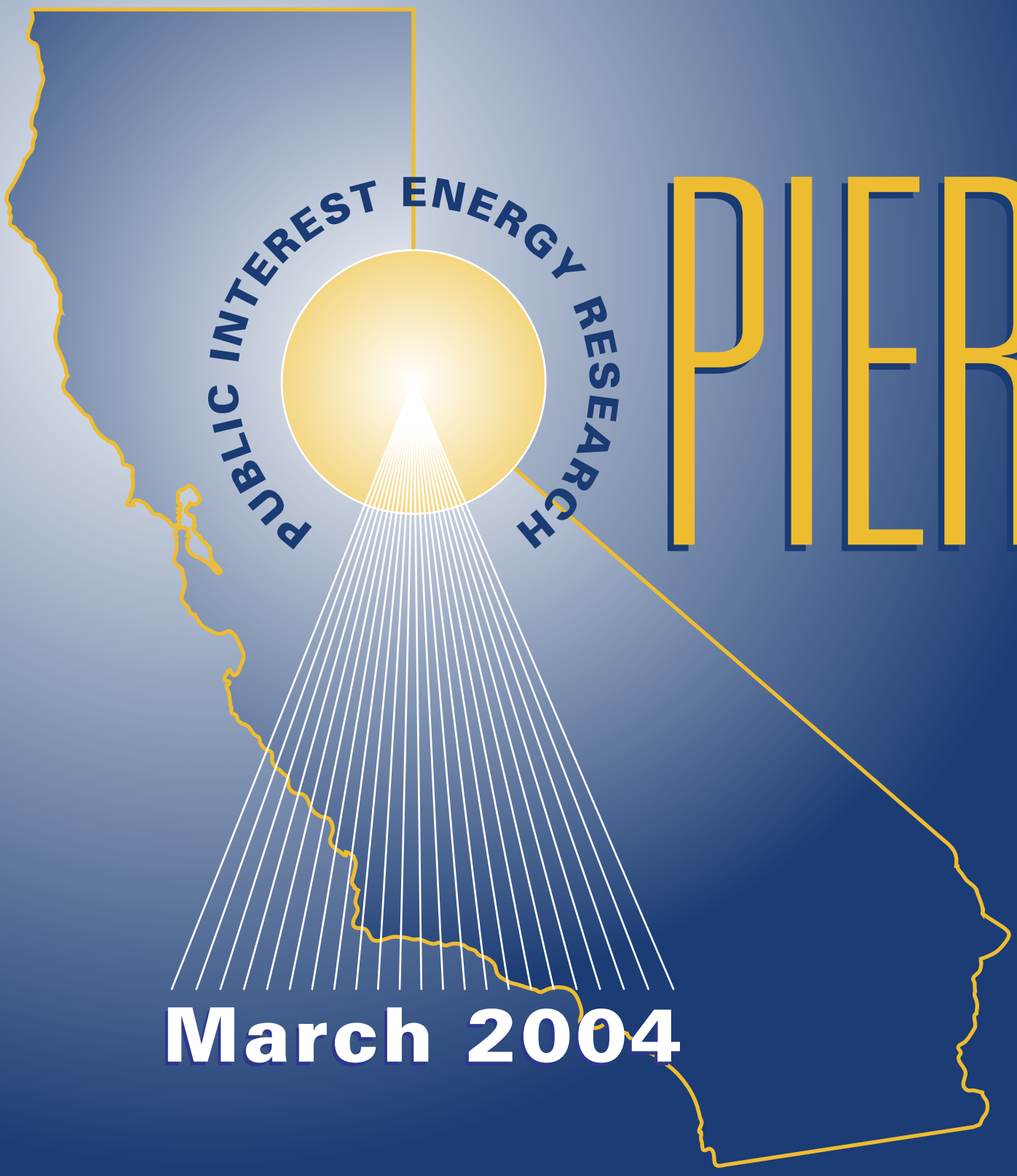
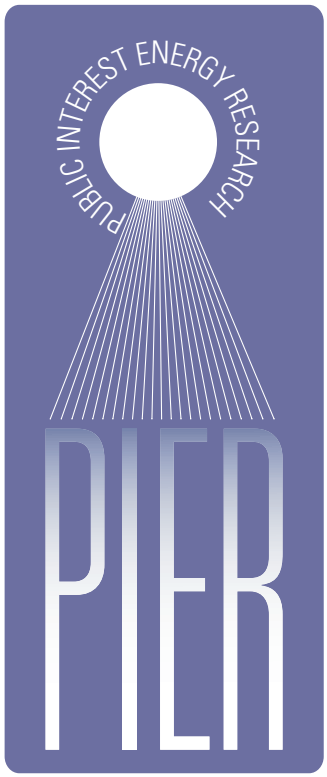


March 2004

California Public Interest Energy Research
Independent PIER Review Panel Report

CALIFORNIA COUNCIL ON SCIENCE AND TECHNOLOGY



Independent PIER Review Panel Report
March 2004

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Table of Contents

List of Tables

List of Figures

Executive Summary

This second Independent Review Panel (IRP) was formed to evaluate the Public Interest Energy Research (PIER) program and make recommendations to both the Legislature and the California Energy Commission (CEC) regarding program design and implementation, as well as the degree to which the recommendations of the first IRP have been implemented.

The IRP commends the CEC for its accomplishments in the three years since the first PIER program review. We now find that the PIER program is better defined, has good leadership, and in most program areas, has well conceived research strategies. However, the IRP has identified several key issues of concern that appear to affect the ability of the program to fully realize the benefits of public interest energy research.

The IRP believes that further progress can be made through near-term changes internal to the PIER program.

- **The most immediate need is to fill the existing knowledge gap. The CEC should give the PIER Program Manager authority to fill vacancies and personnel shortfalls and supplement staff resources with contract staff.** This action would address the unintended consequence of staff resource cuts, which have imposed large burdens on remaining staff and threatens the program's effectiveness.
- **PIER management should streamline the advisory committee process, reconstitute the PIER Policy Advisory Council, reduce the number of program-area advisory committees, and link the advisory groups through shared membership.**
- **To ensure the integration of PIER efforts with research and development (R&D) programs at the state and national level, the PIER Program Manager should be given funding authority to support cross-program coordination, site visits, and staff professional development.**

Beyond these near-term issues, fundamental organizational limitations hinder the ability of PIER to become a first-class R&D organization. The current organizational structure of the CEC is not optimal for R&D. The CEC is a regulatory agency with limited flexibility, a near term focus, and a risk-averse culture. Under the current civil service rules, it is difficult to attract and retain top research managers. Managers do not have the independence and authority they need to be as effective as possible. The

PIER IRP believes that these problems need to be addressed before the PIER program can achieve the excellence that California citizens need and deserve.

We strongly recommend that the CEC develop a strategic operational and implementation response to solve PIER's structural problem. The response should include the development of two parallel plans, one to include a greater degree of operational independence and authority within the CEC and the other to include a structure outside of the CEC. We recognize that implementation is likely to require legislative action. For the IRP to incorporate the evaluation of the plans in its final report, the CEC's response should be completed by August 1, 2004.

Chapter 1. Introduction

1.1 Charge to the Panel

Assembly Bill (AB) 1890 restructured the California electricity industry in 1996.[1] The legislation also authorized collection of a surcharge on retail electricity sales of not less than $62.5 million annually for four years to ensure a continuation of public interest energy research, development, and demonstration projects. The Public Interest Energy Research (PIER) program was established at the California Energy Commission (CEC) to implement this provision, funded at $61.8 million. Senate Bill (SB) 90 further defined the PIER program in October 1997, identifying key program areas and administrative and funding criteria.[2] While the originating legislation assured a funding level of not less than $62.5 million for four years, recent legislation continues the PIER program until 2011 at the same $62.5 million per year investment rate.[3]

Public Resources Code Section 25620.9(a) directed that an independent panel be established to conduct a comprehensive evaluation of the PIER program. The evaluation was to include a review of the public value of programs including, but not limited to, such factors as the monetary and non-monetary benefits to public health, the environment of those programs and the benefits of those programs in providing funds for technology development that would otherwise not be adequately funded.

The first PIER IRP evaluated the PIER program from February 1999 through March 2001. The findings of this evaluation were provided to the Governor and Legislature in the form of two reports released March 2000 and March 2001.[4] The March 2000 report strongly endorsed the need for the PIER program in California, but also highlighted a variety of problems hindering effective program execution. These problems included the lack of a program director; a mismatch and lack of clarity between responsibilities, authority and assets for program area managers; limited coordination among other CEC programs; an overly complex and time-consuming contracting process; and unclear connections among other federal and private-sector energy R&D activities, California's future energy-related needs and public interest criteria. The CEC addressed many of the comments prior to the final report of March 2001.

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[1] Assembly Bill 1890, Deregulation of the Electrical Industry, September 23, 1996.

[2] Senate Bill 90, as amended, Energy resources: renewable energy resources: funding (enacted in 1997). The PIER program does not address issues related to transportation or nuclear energy.

[3] Assembly Bill 995 / Senate Bill 1194 (9/2000).

[4] CCST, California Independent PIER Review Panel Report, March 2000; and CCST, California Independent PIER Review Panel Final Report, March 2001.

The second PIER IRP started in June 2003 and will evaluate the PIER program through January 2005. The CEC requested the assistance of the California Council on Science and Technology (CCST) to nominate IRP members and manage the review process. The IRP members were selected because of their competencies in areas necessary to evaluate the PIER program and their broad experience in research, development, and demonstration program management and execution.[5] The IRP reviewed PIER documentation, including draft strategic plans and PIER project summaries, met with PIER personnel and CEC commissioners, and considered alternative R&D organizational structures. The IRP appointed subcommittees, who evaluated the program areas in more detail (The evaluations can be found at the CCST website at www.ccst.us). The IRP also reviewed whether or not the 13 expectations of the first IRP have been achieved (see Chapter 3).

A preliminary report to the Governor and Legislature on the PIER program implementation is required no later than March 31, 2004 and a final report no later than January 31, 2005.

This preliminary report presents the IRP's findings regarding the PIER program management and the organization within the CEC.

1.2 Approach

The IRP examined recent PIER program planning and management practices, the context of California's state energy policies, administrative and organizational issues, research review processes and advisory committees functions. The IRP did not assess or make recommendations about proposals submitted to the PIER program, because that responsibility was outside of the IRP's scope.

The IRP held five public meetings from June 2003 through January 2004. These meetings included briefings by CEC commissioners, the CEC Executive Director, PIER program managers and staff on plans, execution, and results to date. The IRP included management, staffing, contracting, travel, intellectual property, review and advisory process issues as well as the core public value issues in its program review.

To better frame its review of the PIER program, the IRP developed questions for the program managers to address. For the overall assessment of the PIER program, the IRP's questions focused on the program area portfolio in the context of the state's energy needs and the program manager's method of selecting, managing, measuring success and terminating projects.

[5] See Appendix D, Matrix of Panel Member Competencies. Panel member selection included conflict of interest disclosure. While some panel members are under contract with CEC or other interested parties, no conflicts of interest exist with respect to PIER.

For specific program areas, the IRP and program area managers were requested to answer the following questions:

1. What are the overall goals and benefits of the program?
    - What vision is being communicated and to whom?
    - How were goals set and who was involved in the process?
    - What is to be accomplished in the program?
    - If successful, what difference will it make (i.e., what are the benefits to California)?
    - How successful has the program been to date?
    - Identify the program benefits according to the stated goals of the PIER program.
    - Have the CEC's Integrated Energy Policy Report (IEPR) or the Energy Action Plan (EAP) impacted the program's goals?
2. How is the project selection process chosen and managed?
    - How are winning projects selected?
    - Is there a portfolio of projects with different time scales (near, middle, far)?
    - How do you choose between a competitive solicitation for proposals vs. a sole-source grant or contract?
    - What is the invitation process: how are vendors identified and attracted to the program?
    - What approvals need to be obtained?
3. What management processes are in place?
    - What are the formal criteria for success?
    - How is the success or failure of a project tracked and communicated to other PIER managers?
    - How are projects redirected or cancelled and under what conditions?
    - Has any project been cancelled?
    - How are outside advisory boards and committees used?
4. What lessons have been learned?
    - What changes have been made in the selection process, the reporting/controls, and the size and scope of programs?
    - What changes have been made in response to the 2002 technical reviews?

- What further changes would you recommend?

The information provided to the IRP by the responses to this questionnaire played a major role in the evaluation.

Chapter 2. Importance of Energy R&D in California

California has an outstanding record of leadership in energy R&D and in the development of sound energy policies and practices. California's energy intensity (energy consumption per gross state/domestic product) is comparable to that of Germany and Japan, and significantly lower than for the U.S. national average.[6] A rich mixture of low energy-intensity industries, advanced energy efficiency standards, and a relatively mild climate have contributed to California's success to date, but the state faces an uncertain energy future.

As a response to the energy crisis of 2001, and in order to ensure a stable energy market in the future, California's principal energy agencies recently created an Energy Action Plan for California.[7] The goal of the Energy Action Plan is to ensure that adequate, reliable, and affordable electrical power and natural gas supplies are provided to California's consumers in a cost-effective and environmentally sound way. The energy agencies intend to achieve this goal through six specific actions:

- Optimize energy conservation and energy efficiency
- Build sufficient new generation
- Require renewable generation equivalent to at least 20% of sales by 2010 [8]
- Upgrade and expand the electricity transmission and distribution system
- Promote distributed generation
- Ensure a reliable supply of reasonably priced natural gas

While R&D is not explicitly mentioned in the six actions of the Energy Action Plan, it is essential for each and every one of these actions. R&D produces the information and the technologies that enable California to consider various options to achieve the goal of the Energy Action Plan. The information gained helps in understanding energy-environmental-economic linkages and in developing the most cost-effective

[6] In 2000, the energy intensity of California, expressed as total energy consumed per dollar of gross state product, was 6,405 BTU/$. U.S. Department of Energy, Energy Information Administration (EIA), 2003; and U.S. Department of Commerce, Bureau of Economic Analysis, 2003. In 2000, the energy intensities of Germany, Japan, and the U.S. were 6,352 BTU/$(GDP-PPP), 6,377 BTU/$(GDP-PPP), and 9,520 BTU/$(GDP), respectively. World Bank, World Development Indicators, 2003.

[7] State of California, 2003. Energy Action Plan.

[8] This goal is an accelerated version of the Renewable Portfolio Standard (RPS), which was signed into law by the Governor in 2002 (Senate Bill 1078), and requires renewable generation equivalent to at least 20% of sales by 2017.

solutions to address California's energy challenges. R&D leads to the development of innovative technologies that help to protect the environment while at the same time stimulating energy-related business activities. R&D provides the basis for sound policy decisions and their implementation and, in this way, contributes substantially to the enhanced living standard of California's citizens. The PIER program has provided vital information and has anticipated this direction by providing options in renewables, clean distributed generation, additional energy efficiency measures and developing mechanisms for integration to the transmission and distribution system.

The PIER program therefore has contributed and should continue contributing to the California challenge to develop a vibrant economy with a small environmental footprint. This is the kind of leadership that California is known for.

2.1 California Energy Challenges

California still faces numerous challenges in its energy future. The economy is showing signs of recovery, which will lead to an increased load on the state's energy supply capacities. The state is expected to continue its rapid population growth of the last several decades. Much of this growth – and considerable internal migration – will be in inland areas, which have hotter climates than in the currently densely populated coastal areas. New construction in these regions will increase the use of residential and commercial air conditioning. Trends toward larger residences and increased electrical appliance use statewide will also increase energy usage.

These increased energy demands – both base load and peak load – will further encumber an already strained generation, transmission, and distribution network. California and the Western States region currently operate with very little electric power reserve capability during peak summertime demands, and peak demand growth exceeds the growth in generation capacity. Not only will California need additional supply, but it must continue to reduce demand and ensure that additional supply consists of renewable power systems.

As the use of information systems becomes integral to the functioning of the economy, the quality and reliability of electric power will be increasingly important. Modern manufacturing processes are more and more computer controlled – a power outage for less than a second can create a disruption in the production process and lead to massive financial losses. Since electricity storage capacity is limited, the introduction of clean distributed generation and improvements of California's transmission/distribution systems are inevitable.

California's transmission system was originally designed and built to serve mainly local power needs. It did not anticipate the active wholesale market. Today, the transmission system is used in ways it was not designed for. Fragmented transmission planning, siting and financing problems are impediments to the necessary upgrading of the transmission system. However, there are alternatives to building new

transmission lines. These include energy efficiency improvements that reduce overall electricity usage, peak load management, distributed generation that is located near the customer load, and emerging transmission technologies that increase the transfer capability of the existing transmission system, such as Flexible Alternating Current Transmission Systems (FACTS) or Dynamic Thermal Circuit Ratings (DTCR) Technologies. All of these options require R&D support.

Another important challenge is the steadily increasing consumption of natural gas. California has limited pipeline capacity for the supply of natural gas from other states. Currently, 85% of statewide demand for natural gas has to be imported. California is located at the western end of a complex network of pipelines that spans the United States and Canada. Increasing demand for natural gas in Nevada, Arizona and the Pacific Northwest may lead to supply constraints. California aims to reduce its dependence on natural gas through higher use of renewable energy sources, enhanced use of cogeneration (combined heat and power), and improved energy efficiency of natural gas fired power plants. Many of these options are being studied by the PIER program. Other options include the better use of existing storage capacity for natural gas, enhanced natural gas drilling and exploration in California, and the development of liquefied natural gas facilities to allow the import of liquefied natural gas from overseas.

Climate changes impose a significant risk to California. Rising temperatures and sea levels, along with changes in hydrological and ecological systems, are threats to California's economy, public health, and environment. The PIER program is examining technologies to mitigate and/or adapt to these threats.

Targeted R&D can help to address these energy challenges through energy efficiency improvements; development of affordable, clean, and distributed energy sources; improvement of transmission line capacities and better load management; research on alternative fuels for power generation to natural gas, such as renewable energy sources; and the development of better, regional models showing the impacts of climate change and the development of climate change mitigation and adaptation options.

2.2 PIER Cost-Benefit Analysis

The goal of PIER is to enhance the affordability, reliability, diversity and the environmental standard of California's electricity supply system. The mission is to fill research gaps that are not adequately provided by competitive markets and to advance science and technology. PIER funds R&D activities that offer near- and long-term benefits to California.

Public benefits of PIER may include:

- lowering energy costs for consumers and businesses;

- enhancing the reliability of California's electricity supply system;
- reducing environmental impacts of electricity generation, delivery, and use;
- providing the basis for and support of the implementation of energy policies in the public interest of California's citizens;
- developing new industries that address widespread energy concerns and contribute to the state's economic growth; and
- advancing science and technology.

The program focuses on six energy-related research areas: renewable electric generation; environmentally-preferred advanced generation (fossil-fueled distributed generation technologies); environmental research; buildings end-use energy efficiency; industrial, agricultural and water end-use energy efficiency; and energy systems integration tools and information.

Since PIER's inception in 1998, a total of about $260 million has been encumbered for research contracts. A review of contracts completed through 2002 revealed a total of 20 commercialized products with projected benefits of $221 to $576 million.[9] The benefits are significant in comparison to the total contract disbursements of about $125 million between 1998 and 2002, resulting in a benefit-to-cost ratio between 2 and 5 to 1.[10] Table 2.1 lists the PIER R&D products and their benefits commercialized through 2002.

[9] CEC. 2003. Evaluation of the Benefits to California Electric Ratepayers from the Public Interest Research Program, 1998-2002.

[10] op.cit.

Table 2.1 Benefits of PIER R&D Products Commercialized Through 2002

Product Name	Year of First Use	Sales or Applications in First Five Years	Range of Benefits
Residential and Commercial Buildings End Use Energy Efficiency:			
Berkeley Lamp	2001	5,000 to 60,000	$2 to 23 million
Commercial Kitchen Ventilation	2007	2,000 to 10,000	$14 to 71 million
Particulate Emissions Measurement for Unhooded Restaurant Appliances	2001	Not tracked	< $1 million
Revised Residential Framing Factors—Title 24 Update (2005)	2005	100,000-200,000	$2 to 6 million
Duct Sealing Requirements for Small Commercial HVAC Systems—Title 24 Update (2005)	2005	50 to 175 million sq. ft.	$40 to 140 million
Allowable Placement of Roof/Ceiling Insulation in Nonresidential Buildings—Title 24 Update (2005)	2005	18 to 30 million sq. ft.	$67 to 112 million
Requirements for Skylight Use in Low-Rise Residential and Commercial Buildings—Title 24 Update (2005)	2005	80 to 175 million square feet	$70 to 150 million
Goettl Comfortquest Gas Heat Pump	2002	<100	< $1 million
Real-Time Energy Management and Control Systems	2002	Not quantified	
Environmentally Preferred Advanced Generation:			
Catalytica Xonon Burner	2002	50 to 250 MW	$5 to 25 million
Energy Systems Integration:			
DG Interconnect Hardware	2001	Not quantified	
Real-Time Monitoring and Dynamic Rating System For Overhead Transmission Lines	2000	Not quantified	
Interconnection Standards for Small Distributed Generators	2002	500 to 2,000 kW	$4 to 16 million
Improved Substation Seismic Design	2002	--	$1 to 2 million
Reduced Utility Building Seismic Vulnerability	2002	100 buildings	$15 to 20 million
Renewable Energy Technologies:			
NO_X Control in Biomass-Fueled Boilers with Natural Gas Cofiring	2002	2 to 7 boilers	$0.2 to 1 million
PowerGuard-Solar Electric Systems for Flat Roofs	2001	5 to 10 MW	$30 to 80 million (Revenues)
Energy-Related Environmental Research:			
Low NO_X FIR Burner for Gas Boiler	2002-03	5 to 15	< $1 million
Industrial, Agriculture, and Water End Use Energy Efficiency:			
Cast Metal Industry Electricity Consumption Study	2001	5-50% CA market	$0.5 to 5 million
Poultry Rinse Water Recycling	2002	10% to 50% of market	$1 to 5 million

Chapter 3. Evaluation of PIER's Performance since 2001 Based on First IRP Recommendations

In March of 2001, the first IRP offered "a set of expectations of what the Governor, the Legislature, the CEC and the PIER program must accomplish over the next year to transform PIER into a high-quality research program within the CEC. If these expectations are not achieved, then the Legislature should consider the option of developing a PIER organization outside the CEC."

The IRP's future expectations fell into three categories: those that CEC must accomplish internally; those that CEC must accomplish externally with the cooperation of the Governor and Legislature; and those that involve developing a broader set of "energy relationships."

3.1 Expectations Internal to the CEC

- *PIER organizational responsibility will have grown through the formation of a dedicated division with program managers and functional heads solely responsible for PIER.*

  CEC has developed a coherent PIER research team with a management and technical staff dedicated to PIER goals and objectives. However, the team has yet to acquire division status with the authority and resources needed by a "high-quality" research program.

- *The PIER Program Manager will have been given authority to manage the PIER budget and selected authority to administer those funds.*

  The PIER Program Manager has responsibility for managing the PIER budget as approved by the CEC R&D Committee and for program planning in coordination with the Committee. However, as a contract employee, the Program Manager has little formal authority and exercises control largely through the informal process of personal contacts and respect of the staff for his personal experience and ability.

- *The quality and experience base of PIER research managers will have continued to develop.*

  PIER has competent team leaders in place along with strong technical managers and a small but high quality technical staff. However, civil service requirements and, more recently, budgetary issues have prevented the filling of needed staff positions and the hiring of expert consultants. The result is a short-handed staff and a lack of intellectual resources in several important research areas.

- *California energy research targets will have been set and contracts or grants awarded to achieve those targets.*

  PIER has developed a set of California specific issues that are the basis of its research projects. A contracting and grants process is in place and operating. PIER programs are linked to related state programs, such as Title 24, Renewable Portfolio Standard, Air Resources Board and environmental regulations. PIER issues, which were developed in 2002, anticipated and fed into the California Energy Action Plan issues of 2003. Although in some cases long-term goals need to be more clearly defined and better articulated, PIER is generally recognized as doing a good job of linking its program to state energy policy.

- *The PIER Program Manager will have developed a management roadmap.*

  Budgetary and administrative processes have been improved and policy guidance clarified; however, no formal management roadmap has been developed. There is an urgent need for the CEC to develop a management plan and a formal organizational structure to properly staff and more effectively manage the program.

- *The PIER program will have, on average, awarded contracts in four or less months.*

  PIER and CEC have done a great job in improving the efficiency and response time of the contracting process. The average elapsed time processing in a competitive procurement, between the announcement of the selected awardee and the signing of the contract, is now 3.5 months.

3.2 Expectations External to the CEC

- *The Governor and the Legislature will have been provided with the CEC forecasts of energy trends, needs, and resources developed as part of PIER's strategic planning process.*

  PIER has not been assigned the task of providing strategic analyses and energy forecasts to the legislative or executive branches of the government. However, PIER submitted a legislatively mandated investment plan in March of 2001 outlining broad energy trends and needs, and the CEC provides monthly status reports to the Governor's office. PIER also developed a set of energy issues, which are tied to those later developed under the California Energy Action Plan and Integrated Energy Policy Report.

- *The CEC will have requested and received legislative relief from specific constraints on PIER innovation related to contracting, streamlining, and staffing.*

  PIER has made vigorous efforts to get legislative relief on various management and administrative constraints. A number of legislative remedies were suggested and rewrites were submitted to and approved by appropriate senate staff as well as the

Department of General Services for consideration as part of Senate Bill (SB) 1038. This bill has yet to be considered by the Legislature and, given current budgetary issues, the outcome is uncertain.

- *PIER will have become an integrated part of California's funded energy efficiency and renewable energy programs.*

  PIER has been working more closely with the California Public Utilities Commission and the utilities through the Emerging Technology Coordinating Council in the demonstration and deployment of PIER technologies. PIER has developed closer integration with the activities of the CEC Renewable Energy Program due to the Renewable Portfolio Standard and CEC commissioner interest, and PIER is advocating a natural public good charge to fund critical infrastructure and natural gas efficiency R&D.

3.3 Expectations of a Broader Set of Energy Relationships

- *The CEC will have developed a mechanism for informing the California Congressional Delegation of federal funding needs.*

  PIER's efforts, carried out with the cooperation of CCST, have established a standing relationship with the California Delegation's caucus leaders. The CEC Chairman, the CEC Executive Director, and the PIER Program Manager have given presentations to the Delegation members and their legislative directors.

- *The CEC will have begun to affect the portfolio of DOE programs and their funding to meet California's energy needs.*

  PIER has been successful in establishing a close working relationship with the U.S. Department of Energy (DOE) and with its national laboratories, particularly Lawrence Berkeley National Laboratory and the National Renewable Energy Laboratory. DOE consults with PIER in a number of program areas, and as a result, DOE has provided collaborative funds for a number of PIER projects. In addition, PIER is a participant in a DOE/multi-state program, the State Technologies Advancement Collaborative, that is being carried out with the Association of State Energy Research and Technology Transfer Institutions.

- *Partnerships and collaborations will have been pursued with other research centers.*

  PIER has established relationships with other energy related research centers in the state and elsewhere in the federal laboratory system. For example, PIER has a growing interaction with the National Oceanic & Atmospheric Administration on climate change. There is a major contract in place with the University of California that lays out standard terms and conditions. PIER is working with the recently established Electricity Innovations Institute of the Electric Power Research Institute to develop

co-funded R&D projects. PIER is collaborating with a number of state agencies including: the Air Resources Board, Department of Water Resources, Department of Forestry and Fire Protection, and the Department of Conservation.

- *PIER program advisory groups will consist of knowledgeable people from a range of stakeholders including: utility, industry, regulatory, academic, and public interest.*

  The PIER program has an elaborate advisory structure covering all program areas and with good stakeholder representation. In addition, there are annual technical review panels for each major program area who prepare detailed reports for the Program Manager. It would appear that, as the PIER organization develops, this elaborate system could be simplified in the interest of reducing costs and increasing efficiencies while retaining the involvement of the stakeholders. This is almost certainly true if the PIER Policy Advisory Council, which has not been active recently, is activated. The program would benefit from its overview.

3.4 In Summary:

This IRP finds that each of the 13 expectations of the previous IRP has been addressed, and in most cases, real progress has been made. The program areas are better defined with competent team leaders in place. There is an able program manager with general responsibility for the program, although he does not have a career position or a formal appointment and therefore lacks formal authority. The program has a capable, if small, dedicated technical staff. Well-conceived research strategies are in development and contracting procedures have been streamlined. The program is proceeding with relevant research and is producing practical results. However, the IRP is concerned about the program's future.

The program is having difficulty in acquiring and maintaining a technical staff with the depth and breadth required to sustain it. The lack of real authority on the part of the Program Manager and the tenuous nature of this appointment (he is an 80% time temporary appointment and there is no appropriate permanent position) are matters of major concern to the IRP and the staff. Cumbersome administrative practices and staffing requirements remain major concerns as well. Unless corrected, these issues will almost certainly limit PIER's ability to evolve into what should be CEC's objective, that of creating a "truly outstanding research & development program that will benefit the citizens of California."

Chapter 4. Evaluation of PIER Program Implementation

The PIER program has made considerable progress toward meeting the 2001 PIER IRP expectations under the leadership of the current PIER Program Manager and the new CEC R&D Committee consisting of Commissioners Arthur Rosenfeld and John Geesman.

- The program goals are better defined, the research plans have been improved and the contracting procedures have been streamlined.
- The PIER program is well linked to California energy policies and governmental energy programs.
- PIER funds ongoing appropriate collaborative research activities with a multitude of excellent research organizations, within California and nationwide.
- Its cooperation with DOE has vastly improved and PIER has taken on a leading role in California related research areas, such as the integration of energy systems into the electricity grid.
- The program has effective leadership thanks to the outstanding managerial skills of the appointed Program Manager. A severe downside however, is that this manager is a contract employee and cannot directly manage the PIER program or hire and fire employees. Furthermore, as part of cost cutting, the PIER Program Manager is presently not hired on a full time basis.
- The program has been destabilized and its effectiveness severely threatened by budget cuts involving the termination of contracts with key technical personnel. These skills are not available within the CEC and not otherwise available to PIER. Furthermore, since the PIER program is funded by an assessment of the California power companies, these actions resulted in no cost savings to the State of California.

The IRP wants to congratulate the CEC on accomplishments to date, but believes the program must still be enhanced. The special needs of managing R&D have been achieved primarily through informal arrangements and not by specific organizational structure, which is an important requirement for a first class research program. The PIER Program Manager, PIER program area managers, and contractors all ascribe the difficulties to the history and culture of the CEC, which is not conducive to R&D management. The lack of the CEC's focus on R&D makes it more difficult to preserve the PIER program in face of legislative budget cuts. Recent staff and budget cuts within the CEC affected the PIER program in a manner disproportionate to cuts in

other divisions and programs of the CEC. Only individual loyalty is maintaining the present high PIER program standards. The following sections discuss these issues in more detail.

4.1 Leadership and Organization

The PIER program now has an excellent Program Manager, who is hired as a contractor and not on a full time basis due to CEC imposed budget constraints. His duties are to plan and manage the overall strategy and direction of the PIER program in conformance with the policy and priority decisions of the CEC R&D Committee. Other duties are to provide overall program vision and strategic direction, and to coordinate and communicate with outside organizations and the Legislature. A deputy division chief, who is a full-time civil service employee within the CEC, assists the PIER Program Manager. His duties are to manage day-to-day program activities and to supervise staff. Each of the six PIER program areas has a permanent full-time program area manager. Under recent budget cuts, the PIER staff has been reduced approximately 30%. The budget cuts disproportionately affect the PIER program as the bulk of its energy expertise lies in the skills of the energy related experts who were contract employees and whose jobs were terminated in these reductions.

The authority of the current contractor PIER Program Manager is only informally defined. The current PIER Program Manager does not have direct control over staffing for the program. This includes selection of staff based on the capabilities needed for PIER, determining staffing levels and level of effort, enforcing staff availability and commitments, and providing input to staff performance evaluations. The PIER Program Manager does not have the authority to sign research contracts or to manage budgets, because the civil service structure of the CEC does not allow a contractor to take on these responsibilities. State employees within the CEC currently execute them by informal agreement with the PIER Program Manager. This system is working only because of good personal relationships, but it could change with another PIER program manager.

A PIER program manager needs the authority to manage personnel and budgets. He or she must also be the person who is accountable for PIER, and responsible for presenting and defending the program to the CEC, the external oversight agencies, the Legislature and the Governor. The incumbent PIER Program Manager performs these functions informally, since he is not a civil service employee. This management arrangement is dysfunctional and needs to be changed to a normal management structure.

4.2 Knowledge Base

Staff knowledge of energy technology, markets and trends directly affects planning processes, allocation decisions and source selection. Staff familiarity with R&D management processes and contracting procedures affects the efficiency of program execution.

In general, the IRP believes that PIER has a strong knowledge base in most technical areas. However, current budget issues have required that PIER's remaining open positions be deleted, staff be reduced, and a hiring freeze introduced. Nearly all contract staff have been laid off. The result is that PIER may have a lack of "intellectual critical mass" and a severely reduced knowledge base in some important areas. This has taken place at the same time that the total number of contracts continues to increase.

This development has led to awarding larger research contracts (in dollar terms) as a means to manage with staff limitations. It also led to large-scale outsourcing of blocks of R&D contracts to organizations outside the CEC. This makes it more difficult to guarantee that PIER projects adhere to the CEC goals and PIER objectives.

An additional issue is the extremely limited travel budget for PIER staff. This hinders staff professional development and key interchanges with staff and stakeholders in other programs including the U.S. DOE. These constraints severely affect the ability of PIER staff to keep up to date on scientific, technological and policy issues relevant to the PIER program and to develop collaborative, cross-cutting programs.

Nevertheless, the IRP was impressed by the motivation of the PIER staff in spite of all these constraints. On the other hand, the IRP is concerned that this motivation on the part of the PIER staff may be lost in view of the losses in the skill base and the increasing work loads.

4.3 Portfolio Analysis

The PIER program is currently divided into six program areas with a manager assigned responsibility for each program area:

- Renewable energy research (Renewables)
- Environmentally-preferred advanced generation (EPAG)
- Residential and commercial buildings end-use energy efficiency (Buildings)
- Industrial, agricultural, and water end-use energy efficiency (IAW)
- Energy-related environmental research (EA)
- Energy Systems Integration (ESI)

Additionally, PIER has an Energy Innovations Small Grant (EISG) program that funds smaller research to establish the feasibility of new, innovative energy concepts.

The IRP divided into subcommittees, each assigned to a specific program area. They investigated each of the areas in more detail. These analyses can be found at the CCST website (www.ccst.us). These reports give most of the program areas' efforts high marks in terms of quality, applicability and balance to the PIER program goals. In addition, in the fall of 2002, the PIER program convened outside technical review panels for each program area. The detailed reports are accessible at the CCST website (www.ccst.us) and at the CEC website (www.energy.ca.gov). All in all, the PIER efforts received a very effective set of reviews from a large set of very knowledgeable reviewers and received high marks. The good news is that the program has been going well; unfortunately these efforts are threatened by a lack of appropriate management structure and flexibility and by losses in critical personnel.

The PIER research portfolio is based on a broad goal of the CEC R&D Committee for relative funding levels: 50% supply side (Renewables, EPAG, EA) and 50% demand side (Buildings, IAW). The PIER ESI program area and the EISG program include research projects that address both the supply and the demand side.

Between the program's inception in 1998 and June 2003, the PIER program encumbered $260 million for research contracts. The current PIER research portfolio is depicted in Figure 4.1.

There are several research activities funded under PIER that cut across the six PIER program areas lines. These are listed in Table 4.1.

The PIER research portfolio is geared to address issues that are specific to California, such as population shifts, water issues, emission standards, etc. (see Table 4.2).

The PIER portfolio has an emphasis on near-term and low-risk research. Where possible, PIER projects tie into synergistic state regulatory and subsidy programs, such as the Renewable Portfolio Standard (RPS), Building Codes 20 and 24, Air Resource Board rules on distributed generation emissions, etc., and are collaboratively undertaken with other CEC divisions and other state agencies (see Table 4.3).

The portfolio of recipients of PIER funds is depicted in Figure 4.2.

The IRP believes that except for minor issues the current PIER research portfolio is well focused, addresses issues relevant to California as outlined in the Energy Action Plan, meets PIER objectives and is well balanced.

Figure 4.1 PIER's Research Portfolio

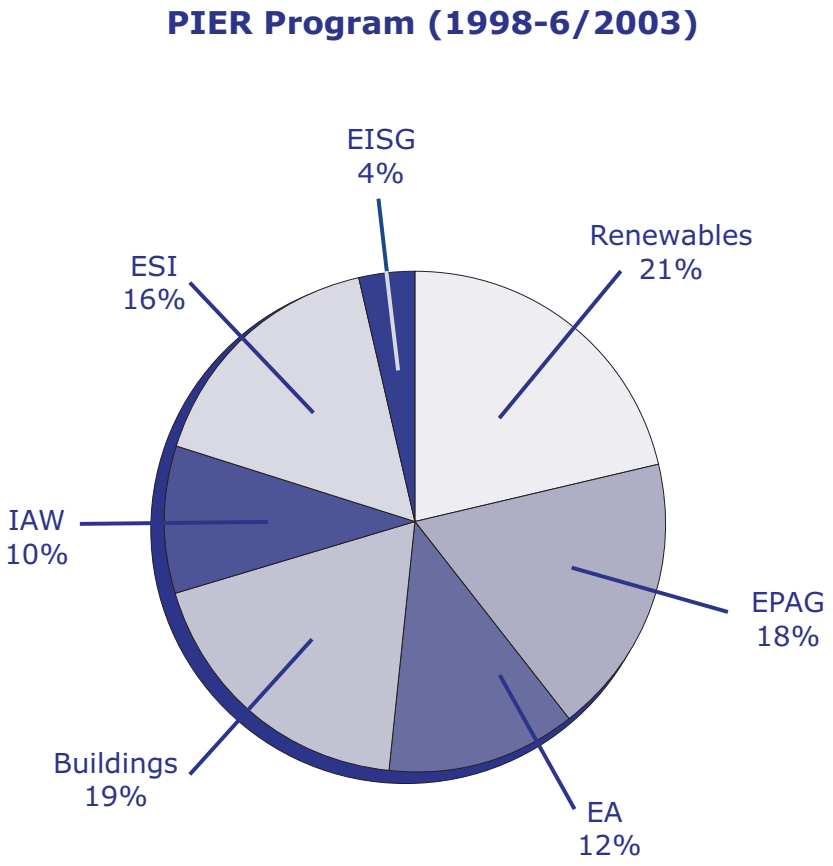


Table 4.1 Cross-cutting Research Areas

Research Area	PIER Program Areas					
	Renew	EPAG	EA	Bldgs	IAW	ESI
Distributed Energy Resources	⊗	⊗	⊗		⊗	⊗
Demand Response				⊗	⊗	⊗
Hydrogen Infrastructure		⊗	⊗			
Electricity Storage	⊗				⊗	⊗
Water Technology Issues			⊗		⊗	
Transmission	⊗		⊗			⊗
Indoor Environment R&D			⊗	⊗		
Zero Energy Buildings	⊗			⊗		
RPS	⊗		⊗			⊗
Carbon Sequestration		⊗	⊗			

Table 4.2 Significant California Energy Issues Addressed by PIER

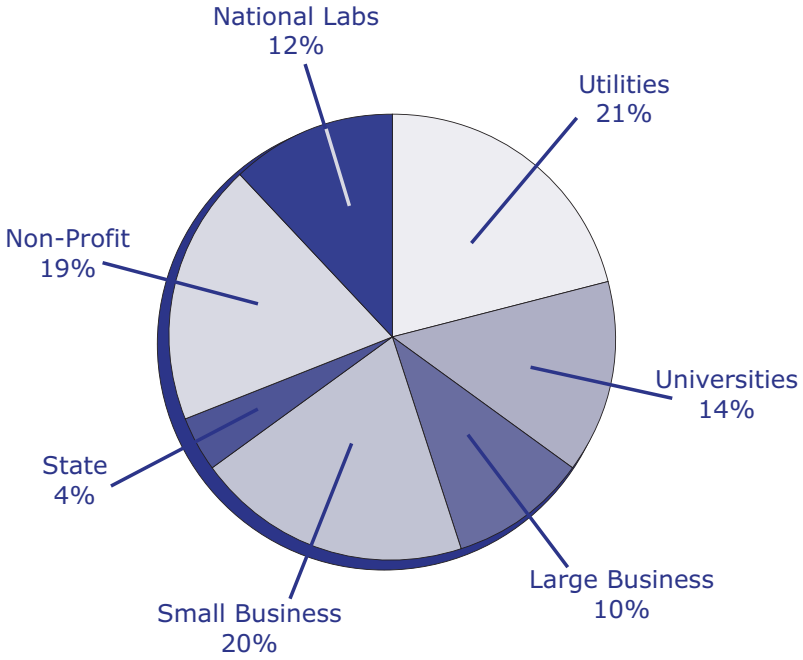
California Energy Issues	PIER Program Areas					
	Renew	EPAG	EA	Bldgs	IAW	ESI
Peak demand impacts reliability, affordability, and availability	M			**H**	**H**	**H**
Transmission and distribution system inadequate for distributed energy resources and congestion	M					**H**
Transmission grid inadequate for reliability, operability and efficiency			M			**H**
Emission standards driving need for new cleaner generation technologies	M	**H**	M			
Renewable portfolio standard driving need for acceptable and low-cost renewable systems	**H**		M			M
Reduction in energy per capita and per gross state product still cornerstone of California policy		**H**		**H**	**H**	M
California must be responsive to climate change issues	M	M	**H**	M		
Restructured markets will require improved reliability, quality and affordability	**H**	M			M	**H**
Infrastructure security must be addressed	M					M
Technology development and assessment must tie to changing market needs	**H**				**H**	**H**
Regulatory, environmental and economic policy decisions relative to electricity markets and technology require analyses	M		**H**	M	M	M

H … high importance, M … medium importance (Scoring by PIER program area managers)

Table 4.3 PIER Collaborations With Other CEC Divisions and Other State Agencies Addressing State Regulatory and Subsidy Programs

PIER Program Areas	Internal Agency Activities (CEC)	Collaborations with Other State Agencies
Renewables	• **Renewable Portfolio Standard** *(Technology Systems Division)*	• California Department of Forestry and Fire Protection • California Independent System Operator
EPAG	• **Fuel Cells** *(Technology Systems Division)* • **Hydrogen** *(Transportation Energy Division)*	• Air Resources Board
EA	• **Environmental Issues** *(Siting Division)*	• California Department of Conservation (Division of Oil, Gas, and Geothermal Resources) • California Department of Forestry and Fire Protection • Air Resources Board
Buildings	• **Title 24** *(Energy Efficiency Division)* • **Real Time Pricing** *(Energy Efficiency Division)*	• California Public Utilities Commission
IAW	• **Water Efficiency** *(Energy Efficiency Division)* • **Real Time Pricing** *(Energy Efficiency Division)*	• California Department of Water Resources • California Department of Conservation (Division of Oil, Gas, and Geothermal Resources)
ESI	• **Real Time Pricing** *(Energy Efficiency Division)* • **Transmission and Distribution Issues** *(Siting Division)*	• California Public Utilities Commission • California Independent System Operator

Figure 4.2 PIER Research Partners



4.4 Contracting Procedures

The independent review of the PIER program in 2000 identified three key issues regarding the PIER contracting procedures:

- The project selection and contracting processes were overly complex.
- The time from receipt of a proposal to contract signature was too long.
- A significant portion of the process-related problems was internally imposed or inherent in CEC's structure.

The 2001 report of the previous PIER IRP included the following recommendations on how to improve the contracting processes:

- Reduce the time from issuance of a competitive solicitation to starting work on an executed contract to less than six months.
- Develop research agreements that are more flexible and contain provisions for unexpected and mid-course corrections yet still have appropriate levels of accountability.
- Improve the consistency and quality of contract management through training of PIER staff.
- Establish an on-going mechanism to improve the contracting process.
- Award contracts in four or less months on average.

In order to achieve these goals, the PIER program established in September of 2001 a PIER Administrative Streamlining Team, called "Team Sparkey." This team created standardized work statement templates, revised standard terms and conditions in PIER research contracts, and established master research agreements with the University of California Office of the President and the Electricity Innovations Institute to get more flexibility and to speed up the contracting process. The result is that the average contract process time between the announcement of the selected awardee of a competitive solicitation and the signing of the contract with the awardee was reduced from 7.2 ± 10 weeks before the introduction of the administrative changes to currently 3.5 ± 2 weeks (see Figure 4.3).

Figure 4.3 Reduced Contract Processing Time

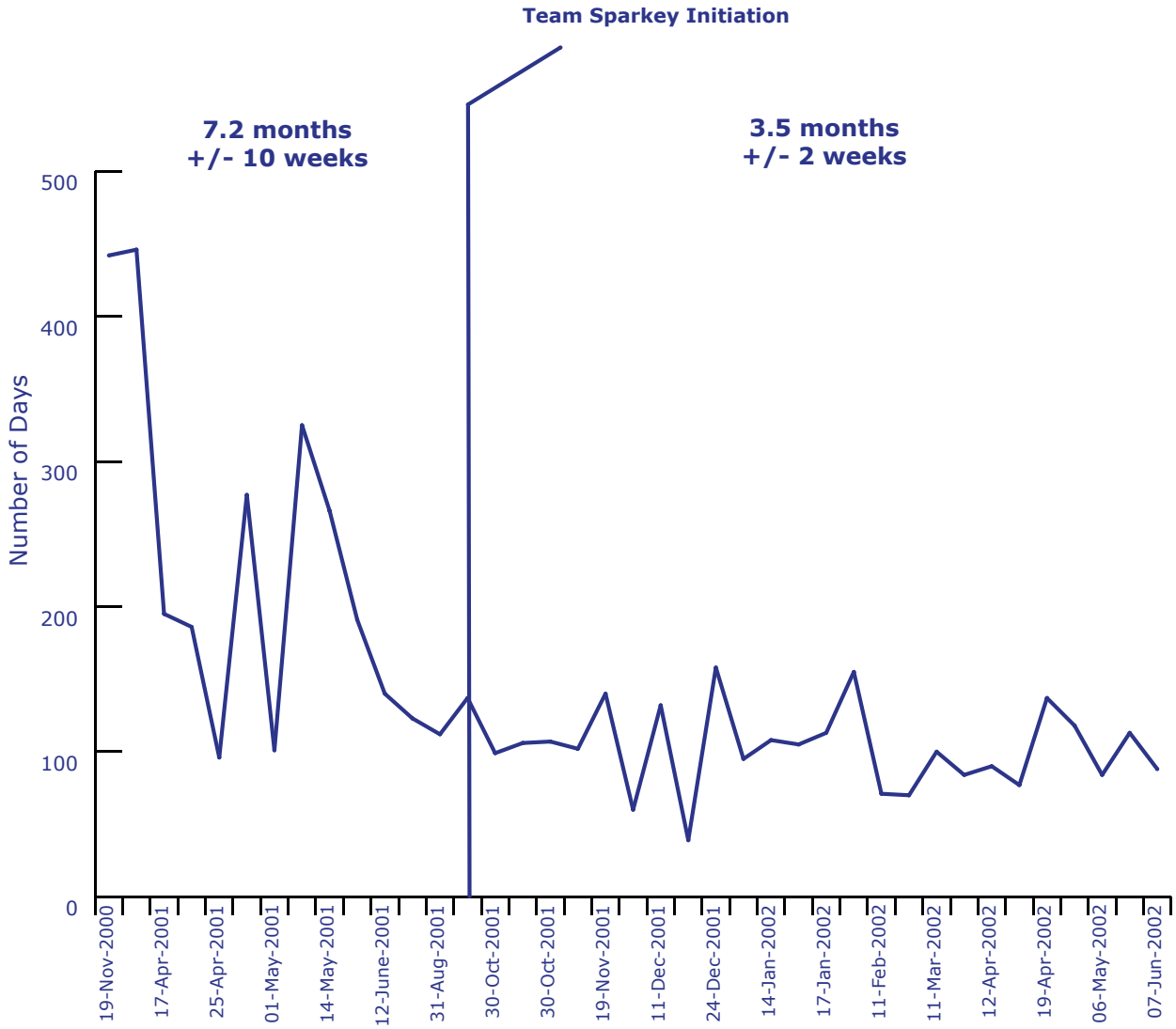
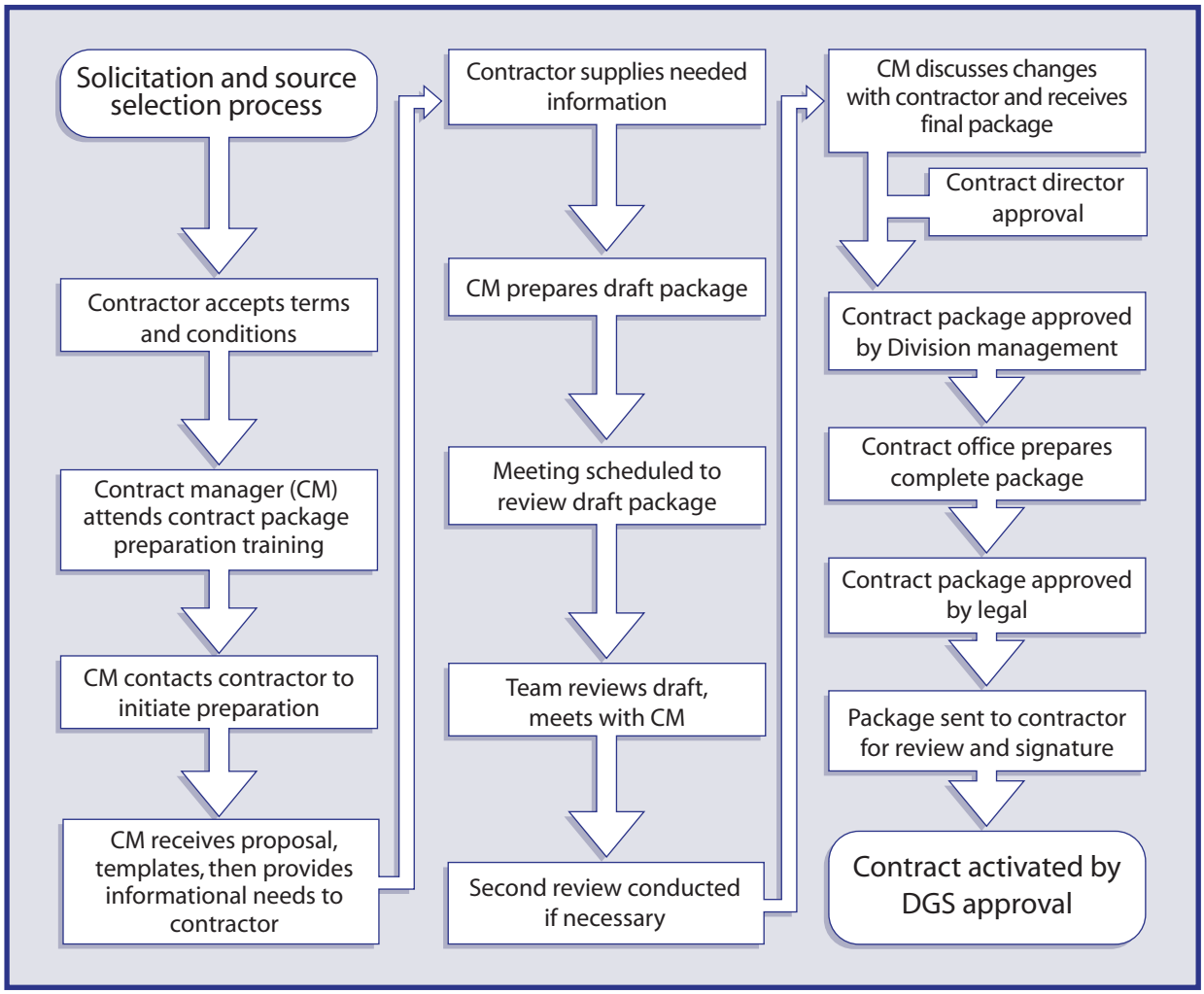


Figure 4.4 PIER Contract Preparation Process Flow



While the CEC has made considerable strides to shorten the time it takes to process agreements, the fundamental process has never been changed (see Figure 4.4). The CEC is currently asking the Department of General Services (DGS) to raise the authorization cap for research contracts not requiring DGS approval. Further improvements of contracting processes may not be in the purview of the CEC and may require legislative action.

Chapter 5. Alternative Organizational Structures

The performance of the PIER program has significantly improved since the last review in 2001. However, fundamental organizational limitations hinder the ability of PIER to become a first-class R&D organization. The current organizational structure of the CEC is not optimal for R&D. The CEC is a regulatory agency with limited flexibility, a near term focus, and a risk-averse culture. Under the current civil service rules, it is difficult to attract and retain top research managers. Managers do not have the independence and authority they need to be as effective as possible. The PIER IRP believes that these problems need to be addressed before the PIER program can achieve the excellence that California citizens need and deserve.

The IRP strongly recommends that the CEC develop a strategic operational and implementation response to solve PIER's structural problem. The response should include the development of two parallel plans, one to include a greater degree of operational independence and authority within the CEC and the other to include a structure outside of the CEC. We recognize that the implementation is likely to require legislative action. These two options for restructuring the PIER program are discussed below.

5.1 Enhance PIER within the CEC

The IRP finds that PIER's subordinate administrative position within the CEC is not commensurate with its budgetary weight and with the program's potential impact on California's future. By elevating PIER to a CEC division, creating the position of director, and vesting greater responsibility in the program managers, the program would be less subject to its current constraints. This change in status would be more than merely symbolic; with the director granted full authority over project selection and management of staff resources (but still guided by CEC objectives and policies), the commission would be able to attract outstanding candidates for the position.

However, the necessary reorganization efforts would most likely take two to three years and would not resolve all current program limitations. The PIER director would still be bound to civil service constraints in managing personnel. The elevation of PIER to a CEC division would require hiring additional staff, which is very difficult in the near future due to the state budget crisis. The problem of the cultural incompatibility of a regulatory agency as research administrator would not be addressed by this option.

5.2 Move PIER (partially) outside of the CEC

The IRP has identified a number of inadequacies in the current organizational structure of PIER/CEC. As noted elsewhere in this report, many of the difficulties that PIER faces stem from its situation in an agency with a culture that is not ideal for an R&D program.

I. Create a Joint Powers Agreement

In the first IRP evaluation of the PIER program, a promising mechanism had been identified that would alleviate the existing structural problems of the CEC. This mechanism is called a Joint Powers Agreement and it creates a Joint Powers Authority (JPA). A JPA would team the CEC/PIER with another state agency having more experience in R&D management and the ability to attract and hire experienced R&D senior management. A likely candidate would be the University of California. This mechanism has precedents in state government; there are currently 154 JPAs in California.[11] A JPA would exist as an independent entity, with a board of directors that appoints a CEO to administer PIER. The CEC would fund the JPA. CEC commissioners would serve on the board of directors of the JPA, thereby preserving a strong hand for CEC governance of PIER while maintaining the link between PIER and the energy policy-making function of CEC. This would allow the CEC to continue to utilize research funded by PIER for the benefit of the state.

The main purpose of a JPA is flexibility in administrative procedures. The JPA board could, for areas such as contracting or personnel management, authorize use of rules and procedures of either JPA partner as best suits the needs of PIER. It is this that allows the hiring of some permanent PIER staff outside civil service under the auspices of UC or another non-CEC partner in the JPA. Once a JPA is formed, a transition of functions from the present arrangement in the CEC alone to the JPA could be planned in the best interests of a successful PIER program and good working relations with the CEC.

Potential problems that should be considered before forming a JPA are that this reorganization option is very likely to require authorization from the Legislature, that the administrative structure of a JPA is likely to be more complex and expensive than that of a single agency, and that there is the potential of a conflict of interest if the partner organization is also authorized to conduct research.

II. Create a Public Benefits Corporation (PBC)

The creation of a new Public Benefit Corporation (PBC) to administer the PIER program would allow a broad governance of PIER. Besides the CEC, private entities, such as investor-owned utilities, universities, public interest groups or other non-

[11] See website of the California Association of Joint Power Authorities <http://www.cajpa.org>.

profit organizations could be included in the governing board of PIER. The PBC is, therefore, a reorganization option that would allow the participation of a wider range of interested stakeholders than under the CEC alone or under a JPA between the CEC and another public agency.

There are precedents of this administration model for public interest energy programs. The New York State Energy Research and Development Authority (NYSERDA) serves as the statewide administrator for New York's various public goods energy programs. In the Pacific Northwest region (Washington, Oregon, Idaho and Montana), various public and private entities mutually created a non profit corporation to administer a portion of that region's public interest energy efficiency programs.[12]

Advantages of a PBC are that it includes multiple stakeholders, and that the administration of the PBC is likely to be more effective, flexible and efficient than that of a public agency or a JPA since a PBC may be able to operate without the restrictions of various laws that constrain state agencies in managing personnel and resources. The inclusion of the private sector in the governing board of the PBC is likely to enhance the market connectedness of PIER.

Several potential difficulties should be considered that are connected to the establishment of a PBC to administer the PIER program. The California Legislature would need to authorize this new organization. The extent to which the PCB would be exempted from state laws constraining the administration of PIER within the CEC would need to be clarified. There are also likely to be some start up costs associated with the creation of the new organization, such as for locating and hiring personnel.

[12] CEC, Administration Issues and Options Concerning California's Public Interest Energy Research Programs, Memorandum from David Abelson, CEC Senior Staff Counsel, January 20, 2004.

Chapter 6. Recommendations

The importance of energy R&D to California's continued economic growth, environmental performance, and science and technology leadership demands that the PIER program be implemented effectively. The state has the intellectual resources and economic infrastructure to address those challenges through a well-managed R&D program.

The IRP commends the CEC for its accomplishments in the three years since the first PIER program review. We now find that the PIER program is better defined, has good leadership, and in most program areas, has well conceived research strategies. However, the IRP has identified several key issues of concern that appear to affect the ability of the program to fully realize the benefits of public interest energy research.

This IRP finds that each of the 13 expectations of the previous IRP has been addressed, and in most cases, real progress has been made. The program areas are better defined with competent team leaders in place. There is an able PIER Program Manager with general responsibility for the program, although he does not have a career position or a formal appointment and therefore lacks formal authority. The program has a capable, if small, dedicated technical staff. Well-conceived research strategies are in development and contracting procedures have been streamlined. The program is proceeding with relevant research and is producing practical results. However, the panel is concerned about the program's future.

The program is having difficulty in acquiring and maintaining a technical staff with the depth and breadth required. The lack of real authority on the part of the PIER Program Manager and the tenuous nature of this appointment are matters of major concern to the IRP and the staff. Cumbersome administrative practices and staffing requirements remain major concerns. Unless corrected, they will almost certainly limit PIER's ability to evolve into what should be CEC's objective, that of creating a "truly outstanding research and development program that will benefit the citizens of California."

As with the first IRP, the current IRP found that many of the factors affecting the efficiency and effectiveness of the PIER program's planning, contracting and management processes are internal to the CEC. At a fundamental level, these factors are inherent in the current structure of the agency and its operating procedures. The PIER organization has largely been shaped by the CEC's internal constraints. These limiting policies and practices need to be further addressed if the PIER program is to meet expectations and mature into an outstanding R&D organization. In particular, the characteristics of the CEC's organizational culture and bureaucracy conflict with the characteristics of an organizational environment that facilitates a superior R&D program. The IRP felt this issue was key to PIER's successful future and enclosed as, Appendix B, a description of what characterizes a successful R&D organization.

The IRP believes that further progress can be made through near-term changes internal to the PIER program, including:

- **The most immediate need is to fill the existing knowledge gap. The CEC should give the PIER Program Manager authority to fill vacancies and personnel shortfalls and supplement staff resources with contract staff.** This action would address the unintended consequence of staff resource cuts, which have imposed large burdens on remaining staff and threatens the program's effectiveness.
- **PIER management should streamline the advisory committee process, reconstitute the PIER Policy Advisory Council, reduce the number of program-area advisory committees, and link the advisory groups through shared membership.**
- **To ensure the integration of PIER efforts with research and development (R&D) programs at the state and national level, the PIER Program Manager should be given funding authority to support cross-program coordination, site visits, and staff professional development.**

Beyond these near-term issues, fundamental organizational limitations hinder the ability of PIER to become a first-class R&D organization. The current organizational structure of the CEC is not optimal for R&D. The CEC is a regulatory agency with limited flexibility, a near term focus, and a risk-averse culture. Under the current civil service rules, it is difficult to attract and retain top research managers. Managers do not have the independence and authority they need to be as effective as possible. The PIER panel believes that these problems need to be addressed before the PIER program can achieve the excellence that California citizens need and deserve.

We strongly recommend that the CEC develop a strategic operational and implementation response to solve PIER's structural problem. The response should include the development of two parallel plans, one to include a greater degree of operational independence and authority within the CEC and the other to include a structure outside of the CEC. We recognize that implementation is likely to require legislative action. For the IRP to incorporate the evaluation of the plans in its final report, the response should be completed by August 1, 2004.

Biblography

California Council on Science and Technology (CCST), "California Independent PIER Review Panel Report," March 2000.

California Council on Science and Technology (CCST), "California Independent PIER Review Panel Final Report," March 2001.

California Energy Commission (CEC), "Evaluation of the Benefits to California Electric Ratepayers from the Public Interest Research Program, 1998-2002," May 2003.

California Energy Commission (CEC), "Integrated Energy Policy Report," Docket No. 02-IEP-1, October 2003.

California Energy Commission (CEC), R&D Committee, "Energy Development: Research, Development and Demonstration and Electric Industry Restructuring," 1995.

California Energy Commission (CEC), R&D Working Group, Working Group Report on Public Interest Research, Development and Demonstration Activities, Appendices, P500-96-010A, September 6, 1996.

Corey, E. Raymond, Technology Fountainheads, Harvard Business School Press, Boston, MA, 1997.

State of California, Consumer Power and Conservation Financing Authority, Energy Resources Conservation and Development Commission, Public Utilities Commission, "Energy Action Plan," May 2003.

Appendix A: California Energy Commission Letter

STATE OF CALIFORNIA - THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, *Governor*

CALIFORNIA ENERGY COMMISSION
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March 1, 2004

Mr. Carl Weinberg
Weinberg Associates
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Walnut Creek, CA 94596-5808

Dear Mr. Weinberg:

Thank you for sending us a draft of the *Independent Review Panel's 2004 Report on the California Energy Commission's Public Interest Energy Research (PIER) Program*. We sincerely appreciate the time the Panel has spent evaluating the program and the thoughtful comments provided in the draft report.

The Energy Commission took seriously the comments and recommendations of the first Independent Review Panel and implemented many modifications in the PIER program which are recognized in your draft report. These changes and the current success of the program would not have been possible without the efforts and dedication of the PIER program director, team leads, and program staff as well as others in the Energy Commission associated with the PIER program.

We recognize that it takes a lot of work to maintain and further develop a first-class, state-managed energy research and development program. The observations and recommendations made in your report will aid in this effort. Unfortunately, the state's budget crisis has had an adverse impact on the PIER program as it has on other programs within the Energy Commission and all aspects of state government. Our hope is that as the crisis is resolved, we will be able to achieve changes to the program that we mutually desire. The draft report concludes with a recommendation that the Energy Commission develop, by August 1, 2004, an operational and implementation response. We have begun this work and anticipate having it complete by the date requested.

We appreciate the Panel's support regarding the necessity of having a state-funded, energy research and development program that has strong ties to state energy policy and implementation programs, is able to bring federal and private research funds to California, and compliments research performed in the private and academic sectors.

Sincerely,

WILLIAM J. KEESE
Chairman

Appendix B: Essentials of Successful R&D Management

The legislation that created PIER anticipated a state-managed energy R&D program that would support energy-related research not adequately funded by public- or private-sector organizations. PIER was expected to support a coordinated set of projects with significant public benefits; it was not simply a funding mechanism to provide contracts and grants to interested parties. In practice, this meant that PIER would need to identify state energy challenges, formulate a program for meeting those challenges, develop a strategy for implementing the program, develop and release RFPs, evaluate proposals and select projects for funding, negotiate contracts or other funding vehicles, monitor the research activity, and assess how well projects met program goals. These are the responsibilities of an R&D management organization; how well it carries out these responsibilities is determined by the organization's characteristics.

There is no single best path to a superior R&D management organization. However, certain principles pertaining to leadership, organizational environment and knowledge base guide all superior R&D management organizations, and, to some extent, all innovative organizations.[13] While no organization or program can be expected to reflect all of these principles when it launches, a superior R&D management organization will continuously incorporate these principles into its operations.

Leadership

An R&D management organization requires a strong leader, not simply a manager. A leader keeps others in focus, maintains morale, and creates an environment that enables the fullest exploitation of talents. A leader earns the trust of everyone in the organization, both above and below, and has full responsibility for and authority over intellectual, administrative, personnel, and financial areas. The leader facilitates relationships with other relevant organizations and creates and maintains an environment appropriate for R&D management.

[13] R&D management organizations that have struggled with some of the same issues that the CEC faces in administering PIER and that, to varying degrees, have found solutions, are the Defense Advanced Research Projects Agency (DARPA), the Electric Power Research Institute (EPRI), the Gas Research Institute (GRI), the Atomic Energy Commission (AEC) and the Advanced Technology Program (ATP) at the National Institute of Standards and Technology (NIST). An excellent discussion of the experiences at the R&D organizations is contained in Corey (1997).

A single leader improves accountability and consistency in program direction. He or she must have the authority to develop the vision to link program objectives to challenges, and to develop a strategy for addressing those challenges. The leader also has the responsibility to present and defend the strategy and objectives to external oversight authorities. There is less tendency for oversight organizations to micromanage if there is respect for the leader and understanding and acceptance of program plans and objectives.

A leader must be able to deploy resources, dollars and people. Activities must be coordinated among various disciplines and specialties. Each project must be embedded in a portfolio that balances the need for setting the objectives, available resources, degree of risk, and time of completion.

An R&D leader needs to control the program budget, with clear rights and authority that confer stature and respect. A leader requires the authority to use a variety of funding mechanisms, appropriate for different types of R&D activities. He or she also must have the ability to respond rapidly to a changing environment, including the relative importance of subject areas, budget and staff changes, quality of R&D performers, and program outputs and outcomes.

Innovative groups thrive on challenging work and stimulating colleagues. Such a group requires a superior leader, especially when the group must be formed quickly and action taken quickly. The leader's charge is especially difficult if the group is inherited from a prior program, or if the personnel have been designated by others. Successful leaders seek to reduce distractions, and are allowed to do so, while ensuring that information flow is sufficient to the organization's planning needs.

Successful leaders insulate their people from bureaucratic interference and ensure their autonomy, even when this protection may conflict with the organization's norms of control over decision processes, funds, contracts, and rules changes. The successful leader benefits from an enlightened administrative oversight that values the rewards of innovation more than it values control.

Organizational Environment

A superior R&D management organization has well-established concepts and processes that define the organization's goals and objectives. These goals and objectives are jointly developed with upper management and stakeholders to ensure that the right problems and the potential influence of R&D are understood. The organization must communicate with political bodies who have oversight responsibility.

A superior organization has a vital and clear objective purpose, and can link each of its activities to that purpose. It becomes the framework for purposeful R&D management.

An R&D management organization requires an environment that fosters innovative thinking and allows intelligent failure. A well-functioning organization must be open and fair. R&D management organizations must reduce the fear of nonsuccess. Bold and risky, but well-conceived and managed projects that fail but yield valuable information must not be punished. Otherwise, only guaranteed successes will be funded, stifling innovation. This is a particularly difficult environment to develop in a public organization, wherein setbacks can be construed as mismanagement of funds. The authorities that oversee disbursement of public funds as well as citizens should prize innovation and tolerate occasional failure as an acceptable cost of the innovation process.

A successful R&D program requires an environment that minimizes oversight organization interference in program execution. Inappropriate interference by oversight organizations with established program management procedures can reduce the efficiency and effectiveness of R&D management. There is a distinction here between appropriate policy guidance and oversight functions, and micromanagement by external organizations.

Good R&D management also enables stakeholders to provide feedback to program managers in order to improve overall policies, objectives, processes, and resource allocation among program areas. The feedback process should be at least partially internal to the program.

Knowledge Base

A successful contractual R&D management organization requires a high-quality team of managers and staff. The organization's knowledge base – its ability to provide technical assessments of proposals and provide technical oversight of projects – resides in its staff. High-quality staff are drawn to the organization by its mission, its leader, and an operating environment in which they can be assured of the responsibility, authority and resources to perform effectively.

The leader of a superior organization should engage the most talented, knowledgeable, and experienced managers who possess the diversity to address a spectrum of challenges. Superior performance requires good content knowledge, recognized by peers. High-quality information on the technologies and disciplines involved in the programs should flow quickly and directly to the work groups.

Appendix C: Abbreviations and Acronyms

SYMBOL	DEFINITION
CCST	California Council on Science and Technology
CEC	California Energy Commission
DGS	Department of General Services
DOE	Department of Energy
EAP	Energy Action Plan
EIA	Energy Information Administration
EISG	Energy Innovations Small Grant Program
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
GRI	Gas Research Institute
IEPR	Integrated Energy Policy Report
JPA	Joint Powers Authority
NRDC	National Resources Defense Council
NYSERDA	New York State Energy Research and Development Authority
PG&E	Pacific Gas & Electric Company
PIER	Public Interest Energy Research
R&D	Research & Development (this can often include demonstration)
RFP	Request for Proposal
RPS	Renewable Portfolio Standard
UC	University of California

Appendix D: Biographies

PIER Independent Review Panel Members
Short Biographies

Carl J. Weinberg, Chair

Carl Weinberg is the principal of Weinberg Associates, which he founded in 1993 after 19 years with the Pacific Gas and Electric Company (PG&E) where he effectively managed and grew an internationally respected energy research and development program. Weinberg Associates was formed with the primary objective of accelerating the introduction of renewable and distributed power systems.

Prior to joining PG&E in 1974, he spent 21 years in the United States Air Force. He received a B.S. and M.S. degree in civil engineering from the University of California, Berkeley and a M.S. in physics from Vanderbilt University. He is a registered civil engineer and a member of the California Civil Engineering Honor Society XE, the Engineering Honor Society, the Research Honor Society ΣX, Cal Club, and the University of California Order of the Golden Bear.

Linda R. Cohen, Vice-chair

Linda Cohen is professor for the Department of Economics at the University of California, Irvine, and the 2003-2004 Gilbert White Fellow, Resources for the Future. She received an A.B. from the University of California, Berkeley in mathematics and, in 1979, a Ph.D. from the California Institute of Technology in social sciences. Her fields of study are political economy, government regulation, government policy for science and technology, and positive political theory and law.

Cohen has held positions at the Brookings Institution, the Kennedy School of Government, Harvard University, and the Rand Corporation. She was the 1998 Olin Visiting Professor in Law and Economics, University of Southern California Law School and is a member of the Irvine Research Unit in Mathematical Behavioral Sciences at the University of California, Irvine.

Robert P. (Chris) Caren

Chris Caren is the retired corporate vice president of Science and Engineering of the Lockheed Corporation, where his career spanned over 30 years. Among the positions he held at Lockheed were research scientist, laboratory director, chief engineer (Space Systems), program manager, director of the Palo Alto Research Laboratory, vice president and general manager of the Research and Development Division, and finally the corporate CTO position. He has carried out research in energy systems, low temperature technology, heat transfer, and plasma technology. Caren holds B.S., M.S. and Ph.D. degrees in physics from Ohio State University. He is a fellow of the American Association for the Advancement of Science, the American Astronomical Society, the American Institute of Aeronautics and Astronautics, and the Society of Automotive Engineers. He is also a member of the National Academy of Engineering.

Caren is founder and member of the Board of Directors of Litex Inc., a company involved in automotive emission reduction systems. He is past chairman of Hawkeye Enterprises, a company that was involved in the upgrade of natural gas. He is also a member of the Board of Directors of Superconductor Technologies Inc. a company producing high-end telecommunication products.

T. Kenneth Fowler

Ken Fowler is professor emeritus, Department of Nuclear Engineering at the University of California, Berkeley. Fowler was chair of the Department from 1988 to 1994 and helped establish the multi-disciplinary Center for Nuclear and Toxic Waste Management at the University of California, Berkeley. His honors and awards include elected membership in the National Academy of Sciences; Fusion Power Associates Distinguished Career Award, 1995; and The Berkeley Citation, 1995. He was a member of the 1999-2001 review panel for California's Public Interest Energy Research Program.

His areas of interest include energy research funding and the appropriate role of government in anticipating problems of energy-associated pollution and energy-associated competition for resources in its research funding policies. He also focuses on issues of public trust and confidence in institutions, especially as they relate to energy companies and energy-related governmental laboratories and agencies.

Harold M. (Hub) Hubbard

Harold Hubbard's particular interests are in the areas of research and development management; energy technologies; sustainable development; and public policy relating to science, engineering and technical systems. After receiving a Ph.D. in chemistry with a minor in chemical engineering from the University of Kansas, Hubbard joined Dupont's Atomic Energy Division. He was assigned first to Argonne National Laboratory and later transferred to the Dupont Explosive Department's Experimental Station Laboratory. When he resigned to accept a position at Midwest Research Institute (MRI) after 18 years as a member of the Dupont research staff, Hubbard was a research manager at Dupont's Eastern Laboratory.

In 1970, he joined the MRI as director of Physical Sciences. Hubbard was appointed executive vice president of MRI in 1981 and then transferred to Colorado to become the executive director and CEO of the Solar Energy Research Institute (SERI) from 1982 to 1990. In 1991, after spending a year in Washington, D.C., as a visiting Senior Fellow at Resources for the Future, he was appointed the Spark M. Matsunaga Distinguished Fellow in Energy and Environment at the University of Hawaii at Manna.

Alan C. Lloyd

Alan Lloyd was appointed as chairman to the California Air Resources Board by Governor Gray Davis in February 1999. Lloyd earned both his B.S. in chemistry and Ph.D. in gas kinetics at the University College of Wales, Aberystwyth, U.K.

Lloyd most recently served as the executive director of the Energy and Environmental Engineering Center for the Desert Research Institute at the University and Community College System of Nevada, Reno. Previously, he was the chief scientist at the South Coast Air Quality Management District from 1988 to 1996, where he managed the Technology Advancement office that funded public-private partnerships to stimulate advanced technologies and cleaner fuels.

Johnetta MacCalla

Johnetta MacCalla is chief executive officer of ASCI, Automated Switching and Controls, Inc., a high-tech company serving the public sector, especially the transportation industry. Her specialties include system design, development and installation of communication and control systems using fiber optics, wireless radio and networked cables as well as control signaling and robotic systems. She is the publisher of over 17 papers on communications and control.

MacCalla was a Hughes Doctoral Fellow and the recipient of a Bell Labs Fellowship. She is a former council member of the California Council on Science and Technology. She is a graduate of the University of Southern California, Stanford University and Brown University. She has been project manager for many high-tech projects including BART, Port of Los Angeles, TRW, NASA, and the U.S. Military.

William J. McLean

William McLean is director of the Combustion Research Facility at Sandia National Laboratories. He is also responsible, under Sandia's Energy and Critical Infrastructure Strategic Business Unit, for overall program management of Sandia's Energy Efficiency research programs. He maintains close association with the U.S. Department of Energy research programs sponsored by the DOE Office of Science and DOE Office of Energy Efficiency and Renewable Energy.

McLean received his undergraduate and graduate education in mechanical engineering at the University of California, Berkeley and was associate professor of Mechanical Engineering at Cornell University before joining Sandia 25 years ago. In the past his research has involved coal combustion, flame chemistry, engine combustion and alternative fuels.

Peter M. Miller

Peter M. Miller is a scientist with the Natural Resources Defense Council, Inc., a nonprofit national environmental organization. He is part of NRDC's energy project, which promotes the increased development of energy efficiency and other environmentally sound and cost-effective energy resources. His work involves research, analysis, and advocacy at the state, national, and international levels. He has participated in utility advisory committees in California, Hawaii, and the Pacific Northwest, in numerous proceedings before the California Energy Commission, the California Public Utilities Commission and the Northwest Power Planning Council, and in rulemakings before the U.S. Department of Energy. He was appointed to the California Board for Energy Efficiency in April 1997.

Maxine L. Savitz

Maxine Savitz retired from Honeywell, Inc., where she was general manager, Technology Partnerships. She has over 30 years of experience managing research, development and implementation programs for the public and private sectors. Savitz joined Honeywell, previously AlliedSignal, in 1985. From 1987 until June 2000, she was the general manager of AlliedSignal Ceramics Components, which is the only U.S. owned silicon nitride structural ceramic manufacturer for gas turbine application. In this capacity, she oversaw the development and manufacturing of innovative materials for the aerospace, transportation, and industrial sectors. Prior to joining Honeywell, she was employed at the U.S. Department of Energy and its predecessor agencies. From 1979 to 1983, she served in the capacity of deputy assistant secretary for conservation at DOE.

Her areas of interest include energy efficiency (buildings, industry, transportation) R&D, policies and programs, distributed energy resources, gas turbines, microturbines, and fuel cells and high temperature materials and application.

Jananne Sharpless

Jananne Sharpless was appointed to the California Energy Commission in January 1994 and was a member through 1999. By law, the five members of the Commission have professional training and background in specific areas - engineering and physical science, environmental protection, economics, law and one commissioner from the public at large. Sharpless filled the environmentalist position. She graduated from the University of California, Davis with a B.A. degree in political science.

She has served on the United States Environmental Protection Agency Clean Air Act Advisory Committee; Federal Fleet Conversion Task Force; chairwoman 1990 United California State Employees Campaign; and chairwoman (1986-1987) Alternative Fuels and Vehicles Review Task Force (AB 234). From 1985-1993, Sharpless was both secretary of Environmental Affairs and chairwoman of the California Air Resources Board (1991 to 1993). She was also the chief deputy secretary of the Environmental Affairs Agency (1983-1985).

Esteban Soriano

Esteban Soriano has served as a faculty member, program director, executive director, and vice president of universities and colleges. He recently joined the University of California, Merced and serves as vice chancellor for University Advancement. In his professional career, he has been awarded designation as Ford Fellow, National Research Fellow, Fulbright Scholar, and J. H. Sanders Marketing Fellow. Soriano's disciplines are communication and market research.

Eleven years ago, Soriano left a senior administrative position at the University of California, Riverside to begin his own market research and program assessment company. That firm, The Resource Group, soon became one of the most relied upon research and assessment companies in California (specializing in educational and economic assessments). He has served three U.S. Presidents on national boards and commissions: the national task force looking at the communication needs of rural America (Carter); the Teacher in Space Selection Panel (Reagan); and the National Skill Standards Board (Clinton).

Arnold M. Sowell, Jr.

Arnold M. Sowell, Jr. is a former deputy secretary of policy and planning for the State and Consumer Services Agency. He is currently with the office of Assemblymember Fabian Nuñez. Sowell has served as an advisor to the California Waste Board for the last five years. During that time, he also served as an advisor to the California Waste Board chairman. Sowell has had an extensive career in state and local government having served in various positions. They include: senior consultant to then-Speaker Willie Brown; principal fiscal analyst to San Francisco City Controller Edward Harrington; assistant to former Mayor Art Agnos of San Francisco; and senior fiscal and policy analyst in the Legislative Analyst's Office. He earned a bachelor of science degree from Oregon State University and a master of public administration degree from the University of Washington.

James L. Sweeney

James L. Sweeney, of Stanford University, is professor of Management Science and Engineering, Senior Fellow of the Stanford Institute for Economic Policy Research, and senior fellow (by courtesy) of the Hoover Institution on War, Revolution and Peace. His professional activities focus on economic policy and analysis, particularly in energy, natural resources, and the environment. He holds a B.S. degree from Massachussetts Institute of Technology in electrical engineering and a Ph.D. from Stanford University in engineering-economic systems.

At Stanford, he has served as chairman of the Department of Engineering-Economic Systems and Operations Research, director of the Energy Modeling Forum, chairman of the Institute for Energy Studies, and director of the Center for Economic Policy Research (now the Stanford Institute for Economic Policy Research). He currently is on the executive committee of the Interdisciplinary Program in Environment and Resources, on the faculty advisory committee of the Earth Systems Program, and part of the Global Climate and Energy Program.

Irvin L. (Jack) White

Irvin White has over 30 years public and private sector management and leadership experience in energy, environment, science and technology policy, research and development management, and relationship management. He recently retired for the fifth time—this time from his position as executive director of the Association of State Energy Research and Technology Transfer Institutions, an organization of state energy research and development organizations he co-founded in 1990.

He was managing partner of The Winslow Group, a management-consulting firm that specialized in enterprise development and management. Prior to co-founding The Winslow Group, he was the senior director for Energy Programs at Pacific Northwest National Laboratories. From 1981 to 1991, White was the president of the New York State Energy Research and Development Authority. White has also served as the assistant director for Energy and Minerals in the Bureau of Land Management, Department of the Interior, and acting director for Exploratory Research at the U.S. Environmental Protection Agency. Before entering the federal service, he was a member of the faculties of the Universities of Oklahoma and Arizona and Purdue University. At Oklahoma, he was co-founder and assistant director of the Science and Public Policy Program, one of the most successful programs of its kind in the country.

Matrix of IRP Members' Competencies

Panel members were chosen based on an assessment of the required capabilities needed on the IRP. Table A.1 shows the match between needed capabilities and IRP member competencies.

Table D.1 Matrix of IRP Member Competencies

	Academic	Industry	Public Interest
Technology – Issues in R&D for Energy and Other Technologies	Soriano	Caren MacCalla Savitz Weinberg	
Economics/Markets – Market Impacts of Technologies, Economics of Energy	Cohen Sweeney		
General Energy and Energy Alternatives	Fowler	Hubbard McLean White	
Public Health and Environmental Impacts			Miller Sowell
State Government Policies – Contracting and Civil Service			Lloyd Sharpless

CCST PIER Review Committee Members
Short Biographies

Richard E. Balzhiser – 2003 Chair

Richard E. Balzhiser retired as president and chief executive officer of the Electric Power Research Institute (EPRI) in August 1996. He remains active in a president emeritus role at EPRI in addition to serving on the boards of Reliant Energy, Aerospace, Electrosource, and Nexant. Balzhiser joined EPRI in 1973 at the time of its founding as director of the Fossil Fuel and Advanced Systems Division. He became vice president of Research and Development in 1979 and executive vice president in 1987 before assuming the presidency in 1988.

Prior to joining EPRI, he served in the White House Office of Science and Technology as assistant director for Energy, Environment and National Resources, 1971-1973. He was professor of Chemical Engineering from 1960-70 except for 1967-68 when he served as a White House Fellow in the Office of the Secretary of Defense. He was twice elected to serve on the Ann Arbor City Council. Balzhiser received his B.S. and Ph.D. degrees in chemical engineering and his M.S. in nuclear engineering from the University of Michigan and was an Academic All American on Michigan's 1953 football team.

Miriam John – 2004 Chair

Miriam John is currently vice president of Sandia's California Division. Prior to her current position, John served as the director of the Center for Exploratory Systems and Development and in a number of managerial and technical roles for the laboratory, including nuclear weapons development, systems analysis, and thermal analysis/fluid mechanics R&D. John received a B.S. in chemistry from Rice University, an M.S. in chemical engineering from Tulane University, and a Ph.D. in chemical engineering from Princeton University.

Concurrent with her Sandia assignments, John has been recruited for a number of defense community efforts. She is a member of the Department of Defense's Threat Reduction Advisory Committee (for which she chairs the Nuclear Deterrent Transformation Panel), the National Research Council's Naval Studies Board and Board on Army Science and Technology. She is a recent past member of the Air Force Scientific Advisory Board and DOE's National Commission on Science and Security. She is a National Associate of the National Academies of Science and Engineering.

Lawrence B. Coleman

Lawrence B. Coleman is the University of California vice provost for Research and professor of Physics at the University of California, Davis. He served as chair of the University-wide Academic Senate in the 1999-2000 academic year following a year as vice chair of the University of California Senate. Arriving at Davis in 1976, he was promoted to associate professor in 1982. While at the University of California, Davis he has held the positions of chair, Davis Division of the Academic Senate, 1995-1997; director, The Internship and Career Center, 1988-1994; acting vice provost, Academic Programs and dean, Undergraduate Studies, 1991-1992; and acting associate vice chancellor, Academic Programs, 1990-1991.

Lawrence Coleman received a Ph.D. from the University of Pennsylvania in 1975 in experimental condensed matter physics. He received a B.A. in physics from The Johns Hopkins University in 1970.

Susan Hackwood

Susan Hackwood is currently professor of Electrical Engineering at the University of California, Riverside and executive director of the California Council on Science and Technology. Hackwood received a Ph.D. in solid state ionics in 1979 from DeMontfort University, UK. Before joining academia, she was department head of Device Robotics Technology Research at AT&T Bell Labs. In 1984 she joined the University of California, Santa Barbara as professor of electrical and computer engineering and was founder and director of the National Science Foundation Engineering Research Center for Robotic Systems in Microelectronics. In 1990, Hackwood became the founding dean of the Bourns College of Engineering at the University of California, Riverside.

G. Scott Hubbard

Scott Hubbard serves as director of NASA's Ames Research Center in the heart of California's Silicon Valley. Prior to his appointment, Hubbard was the deputy director for Research at Ames. In March of 2000, Hubbard was called to NASA Headquarters, where he served as the first Mars program director and successfully restructured the entire Mars Program in the wake of mission failures.

Some of Hubbard's previous key roles include Ames associate director for Astrobiology and Space Programs; first director of NASA's Astrobiology Institute, and manager of the Lunar Prospector Mission. He is also credited with creating the Mars Pathfinder Mission. Prior to coming to Ames in 1987, Hubbard was vice president and general manager of Canberra Semiconductor and a staff scientist at Lawrence Berkeley National Laboratory. Hubbard received a B.A. in physics and astronomy from Vanderbilt University and conducted graduate studies in semiconductor physics at the University of California, Berkeley.

John P. McTague

John P. McTague is currently professor of Materials for the University of California, Santa Barbara. He is the past vice president, Laboratory Management at the University of California, Office of the President. A physical chemist, McTague received his undergraduate degree with honors in chemistry from Georgetown University in 1960 and his Ph.D. from Brown University in 1965. Brown also bestowed on him an honorary Sc.D. in 1997.

McTague was founding co-chair of the Department of Energy National Laboratory Operations Board and a member of the Secretary of Energy Advisory Board from its inception in 1990 through 2000. In January 1999, he retired from Ford Motor Company, where he served more than 12 years, first as vice president of Research and then as vice president of Technical Affairs. Prior to 1986 McTague served as deputy director and acting director of the White House Office of Science and Technology Policy, and was acting science advisor to President Reagan. During the Bush administration he was a member of the President's Council of Advisors on Science and Technology and U.S. Chair of the U.S.-Japan High Level Advisory Panel on Science and Technology.

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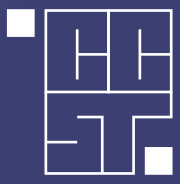

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