

CALIFORNIA
ENERGY
COMMISSION

**PUBLIC INTEREST ENERGY RESEARCH
(PIER) PROGRAM 2007 ANNUAL REPORT**

COMMISSION REPORT

April 2008
CEC-500-2008-026-CMF



Arnold Schwarzenegger, Governor

CALIFORNIA ENERGY COMMISSION

Jackalyne Pfannenstiel
Chairman

James D. Boyd
Vice Chair

Commissioners:

Arthur H. Rosenfeld, Ph.D.
Jeffrey Byron
Karen Douglas, J.D.

Melissa Jones
Executive Director

Thom Kelly, Ph.D.
Deputy Director
**ENERGY RESEARCH AND
DEVELOPMENT DIVISION**

Martha Krebs, Ph.D.
PIER Program Director

DISCLAIMER

This report was prepared by a California Energy Commission staff person. It does not necessarily represent the views of the Energy Commission, its employees, or the State of California. The Energy Commission, the State of California, its employees, contractors and subcontractors make no warrant, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the California Energy Commission nor has the California Energy Commission passed upon the accuracy or adequacy of the information in this report.

Acknowledgments

The *2007 PIER Annual Report* was prepared with contributions from the following staff:

Energy Research and Development Division

Jennifer Allen
Kelly Birkenshaw
Norm Bourassa
Mary Jane Coombs
Bert Fegg
Guido Franco
Sandra Fromm
Jesse Gage
Mike Gravely
Myoung-Ae Jones
Linda Kelly
Pramrod Kulkarni
Nancy Libonati
Daryl Mills
Philip Misemer
Joe O'Hagan
Jamie Patterson
Chris Scruton
Michael Seaman
Prab Sethi
Art Soinski
Linda Spiegel
Valentino Tiangco
Allan Ward

Media and Public Communications

Susanne Garfield
Adam Gottlieb
Carol Robinson

Abstract

The Public Interest Energy Research (PIER) Program was created in 1996 when the state Legislature enacted Assembly Bill 1890 (Brulte, Chapter 854, Statutes of 1996), California's electric utility restructuring legislation. This law required that funds be collected annually from the three investor-owned electric utilities and deposited in the Public Interest Energy Research and Development Account, to be invested by the Energy Commission in public interest energy-related research, development, and demonstration (RD&D). Passage of this law shifted administration of public interest RD&D from California's investor-owned utilities to state government—a major change intended to ensure the continuation of public interest energy RD&D.

The Energy Commission's 2007 Public Interest Energy Research (PIER) Annual report is prepared pursuant to Public Resources Code Section 25620.8. This report covers projects funded in the period from January 1, 2007, through December 31, 2007. The Energy Commission's Research, Development, and Demonstration Division has supported public interest energy research, development, and demonstration for renewable energy resources, advanced electricity generation, transmission and distribution, transportation, energy efficiency and demand response, and climate science. This latest annual report highlights recently funded research, completed projects, and current activities.

Table of Contents

- Abstract..... ii
- CHAPTER 1: Introduction 1
- CHAPTER 2: Recent Changes in Program Emphasis 2
 - New Transportation Research 3
 - Energy Efficiency Emphasis 4
 - New Natural Gas Research 4
- CHAPTER 3: Research, Development and Demonstration Investments in 2007 5
 - Advanced Transportation Technologies 5
 - Energy Efficiency and Demand Response..... 6
 - Efficiency 6
 - Demand Response 6
 - Advanced Generation 7
 - Renewable Resources 7
 - Transmission and Distribution 8
 - Transmission 8
 - Distribution 9
 - Climate Science and Energy 10
 - Program Administration 10
- CHAPTER 4: Ensuring RD&D Benefits..... 11
 - Policy Initiatives..... 11
 - New Advisory Board 11
 - Program Implementation: Strategic Partnerships..... 12
 - Land Use Planning..... 12
 - Green Buildings..... 12
 - Smart Grids 13
 - Carbon Sequestration..... 13
 - Emerging Technology Coordinating Council (ETCC)..... 14
 - Climate Change 15
 - Economic Benefits to California 15
 - Looking Forward—New Benefits Evaluation of PIER Activities 16
- CHAPTER 5: Accomplishments for 2007 17
- APPENDIX—2007 Individual Projects A-1

CHAPTER 1: Introduction

The California Energy Commission administers a total of \$80.5 million Public Interest Energy Research (PIER) Program annually—62.5 million for electricity and \$18 million for natural gas research, development, and demonstration projects. The Energy Commission prepares and submits to the Legislature (Public Resources Code Section 25620.8) an annual report containing the awards made; progress toward achieving research and development portfolio goals; the names of award recipients; the types and actual costs of programs or projects funded; an evaluation of the success of funded projects, costs and benefits; and recommendations for program improvements.

During 2007, Energy Commission oversight and detailed policy direction for the PIER research, development, and demonstration program was provided by the Energy Commission's Research, Development, and Demonstration Committee. The Committee annually conducts a budget review of the PIER program in the spring before the beginning of each fiscal year, examines the status and progress of existing investments, and establishes initial target investment levels for the PIER program areas for the coming fiscal year, consistent with energy policy priorities. These allocations are based on executive orders, state legislation such as Senate Bill 1250 (Perata, Chapter 512, Statutes of 2006), the Energy Commission's Integrated Energy Policy Reports (IEPR), and interagency cooperation and coordination. Throughout the year, the Energy Commission staff carries out program and project development activities within the established budget allocations, using a combination of competitive solicitations, interagency agreements, and sole source contracts to implement the RD&D priorities.

This report describes RD&D activities and accomplishments funded through the Public Interest Research, Development, and Demonstration Fund. Chapter 2 summarizes the funding allocated to the major research areas in 2007, compares them to allocations made in recent years, notes major changes in allocations and describes the reasons for them, and provides information about natural gas research not evident in the pie charts. Chapter 3 describes the program areas and the types of research used to implement California's energy policy, explains their place in the research portfolio, and highlights projects funded in 2007. Chapter 4 discusses continuous implementation, improvement, and benefits measurement steps that affect all research program areas and guide individual public interest energy research funding decisions. Chapter 5 provides an abbreviated list of the PIER Program's RD&D accomplishments in 2007. Finally, an appendix contains a detailed listing of all 2007 contracts that were summarized in the main report¹.

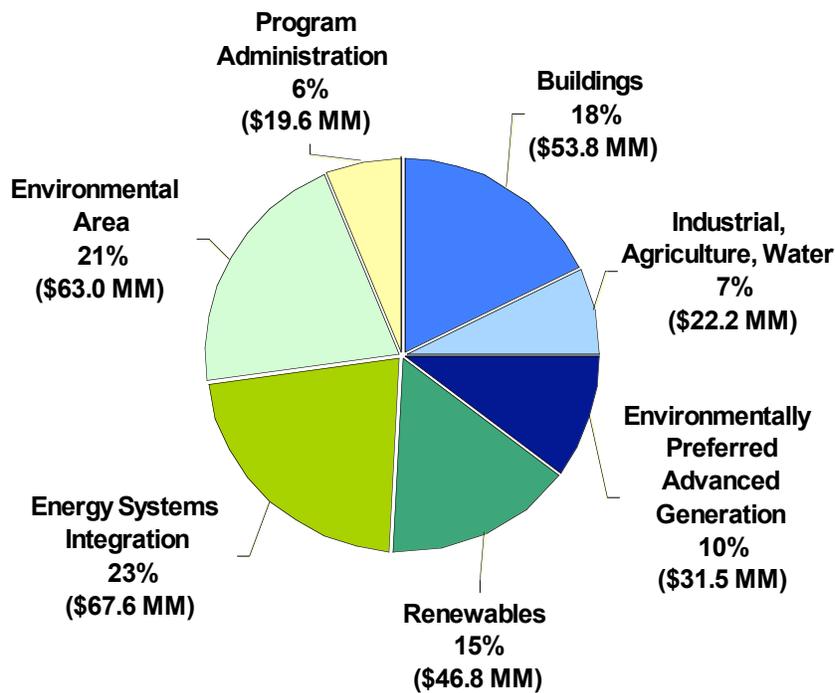
¹ A complete listing of the PIER portfolio can be viewed at the Energy Commission's website at <http://www.energy.ca.gov/pier/descriptions>.

CHAPTER 2: Recent Changes in Program Emphasis

The PIER program implements RD&D activities and advanced science not adequately advanced and commercialized by competitive and regulated markets.

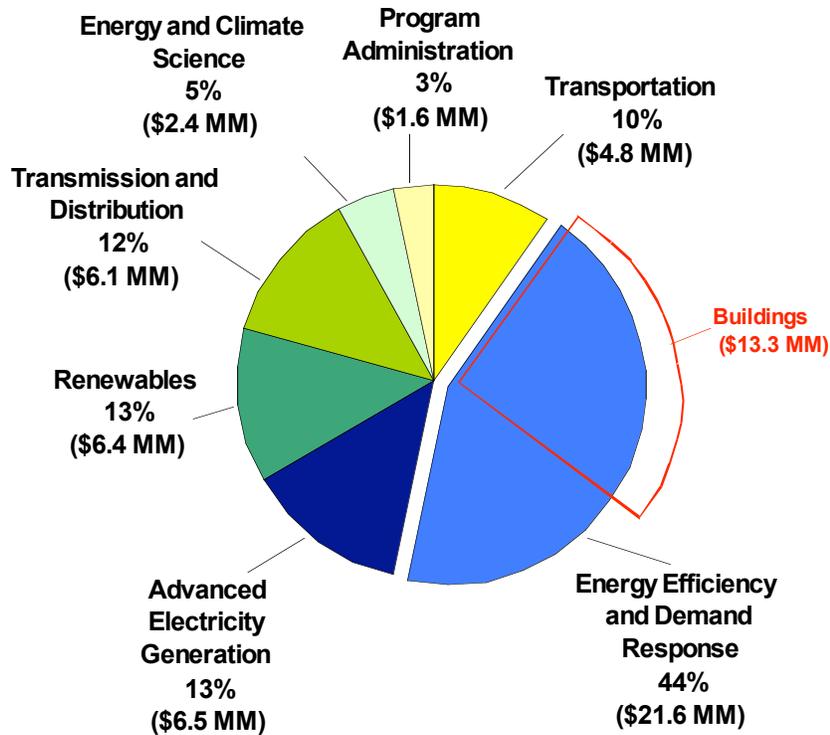
Prior to 2007, the Energy Commission organized its research in seven program areas (Figure 1). This program area research structure included buildings, industrial, agriculture and water, advanced electricity generation, renewables, energy systems integration, environmental area, and program administration across all program areas.

Figure 1. Past Projects by Program Area (2002-2006)
5-year Total = \$304.5 million (MM)



Senate Bill 1250 directs the Energy Commission to meet new research investment goals, while performing a full range of research not supported by competitive markets. Responding to this legislative direction, the Energy Commission created a new research and reporting structure, comprised of transportation, energy efficiency and demand response, advanced electricity generation, renewables, transmission and distribution, energy and climate science, and program administration (Figure 2).

Figure 2. Projects Initiated in 2007
Total \$49.4 million (MM)



During 2007, from January 1 through December 31, the Energy Commission approved \$49.4 million in energy RD&D projects. An additional \$17.6 million was encumbered, but is not included in Figure 2 because it will not result in project contracts until 2008. The remaining \$13.4 million of the \$80.5 million budgeted will be allocated to the new portfolio categories over the next two years.² Important differences in allocations compared to previous years include the new transportation research category; a stronger emphasis on energy efficiency and demand response; and inclusion of natural gas research funding throughout all the categories.

New Transportation Research

The Energy Commission awarded \$4.8 million for PIER transportation research during the year. Use of public interest research investments in transportation were first authorized by Senate Bill 76 (Chapter 91, Statutes of 2005), which directed development of alternative fuels and vehicle efficiency technologies to benefit electric and natural gas ratepayers. Senate Bill 1250 subsequently sharpened the Energy Commission’s research focus and added transportation research to its priorities. Both laws require the Energy Commission to coordinate with the California Air Resources Board (ARB) on new transportation RD&D efforts.

Additionally, the passage of Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Alternative and Renewable Fuel and Vehicle Technology Program, also requiring Energy Commission collaboration with ARB to address transportation-related greenhouse gas emissions.

² The Commission is authorized to encumber funds over a two year period.

AB 118 implements the State Alternative Fuels Plan created under AB 1007 (Pavley, Chapter 371, Statutes of 2005) and emphasizes the commercialization of new alternative fuel and advanced vehicle efficiency technologies, with a particular focus on fuels that lead to sustainable feedstocks. Funding for AB 118 includes an annual \$10 million transfer from the existing PIER account to the Alternative and Renewable Fuel and Vehicle Technology Fund. The Energy Commission is coordinating its PIER transportation program with the new alternative and renewable fuel and vehicle technology program as it implements AB 118.

Energy Efficiency Emphasis

Responding to Senate Bill 1250, the PIER Program encourages and advances science, technology, and knowledge that will directly lead to the development and use of new commercial products and services in the state. Energy efficiency remains the state's electricity resource of first choice. Reducing water consumption is an energy-saving measure.

As noted in the 2007 IEPR, state energy efficiency initiatives, programs and standards have helped California maintain a flat rate of electricity consumption per capita for the last 30 years (2007 *Integrated Energy Policy Report*, p. ES-2). Today, aggressive energy-efficiency upgrades are essential to achieving a lower-cost energy future and will help California achieve the California Global Warming Solutions Act of 2006 (Assembly Bill 32, Núñez, Chapter 488, Statutes of 2006) goal of reducing greenhouse gas emissions to 1990 levels by 2020. The allocation of 44 percent of the contract funding in 2007 to the energy-efficiency area reflects the interaction of research efforts in buildings, industry, agriculture, water, and demand response, and it demonstrates the Energy Commission's commitment to achieve additional energy efficiency.

New Natural Gas Research

Natural gas technology has become a major new area of energy RD&D focus. Although much of the early PIER research focused on electricity-related applications, the Energy Commission has expanded its natural gas public interest RD&D efforts consistent with changes in new laws and regulation. For example, Assembly Bill 1002 (Wright, Chapter 932, Statutes of 2000) requires a ratepayer surcharge on all natural gas consumption in the state, to be appropriated to the California Public Utilities Commission (CPUC) for low-income and public-purpose programs such as energy efficiency and public interest research and development.

In August 2004, the CPUC adopted Decision 04-08-010, establishing the funding level and administrator's responsibilities for natural gas public interest RD&D and identified the Energy Commission as the administrator of the natural gas funds. The 2007–2011 *Natural Gas Research Investment Plan*³ captures the synergies between natural gas and electricity RD&D and outlines the PIER Natural Gas Program's strategic priorities.

Consistent with this plan, the Energy Commission awarded \$6.6 million for natural gas research projects in 2007. The contracts for natural gas research do not appear as a separate item in Figure 2, but are incorporated and reported in their primary research categories. For example, the \$4.5 million awarded in the transmission and distribution research category includes \$1.6 million for natural gas transmission, storage, and distribution.

³ State of California, California Energy Commission, 2007-2011 *Natural Gas Investment Plan*, Sacramento, CA 2007.

CHAPTER 3: Research, Development and Demonstration Investments in 2007

The Energy Commission, through PIER, takes a portfolio approach to RD&D. This approach provides tangible energy and environmental benefits to the state's electricity and natural gas customers, increases diversity and reduces risks when developing new solutions to California's energy challenges, spans near-term, mid-term, and long-term planning horizons, and attempts to manage risks and rewards of RD&D investments by taking a holistic and integrated approach.

The following seven research categories comprise the PIER technology research program portfolio. They are listed and discussed in the same clockwise order as Figure 2.

- Transportation (\$4.8 million)
- Energy efficiency and demand response (\$21.6 million)
- Advanced electricity generation (\$6.5 million)
- Renewable resources (\$6.4 million)
- Transmission and distribution (\$6.1 million)
- Energy and climate science (\$2.4 million)
- Program administration (\$1.6 million)

The funded projects within each area reflect state energy policy. The following discussions explain each area's place in the energy research portfolio, describe its research intent, and highlight projects funded during 2007.

Advanced Transportation Technologies

Transportation is the single largest energy-consuming sector of the state's economy. Approximately 98 percent of the energy used in this sector comes from petroleum, and of that, 40 percent comes from imports of crude oil and oil products. Transportation is also the single largest emitter of greenhouse gases in California, therefore reducing greenhouse gases in the transportation sector is essential to achieving AB 32 goals.

The Energy Commission's transportation research investments—over \$4.8 million, 10 percent of all awards in 2007—are intended to advance science or technology in three areas: alternative and conventional fuels, vehicles, and land use. Alternative fuels research aims to reduce costs and increase availability of "upstream" resources, find more-efficient, less-polluting energy conversion methods, and improve the efficiency and safety of alternative fueling infrastructure. Vehicle research concentrates on improving efficiency and deploying alternative fuel vehicles. Land use research will develop better tools and methods to offer better choices for reducing personal vehicle use.

Transportation research investments in 2007 focused on vehicle technologies and alternative fuels:

- A research center for plug-in hybrid electric vehicles was established at the Institute for Transportation Studies at University of California, Davis.
- The Energy Commission co-planned and funded five projects with the California Air Resources Board (ARB) that will reduce emissions and improve efficiency of natural gas vehicles, and determine the effects of biodiesel on heavy duty engine efficiency and emissions.

Energy Efficiency and Demand Response

Energy efficiency and demand response research has been a mainstay of the PIER program from its inception.⁴ SB 1250 and AB 32 have reinforced the importance of new energy efficiency and demand response research by establishing a new emphasis on market penetration of technologies. The Energy Commission is investing in new technologies, tools, and methods to further boost the cost effectiveness of energy efficiency products by supporting an integrated portfolio of research projects that address energy efficiency and demand response needs in the commercial, residential, industrial, agricultural, and water supply sectors. Forty-four percent (\$21.6 million) of PIER research funding in 2007 was allocated to energy efficiency and demand response technology development. Of the total \$21.6 million, over sixty percent (\$13.3 million) of this funding was used for energy efficiency technology research, with the remainder funding end-user demand response technology.

Efficiency

Energy Commission energy efficiency research follows the new directions in SB 1250 and new urgency for action reflected in AB 32 by shifting the energy efficiency research portfolio emphasis toward efforts that lead to near-term market results. Allocations for the 2007 PIER budget reflect this emphasis for energy-efficiency research and commit PIER to bridging the gap that exists between a newly developed technology and its market deployment and acceptance. The following projects funded in 2007 assist in near-term market entry of technology products:

- Enhancing **EnergyPlus** building energy simulation software to help bring under-floor air distribution systems to market.
- Demonstrating the **Personal Office Lighting system** and **Pedestrian Walkway Lighting System** using light-emitting diodes (LEDs).
- Demonstrating near-term industrial technologies that support the CPUC's big bold energy-efficiency strategies:
 - fanless cooling systems and direct current servers in data centers;
 - high-efficiency freezing methods for refrigerated warehouses;
 - high-capacity, long-life battery storage for peak load modulation; and
 - efficient sludge dewatering systems.

Demand Response

California's electricity grid is stressed from continuous growth in peak electricity demand. "Demand response" tools—using technologies that notify customers when energy prices are high or when there is a system emergency so that they can elect to reduce load—are emerging as a powerful consumer-oriented means to: reduce the need to construct traditional fossil-fueled power plants; help grid managers avoid electricity outages; and reduce reliance on existing polluting, expensive fossil-fuel peaking units. The following examples illustrate some of the demand response technologies funded in 2007:

- Development and testing of **Automated Demand Response** (Auto-DR), an open, interoperable signaling communication and technology platform designed to provide commercial customers with automated electronic price and reliability signals, and the capability to automate their own DR strategies.
- Development and testing of demand response with the California Independent Systems Operator (California ISO).

⁴ The Energy Commission believes that California can gain even more savings from the building stock using RD&D to increase efficiency technologies and techniques. One example of RD&D that is proven to be effective in helping achieve savings is the Commission's Building and Appliance Efficiency Standards. Building standards are estimated to save approximately 10,000 gigawatt hours per year (GWh/yr); state Appliance Standards provide an additional 12,000 GWh/yr of energy savings.

- Development of micro-electronic technologies such as energy scavenging, energy storage conversion, sensors, and micro-radios to significantly decrease the cost and increase the functionality of future energy meters, thermostats, and other devices.
- Research and testing of wireless technologies that can communicate through walls and floors of buildings, to improve the receipt of electronic signals through various construction materials.

Advanced Generation

The 2007 *Integrated Energy Policy Report* recommends expanding reliance on new distributed generation (DG) resources, which can produce electricity onsite, and use natural gas to generate electricity more efficiently.⁵ The focus of the PIER advanced generation program is fossil-fueled DG systems interconnected to the utility distribution system.⁶ In 2007, \$6.5 million in contracts was awarded for advanced generation research.

A well-designed and well-operated type of DG system—often referred to as *combined heat and power* (CHP) or *combined cooling, heating, and power* (CCHP), which uses the waste heat from the electricity generation—can improve reliability of the electric utility grid at low cost. It can also achieve efficiencies as high as 80 percent—well above those of the newest natural gas combined-cycle power plant and without a power plant’s line losses due to long-distance transmission. Also, by taking advantage of the waste heat created during industrial processes and reducing transmission and distribution losses, CHP has the potential for greatly minimizing greenhouse gases.⁷ An important focus of this research category is developing analytical techniques for assessing the life-cycle environmental impacts of emerging renewable and DG technologies.

Advanced generation competitive solicitations released in 2007 were for lower cost, lower emissions, and more reliable CHP/CCHP system development and demonstration. New uses of geographic information systems (GIS) could result in analysis of the impact and interaction of biomass, wind, solar, and conventionally fueled DG projects on the electricity grid. The following research products are intended to encourage the integrated planning, siting, and permitting of renewable generation and non-renewable DG and CHP/CCHP:

- Consolidated renewable and non-renewable resource information, including land use, demographic, and economic data, as well as electricity grid and planning information.
- An analytical decision tool to evaluate the practical potential for non-renewable DG in California.

Renewable Resources

Renewable resources are essential for reducing greenhouse gas emissions and reaching AB 32 goals. The state’s energy loading order for new energy resources puts renewable technologies immediately following efficiency and demand response technologies as the preferred resources to meet California’s growing energy needs. Already 11 percent of the electricity delivered to California homes and businesses is obtained from renewable resources. The Renewables Portfolio Standard (RPS) requires 20 percent of the state’s electricity come from renewable sources by 2010; the Governor, the Energy Commission, and the CPUC have endorsed a further enhanced goal of 33

⁵ Goals for advanced generation identified in the 2007 IEPR include eliminating all non-bypassable and standby reservation charges for all DG and CHP/CCHP systems and adopting a DG portfolio standard, so that these clean resources are treated the same as demand-reduction or efficiency resources in regulatory proceedings.

⁶ Stand-alone back-up generators, operating only when the power goes out, are not included in this definition.

⁷ The March 2006 Climate Action Team report estimated nearly 5 million metric tons of CO₂ equivalents per year could be avoided by 2020 through an aggressive deployment of CHP throughout California.

percent by 2020. New second and third generations of renewable energy technology through RD&D will be developed to assist in achieving these goals.

For 2007, PIER expanded its renewable energy portfolio to include more geothermal, solar, wind, and biomass power plants. In 2007, \$6.4 million in contracts was awarded for renewables research.

Four major solicitations were developed and issued for projects that develop and demonstrate renewable energy technologies to increase the technical, economic, and environmental performance of:

- biopower projects that convert California's organic waste streams into electricity,
- solar photovoltaic projects consistent with the California Solar Initiative,
- thermal solar and other renewable energy technologies that displace natural gas, and
- technologies used to produce and optimize the production of geothermal power and heat.

In addition, two new modeling projects to expand energy production from intermittent renewable energy resources were launched:

- The Regional Integration of Renewables Project—managed by Pacific Gas and Electric (PG&E)—is developing a set of transmission planning scenarios that are initially focused and coordinated among Northern California transmission owners and operators.
- The Renewable Resource/Transmission Project—managed by the Center for Renewable and Energy Efficient Technology—will assist the Renewable Energy Transmission Initiative (RETI), a new collaboration among utilities, regulatory agencies and renewable energy developers, in identifying an optimal statewide mix of renewable resources to meet diversity, climate change and generation goals and identifying renewable resource zones that minimize requirements for new transmission capacity.

Transmission and Distribution

SB 1250 specifically identified the importance of RD&D for new transmission infrastructure that will connect utility-scale renewables to the California electricity grid. The 2007 IEPR examined the current status of the California distribution system and encouraged additional RD&D efforts. In 2007, \$6.1 million in contracts was awarded for transmission and distribution research.

PIER transmission and distribution research focuses on improving methods for siting new transmission lines, by ensuring that the electric grid reliability and operational performance level would be maintained following implementation of any proposed updates, changes, and improvements. It also focuses on researching new and emerging technologies that can help increase the amount of renewable resources being used and reduce energy losses.

Transmission

The goal of PIER transmission research is to help California grid operators manage the future electricity grid more efficiently and reliably while accepting a large increase in renewable generation. PIER transmission research is identifying methods and tools to help the California ISO and California utilities better manage California's transmission system.

The most promising research area is the placement and use throughout California of new phasor measurement units. Phasor measurement units can provide the grid's transmission controllers insight into grid stability that is not available otherwise. PIER is also developing displays and tools—for example, using advanced techniques to mathematically integrate and consolidate critical operational data—that present information in an easily usable format so the operators can respond rapidly to changing grid conditions. Additionally, PIER transmission research is developing and testing new intelligent agent technology that can help grid operators respond rapidly when renewable resources have unplanned changes in energy output.

PIER transmission research also includes improving grid load-modeling capabilities to address the unique performance of new energy-efficient residential air conditioners, and minimize the grid impacts of extreme events caused by natural disasters and unexpected system failures. The following new research awarded in 2007 illustrates the program's focus assuring the reliability of the transmission grid:

- Development of an expanded suite of real-time operator and reliability coordinator tools that will allow the system operator to see what is happening in most of the western power grid.
- Research grid protection technologies that will use wide-area phasor measurements to allow rapid and responsive grid control and avoid cascading blackouts.

Distribution

The PIER distribution program supports the management and use of customer resources, including distributed renewable energy, combined heat and power, demand response, energy storage, and reduced greenhouse gas production at the distribution level.

To help ensure continued grid reliability, the distribution research program brought together an interdisciplinary and international team of researchers. This team is testing new scientific approaches based on new micro technologies and sensors to diagnose and establish the remaining life of tens of thousands of miles of underground cable in California. The program is also looking for opportunities to deploy these micro sensors on the distribution system to relay system condition information cheaply and quickly to system operators. These real-world monitors will help ensure that equipment is operating safely and reliably.

Advanced distribution automation technologies (such as sensors, processors, communicators, and switches) can more efficiently control and monitor electrical distribution system operations by providing intelligent monitoring and transferring critical information in real time to system operators. Currently, there is a very limited monitoring of distribution systems, and this is predominantly through radio signals. This automation could be cost-effectively integrated into existing and new systems to increase the distribution system's reliability (decreased duration and frequency of power outages), efficiency (system and energy loss savings), and flexibility (by allowing higher penetrations of DG resources). This research suggests that an increased penetration of DG and advanced distribution automation could create \$312 million per year in benefits for California.

The distribution research program is relatively new, but the development of new inexpensive and reliable diagnostic techniques is a high priority to assure continued system reliability. Distribution research funded in 2007 include new diagnostic techniques that will allow utilities to reliably determine the remaining life of underground distribution cables without interrupting service to customers.

Climate Science and Energy

California's in-state and imported electricity generation currently accounts for 25 percent of California's greenhouse gases, which affect local and global climate. Natural gas consumption from stationary sources contribute approximately one-third of the carbon dioxide (CO₂) emissions from the combustion of fossil fuels in California. The Energy Commission initiated research in 2001 with an exploratory study on the impacts of climate change on major sectors of the economy. This and other studies suggest that climate change is so potentially harmful to the future of energy resources, and could affect energy demand so significantly, that climate change research must be an energy priority. In 2007, \$2.4 million in contracts was awarded for climate science and energy research.

In 2003, the Energy Commission developed a long-term climate change research plan and created the California Climate Change Center, a virtual research institution with diverse climate research activities based at several universities and research institutions throughout California. Its main objective is to develop the tools and information needed to identify: (1) how climate change affects energy supply and demand in California, (2) plausible climate change scenarios for California, (3) how the physical impacts of climate change would affect California's environment and economy, and (4) the merits of different mitigation and adaptation strategies that would particularly effect California energy supply or demand. To address these policy questions, research activities are organized into four areas: climate monitoring, modeling, and analysis; greenhouse gases (GHGs) inventory methods; options to reduce net GHG emissions; and impacts and adaptation studies.

Examples of studies in this program awarded during 2007 include:

- Scripps Institution of Oceanography to produce probabilistic climate projections for California at a detailed level. These projections will aid impacts and adaptation studies and long-term planning in California.
- University of California, Berkeley for field validation on the role of aerosols (small particles) impacts on precipitation levels and meteorological and hydrological conditions in California. This research encompasses several studies using satellite data, numerical models, statistical analysis of runoff, and measurements taken by research aircrafts.
- University of California, Davis to research and estimate greenhouse gas emissions from dairy farms based on extensive measurements taken in both pilot units and operating dairy farms. The model will help improve emission estimates for this industry, develop more realistic options to reduce emissions, and potentially allow dairy farmers to sell offsets to electric utilities, lowering compliance costs.

Program Administration

This program area provides administrative support for the PIER program activities. These support functions apply across all program categories and so are accounted for separately. They improve and provide information about the research portfolio and its results through: program management, computer-based budgeting, tracking, account processing, file maintenance, equipment and methods, database queries, information development and dissemination, qualified independent appraisals of salvage demonstration equipment, and other administration activities.

CHAPTER 4: Ensuring RD&D Benefits

The Energy Commission's PIER program is now 10 years old and has invested more than \$529 million of public funds in a diversified portfolio of projects supporting policy on a broad, interrelated set of energy issues. Public interest research, development, and demonstration funds are to be expended on projects that serve the public interest and demonstrate that they address energy services and products that provide value to California and others; technology development and demonstrations that advance scientific knowledge; and research not adequately provided by competitive and regulated markets. Importantly, the Energy Commission's research funds also leverage federal, private industry, and other funding sources to augment research interests and financial benefits to California. For example, a \$5.1 million investment in carbon sequestration research has already returned \$11.4 million in additional research funding. While developing technology is a clear policy priority and primary focus, the PIER program also recognizes the need to provide decision-making with a robust research knowledge base to inform future policy.

To ensure that the public interest energy RD&D portfolio continues to provide tangible benefits to California within the broader context of national and international efforts to address energy research needs and opportunities, the PIER Program is guided and evaluated regularly, using avenues described below.

Policy Initiatives

The PIER Program supports energy policies formulated by the governor of California, the Energy Commission's IEPR, legislation, and the joint Energy Commission/CPUC Energy Action Plan. Energy policy priorities place energy efficiency and demand response improvements first, renewable energy second, and clean fossil-fuel generation as third for meeting California's future energy needs. Research, development, and demonstration are specifically identified in the Energy Action Plan as an essential element for implementing every one of these policies. SB 1250 had a particularly fundamental effect on PIER's priorities, as noted previously in this report. As major state initiatives shift the focus of energy priorities, the Energy Commission's RD&D investments adjust accordingly, as shown with the recent increased emphasis on transportation and energy efficiency.

New Advisory Board

In 2006, SB 1250 directed the Energy Commission to form an advisory board to provide strategic guidance on funding priorities for PIER. The advisory board consists of representatives from the California Public Utilities Commission (CPUC), consumer organizations, environmental organizations, and the investor-owned utilities. Additionally, six members of the California Legislature may meet with the advisory board and participate in its activities. Senate President Pro Tem Don Perata appointed Senators Christine Kehoe, Alan Loewenthal, and Robert Dutton; Speaker Fabian Núñez appointed Assembly Members Loni Hancock, Ira Ruskin, and Michael Feuer. Energy Commissioners, Arthur H. Rosenfeld and James D. Boyd serve as co-chairs of the Advisory Board.

Through publicly noticed, open meetings, the advisory board assists the Energy Commission in establishing strategic planning goals:

- ensure that the program is focused on public interest research consistent with the goals established by SB 1250,
- develop and maintain a vision for the state's energy RD&D needs,
- provide strategic input in establishing funding priorities within the context of a balanced public interest RD&D portfolio in appropriate focus areas,
- tap the technical, market, economic, and environmental expertise within their organizations (and other relevant public and private sector entities) to identify research needs and guide

- research initiatives, and
- facilitate application of promising new technologies, planning tools, and knowledge resulting from the RD&D initiatives funded by the PIER Program, in cooperation with other partners.

The advisory board held the first of up to 3 meetings per year on January 8, 2008 to receive a general introduction to the PIER program with focused presentations on buildings efficiency, demand response, and climate science research. The second meeting is scheduled for April 22, 2008. Future meetings will address current budget priorities, initiatives for the future, and policy drivers underlying the RD&D portfolio priorities.

Program Implementation: Strategic Partnerships

The Energy Commission relies on strategic partnerships to help avoid duplication, build on successful RD&D work, generate new ideas, leverage public and private investments, and ensure that the PIER RD&D portfolio provides benefits to the state's electric and natural gas customers. Such partnerships facilitate interagency research coordination and cooperation and often include other state agencies, local and regional entities, industry, utilities and researchers. Key partnerships for PIER include groups researching land use, green buildings, smart grids, carbon sequestration, emerging technology coordination, and climate science.

Land Use Planning

The 2007 IEPR recommends research to quantify the effects of land use on energy and to improve tools for integrating energy considerations into future planning and development. Such research cuts across multiple program areas in PIER and can involve complex interrelationships among sectors. For example, land-use planning decisions by local agencies are important to transportation program efforts to reduce California's current 3 percent annual increase in vehicle miles traveled (VMT) by state residents, and those same decisions are important to energy efficiency programs, to reduce building energy use. Although increasing urban density may reduce VMT, it can also contribute to the heat island effect, increasing temperatures in local neighborhoods. Planting more trees may reduce the resulting air conditioning demand, but if the trees are not strategically planted they could limit rooftop solar photovoltaic installations. Such complicated decision making involves the close cooperation of experts in a variety of fields.

Working with the Gas Technology Institute, San Diego State University, U.S. Department of Energy (DOE), and the city of Chula Vista, the Energy Commission has established the National Energy Center for Sustainable Communities and has invested \$380,000 to compare business-as-usual development plans for three new communities planned on 1,500 acres of land that is part of Otay Ranch. Chula Vista hopes land use model research will demonstrate how to reduce energy consumption and guide all future development within its municipal boundaries.

Green Buildings

The state asks those who design, develop, build, and maintain and lease commercial properties to implement sustainable energy efficiency practices. Governor Executive Order S-20-04 directs the state to reduce the consumption of grid-based electricity in its own buildings by 20 percent by the year 2015. With that initiative, Governor Schwarzenegger has asked the state to "lead by example" by demonstrating that sustainability is achievable, desirable, and economically sensible. Interagency coordination, whereby state agencies work together to achieve these goals, is at the heart of its implementation.

Furthering this program, the Energy Commission has signed a Memorandum of Understanding (MOU) with the California Department of General Services (DGS) and the University of California, Davis California Lighting Technology Center (CLTC), to help bring advanced lighting

technologies to state buildings. As a result, new energy-efficient lighting technologies are being tested on the campuses and state buildings of the University of California, California State University, and the California Community College system. Solid-state task lighting is one such new technology being demonstrated. This new system, with potential to cut office lighting energy in half, is being evaluated by DGS in its buildings occupied by the Departments of Motor Vehicles, Mental Health, and the Energy Commission. The MOU has helped the DGS structure its “Nine Buildings” retrofit project to vastly improve lighting energy use across a wide range of state properties.

Smart Grids

The Energy Commission is working with the CPUC, other regulators, and utilities to help assess state policies on open transmission access for new electricity generation technologies; develop reference designs and minimum standards for generators to interface with grid operations; and encourage the development of new tariffs and utility programs to take advantage of “smart grid” advances.

Representing both the customer and producer sides of the meter, a smart grid relies upon a series of innovations to open the door for California’s utility customers to better manage their electricity use and respond to the producers’ need for generation, transmission, and distribution resources on a real-time basis. Smart grid technologies include advanced communications and controls, intelligent software, and nimble self-healing systems designed to avoid rolling blackouts. With minimal cost, these technologies can boost efficiency while improving reliability.

The Energy Commission sponsors research in the following areas:

- New and more intelligent controls to increase the penetration of renewable technologies on the California grid. By quickly integrating large amounts of carbon-free resources with energy storage and other grid systems, the utility grid can accommodate the intermittent nature of wind, solar, and hydroelectric technologies.
- New automation technologies that allow California utilities to operate their distribution systems more reliably, thereby reducing operating costs and providing flexibility in responding to future needs.
- Capability assessment of new grid-friendly devices that are able to sense grid conditions and quickly respond by enabling end-use customer response to be based on the grids’ real-time reliability needs.
- Emerging communications and control technologies for residential customers, allowing them to better manage home energy use.

Carbon Sequestration

Working with the Department of Conservation, ARB, the California Department of Water Resources, and other state and federal agencies, the Energy Commission prepared *Geologic Carbon Sequestration Strategies for California: Assembly Bill 1925 Report to the California Legislature* to recommend how the state could store the carbon emissions from fossil fuel sources underground. This report was used for the 2007 IEPR, and among the principal findings is that gaps in statutory frameworks—particularly, uncertainty regarding long-term liability for underground storage basins—are significant barriers.

More than 100 “sedimentary basins” have been screened for viability. Although California appears to have the potential to store and capture twice the amount of carbon emissions mandated by AB 32, the majority of these potential sequestration sites require further RD&D to verify large-volume storage, methodologies for selecting and certifying sites, and techniques for post-injection monitoring and verification.

The West Coast Regional Carbon Sequestration Partnership (WESTCARB), established in 2003 and managed by the Energy Commission, is one of seven research partnerships co-funded by DOE to characterize regional carbon sequestration opportunities and conduct technology validation field tests. It is currently exploring opportunities in the western United States for removing CO₂ from the atmosphere by capturing it at industrial facilities before it is emitted, and then storing it securely underground.

WESTCARB research is being conducted in three phases. Phase I (2003–2005), Regional Characterization, identified the region's major stationary CO₂ sources in the western states and characterized their sequestration potential. This characterization revealed annual major stationary source emissions in California of 159 million metric tons of CO₂, and a potential storage resource of between 80 to 300 billion metric tons CO₂ in the state.

Phase II (2005–2009, ongoing), Pilot Tests, is performing small-scale field tests of carbon sequestration technologies. Terrestrial, forestry-based carbon sequestration field tests are focusing on tree planting in rangelands and other formerly forested areas, forest "fuel treatments" to reduce CO₂ emissions from severe wildfires, and conservation practices to promote large tree stands. The partnership is also conducting geologic sequestration validation field tests, which involve injection of a small quantity of CO₂ into suitable geologic formations in the Western U.S., and monitoring CO₂ absorption by porous rocks, to refine predictive models and ensure reliable storage.

Finally, WESTCARB has submitted a proposal for a grant from the DOE for a Phase III (2008–2018) large-volume CO₂ storage test. For this test, WESTCARB will capture and store the exhaust of an innovative oxy-combustion power plant in California's San Joaquin Valley, an especially promising storage location in the state. The goal of this Phase III field test is to validate the feasibility, safety, and efficacy of commercial-scale carbon storage in deep saline formations.

Emerging Technology Coordinating Council (ETCC)

To help achieve ambitious energy savings goals and to facilitate market introduction of energy saving products, the CPUC, Energy Commission, PG&E, Southern California Edison (SCE), Southern California Gas Company (SoCal Gas), and San Diego Gas and Electric (SDG&E) participate in the Emerging Technologies Coordinating Council (ETCC). The ETCC provides a collaborative forum for the Energy Commission and the utility stakeholder partners to exchange information on RD&D opportunities and to coordinate introduction to the marketplace new "emerging technologies." The Energy Commission works with individual utilities to demonstrate and document the energy savings from new technologies at utility customer sites. The information obtained from these demonstrations can be used by California utility partners to substantiate energy savings to the CPUC in formal filings for incentive based programs. Utility incentive programs represent a primary avenue for wide-spread introduction of the products of research to the market.

The ETCC focuses on screening potential technologies, assessing them to validate performance and customer acceptance, and recommending the proven winners for investor-owned utility customer education and rebate programs. The council is particularly interested in technologies that offer large energy savings and rapid market penetration, such as advanced lighting, water heating, and air-conditioning systems, for all classes of customers.

ETCC stakeholders help achieve California's energy-reduction goals by streamlining the market introduction of energy-saving products and services; leveraging strengths and technology expertise; providing broad access to new technology assessments; and providing critical public outreach. This collaborative partnership supports advanced technologies and supplies critical information to decision makers, to help inform state energy policy. To further broaden its scope and effectiveness, the ETCC is working to extend coordination of its activities to include municipal utilities, such as the Sacramento Municipal Utility District (SMUD) and Los Angeles Department of Water and Power (LADWP).

Climate Change

Executive Order S-03-05, signed by Governor Schwarzenegger on June 1, 2005, created the Climate Action Team (CAT), which is chaired by the Secretary for Environmental Protection, Linda Adams, and includes high-level representatives from the Energy Commission, ARB, CPUC and other state agencies. The CAT coordinates state level efforts in the area of mitigation (reduction of greenhouse gas emissions), provides assistance and input to ARB for the implementation of AB 32, and is expected to provide oversight and coordination of all climate change research in the state. In this way, the energy-focused climate science research at the Energy Commission will be integrated with and not duplicate the climate change research performed elsewhere. The Executive Order also calls for the preparation of biennial climate change science reports on impacts and adaptation. The Energy Commission participates in numerous CAT committees and provides a leadership role in the following subgroups: (1) Energy, (2) Land Use, and (3) Climate Change Science (Scenarios). The Climate Change Science Scenarios subgroup is in the process of updating the 2006 Scenarios Report, which contained 17 new scientific studies on the potential impacts of climate change on key resources in California. The 2008 Biennial Climate Change Science Report will use new models and statistical techniques supported by PIER research, such as new dynamic ecological and coastal models, specifically designed to assess climate impacts in California. The 2007 scientific climate change research includes the following projects:

- researchers at the University of California at Berkeley and Lawrence Berkeley National Laboratory plan to develop new econometric methods to improve estimates of impacts from climate change on household energy and water demand, and
- Scripps Institution of Oceanography plans to develop a new statistical technique that will enable global climate models to estimate the potential increases in frequency and severity of hot spells that normally strain California’s electricity generating system. Extreme events for other sectors, such as water and public health, will also be investigated.

Economic Benefits to California

In 2007, the Energy Commission was directed to prepare a special report on the Energy Commission’s quantifiable expectations for research and how research projects are selected and evaluated. Because that report, *Response to Supplementary Language Line Item 2860-001-0381 in the Energy Commission’s Budget for the PIER (Public Interest Energy Research) Program*, included numerous examples of the Commission’s benefits from past research, they are not reprinted here.

Table 1 provides a summary of expenditures on PIER projects by research stage in 2004-2006. Approximately \$4.20 of each \$5.00 of PIER funds is spent on research activities in California and benefits accrue across a broad base of state interests including energy consumers, utilities, the academic research community, entrepreneurs, and society in general.

Table 1. Percent of PIER funds spent in California

Research Stage	Total (\$)	California (\$)	%
Basic Research	11,740,821	8,273,253	70.5
Technology Development	37,769,414	30,749,881	81.4
Technology Demonstration	23,768,826	22,197,757	93.4
Market Support	13,846,394	11,110,615	80.2
Policy /Regulation Support	8,358,030	7,489,028	89.6
Totals	\$95,483,485	\$79,820,534	83.6%

Source: September 1, 2007 Report

Out-of-state expenditures are typically associated with collaborative research in which there is significant leveraging of the funds with other research organizations that include the federal government. For example, the Energy Commission has provided WESTCARB, the joint carbon sequestration study undertaken by several supporting western states, with \$5.1 million of PIER support that already returned \$11.4 million and may return \$62 million beginning in 2008.

Results from PIER report, *Evaluation of the Benefits to California Electricity Ratepayers from the Public Interest Energy Research Program, 1998–2003*, commissioned to quantify the program's success, bears repeating. That study examined whether the entire investment portfolio returns more benefit to California citizens than it costs, and although it did not fully account for indirect benefits such as job creation and environmental improvements, the study found that every \$1 spent on energy RD&D in California returned \$1.30–\$3.40 in benefits to the state's economy.

Looking Forward—New Benefits Evaluation of PIER Activities

RD&D programs typically use a few "winners" to illustrate success because there is no generally accepted approach for assessing research costs and benefits. The Energy Commission has found that there are few examples of completed benefit evaluations for RD&D programs and no industry standard protocols for evaluating benefits that allow for useful, consistent comparisons among program results or from year-to-year within a program. As a result, the PIER program is undertaking a research project to develop clear protocols and new evaluation tools to evaluate RD&D programs, and these protocols and tools will be available by 2009.

In an effort to develop a more effective evaluation tool, the Energy Commission contracted with KEMA to develop a methodology to evaluate the benefits of RD&D. As part of this work, KEMA will gather all known current evaluation methods used by other research programs and develop a standard methodology. They will then apply the methodology to selected projects to evaluate the benefits of PIER's research. If the methodology proves successful, the Energy Commission will use it to evaluate the PIER program benefits more comprehensively. The Energy Commission will report results in the 2009 PIER Annual Report. The Energy Commission plans to refine the method(s) as needed each year, with the goal of creating a robust and ongoing benefits evaluation program and a comprehensive, science-based evaluation effort. It will be applied to more PIER activities in the future, with the expectation that the evaluation methodology will be continually improved and ensure that the RD&D program focuses on the projects most beneficial to California.

The Energy Commission's PIER program made notable accomplishments during 2007 resulting from years of research in previously funded RD&D cycles. As typical of RD&D programs, many of these are not readily quantified. Until the current PIER research yields better program metrics in 2009, this annual report will continue to follow the path laid out in standard reporting protocols – listing the successes. Chapter 5 provides an abbreviated list of research successes achieved in 2007.

CHAPTER 5: Accomplishments for 2007

RD&D funded by the Energy Commission provides information and tools for better decision-making by individuals and state policy makers, energy design tools for architects and engineers, wind and solar resource assessments for developers and utilities, and environmental research to better understand and reduce impacts of advanced supply technologies, such as “once-through” cooling for conventional electricity generation. The following selected accomplishments for 2007, which resulted from previously funded research, reveal the diversity of RD&D activities and specific ways in which the PIER program portfolio addresses SB 1250 and other energy policy goals.

Transportation

A Plug-In Hybrid Electric Vehicle (PHEV) Research Center was established in 2007 to support advanced transportation.

- In its first year, the center initiated three research projects addressing consumer behavior; vehicle architecture and control modeling; and lifecycle modeling.
- This project received additional funding from the ARB for the conversion of a fleet of 10 Toyota Prius vehicles to “plug-in-capable” Priuses.
- A study of early PHEV drivers—which is available on the newly created PHEV Center website—discovered that early adopters are not focused on marginal cost issues, but are more likely interested in environmental and oil security issues. In the absence of incentives and other behavioral frameworks, they are also likely to plug in their cars whenever they wish.
- A new PHEV Center website was launched in October 2007, to be a reference point on PHEV technology and news for interested parties of all awareness levels, as well as a venue to disseminate the results of studies completed by the PHEV Research Center.

A solicitation was conducted in 2007 to fund demonstrations of advanced biofuel production technologies. Two were made, and contracts will be finalized in 2008.

- The San Francisco Public Utilities Commission and Metcalf & Eddy Form will demonstrate the production of biodiesel from waste grease.
- The Renewable Energy Institute International will validate a biomass three-way catalyst conversion system that creates ethanol.

Energy Efficiency and Demand Response

The PIER energy efficiency and demand response program is an integrated portfolio of research projects that addresses the state’s energy efficiency needs in the commercial, residential, industrial, agricultural, and water supply areas.

Building and End-Use Efficiency

State Building Energy Efficiency. Table A-1 lists 12 changes that were incorporated into the final language of the 2008 Title 24 Building Standards as a result of technical research conducted by the PIER building efficiency RD&D program.

Table A-1. Changes to 2008 Title 24 Building Standards

PIER Research Project	Mandatory Measures	Prescriptive Requirements	Performance Method	Compliance Option
FDD ¹ for Packaged Systems			✓	
FDD for AHUs ² & VAV ³ Boxes			✓	
LED ⁴ Exterior Lighting	✓			
Load Shedding Florescent Lighting Ballasts		✓		
LED Night Lighting in Hotel Bathrooms	✓			
Integrated Classroom Lighting System Design		✓		
Displacement Ventilation Systems				✓
Underfloor Air Distribution				✓
Residential ACM ⁵ Attic/Duct Model			✓	
Cool Roofs for Residential Buildings			✓	

¹ Fault Detection &

² Air Handling

³ Variable Air

⁴ Light Emitting

⁵ Alternative Calculation

Studies of occupant ventilation practices and indoor air quality in new homes found that new single-family detached homes in California are built relatively airtight and that many of these homes have low outdoor air exchange rates, resulting in elevated concentrations of some indoor air pollutants. As a result, the Title 24 Building Energy Efficiency Standards for new home construction will require continuous ventilation in new homes.

New technologies either demonstrated or became commercially available in 2007 include:

- Bi-level Stair Luminaire (Manufacturers: Lamar Lighting Co., Lithonia Lighting)
- Integrated Office Lighting System with Personal Lighting System (PLS) Light emitting diode (LED) task lighting (Manufacturer: PLS by Finelite Inc.)
- Integrated Classroom Lighting System (Manufacturer: Finelite Inc.)
- Load Shed Ballast (Manufacturer: Osram Sylvania Inc.)
- Demand-Controlled Kitchen Ventilation (Manufacturer: Melink Corp.)
- Wireless Constant Air Volume to Variable Air Volume Conversion Controls (Manufacturer: Federspiel Controls)
- A classroom displacement ventilation system project demonstrated a 25-50 percent cooling energy savings compared to conventional systems.
- An advanced heat pump air conditioner for modular classrooms was demonstrated to be 44 percent more energy efficient during cooling, 38 percent more efficient during heating applications, and 7 times quieter than conventional products.
- Co-funded with California utilities, and heating, ventilation, and air conditioning (HVAC) manufacturers the Western Cooling Efficiency Center (WCEC) was established on the University of California Davis campus.
- Improved analytical techniques for measuring indoor air quality that can contribute to future Title 24 codes.
- Demonstrated energy saving products at State Universities, California Community Colleges, and at Department of General Services operated buildings.

- Incorporated an Energy Module into the community planning tool, PLACE³S. This tool allows users to calculate energy use of various building types and land used, analyze deployment of distributed generation technologies and selected energy efficiency measures, and compare relative energy use and related emissions for different land use scenarios.

Demand Response

- Developed a “Real-Time Transmission Line Rating System” to allow electric utilities to ease constraints on transmission line power transfers. Results in field tests in California indicate that a 1 megawatt increase in rating facilitated by this system can result in a net of 14 megawatts increase in transmission capability to the region. Increased transmission line ratings are possible more than 90 percent of the time in the summer months. To date, more than 35 of these systems were installed in California.
- Developed and tested an Automated Demand Response technology more than 150 different locations.
- Automated Demand Response interconnects facility energy management or other on-site control systems with customer-programmed energy management and curtailment strategies that are automatically dispatched in response to utility price and reliability signals. These signals can be provided over the Internet or other communication media. Automated Demand Response field results demonstrate that this technology can provide consistent and predictable results.
- One California utility was able to increase its Automated Demand Response participant portfolio from approximately 2 megawatts (MW) of demand response in 2006 to well over 20 MW in 2007. One previously unrecognized benefit is that customers often install new energy efficiency equipment as they enroll in Automated Demand Response programs because detailed engineering audits and assessments are provided as part of the overall package. Overall, customers benefit financially not only from the Automated Demand Response, but from future efficiency savings as well.
- A novel heat pump that recirculates waste or low-grade heat and then converts it to cold temperatures to meet refrigeration or other cooling needs has been verified to use up to 33 percent less thermal energy and 80 percent less electrical energy than conventional technology.
- Electrolysis technology for wine stabilization that eliminates the need for refrigeration, resulting in 80 percent electrical cost savings in a wine processing step.
- The Compressed Air System Efficiency (CSE) Index, developed in collaboration with Southern California Edison (SCE), enabled SCE to establish a credible baseline for energy use and then give rebates in proportion to the savings accomplished by an industrial customer’s compressed air system.

Advanced Electricity Generation Technologies

- In September 2007, the Energy Commission released a grant solicitation with \$5.8 million in possible funding for combined cooling, heat, and power (CCHP) systems. Eligible projects are to exceed applicable standards for reducing greenhouse gas emissions and for maintaining high fuel use efficiency and low emissions during the field operation of developed products. Five grants are anticipated to be awarded in 2008.

Renewable Energy Resources

- A Yolo area landfill successfully demonstrated the use of “bio-reactors” to dramatically reduce the cost of landfill gas production.

- The Intermittency Analysis Project⁸ concluded that the California transmission system can operate reliably and cost-effectively when increased levels of wind and solar resources are added to the state's supply portfolio. Detailed scenario-based simulations of statewide system operations were developed and conducted to determine the effect of renewable resource intermittency on hourly, daily, and seasonal operations. Separate reports were completed to learn from European and Asian experiences with high wind penetration levels and new grid-friendly generation technologies.
- The Integrated Forecast and Reservoir Management (INFORM) Project demonstrated the value of using probabilistic runoff forecasts by comparing near-real-time tests of the integrated system with actual data and management input for four large Northern California reservoirs: Shasta, Oroville, Trinity, and Folsom Reservoirs. Probabilistic runoff forecasts were developed from global circulation models and regional hydrologic models, validated with historical and real time data, and showed that use of this approach could increase water storage by 10 percent.
- A high-speed flywheel system was developed that provides frequency control without fossil fuel combustion. The California ISO certified the Beacon flywheel technology as a potential supplier for its frequency control services. Since then, Beacon has raised \$25 million dollars in private equity funds and obtained a \$1 million grant from the Department of Energy to develop a 20 megawatt facility to supply frequency control to the nation's transmission systems.

⁸ The Intermittency Analysis Project developed scenarios that considered contributions from all renewable sources but did not focus on all sources. It specifically sought to determine the feasibility of integrating intermittent renewables to the extent necessary to meet RPS targets.

Climate Science

- Research on the role aerosols (small particles) have on precipitation levels and meteorological and hydrological conditions in California suggests that aerosols are reducing precipitation levels in the Sierra Nevada.
- A new model can estimate GHG emissions from dairy farms, based on extensive real-world measurements in pilot stations and dairy farms. Accurate emission estimates are needed for the implementation of AB 32, and this information was lacking for this sector. A national organization of dairy producers has invested about \$1 million dollars to further enhance this model and make it suitable for regions outside California.
- PIER-funded researchers found that observed warming in the Central Valley is expected to accelerate in the future.

APPENDIX—2007 Individual Projects

This appendix contains a summary of the project work performed during the calendar year of 2007. The table includes the project name, contract number, start date, contractor, project amount, and a total for each area. During 2007, from January 1 through December 31, the Energy Commission approved \$49.4 million in energy RD&D projects. An additional \$17.6 million was encumbered, but is not included in the tables below because it will not result in project contracts until 2008. The remaining \$13.4 million of the \$80.5 million budgeted will be allocated to the new portfolio categories over the next two years

Summary of Calendar Year 2007 Projects by SB 1250 Policy Goals

SB 1250 Policy Goals	Project Funding Total	Project Count
Transportation	\$4,788,295	12
Energy Efficiency and Demand Response	\$21,569,830	68
Advanced Electricity Generation	\$6,539,861	32
Renewables	\$6,385,493	36
Transmission and Distribution	\$6,102,632	14
Climate Science	\$2,354,467	16
General	\$1,630,772	20
Grand Total	\$49,371,350	198

Details of Calendar Year 2007 Projects by SB 1250 Policy Goals

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Grand Total					\$49,371,350	198
Transportation Total					\$4,788,295	12
Transportation	500-06-043	1	California Air Resources Board	PIER-NG Transportation Research – 2006 Program, California Air Resources Board Projects	\$100,000	6/11/2007
Transportation	500-06-043	2	California Air Resources Board	Field Demonstration of 0.2 Grams Per Brake Horsepower-Hour NOx Natural Gas-Fired Engine	\$125,000	6/11/2007
Transportation	500-06-043	3	California Air Resources Board	Using Gasoline, Diesel, and Compressed Natural Gas (CNG) Vehicles, Characterize the Significance of Lube Oil in PM Formation	\$100,000	6/11/2007
Transportation	500-06-043	4	California Air Resources Board	Using the California Fleet, Conduct Physicochemical and Toxicological Assessment of Particulate Matter Emissions	\$225,000	6/11/2007
Transportation	500-06-043	5	California Air Resources Board	Heavy-Duty Emissions and Fuel Consumption Improvement	\$150,000	6/11/2007
Transportation	500-06-043	6	California Air Resources Board	Determining the Volatility of Ultrafine PM Emissions from Compressed Natural Gas Vehicles Control Technologies	\$350,000	6/11/2007
Transportation	500-07-012	1	UC Riverside	Effect of Natural Gas Fuel Composition on Vehicle Performance and Emissions	\$400,000	12/4/2007
Transportation	E2I-WA-130	1	Electric Power Research Institute (EPRI)	Environmental and Societal Benefits of Electrifying Transportation: Plug-in Hybrids Environmental Study	\$79,098	3/1/2007
Transportation	ICF-06-011	1	SDV-SCC, Inc.	Summary of Partnership for a New Generation of Vehicles (PNGV) Results	\$17,829	3/7/2007
Transportation	NCI-06-012	1	Navigant Consulting, Inc.	PIER NG Transportation Alternative Fuels RD&D Roadmap Development	\$41,800	3/12/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Transportation	NCI-06-018-P-R	1	Navigant Consulting, Inc.	Identification of Transportation RD&D Opportunities	\$199,568	12/19/2007
Transportation	UC MR-060	1	Institute of Transportation Studies - UC Davis	Plug-In Hybrid Electric Vehicle Research Center	\$3,000,000	2/1/2007
Energy Efficiency and Demand Response Total					\$21,569,830	68
Energy Efficiency and Demand Response	07-205.01-021	1	American Council for an Energy Efficient Economy	Co-Sponsorship of the Behavior, Energy and Climate Change Conference	\$4,995	11/7/2007
Energy Efficiency and Demand Response	500-02-023	1	UC Davis	Energy-Related Indoor Environmental Quality Research: Small and Medium Commercial Buildings Field Study	\$1,060,000	3/1/2007
Energy Efficiency and Demand Response	500-03-026	20	Lawrence Berkeley National Laboratory	Demand Response Behavior Study -- Behavioral study of residential time of use customers to assess responsiveness and the ability to enhance response to time of use pricing.	\$263,000	5/1/2007
Energy Efficiency and Demand Response	500-03-026	23	Lawrence Berkeley National Laboratory	Demand Shed Strategies, Phase 2 (Buildings) -- Advanced DR Lighting, Residential T-Stats, DR Strategy Assessment Tools, & DR Smart Appliance Scoping Study	\$390,000	3/14/2007
Energy Efficiency and Demand Response	500-03-026	24	Lawrence Berkeley National Laboratory	Behavioral study of small commercial customers, comparing reactions to price vs. payment incentives (HMG).	\$220,000	5/1/2007
Energy Efficiency and Demand Response	500-03-026	25	Lawrence Berkeley National Laboratory	Behavioral study of residential TOU customers with interventions to assess responsiveness and ability to enhance response to TOU pricing (RIA).	\$281,000	5/1/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Energy Efficiency and Demand Response	500-05-032	1	Purdue University Herrick Lab	A Virtual Refrigerant Charge Sensor	\$187,738	8/13/2007
Energy Efficiency and Demand Response	500-05-032	2	Lawrence Berkeley National Laboratory	Measuring Outdoor Air Intake Rates in Existing Buildings	\$107,630	10/1/2007
Energy Efficiency and Demand Response	500-05-032	3	Lawrence Berkeley National Laboratory	Low Energy Cooling for California Climates: Climatic Feasibility and Energy Savings Potential of Mixed-Mode Commercial Buildings	\$150,000	10/1/2007
Energy Efficiency and Demand Response	500-05-032	4	UC San Diego	Simulation of Energy Performance of Under floor Air Distribution (UFAD) Systems	\$199,814	7/1/2007
Energy Efficiency and Demand Response	500-05-032	6	California Lighting Technology Center - UC Davis	Improved Day lighting Controls through Dual Loop Sensing	\$199,736	7/1/2007
Energy Efficiency and Demand Response	500-05-032	7	Lawrence Berkeley National Laboratory	Energy Benchmarking Protocol for Hospitals	\$105,000	10/1/2007
Energy Efficiency and Demand Response	500-05-032	8	Field Diagnostics Services, Inc.	Expanded Test Protocols for Low Ambient Testing of Unitary AC Systems	\$62,174	6/6/2007
Energy Efficiency and Demand Response	500-06-004	1	San Diego State University Research Foundation	Energy Efficient Community Development Research Project	\$380,000	3/30/2007
Energy Efficiency and Demand Response	500-06-022	1	Lawrence Berkeley National Laboratory	Energy Efficient Digital Networks	\$1,299,000	1/15/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Energy Efficiency and Demand Response	500-06-023	1	Pacific Gas and Electric Company	Energy Efficient Natural Gas Chillers, Water Heating and Food Service Equipment	\$667,000	1/29/2007
Energy Efficiency and Demand Response	500-06-028	1	National Renewable Energy Laboratory	Solar Access Design Tools for Community Planning and Building Energy Code Development	\$450,000	4/1/2007
Energy Efficiency and Demand Response	500-06-029	1	Heschong Mahone Group	Hot Water Distribution System Research	\$1,429,841	3/19/2007
Energy Efficiency and Demand Response	500-06-035	1	Architectural Energy Corporation	Lighting California's Future	\$2,502,779	5/1/2007
Energy Efficiency and Demand Response	500-06-036R	1	Lawrence Berkeley National Laboratory	Water Heating and Hot Water Usage in California Homes	\$1,124,000	5/23/2007
Energy Efficiency and Demand Response	500-06-039	1	Heschong Mahone Group	Optimizing Human Factors in the Lighting Efficiency Equation	\$975,740	5/14/2007
Energy Efficiency and Demand Response	500-06-040	1	Cal Poly Corporation	Agricultural Water and Energy Efficiency	\$1,600,000	6/11/2007
Energy Efficiency and Demand Response	500-06-041	1	Lawrence Berkeley National Laboratory	High Performance Building Façade Solutions	\$500,000	6/1/2007
Energy Efficiency and Demand Response	500-06-046	1	Lawrence Berkeley National Laboratory	Automated Rooftop Air Conditioning at Target and HVAC ePrimer	\$260,000	6/25/2007
Energy Efficiency and Demand Response	500-06-049	1	Center for the Built Environment - UC	Efficient Commercial Comfort Systems	\$600,000	10/16/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Demand Response			Berkeley			
Energy Efficiency and Demand Response	500-06-052	1	Electric Power Research Institute (EPRI)	EPRI Collaborative Research Portfolio Agreement	\$446,000	7/1/2007
Energy Efficiency and Demand Response	500-06-053	1	Lawrence Berkeley National Laboratory	Energy Efficient High-tech Buildings	\$1,100,000	6/29/2007
Energy Efficiency and Demand Response	500-06-058	1	Lawrence Berkeley National Laboratory	Develop Benchmarking and Energy & Water Savings Tool (BEST) for California Dairy Processing Industry	\$275,000	8/8/2007
Energy Efficiency and Demand Response	500-06-059	1	Sacramento Municipal Utility District	Demonstration of a Vanadium Redox Battery to validate performance and economics for peak load reduction for a SMUD industrial customer	\$100,000	7/2/2007
Energy Efficiency and Demand Response	500-07-005	1	Consortium For Energy Efficiency	Lighting for Tomorrow 2007-2008	\$36,000	9/19/2007
Energy Efficiency and Demand Response	500-07-006	1	Lawrence Berkeley National Laboratory	Residential Forced Air System Cabinet Leakage and Blower Efficiency	\$250,000	11/15/2007
Energy Efficiency and Demand Response	500-07-008	1	Lawrence Berkeley National Laboratory	EnergyPlus Enhancements for Title-24 Standards	\$400,000	12/1/2007
Energy Efficiency and Demand Response	500-07-009	1	San Jose State University Foundation	Environmental Business Cluster Business Assistance Program for PIER Companies	\$220,000	7/1/2007
Energy Efficiency and Demand Response	500-07-011	1	Western Cooling Efficiency Center - UC Davis	Advancing Efficient Cooling in California	\$200,000	12/4/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Energy Efficiency and Demand Response	500-98-014	212	Angela Chuang	Electric Service Reliability Analysis Tool	\$50,000	11/1/2007
Energy Efficiency and Demand Response	500-98-014	222	University of Miami	Hybrid DC- and AC-Linked Microgrids	\$50,000	7/1/2007
Energy Efficiency and Demand Response	500-98-014	226	Clever Fellows Innovation Consortium (CFIC), Inc.	The Next Wave in Air-conditioning: Acoustic-Stirling Commercial Rooftop Units	\$86,762	6/15/2007
Energy Efficiency and Demand Response	500-98-014	227	Michigan State University	Woven turbo wheel as key technology for economical compact and high-efficient R718 chiller that uses only water as refrigerant	\$95,000	7/1/2007
Energy Efficiency and Demand Response	500-98-014	228	Rensselaer Polytechnic Institute	High-Efficiency and Low-Cost Single-Phase PFC Converters	\$94,210	7/1/2007
Energy Efficiency and Demand Response	500-98-014	230	Clustered Systems	Fanless Cooling System for Servers and Storage Systems	\$95,000	8/20/2007
Energy Efficiency and Demand Response	500-98-014	231	Nexajoule, Inc.	Residential Sub-Wetbulb Evaporative Chiller System	\$95,000	10/15/2007
Energy Efficiency and Demand Response	500-98-014	232	Desert Research Institute	Utility Monitoring System Hardware Development	\$94,859	8/15/2007
Energy Efficiency and Demand Response	500-98-014	234	EPB Consulting Group	Residential Integrated Ventilation Energy Controller	\$89,856	12/1/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Energy Efficiency and Demand Response	500-98-014	235	Engsysco, Inc.	Feasibility Analysis of Cleanroom Airflow Reduction Based on Establishment of Theoretical Basis and Required Validation	\$95,000	9/10/2007
Energy Efficiency and Demand Response	500-98-014	238	Energy Concepts Company	Solar Thermal Heat Pump/Chiller	\$95,000	8/15/2007
Energy Efficiency and Demand Response	BOA-99-170-P	1	Lawrence Berkeley National Laboratory	Hospital Efficiency Research	\$112,000	11/12/2007
Energy Efficiency and Demand Response	BOA-99-181-P	1	The Regents of the University of California, Office of the President - CIEE	Requirements Engineering for Advance Metering Infrastructure and the Home Automation Network (AMI-HAN) Interface	\$25,200	10/24/2007
Energy Efficiency and Demand Response	BOA-99-183-P	1	The Regents of the University of California, Office of the President - CIEE	RD & D for PIER Bldgs - Lighting Research Program (LRP)	\$80,621	10/15/2007
Energy Efficiency and Demand Response	BOA-99-184-P	1	The Regents of the University of California, Office of the President - CIEE	Development of Smart Grid Implementation Plans Associated with Legacy Distribution Automation Equipment Upgrades, Demand Response Infrastructure, and the PCT Reference Design	\$417,840	11/8/2007
Energy Efficiency and Demand Response	BOA-99-185-P	1	Center for the Built Environment - UC Berkeley	Title 24 Compliance Model for Under Floor Air Distribution	\$145,000	11/12/2007
Energy Efficiency and Demand Response	E2I-WA-128	1	Electric Power Research Institute (EPRI)	Assessment of Industrial Applications for Emerging Retrofit Energy Savings Technologies	\$100,000	1/1/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Energy Efficiency and Demand Response	ICF-06-010	1	Itron, Inc.	California Commercial End Use Survey (CEUS) Technical Support	\$64,300	2/26/2007
Energy Efficiency and Demand Response	NCI-06-009	1	Navigant Consulting, Inc.	Support Development of PIER Water-Energy Five Year Strategic Plan and Roadmap	\$210,000	3/15/2007
Energy Efficiency and Demand Response	NCI-06-013	1	Navigant Consulting, Inc.	PIER Buildings Program RFP Support	\$57,449	5/7/2007
Energy Efficiency and Demand Response	NCI-06-014-P-S	1	Navigant Consulting, Inc.	PIER Buildings Program RFP Support	\$24,977	11/16/2007
Energy Efficiency and Demand Response	NCI-06-017-P-R	1	Navigant Consulting, Inc.	Analysis and Implications of the CPUC Zero Energy Building (ZEB) Initiative	\$249,709	12/17/2007
Energy Efficiency and Demand Response	NCI-06-020-P-R	1	Navigant Consulting, Inc.	Support Development of PIER Water-Energy, Five Year Strategic Plan and Roadmap - Continuation and Completion of WA 009	\$81,111	12/19/2007
Energy Efficiency and Demand Response	RM500-06-001	1	National Association of State Energy Official	Improved Gas Water Heating Systems	-\$145,000	2/1/2007
Energy Efficiency and Demand Response	SAIC-06-010	1	Rick Chitwood Associates	PIER Buildings Efficiency Project Design Review and Quality Assurance	\$46,534	2/26/2007
Energy Efficiency and Demand Response	SAIC-06-017	1	Alternative Energy Systems Consulting, Inc.	I-PLACE3S Energy Module-Distributed Generation and DEER Baseline Buildings and Energy Efficiency	\$40,000	3/15/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Energy Efficiency and Demand Response	UC BOA-172	1	EnerNex Corporation	R&D Demonstration Process for Demand Response Consumer Portal Information Exchange	\$49,464	2/2/2007
Energy Efficiency and Demand Response	UC BOA-174	1	L'Monte Information Services	Requirements Engineering Services for the PIER Buildings Program Area	\$47,090	2/20/2007
Energy Efficiency and Demand Response	UC BOA-178	1	San Jose State University Foundation	San Jose State University Foundation Environmental Business Cluster (EBC)	\$73,752	4/13/2007
Energy Efficiency and Demand Response	UC MR-062	1	UC Merced	Liquid Desiccant Based Integrated Hybrid Refrigeration Technology for Energy Efficient Refrigerated Warehouses	\$242,999	3/16/2007
Energy Efficiency and Demand Response	UC MR-066	1	The Regents of the University of California, Office of the President - CIEE	Develop new technology for Refrigerated Warehouses using Blast freezer fan modulation	\$180,055	5/1/2007
Energy Efficiency and Demand Response	UC MR-069	5	The Regents of the University of California, Office of the President - CIEE	The Effects of Ventilation Filters on Indoor Air Quality In California Classrooms	\$70,390	6/11/2007
Energy Efficiency and Demand Response	UC MR-072	1	Ekster & Associates	Automation of Sludge Thickening Process	\$75,000	6/1/2007
Energy Efficiency and Demand Response	UC MR-075	1	One Cycle Control, Inc.	Field Demonstration of One-Cycle Control Active Power Filter (OCC-APF)	\$334,204	11/1/2007
Advanced Electricity Generation Total					\$6,539,861	32

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Advanced Electricity Generation	07-205.01-006	1	American Society of Mechanical Engineers	Co-sponsorship of the American Society of Mechanical Engineers - Internal Combustion Engines Division Fall 2007 Conference	\$1,195	10/1/2007
Advanced Electricity Generation	07-205.01-025	1	San Jose State University Foundation	Once Through Cooling Workshop	\$4,970	12/3/2007
Advanced Electricity Generation	500-06-026	1	Center for Clean Air Policy	Center for Clean Air Policy	\$60,000	3/19/2007
Advanced Electricity Generation	500-06-027	1	The Regents of the University of California - Sponsored Projects Office	Workshop co-sponsorship - Combined Heat and Power and Energy Efficiency Opportunities for California's Agricultural Sector	\$15,000	4/1/2007
Advanced Electricity Generation	500-06-038	1	Gas Technology Institute	331 kWe High Efficiency and Low Emission Engine Using Thermochemical Fuel Reforming	\$1,960,654	6/30/2007
Advanced Electricity Generation	500-06-051	1	Energetics Incorporated	4th Annual Advanced Stationary Reciprocating Engines Conference	\$20,000	6/29/2007
Advanced Electricity Generation	500-06-054	1	Gas Technology Institute	Sequestration of CO ₂ Emissions through Biocatalytic Mineralization	\$105,000	7/2/2007
Advanced Electricity Generation	500-06-060	1	California Department of Corrections & Rehabilitation	Demonstration of a Dual Function Thermodynamic Cycle for Increasing Turbine Efficiency.	\$450,000	6/30/2007
Advanced Electricity Generation	500-07-003	1	John Maulbetsch	Field Testing and CFD Modeling of Wind Effects on ACC Performance	\$540,000	8/30/2007
Advanced Electricity Generation	500-98-014	204	Institute of Transportation Studies - UC Davis	Hydrogen Enrichment of Landfill Gas for Enhanced Combustion	\$95,000	4/1/2007
Advanced Electricity Generation	500-98-014	215	ITN Energy Systems, Inc.	Development of an Ordered Thin-Film Palladium Alloy Membrane for Hydrogen Separation	\$94,949	2/6/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Advanced Electricity Generation	500-98-014	216	Alzeta Corporation	Ultra Low NOx Duct Burner for Small High Efficiency CCHP Systems	\$94,880	1/15/2007
Advanced Electricity Generation	500-98-014	223	Columbia University	Determining the Feasibility of a High Temperature CO ₂ Separation Membrane	\$73,865	9/1/2007
Advanced Electricity Generation	500-98-014	225	Gas Technology Institute	Feasibility Evaluation of a Direct Carbon Fuel Cell (DCFC) Operating on Petroleum Coke Using a Molten Carbonate Electrolyte	\$94,906	6/1/2007
Advanced Electricity Generation	500-98-014	233	UC Santa Cruz	Evaluation of a CO ₂ Mitigation Option for California Coastal Power Plants	\$95,000	10/15/2007
Advanced Electricity Generation	500-98-014	236	University of Southern California	Carbon Molecular Sieve Membranes with Tunable Properties	\$95,000	9/17/2007
Advanced Electricity Generation	500-98-014	239	Meruit, Inc.	Testbed Design for Gas Turbine Exhaust Pressure Recovery	\$49,750	9/16/2007
Advanced Electricity Generation	500-98-014	240	Altex Technologies Corporation	High Efficiency Heat and Power System for CCHP Applications	\$94,915	8/29/2007
Advanced Electricity Generation	500-98-014	241	Colorado State University	Feasibility Assessment of Operating Gas Engines on Alternative Gas Fuels	\$95,000	9/1/2007
Advanced Electricity Generation	500-98-014	244	Functional Coating Technology, LLC	Highly Efficient Production of Electricity and Syngas Using a Natural-Gas Fuel Cell	\$94,998	9/24/2007
Advanced Electricity Generation	E2I-WA-131	1	Electric Power Research Institute (EPRI)	Emission Performance of an 85 kWe Packaged CHP system	\$60,000	2/1/2007
Advanced Electricity Generation	NCI-06-019-P-R	1	Navigant Consulting, Inc.	Support for the California Microgrid Research Alliance	\$185,333	12/19/2007
Advanced Electricity Generation	PNG-06-002	1	DE Solutions, Inc.	Engine CHP Emission Control Technology	\$749,013	4/16/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Advanced Electricity Generation	PNG-07-001	1	ADI Thermal Power Corporation	A 100 kW dual shell Stirling engine integrated with a catalyzed flow burner designed to meet the CARB 2007 emission standards	\$249,536	10/15/2007
Advanced Electricity Generation	SAIC-06-020-P-R	1	H. Jaeger Associates	Syn Gas Fired Advanced Gas Turbine Analysis	\$19,999	9/17/2007
Advanced Electricity Generation	SAIC-06-028-P-S	1	Alternative Energy Systems Consulting, Inc.	Technical Review of CCHP Proposals	\$14,994	12/10/2007
Advanced Electricity Generation	UC BOA-179	1	Lawrence Livermore National Laboratory	Report to Legislature Accelerating Carbon Sequestration Strategies	\$100,000	6/15/2007
Advanced Electricity Generation	UC MR-026	8	UC Riverside	Assessing Near Field Impact of DG through Tracer Studies	\$399,999	9/1/2007
Advanced Electricity Generation	UC MR-026	9	TIAX LLC	Impacts of Short Term, Interbasin and Interpollutant Credit Trading on air Quality and Credit Prices	\$200,000	6/1/2007
Advanced Electricity Generation	UC MR-067	1	UC Davis	Assessment of Central Valley Agricultural Carbon Sequestration Potential	\$50,000	5/25/2007
Advanced Electricity Generation	UC MR-068	1	National Fuel Cell Research Center - UC Irvine	Research, Development, and Demonstration Plan for Fuel Cells	\$225,905	3/1/2007
Advanced Electricity Generation	UC MR-073	1	Lawrence Livermore National Laboratory	Research Activities for the AB1925 Report to the Legislature on Accelerating Geologic Carbon Sequestration Strategies	\$150,000	9/1/2007
Renewables Total					\$6,385,493	36
Renewables	500-01-032	105	UC Santa Cruz	Evaluating Pre-Construction Sampling Regimes for Assessing Patterns of Bat Activity at Wind Energy Development in Southern California	\$143,388	7/1/2007
Renewables	500-06-024	1	AWS Truewind, LLC	Expanded Sodar Monitoring	\$250,000	2/19/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Renewables	500-06-033	1	Lawrence Livermore National Laboratory	California Geothermal Energy Collaborative	\$450,000	4/16/2007
Renewables	500-06-037	1	Pacific Gas and Electric Company	Regional Integration of Renewables-Northern California Transmission Integration	\$800,000	5/14/2007
Renewables	500-06-044	1	Lawrence Livermore National Laboratory	Effects of Climate Change Impacts on Future Renewable Energy Generation (Wind, Solar, Hydro)	\$425,000	10/1/2007
Renewables	500-06-048	1	Center for Energy Efficiency and Renewable Technologies	Renewable Resource/Transmission Development Scenarios	\$999,714	9/7/2007
Renewables	500-98-014	207	Nanotron	Low Cost Laser Process for Fabricating Multi-Junction Solar Cells	\$95,000	2/1/2007
Renewables	500-98-014	214	Xtreme Energetics, Inc.	Solid-State Electro-Fluidic Solar Tracker	\$95,000	2/1/2007
Renewables	500-98-014	217	Gaia Power Technologies	Time Shifting of PV Generation Using Dispatchable Distributed Energy Storage	\$76,731	2/1/2007
Renewables	500-98-014	218	Iowa State University	Wheat Straw Utilization to Produce Syngas/Hydrogen Fuel for Power Generation	\$95,000	7/1/2007
Renewables	500-98-014	219	Priyam Inc.	Cost Reduction in Solar Cell Electricity	\$95,000	6/1/2007
Renewables	500-98-014	220	Washington State University	Innovative Design of High Solids Digestion Plants for Economic and Renewable Energy Production	\$93,595	8/1/2007
Renewables	500-98-014	221	Solarec, Inc.	Clean and Dispatchable Renewable Electricity through Solar Reduction of Carbon	\$95,000	7/9/2007
Renewables	500-98-014	224	Scott Larwood	Dynamic Analysis Tool Development for Advanced-Geometry Wind Turbine Blades	\$67,250	6/28/2007
Renewables	500-98-014	229	San Diego State University	Feasibility Study of a Flexible Symmetrical Turbine Blade for Wind Energy Conversion	\$94,856	9/4/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Renewables	500-98-014	237	GC Environmental, Inc.	UV-Photodecomposition of Siloxane	\$95,000	12/1/2007
Renewables	500-98-014	242	University of Southern California	A Pore Flow Reactor for Landfill Gas Clean-up	\$95,000	9/4/2007
Renewables	500-98-014	243	Oregon State University	Enabling the thermochemical production of hydrogen from water: investigation of the Bunsen reaction in a low vapor pressure solvent	\$95,000	9/15/2007
Renewables	BOA-99-182-P	1	The Regents of the University of California, Office of the President - CIEE	Programmatic Renewable Energy Strategic Plan and Multi-Year Technologies RD&D Program Plans	\$221,844	11/15/2007
Renewables	E2I-WA-014	1	Electric Power Research Institute (EPRI)	Assessment of the Compressed Air Energy Storage (CAES) Technology to Meet California Needs	\$50,000	1/15/2007
Renewables	ICF-06-015-P-S	1	Black & Veatch Corporation	Review of Biopower Proposals	\$13,271	11/19/2007
Renewables	NCI-06-010	1	Navigant Consulting, Inc.	Renewables Cost Data Collection and Analysis	\$84,955	1/8/2007
Renewables	NCI-06-021-P-R	1	Navigant Consulting, Inc.	PIER Renewables Roadmap Update	\$55,782	12/19/2007
Renewables	SAIC-06-012	1	Alternative Energy Systems Consulting, Inc.	Biofuels RD&D Proposal Reviews for the 2006-07 Biofuels Grant Solicitation	\$10,709	1/18/2007
Renewables	SAIC-06-014	1	Asset Reliance International, LLC	Wind Monitoring Equipment Valuation	\$1,926	2/26/2007
Renewables	SAIC-06-016	1	Science Applications International Corporation (SAIC)	Natural Gas Replacement Solicitation Technical Reviews	\$43,586	2/28/2007
Renewables	SAIC-06-018	1	Black Mountain Technology	Technical Reviewer for the Bottle Rock Project (Part 1)	\$12,650	4/18/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Renewables	SAIC-06-019	1	Princeton Energy Resources International, LLC	Focused Economic Study of Bio-Energy Production	\$49,978	5/29/2007
Renewables	SAIC-06-021-P-R	1	Susan Sanders Biological Consulting	PIER Research Roadmap for Bird and Bat Collisions with Wind Turbines	\$42,018	11/5/2007
Renewables	SAIC-06-022-P-S	1	Susan Sanders Biological Consulting	PIER Solicitation and Proposal Review Support for Bird and Bat Collisions with Wind Turbines	\$8,326	11/5/2007
Renewables	SAIC-06-024-P-R	1	Xanthus Consulting International	Proof of Concept for Interoperable Communication Standards for Smart Renewable Community Network Used in Community Choice Aggregation.	\$102,235	12/10/2007
Renewables	SAIC-06-029-G-S	1	Science Applications International Corporation (SAIC)	Technical Reviewers for GRDA Solicitation 2007 Proposals	\$49,996	12/17/2007
Renewables	UC BOA-175	1	The Regents of the University of California, Office of the President - CIEE	UC Assistance for the PIER Renewable Area	\$109,886	3/6/2007
Renewables	UC BOA-176	1	The Regents of the University of California, Office of the President - CIEE	PIER Renewable Energy Research Program Management	\$292,796	3/1/2007
Renewables	UC MR-061	1	Center for Aquatic Biology and Aquaculture - UC Davis	Research on Instream Flow Determinations for Hydropower Applications in California	\$1,000,000	2/2/2007
Renewables	UC MR-069	7	The Regents of the University of California, Office of the President - CIEE	Systems Energy Analysis for California	\$75,000	6/11/2007
Transmission and Distribution Total					\$6,102,632	14

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Transmission and Distribution	500-06-008	2	Navigant Consulting, Inc.	Scoping/Workshop to Determine Microgrid Opportunities in California	\$75,557	3/15/2007
Transmission and Distribution	500-06-050	1	Science Applications International Corporation (SAIC)	Advanced Distributed Sensor Networks for Electric Utilities	\$691,841	8/1/2007
Transmission and Distribution	500-06-055	1	Sacramento Municipal Utility District	Demonstration of the Benefits to Applying Electric Energy Storage for Light Rail Trackside Support	\$400,000	6/29/2007
Transmission and Distribution	500-98-014	213	Nove Technologies	Development of High-Performance Magnesium Diboride-based Superconductor/Metal Matrix Composite Components for use in Superconducting Fault Current Limiters	\$95,000	1/8/2007
Transmission and Distribution	KEMA-06-006	1	KEMA, Inc.	Cybersecurity Technical Assistance	\$17,353	2/16/2007
Transmission and Distribution	UC MR-055	1	Black & Veatch Corporation / Lukens Energy Group	Expansion of proprietary models to conduct research on California natural gas infrastructure and California natural gas market demand scenarios	\$266,277	1/1/2007
Transmission and Distribution	UC MR-056	1	Energy & Environmental Analysis, Inc.	Developing a multi-state natural gas infrastructure simulation model to analyze the value of natural gas storage in California	\$732,733	1/1/2007
Transmission and Distribution	UC MR-057	1	Gas Technology Institute	Developing a California natural gas storage technology research assessment	\$350,082	1/22/2007
Transmission and Distribution	UC MR-058	1	MRW & Associates	Developing a research assessment of regulatory barriers to the expansion of natural gas storage facilities in California	\$109,077	1/1/2007
Transmission and Distribution	UC MR-059	1	UC Davis	Developing a Low Cost, Daily Simulation Model of the California Natural Gas Transportation and Storage Network	\$55,948	1/1/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Transmission and Distribution	UC MR-064	1	The Regents of the University of California, Office of the President - CIEE	Development of Fault Current Controller Technology	\$1,175,000	3/1/2007
Transmission and Distribution	UC MR-065	1	National Renewable Energy Laboratory	WECC Wind Generation Modeling	\$573,764	4/1/2007
Transmission and Distribution	UC MR-070	1	UC Berkeley	Underground Cable Fault Detection and Sensor-based Cables for Underground Reliability for Electricity Infrastructures	\$400,000	6/22/2007
Transmission and Distribution	UC MR-076	1	Pacific Northwest National Laboratory	Extreme Event Research	\$1,160,000	11/23/2007
Climate Science Total					\$2,354,467	16
Climate Science	500-06-042	1	California Air Resources Board	Haagen-Smit Symposium 2007	\$50,000	5/1/2007
Climate Science	500-07-001	1	Lawrence Berkeley National Laboratory	Estimating the Global Climate Impact of Urban Albedo	\$150,000	9/17/2007
Climate Science	500-07-004	1	UC Davis	Dynamics of Sierra Nevada Conifer Loss Under Climate Change	\$114,996	10/9/2007
Climate Science	500-07-013	1	Hydrologic Research Center (HRC)	Performance of the Northern California Water System Under Climate Change: INFORM as an adaptation tool	\$199,600	12/4/2007
Climate Science	BOA-99-186-P	1	The Regents of the University of California, Office of the President - CIEE	2008 Scenarios Project Supplementation	\$50,000	12/17/2007
Climate Science	ICF-06-012	1	ICF Resources, LLC	Technical and Outreach Support for the PIER Climate Change Research Program	\$138,238	4/9/2007
Climate Science	SAIC-06-013	1	Science Applications International Corporation (SAIC)	2007 California Global Climate Change Conference Expenses	\$94,998	2/16/2007
Climate Science	UC MR-063	1	UC Berkeley	Water, Energy and Climate Change	\$456,644	3/16/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
Climate Science	UC MR-069	1	The Regents of the University of California, Office of the President - CIEE	Point of Compliance Regulation and Point of Allocation in a CO ₂ Cap and Trade Program for the Electricity Sector in California	\$75,000	9/1/2007
Climate Science	UC MR-069	2	The Regents of the University of California, Office of the President - CIEE	Quantifying Greenhouse Gas Emissions Generated by the Consumption Patterns of California Residents	\$75,000	8/1/2007
Climate Science	UC MR-069	3	The Regents of the University of California, Office of the President - CIEE	Ozone Reductions Using Building Envelopes	\$75,000	7/5/2007
Climate Science	UC MR-069	4	The Regents of the University of California, Office of the President - CIEE	Effects of Global Climate Change on Building Energy Consumption and its Implications on Building Energy Codes and Policy in California	\$75,000	6/11/2007
Climate Science	UC MR-069	6	The Regents of the University of California, Office of the President - CIEE	Rapid Global Warming & Breeding in Migratory Birds: Utilizing an Undervalued Historic Database	\$75,000	12/1/2007
Climate Science	UC MR-069	8	The Regents of the University of California, Office of the President - CIEE	Ecosystem Feedbacks to Climate Change in California: Integrated Climate Forcing from Vegetation Redistribution	\$74,992	6/11/2007
Climate Science	UC MR-071	1	National Center for Atmospheric Research	Validation of Lateral Boundary Conditions for Regional Climate Models Applied to the California Region	\$150,000	7/20/2007
Climate Science	UC MR-074	1	PRBO Conservation Science	Biological Impacts of Climate Change in California (BICCCA)	\$500,000	10/12/2007
General Total					\$1,630,772	20
General	500-06-034	1	The Regents of the University of California, Office of the President - CIEE	PIER Program Manager	\$492,660	6/1/2007
General	ICF-06-014-	1	SDV-SCC, Inc.	Electricity Journal Article	\$4,505	9/17/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
	P-S					
General	ICF-06-016-P-S	1	Public Sector Consultants, Inc.	Contract Business Process Support	\$106,995	11/1/2007
General	ICF-06-017-P-S	1	Public Sector Consultants, Inc.	Support to Reports and PIER Information Management System (PIMS)	\$84,075	11/1/2007
General	ICF-06-018-P-S	1	SDV-SCC, Inc.	Technical editor for 2007 RD&D Annual Report	\$28,549	11/1/2007
General	ICF-06-019-P-S	1	ICF Resources, LLC	Contract Administration and Management Task 1	\$74,700	12/1/2007
General	ICF-06-020-P-R	1	ICF Resources, LLC	Contract Administration and Management Task 1	\$80,340	12/1/2007
General	KEMA-06-008-P-S	1	Public Sector Consultants, Inc.	Software Engineer and Database Administrator for PIMS.	\$53,521	11/1/2007
General	KEMA-06-009-P-S	1	Public Sector Consultants, Inc.	Software Engineer and Database Analyst for PIMS	\$43,943	11/1/2007
General	KEMA-06-010-P-S	1	Public Sector Consultants, Inc.	Information Technology Project Management for PIMS	\$73,690	11/1/2007
General	KEMA-06-011-P-S	1	KEMA, Inc.	Contract Administration and Management Task 1	\$36,294	12/1/2007
General	KEMA-06-012-P-R	1	KEMA, Inc.	Contract Administration and Management Task 1	\$73,920	12/1/2007
General	NCI-06-015-P-S	1	Navigant Consulting, Inc.	Contract Administration and Management Task 1	\$9,210	12/1/2007
General	NCI-06-016-P-R	1	Navigant Consulting, Inc.	Contract Administration and Management Task 1	\$232,710	12/1/2007
General	ROY-06-001	1	Clean Energy Systems, Inc.	Royalty Agreement Between Clean Energy Systems, Inc. and the California Energy Commission	\$0	6/29/2007
General	SAIC-06-011	1	Science Applications International Corporation (SAIC)	2006 PIER Annual Report Preparation	\$34,047	1/11/2007

SB 1250	Contract Number	Project #	Company Name	Project Title	Project Amount	Start Date
General	SAIC-06-023-P-S	1	Science Applications International Corporation (SAIC)	Report - design and editor support.	\$40,094	12/7/2007
General	SAIC-06-025-P-S	1	Science Applications International Corporation (SAIC)	Contract Administration and Management Task 1	\$9,210	12/1/2007
General	SAIC-06-026-P-R	1	Science Applications International Corporation (SAIC)	Contract Administration and Management Task 1	\$145,110	12/1/2007
General	SAIC-06-027-G-R	1	Science Applications International Corporation (SAIC)	Contract Administration and Management Task 1	\$7,200	12/1/2007

