned electric utilities (IOUs) had active RD&D programs. The IOUs, such as Pacific Gas & Electric (PG&E), had robust in-house RD&D programs and also conducted research through national organizations, such as the Electric Power Research Institute (EPRI) and the Gas Research Institute (GRI). The restructuring of electric utility industry in California brought about major changes affecting energy-related RD&D. The electric generation assets, except for nuclear and hydro power, were privatized. Transmission and distribution lines, although still owned by the IOU's, were turned over to an independent system operator for operations. Rate-based RD&D was no longer included in the IOUs charter.

To ensure sustained availability of energy efficient products, in 1996 the California State Legislature mandated a Public Interest Energy Research (PIER) program for energy technologies, which included energy efficiency as one area for attention. There is a precedent for government, especially at the federal level, to fund research in the health, defense, environment, transportation and energy sectors. Yet the creation of the PIER program at a state level, paid by a surcharge on electricity bills, was unusual in its explicit requirement for creating public goods. Although the California legislature created a Public Goods Charge to cover several bigger programs to encourage use of renewable energy or the promotion of existing energy efficiency technologies, the PIER allocation was relatively small at $62 million dollars per year. In 1996 the program had a single program for RD&D efficiency that combined buildings, commercial and industrial energy efficiency. By 1998, however, due to the differences inherent in the consumption patterns and motivation for energy efficiency practices in industrial and buildings sectors, this program was disaggregated into two separate programs. One program focused on energy efficiency R&D for residential and commercial buildings, while the second program concentrated on energy efficiency RD&D for industrial, agriculture and water (IAW) sectors. This latter program uses an acronym PIER- IAW to distinguish it from the other five PIER areas for RD&D: buildings energy efficiency, electric generation, renewable energy, and energy-related environmental research and electric system integration technologies. In this paper the word "PIER" will be substituted for the PIER –IAW program.

Differences between the PIER and other Government RD&D Programs

Government funding for industrial energy efficiency is not unique. The US Department of Energy (DOE) has an active RD&D program through the Office of Industrial Technologies (OIT). The DOE program is larger and older than the PIER program. The genesis, rationale and composition of the California Energy Commission's RD&D program, however, differ in many ways from the federal program. First and foremost, the public benefit[1] criterion for the PIER program was explicitly stated as a pre-condition to engage in the RD&D activity. Secondly, the industries the PIER program selected for attention are different than those of interest to DOE. Some of these industries are quite exclusive to California due to its climate, ecology or, in some cases, economic circumstances. For example, California's food industry includes a fruit and vegetable industry that requires more energy for processing than the grain crops grown in the American Midwest. The wine industry is also unique to California. The concentration of electronics, data processing and computer technology in the Silicon Valley and the southern California region required a different approach for energy efficiency. The same is true for fast emerging biochemical and genetics industries in California.

In general, the DOE program largely focuses on energy-intensive industries that produce commodities such as paper and pulp, steel, aluminum and petroleum refining. For these industries the energy cost constitutes a large portion of their production cost. California's program has its own share of energy intensive businesses, such as food processing, petroleum extraction and refining. In some other industries, such as electronics and biotech, the cost of energy is a much smaller part of the production cost. Consequently, energy savings are given much lower priority compared to energy reliability and availability requirements. Since the products and services of the latter set of industries command much higher prices in the market, these industries may not have a strong economic motivation for reducing energy use. These industries, nevertheless, consume electricity in large quantities and reducing these industries' energy use is still in the public interest.

The differences in industries discussed above require energy efficiency RD&D program planning in California has to go beyond mere energy savings in prime movers and cooling equipment. The program also has to take into account the industries' need for power quality and reliability, and it must strive for energy savings in the equipment and assets essential to achieve power quality and reliability. A data center, which cannot afford to be without electricity at any time and that wants to immunize itself against power quality problems, would deploy oversized back-up generation, use an uninterrupted power supply (UPS) and have oversized cooling equipment for its operation. Although these additional systems are costly and add to the already high cost of electricity, a financial institution using the data center is willing to pay for the added energy cost. The same holds true for a semi-conductor manufacturer. Thus the PIER program explores and promotes technologies that reduce the energy consumption of refrigeration systems, UPS systems and oversized transformers. Equally important, energy efficiency for high technology industries may not happen if the economic incentives for the end-user are not large enough for a vendor to justify development of an energy efficient technology. Hence state government has to foster a sustained development of cost-effective energy efficient equipment to ensure the accrual of public benefits from energy efficiency.

Factors that contribute to the higher cost of energy in California go beyond the commodity cost of electricity and fossil fuels. These factors also include the added energy for compliance with stringent pollution abatement measures, for higher reliability and power quality, and for processes to procure water and to dispose of wastewater. Such factors often increase capital costs and energy consumption. The PIER programs look at RD&D opportunities to increase the energy efficiencies associated with these factors. Cost reductions for these efforts,

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[1] The Public Interest RD&D should *deliver* benefits *desired by the public* that will *not otherwise be delivered by competitive and regulated markets*. Such benefits include, but are not limited to, environmental and health benefits, fuel diversity, less dependence on fossil fuels, system reliability and sustainability.

hopefully, balance the playing field for the California industries that face national and international competition. The above factors affect the design of the PIER industrial energy efficiency RD&D program.

Although differing in many respects from the DOE program, the PIER program has collaborated extensively with DOE and emulated some of its practices when applicable. For example, PIER has built upon DOE's prior work in certain areas such as the RD&D opportunities in the petroleum refining industry. PIER has adopted DOE's approach to developing technology RD&D roadmaps in collaboration with the affected industries. However, when making the RD&D investments, the roadmap priorities by the industries are screened for their ability to meet California's public policy objectives.

The Challenge of Selecting the "Right" Portfolio

The important role that California's industries play in the state's economy makes a strong case for the need for a government sponsorship and involvement in the industrial energy efficiency RD&D. A more formidable challenge, however, is defining the nature and scope of this involvement. Although daunting, the task must be further tempered by resource limitations, the time horizons for performance, and the priorities that help achieve public policy objectives. In addition, to be effective the program must be responsive to the needs of the industries being served.

Public policy guidelines. The two sources of the PIER RD&D program funding are the Public Goods Charges on electricity consumption and, more recently, on natural gas[2] consumption. Consequently, the public benefit becomes an overriding criterion for funding RD&D opportunities. Conversely, the RD&D that has potential for delivering only private benefits to the users or vendors of the technology in the near future should be funded by the private sector and, thus, is outside the of the scope of PIER funding. Unfortunately, the boundary between private and public benefit is not well marked or defined. A technology may contain both type of benefits, and what differentiates one opportunity from another is the degree to which each types of benefit exists and the associated risk at a certain point in the development cycle of the technology. Thus some additional tests have to be applied to make the distinction clear.

A second set of criteria used to determine PIER research funding opportunities is the priorities for energy resources acquisition and management prescribed by the public bodies within California. Usually such priorities are embodied into the policy documents such as the California's Energy Action Plan. These documents reflect policy concurrence among various California energy regulatory, policy and program development bodies, including the California Energy Commission, the Public Utilities Commission, and the quasi-public California Independent System Operator. Such documents, of course, have a direct or indirect approval (through appointed Governor's representatives) from the Executive Branch of the state government. One outcome of the public policy consensus is the development of what is called the state's "Loading Order" policy. This policy is an aftermath of the restructuring of California electricity industry and the energy crisis of 2000-2001. The resulting electricity shortage, severe price increases and concerns about the reliability of future supplies required that the state set the priorities for securing future electricity resources. This "loading order" treats energy efficiency as a "resource" that must be harvested first before securing any other electricity resources

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[2] California Public Utilities Commission Decision 04-080-010. August 2004

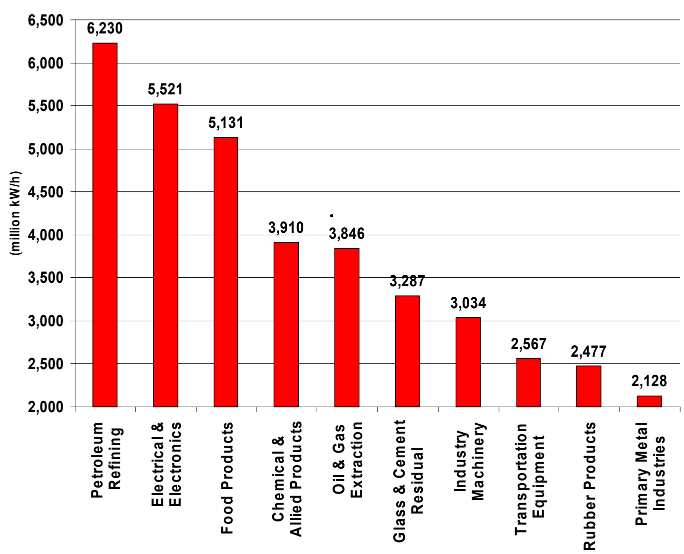
through fossil fuel-based generating plants. The other preferred resources are peak demand reduction, renewable energy resources and distributed generation.

This importance given to energy efficiency in policy documents provides a key mandate for the active development of technologies and processes for industrial energy efficiency. The mandate for electricity demand reduction requires developing tools and options for the industrial customers who have to shed their electrical loads (demand) in response to a short notice for load curtailment. Although there are economic incentives for shedding the load, the PIER program also developed analytical tools that help an industrial customer comply with the load shedding request by analyzing its economic impact and deciding the extent to which the customer can or should comply with the request.

Electricity peak demand reduction, reducing the stress on the transmission and distribution system, reduction of greenhouse gases, preventing atmospheric and water based pollution are all among the public policy objectives included in the criteria for selecting the RD&D projects and developing a portfolio.

Customer level and system level impact of projects. Even after applying the public benefits criteria, the portfolio development requires a further narrowing of the scope of the program. The total level of energy consumption by a specific industry, both electricity and natural gas, is one criterion for determining the RD&D project priority. The data on energy consumption is used to select the high priority industries. The ranking of California's industrial consumers by energy consumption is shown in Figure 1. This data suggests that the PIER program focus on food processing, water treatment, electronics/information technology, and petroleum extraction and refining. (Water is not shown in Figure 1.) The PIER program believes that the industries that consume the highest amount of energy are a better target to achieve meaningful reduction on the state's overall energy consumption and targeting these industries can deliver proportionately higher public benefits.

Figure 1. Comparative Electricity Use by California Industries, Year 2000



Another criteria is the extent to which a particular energy intensive apparatus or process is commonly used by the industrial consumers. Electric motors, pumps, refrigeration, boilers, furnaces and air compressors are some examples of equipment that find extensive use in industrial operations. Because of a ubiquitous use of these types of equipment in industries even a small improvement in their efficiency could result in a substantial reduction in energy use. Consequently the PIER portfolio seeks RD&D projects for these cross-cutting technologies.

Industry need, priorities and participation. Barring a few exceptions, the industrial energy consumers are the ones who ultimately deploy the research products (technologies) of the PIER program. Unless these products meet a well defined industry need and priority, the possibility of their integration in the business operation is rather low. Thus the program must invest in RD&D projects that clearly meet the industry needs and must ascertain that the development of underlying technologies provides a well defined, tangible public benefit. For example, if besides being energy efficient a technology also improves industrial production efficiency, then the development of that technology becomes a priority for the PIER portfolio. Left to the natural selection by market economics, however, such a technology may not have sufficient urgency or economic incentive to be developed by the private sector. Because the public policy objectives are being met, the PIER program would undertake such an effort and, in the process, help industry achieve productivity gains. A recent example of this approach is a PIER investment in an energy efficient wine processing technology that also helped the industry reduce refrigeration costs. While the older process required industry to refrigerate wine for three weeks, the new process eliminates that requirement. The product is now in the market three weeks earlier and working capital costs are reduced. Since the industry normally crushes grapes in October, this three-week reduction in storage time also allows the sale of product before the holiday season and during the New Year's day celebration.

Another criterion considered in setting priorities is the willingness of an industry to work cooperatively with the PIER program in defining its own energy needs, and to actively engage in the technology transfer to its members. Besides working with the industry itself the PIER program also actively engages the local utilities supplying energy to the industrial customers. Often the utility account managers are quite familiar with the industrial user's energy needs and concerns.

Industry participation is absolutely essential because the success of the PIER program depends on the speed with which the new energy efficiency product or process is adopted and the extent of its adoption. The wider the technology adoption, the larger is the delivery of the public benefit. If an industry is unable to actively engage in identifying industry priorities or energy related issues, the industry ranks lower in priority. The PIER program is reluctant to undertake research by second guessing what is essential for the industry or what barriers may stand in the adoption of that technology. The only exception to the above criterion is the set of technologies that are applicable across several industries. Even here, however, efforts are made to engage the end-user to understand the non-technical barriers that might hinder the technology's implementation in that industry.

The scope of the portfolio. The history of energy efficiency technology commercialization shows that the period of development, gestation and final adoption usually spans several years. The PIER program has to determine the stage of a technology or a process development before deciding whether to participate. The stage of involvement for technology development is determined both from the public policy perspective and from the program's ability to meet industrial energy users' needs and urgency to adopt a technology. Some public policies have time-sensitive objectives. The selection and funding of RD&D is also based on research gap analysis, understanding the role of others engaged in the process, the program's resource availability and the policy priorities. Table 1 shows the types of projects in the portfolio distributed over the time horizons.

Table 1. Research Portfolio Balanced by Risk Level and Time-to-Market

Time to Market	Short-term Research (Less than 5 years)	Medium-term Research (5 to 10 years)	Long-term Research (More than 10 years)
Type of Research	• Scale-up • Demonstration • Test Protocol • Performance Validation • Regulation Compliance	• Prototype Development • Modeling /Simulations • Engineering Design	• Basic Research • Proof of Scientific Concepts

The PIER program does not normally engage in basic or theoretical research. The PIER program does not duplicate work done at academic institutions or the national laboratories. Occasionally, when the promise of public benefits of some RD&D opportunities is so overwhelming, and if the PIER participation can be a catalyst for others to advance the work, PIER would fund projects that involve establishing scientific foundations. Such investments, however, are not common for the industrial energy efficiency RD&D portfolio. The PIER program also does not engage in demonstrating technologies that are already commercialized but are limited in their adoption due to institutional barriers. The program will, however, undertake research that may be necessary to overcome institutional barriers, such as a need for setting performance standards or providing the proof of performance for regulatory agencies, such as the Environmental Protection Agency or the Occupational Safety and Health Administration, whose permission is required to use some energy efficiency technologies. PIER's investments in laboratory fume hoods and energy efficient disinfectant technology for chicken processing are two examples of research that involves overcoming institutional barriers.

PIER selects its potential RD&D partners (contractors) depending on the phase of the product /technology development and on the basis of shared organizational goals. Table 2 shows the project types and potential partners for different project types.

Until recently the PIER program had a preference for projects that can be completed and introduced in the market in less than five years. This preference is partially due to the need to harvest the energy efficiency "resource" until California's generating assets and demands are brought into balance. This approach favored funding of projects that are more in the applied technology arena than those involving the development of "proof of concept." PIER also focuses on emerging technologies, which, in spite of technical and potential economic viability, do not penetrate the market at a fast enough pace. If the reason for low-level market penetration is the lack of independent and verifiable performance data from credible sources, then PIER would fund development of the data. Such projects are undertaken often in collaboration with the product vendor, an end-user who can realize the energy cost reduction with some certainty, or an industry association that sees clear benefit for its membership. On the other hand, developing efficiency standards, developing new techniques for measuring efficiency or developing new analytical tools are generally undertaken in collaboration with the utilities, energy research organizations or national laboratories.

Table 2. PIER Program's RD&D Partners by Research Category

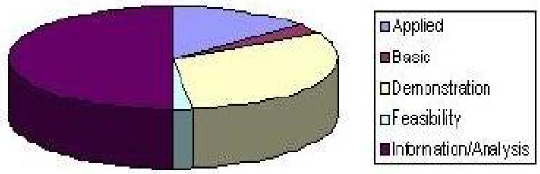
	Short-term Research (Less than 5 years)	Medium-term Research (5 to 10 years)	Long-term Research (More than 10 years)
Cross-cutting RD&D	• National Laboratories • Department of Energy • Electric Power Research Institute • Equipment Vendors • Gas Technology Institute • Utilities • Academic Institutions • Entrepreneurs	• Research Universities • Industry Research Consortiums • Department of Energy • Electric Power Research Institute • Gas Technology Institute • Research Foundations • Industry Associations. • National Laboratories.	• Research Universities • National Laboratories • Department of Energy • Electric Power Research Institute's Strategic Science & Technology Program
Industry Specific RD&D	• National Laboratories • Electric Power Research Institute • Department of Energy • Equipment Vendors • Gas technology Institute • Utilities • Academic Institutions • Industrial Energy Users • Entrepreneurs	• Research Universities • Industry Research Consortiums • Department of Energy • Electric Power Research Institute • Gas Technology Institute • Research Foundations	

PIER often undertakes research that demonstrates the energy efficiency and other ancillary benefits aimed at certain specific energy intensive applications, such as refrigerated warehouses. PIER also helps fund research to develop analytical and benchmarking tools that lead to the measurement of efficiency of energy use or helps the adoption of certain efficiency measures. For example, developing a benchmark for electricity use in petroleum extraction becomes a legitimate project because it helps the small petroleum producers gauge the efficiency of their production and make the necessary adjustments to improve energy efficiency.

Challenges Encountered in Implementing the Program

Since its beginning the PIER industrial program has developed a portfolio of about 100 projects with a total investment of about $35 million. These projects have been in partnership with utilities, national laboratories, and other RD&D organizations, including the Gas Research Institute, Electric Power Research Institute and American Water Works Association Research Foundation. The projects have ranged from $40,000 to $ 1.5 million in value and the time span has ranged from a few months to 3 years. The research project categories include energy use benchmarking, developing analytical and design tools for laboratories, high-tech buildings and data centers, developing and demonstrating new energy efficient technologies or techniques in food processing, metal casting, energy efficient emission controls for boilers, and developing technologies for water treatments. Some information gathering and analysis efforts are also funded for internal use when they help assess market potential, technology trends, scenario analysis or forecasting energy demand and use. Figure 2 shows the general distribution of funds among various categories of RD&D activities.

Figure 2. Portfolio Breakdown by Project Type



Several PIER projects have been successfully completed and are now being commercialized, while many are still in the process of implementation. However, there is now a sufficient body of experience, spread across several types of technologies and project partners, to generalize the challenges one might face in implementing a government-run RD&D program. Although some of these challenges might exist regardless of the funding source, a few barriers and solutions exist entirely because the program is run under the state government auspices. As compared to other RD&D funding organization, such as private companies, academic institutions, non-profit groups, industry research organization, and institutions such as the National Science Foundation, the state government-funded RD&D has some hurdles in developing its portfolio that may not exist elsewhere. These hurdles often compromise the goal of developing a robust RD&D portfolio of projects. Following are some of the main challenges:

Timely procurement of projects with the lowest possible transaction cost. Whenever possible the state's contract rules require that RD&D contracts or grants are awarded on a competitive basis. Often, though not always, the PIER projects are solicited in such a fashion. Yet this process is always time consuming for the organization procuring the RD&D projects and for those who are providing the projects. Consequently, several well qualified vendors shy away from investing the time necessary to develop the bids. The very people within the industrial energy users who should be availing themselves of the opportunity to demonstrate new energy technologies at their own location, and are willing to take the attendant risk, often do not have time to respond to the cumbersome solicitations process. Although the PIER program has streamlined the solicitation process, bidders still find the process to be cumbersome.

Occasionally the PIER program secures projects without competitive bids and on a sole source basis. Quasi-government entities, such as universities and national laboratories, are easier to justify as single source providers. Consequently, this approach results in such entities getting an unduly high number of projects that might have otherwise been undertaken by the equipment manufacturers or by industrial users had the transaction cost in terms of time, money and manpower been smaller.

Public sharing of intellectual property and project data. The PIER program, as a rule, expects to receive a very nominal royalty (1.5% of the revenue from the licensed technology) from the project. This requirement, in some instances, is a barrier for some potential vendors or partners. On other occasions, the ownership of collected data and the possibility of the information being shared by the competition becomes an issue that stops a contract from being signed. Surprisingly, this issue often extends beyond for-profit businesses. Some utilities, universities and national non-profit research organizations have refused research opportunities when confronted with a possibility of sharing data that would be developed through the research.

Fear of public disclosure of proprietary information. Almost all the transactions and contracts of the state government, barring some sensitive issues such as security, are public documents, and could be accessed by the public under the Freedom of Information Act. Although the PIER program has an explicit provision for guarding intellectual property shared by the potential contractor, some other aspects of a contract such as labor rates or profit mark-ups may not be guarded from public disclosure. Some business organizations have found this to be unacceptable and have refused to conduct RD&D work for the program. Usually, smaller companies and educational institutions are less prone to reject projects on these grounds. PIER often suggests that the potential RD&D bidders review the terms and conditions of contract before embarking on the biding process or before submitting proposals.

Problems in Placing Demonstration Projects at Manufacturing Locations

While the challenges in program implementation discussed in the preceding section are caused by the government's administrative requirements, projects requiring manufacturing and service industries' participation have some limitations as well. Rarely is a laboratory demonstration of a technology or a process alone adequate to gain the confidence of an industrial energy manager, and often demonstration in an industrial or business setting becomes necessary. PIER has found that although such demonstrations are very effective in the market penetration of technologies, such an approach often poses daunting barriers. The following are some reasons.

.**Fear of impact on production schedules and product quality**. Energy managers or facilities managers who are willing to locate an energy efficiency demonstration at their site often have to believe in the potential and be the internal champion for the project's installation. Depending on the size of the demonstration and its interface with the existing operation, however, there is a risk that the demonstration might affect the existing operations. The risk of affecting production quality, quantity or schedule becomes a deterrent to participation.

The PIER program is aware of the risk a plant manager takes in trying out a new technology. The program has to make adequate provisions to have demonstrations on a smaller, parallel production line or provide an ability to switch back to the original equipment on a short notice. Also, the savings need to be substantial and to outweigh the risk an energy manager may take. Though significant, this barrier can be mitigated with some creativity, although perhaps adding to the project's cost. The payoffs, however, are handsome since a demonstration in an industrial setting creates more credibility with the industrial users than a laboratory demonstration, thus allowing a high possibility of a quicker proliferation in the market.

The PIER program, however, does not guarantee the performance and savings, and expects the vendors to take that risk. The program does not assume or accept any liability for any and all issues arising out of the installation.

Delay in getting management approval. Industrial organizations, especially large ones, have their own bureaucracies that move at a pace that is sometimes inimical to the time-sensitive demonstration/research projects. These long delays are caused by long legal reviews of contracts, capital budgeting cycles or liability concerns. Such delays compromise the RD&D projects that need to be conducted during a summer peak time or during a harvest season. This scenario is typically the case in food processing or wine treatment industries where production and energy needs are seasonal.

Over the years, the PIER program has anticipated such delays and the projects are scheduled accordingly. Since the energy crisis of 2000-01 in California, however, there is a heightened industry awareness of energy costs and the need for reliability. Consequently, many facility or energy managers now have a relatively easy access to the executive managers. The battle for capital budget, however, still has to be won with other competing projects.

Incompatibility with the capital budgeting / maintenance cycle. PIER demonstration projects typically require some form of match in resources from its partners. This contribution is indicative of the level of commitment to the project and its outcome. In spite of an internal champion and availability of match funds, occasionally the company's capital budgeting cycles do not coincide with the times when the funds are available from the program. Thus timing becomes a crucial issue in securing commitment to the project. Commitments are also held back when the manufacturing operations are at their busy season (e.g. food processing during harvest) or during the maintenance and overhauls, as in case of refineries, which are on multiple-year cycles.

Generic Challenges

Even after overcoming the above mentioned barriers in executing a project, the project may still fail for some of the reasons listed below.

Business considerations. Often projects get terminated for business decisions not related to the specific projects. On more than one occasion the PIER program has had a planned and funded project cancelled because of plant closures or the acquisition of the host site by another company. For business reasons the new owner does not want to pursue the technology demonstration.

Inability to secure the right personnel. The PIER program has encountered situations where the companies have been too busy to spare the right personnel to work on a demonstration or research project or, in other cases, where the companies have had to cutback staff due to a slump in business. In both situations, the lack of personnel has resulted in the termination of promising RD&D projects.

Concern about liability & indemnity. PIER projects have been terminated because of perceived indemnity issues. This issue is critical since the novel technologies being demonstrated are not covered by standard liability insurance. Although for larger companies this fact may not be an issue, the inability to secure indemnity insurance becomes a problem for smaller companies. Often the "deep pockets" syndrome makes the state an attractive target for law suits. The state government requires an explicit indemnity from liabilities arising from a failed technology demonstration. Disagreement on this issue may result in project termination if the industry partner does not agree to explicitly absolve the state government of such liability.

Fear of regulatory disapproval. Potential end users of the technologies are often apprehensive about the use of a novel technology if the approval from a relevant regulatory agency is in doubt. This situation is quite common in the food processing and beverage industries. This situation is also common for new technologies that have impacts on emissions or potential for pollution. In such situations, the demonstration project includes separate tasks that address the specific issues that a regulatory agency might raise before the adoption of an energy efficient technology. The PIER program often works with the Air Quality Management Boards, Occupational Safety and Health Administration and regional Water Control Boards. At least on two occasions the PIER program has successfully demonstrated energy efficient technologies where the final approval has been published in the US government's Federal Register, fostering a faster acceptance.

Measuring Success

In spite of the above barriers, the PIER RD&D portfolio has now started to bear fruit. As the program staff becomes more sophisticated and successful in recognizing the aforementioned barriers, and becomes more adept at mitigating these barriers, the program has begun to deliver on its intended promise. A few technologies in the industrial sector are finding their way into commercial practice. Some analytical work and energy efficiency benchmarking efforts have resulted in development of rebate programs by the state agencies and utilities. The following examples of program successes illustrate research projects where the industrial energy users have begun to reduce their energy usage and cost by using PIER funded technologies. Although a single metric for the program success is yet to be developed, the following are anecdotal cases of successes achieved at a project level.

Demand response tool for industrial customers. After the brownouts of year 2000-2001, the PIER program developed a computer-based, automated decision-making tool that allows an industrial energy user to set priorities for shutting down its operations at the lowest possible economic loss in response to a request for load curtailment. This tool, using advances in communication and control technologies, makes it easy to react to requests from the local electric utility for load reduction in times of limited electricity supply. Responding quickly to such a request by a utility is a critical element for maintaining the electric grid stability. The tool allows the facility to identify which equipment to keep operating and which to shut down. The tool is being tested at a pilot program by a major California utility that expects to deploy this technology for its customer use.

Standardized energy efficiency index for an effective utility rebate program. Until recently the California utilities lacked a simple and reliable method to accurately measure the energy efficiency of compressed air systems commonly used in the industry. These systems use 25 percent of the electricity used in the industrial sector. Lack of a standardized efficiency measure prohibited utilities from establishing a reliable baseline to measure efficiency improvements. PIER, in collaboration with the Southern California Edison utility, developed a procedure for accurately measuring the energy efficiency – now known as the Compressed Air System Efficiency Index. After validating the accuracy and soundness of the method, the index is being used by the utility to support its own energy efficiency rebate program. Energy managers from major industrial companies have shown interest for adopting this method for in-house use. DOE recently organized a national web-cast to facilitate exposure of this index.

Electricity cost reduced by 80 percent for a critical wine treatment process. The PIER program has recently completed a project to reduce energy use in California's wine industry. PIER funded a new technology that uses electro-dialysis to reduce electricity use for refrigeration for a critical step in wine treatment. The electricity consumption for this step is reduced by 80 percent without diminishing wine color, taste and quality. In November 2004 a federal government agency approved this technology for use in the wine industry. After a successful demonstration by PIER, the technology use is now proliferating with funds from private sectors. The total potential savings is around 24 million kWh per year in California.

Conclusion

Successfully blending the private benefits and public good in a program is often difficult. The PIER experience has shown that, with a careful understanding of the industrial energy users' needs, a state-funded research program can develop energy efficiency technologies that deliver public benefits. These technologies, once proven, can be subsequently integrated into industrial operations. As hesitancy in their use diminishes, with subsequent cost reductions, the private benefit becomes sufficiently large enough to ensure proliferation in the market place without government support. Thus the public benefits accrue for a long time without any further government investment.

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