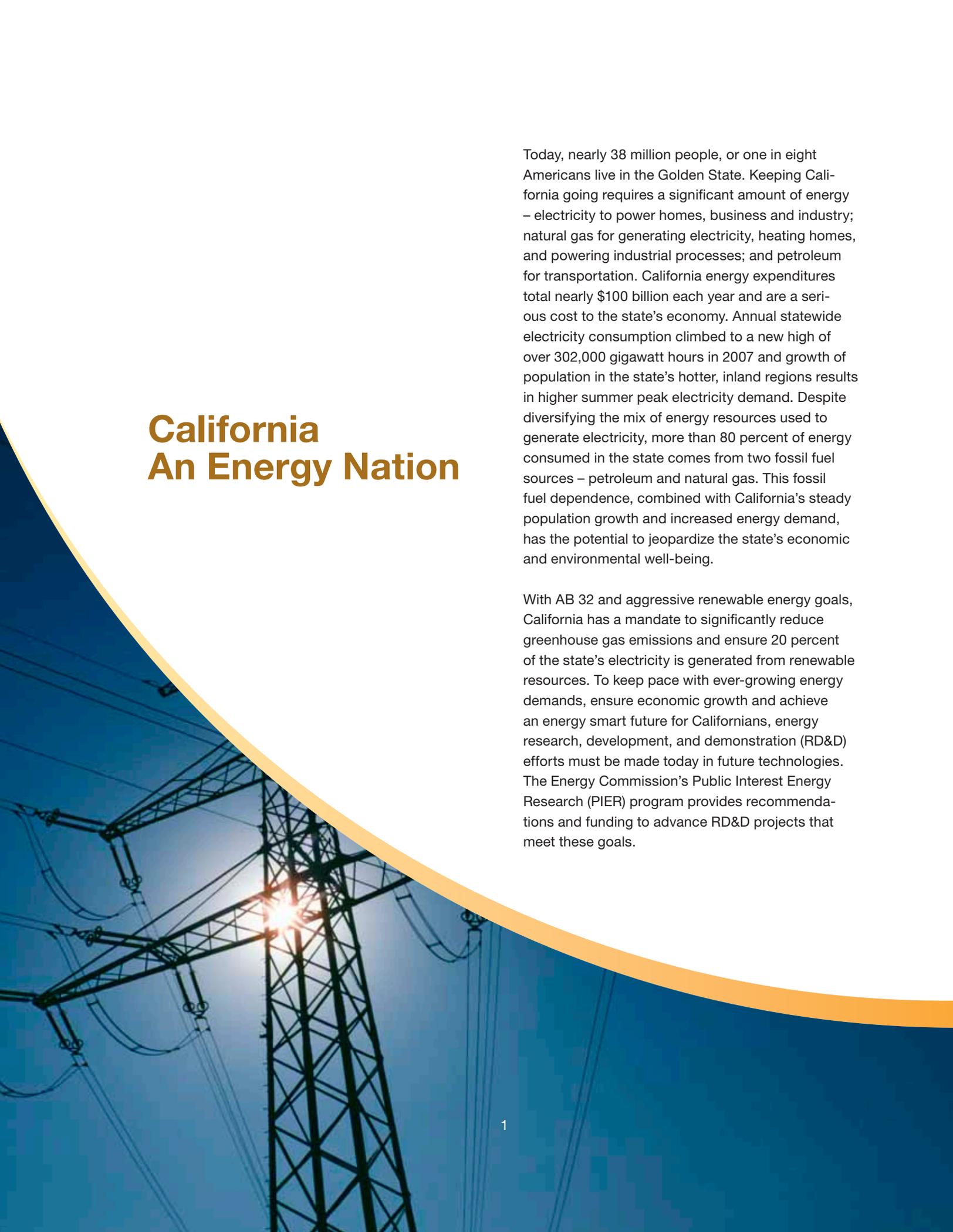


California Energy Commission

PUBLIC INTEREST ENERGY RESEARCH

A Decade of
Advancing California Technology

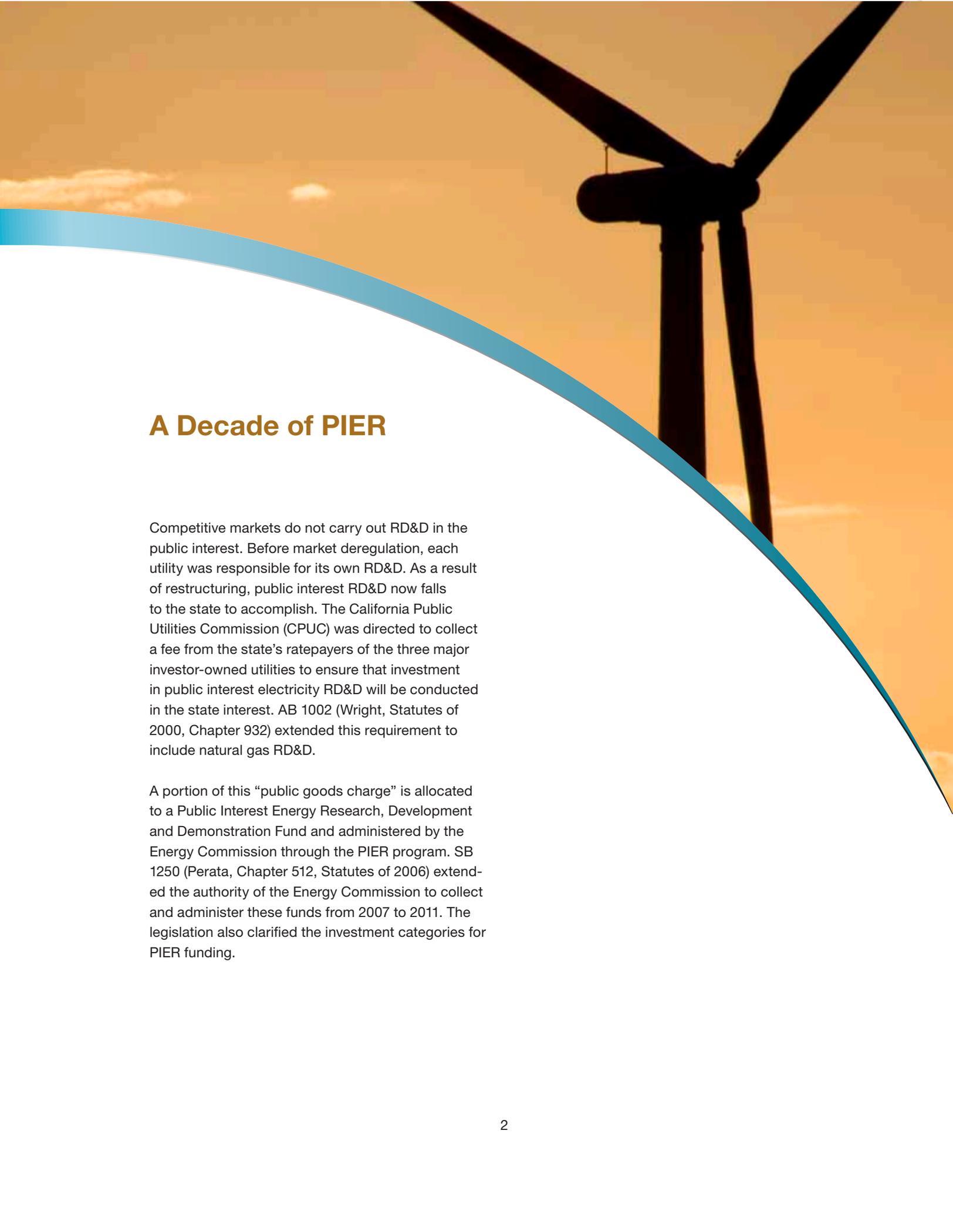




California An Energy Nation

Today, nearly 38 million people, or one in eight Americans live in the Golden State. Keeping California going requires a significant amount of energy – electricity to power homes, business and industry; natural gas for generating electricity, heating homes, and powering industrial processes; and petroleum for transportation. California energy expenditures total nearly \$100 billion each year and are a serious cost to the state's economy. Annual statewide electricity consumption climbed to a new high of over 302,000 gigawatt hours in 2007 and growth of population in the state's hotter, inland regions results in higher summer peak electricity demand. Despite diversifying the mix of energy resources used to generate electricity, more than 80 percent of energy consumed in the state comes from two fossil fuel sources – petroleum and natural gas. This fossil fuel dependence, combined with California's steady population growth and increased energy demand, has the potential to jeopardize the state's economic and environmental well-being.

With AB 32 and aggressive renewable energy goals, California has a mandate to significantly reduce greenhouse gas emissions and ensure 20 percent of the state's electricity is generated from renewable resources. To keep pace with ever-growing energy demands, ensure economic growth and achieve an energy smart future for Californians, energy research, development, and demonstration (RD&D) efforts must be made today in future technologies. The Energy Commission's Public Interest Energy Research (PIER) program provides recommendations and funding to advance RD&D projects that meet these goals.



A Decade of PIER

Competitive markets do not carry out RD&D in the public interest. Before market deregulation, each utility was responsible for its own RD&D. As a result of restructuring, public interest RD&D now falls to the state to accomplish. The California Public Utilities Commission (CPUC) was directed to collect a fee from the state's ratepayers of the three major investor-owned utilities to ensure that investment in public interest electricity RD&D will be conducted in the state interest. AB 1002 (Wright, Statutes of 2000, Chapter 932) extended this requirement to include natural gas RD&D.

A portion of this "public goods charge" is allocated to a Public Interest Energy Research, Development and Demonstration Fund and administered by the Energy Commission through the PIER program. SB 1250 (Perata, Chapter 512, Statutes of 2006) extended the authority of the Energy Commission to collect and administer these funds from 2007 to 2011. The legislation also clarified the investment categories for PIER funding.



Program Funding

Currently, the PIER program receives approximately \$62.5 million per year in surcharges on electricity rates, and \$24 million per year in surcharges on natural gas rates. Since the program's beginning \$587.7 million has been invested in innovative energy technologies.

The Energy Commission's PIER program supports pioneering RD&D in these six program areas:

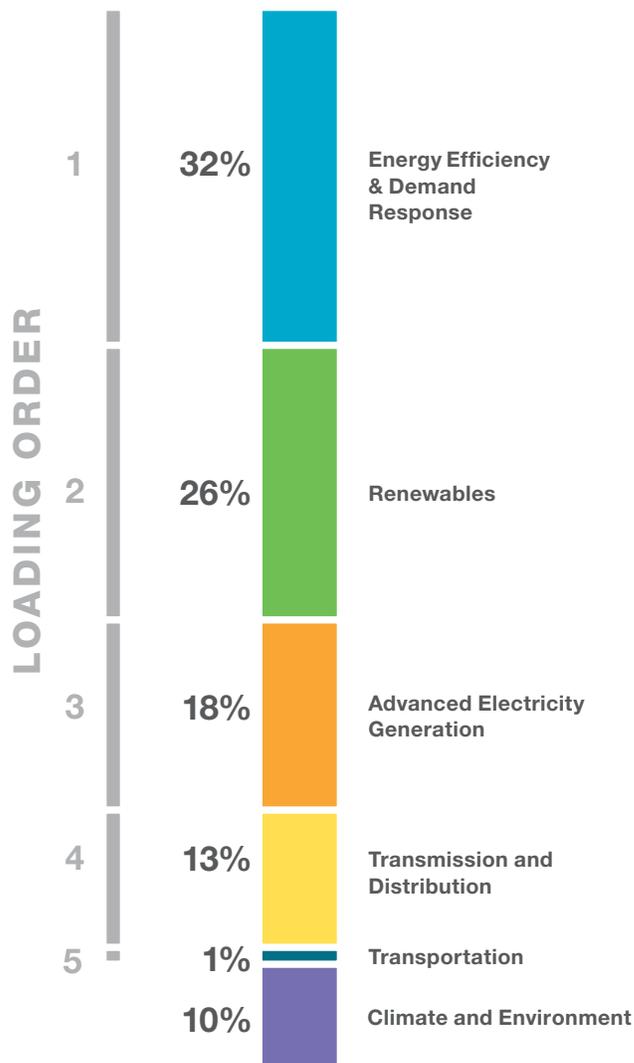
- Energy Efficiency and Demand Response
- Renewable Resources
- Advanced Electricity Generation
- Transmission and Distribution
- Energy-Related Environment and Climate Science
- Advanced Transportation Technologies

Investment Categories

Since 2003, the PIER program has tailored its project investments to follow the state's energy policy for the preferred sequence of energy development to meet growing electricity and natural needs. This "loading order" of new resources specifies that the first priority is energy efficiency; second, renewable resources; and third, clean fossil fuel sources combined with continuous infrastructure improvements. The California Global Warming Solutions Act of 2006 (Nuñez, Chapter 488, Statutes of 2006), also known as AB 32 added additional focus to increase efforts to reduce greenhouse gas (GHG) emissions to 1990 levels by 2020. Currently, state statutes require that renewable energy resources supply 20 percent of our electricity needs by 2010 and the Governor has set a more ambitious goal of 33 percent electricity from renewable resources by 2020. Research and development in technologies that advance and support energy efficiency, renewable energy, transmission and a sustainable environment provide an important link in moving California towards meeting its directives and contributing to economic and environmental health.

PIER Expenditures by Research Category

1997–2008, \$587.7 Million Total



The Energy Commission uses important multiple avenues to further California’s energy policy goals when strategically investing in RD&D projects. These approaches are:

Create Research Roadmaps

Identify technology gaps and cutting-edge research opportunities.

Solicit Competitive Bids and Small Grant Applications

Maximize promising new technologies for development and demonstration.

Achieve Economies of Scale

Use community-scale research opportunities combined with multiple technologies to achieve more bang for the buck.

Integrate Energy and Land Use

Ensure land-use policies reflect the impact of these decisions on energy systems including renewable resources and transportation.

Target Opportunities

Work with individual companies on specific technologies, leverage other current research and take advantage of unexpected opportunities, such as the federal stimulus funding.

Engage the Research Community

Focus California’s world-class scientists and engineers at its universities, national laboratories and industries on the state’s energy priorities..



Funding Forward Looking Projects

The PIER program is administered by Energy Commission staff under the direction of the five members of the Energy Commission through an RD&D Committee, consisting of two Commissioners who provide policy guidance for the program. The RD&D Committee reviews and recommends all RD&D activities before approval by the Energy Commission at public Business Meetings.

Funding decisions in the six strategic RD&D areas follow the SB 1250 goal for the PIER program to “develop and help bring to market energy technologies that provide increased environmental benefits, greater system reliability, and lower system costs.”



The PIER annual report provides a review of the program budget and research accomplishments from the previous year and outlines the investment priorities for next year's strategic PIER program areas. The Energy Commission focuses all RD&D funding to align with California's "loading order" and the energy policies and directives from the Integrated Energy Policy Report (IEPR).

The Energy Commission also encourages stakeholders, experts, and the general public to help determine research priorities. Stakeholders and the public are invited to develop a shared vision through workshops and written comments.

The Energy Commission, with SB 1250 guidance, has also formed an advisory board to provide direction on funding priorities. The board includes representatives from the CPUC, environmental organizations, consumer groups, and the investor-owned utilities. Six members of the California Legislature may be designated as members and participate in its activities.



Strategic Partnerships

The Energy Commission relies on strategic partnerships to help carry out its research, development, and demonstration activities. Partnerships are used to avoid duplication, build on successful RD&D work, generate new ideas, leverage public and private investments, and ensure that the RD&D portfolio provides benefits to the state's electric and natural gas customers. Such partnerships facilitate inter-agency research coordination and cooperation and often include other state agencies, local and regional entities, industry, utilities and researchers.

Additionally, the Energy Commission taps into California's diverse and substantial research capabilities at state universities, national laboratories, and high-tech companies. Creating and sustaining these partnerships helps leverage RD&D investments, and is essential to performing the right research for the greatest benefit to California's ratepayers.



Research and Building Standards

Since 1978, California's Building and Appliance Efficiency standards have saved consumers more than \$56 billion in electricity and natural gas costs. These standards are estimated to save an additional \$23 billion by 2013. The PIER program is an integral part of making certain these standards capture the most efficient technologies and measures currently available that save energy and money for California's residential, commercial, industrial and agricultural consumers. The Energy Commission uses the results and expertise gained from R&D to improve and accelerate highly efficient building technologies into building codes, standards and practices. Some of the PIER projects used in the most recent changes to the 2008 Title 24 Buildings standards are LED exterior lighting, LED night lighting in hotel bathrooms, measures to improve indoor air quality and ventilation efficiency, load shedding florescent ballasts, cool roofs, integrated classroom lighting system design and duct sealing measures to reduce energy losses.



Looking Toward the Future

The PIER program is expected to continue its successes. Funding categories are already guided by the state's established energy loading order and future funding is expected to continue to follow this policy. Fostering new projects with RD&D provides significant economic benefits and growth for California. The Energy Commission's PIER program looks forward to helping the state meet aggressive energy efficiency and GHG reduction goals with essential research and development in the coming years

PIER projects will also be more likely to concentrate on communities, rather than individual homes or businesses. For example, while a few individual buildings with ideal orientations and access to sunlight may be able to completely offset their own electricity consumption through photovoltaics, a community-wide approach could achieve numerous additional energy efficiency and renewable generation technology integrations.



Big Ideas, Small Investments

Not all research is carried out in large corporation or university settings – individuals can have a slice of the PIER investment funds through the Energy Innovations Small Grant (EISG) Program. The EISG provides up to \$95,000 for hardware projects and \$50,000 for modeling projects to small businesses, non-profits, individuals and academic institutions for research that shows the practicability of new, innovative energy concepts. Research projects must target one of the PIER R&D areas, address a California energy problem and provide a potential benefit to California electric and natural gas ratepayers. Many EISG projects have been successfully commercialized and have leveraged the initial PIER seed funds with additional private or federal funding.

For example, Clipper Wind used an EISG to develop an innovative distributed generation drive for wind turbines then obtained over \$13 million from DOE for the commercial development and use of the technology. Since 1999, the EISG program has awarded more than \$13 million to 170 projects like Clipper Wind.



Frito-Lay Solar-Thermal Project

CASE STUDY

Through a partnership with Frito-Lay, this PIER project involves using solar thermal technology in commercial food production. This innovative demonstration project harnesses the sun's energy to produce Frito-Lay's newest snack, Sun Chips®. By using energy efficient parabolic solar collectors that fill the size of two football fields, the sun's rays heat water in parabolic collectors, creating steam to generate electricity that powers a boiler to cook the chips. Frito-Lay saves 15 percent in natural gas costs annually and uses less natural gas. Additional benefits are the reduction of greenhouse gas emissions and better air quality for the Central Valley. Frito-Lay leads by example and encourages other California industries to adopt this energy-saving technology.



Bagging the Sun

California's mandate to generate 20 percent of our electricity from renewable energy by 2010 also spurs private sector development of renewable energy electricity generation sources. Investments by PIER in renewable energy research and development can reduce natural gas demand and electricity load on the state's grid, benefiting California's industry bottom line and reducing state energy demand.



Plug-In Hybrid Electric Vehicles Research Center

CASE STUDY

With \$3 million from the Energy Commission's PIER program, UC Davis established the Plug-in Hybrid Electric Vehicle (PHEV) Research Center to study clean vehicle technology. Plug-in hybrids provide an important near-term solution for reducing our dependence on gasoline. One of the center's initial research projects will place 10 plug-in hybrids with more than 100 local families who will evaluate them for up to eight weeks over the next two years. By investing in alternative forms of transportation, Californians can reduce our dependence on petroleum, increase the use of alternative fuels, increase our energy security, and reduce the factors that contribute to global warming.

The center will study the economic benefits of plug-in hybrid vehicles to the consumer and the electricity grid. The goals of the center are to enhance the commercial viability of plug-in hybrid electric vehicles; provide timely and valuable information for policy makers, industry leaders, consumers, and the environmental community on strategies to address the state's transportation energy challenges; and support PHEV demonstration and related efforts in California.



A Highway Nation

Perhaps no other population in the world has embraced the automobile as passionately – nor is any other state defined as much by the car – as California. California consumes 16 billion gallons of gasoline annually, and is the third largest consumer of gasoline in the world, surpassed recently by China in the number two position and the United States, as a whole, at number one. China’s demand for gasoline is projected to grow dramatically. Currently, 39 percent of the California’s crude comes from instate production, 45 percent of the crude oil supplies is imported from foreign sources and 16 percent shipped from Alaska.



Finelite's Integrated Classroom Lighting System

CASE STUDY

The Energy Commission PIER-funded Finelite Integrated Classroom Lighting System (ICLS) has garnered positive feedback in classrooms all over the Golden State. School districts that have embraced this technology save on energy costs and provide teachers and students a better learning environment with softer, functional and more directional lighting conditions. Installations in 78 California locations representing 41 cities include: 28 K-12 schools, three University of California campuses, six California State University campuses and four California community colleges. In May 2008, the American Institute of Architects named the Nueva School in Hillsborough (San Mateo County) one of its Top Ten Green Projects because of its adoption of the ICLS. Other states following California's lead include: Alaska, Indiana, Kentucky, New York, and Texas.



Illuminating Education for Today's Students

California's school system is the largest in the country. One out of every eight students in kindergarten through 12th grade in America attends school in our state. With more than six million students in approximately 9,800 schools, California's public education system is impressive and challenging. Each year 100,000 new students enter the California school system – most spending their time in more than 30-year-old buildings.

Improving student performance and increasing achievement in the 21st Century are linked to clean, smart, and comfortable classroom settings. California schools spend \$700 million a year – nearly three percent of their total budget – on energy. That's about the same amount schools spend on books and supplies every year. Investing in today's design knowledge and most efficient technology provides a smarter, more comfortable learning environment in a facility that costs less to operate and enables educators to focus on students.

If all of California's schools used more energy efficient lighting, for example, the energy savings potential would be nearly 562 gigawatt hours annually when compared to current classroom lighting.



Winesecrets Selective Tartrate Removal System

CASE STUDY

Napa-based Winesecrets is using PIER funding to demonstrate to California's wine industry how to improve their product and save money with innovative energy-saving technology.

Winemakers go to great lengths to prevent the formation of crystalline sediment in wine known as tartrates. These harmless crystals are usually removed through a process known as cold stabilization – one of the most energy-intensive processes for a winery. The Selective Tartrate Removal System (STARS) eliminates costly refrigeration by removing tartrates through electro dialysis – passing the wine through membranes to remove sediment. The process results in a 95 percent savings of electricity consumption and its mobile technology goes on-site to the wineries. Domaine Chandon and Fetzer Wineries have successfully used this technology that saves energy and produces a high quality product. If adopted by all California wineries, STARS could save 24 million kilowatts each year (about \$2.6 million annually).



Wine and California's Economy

Wine is California's most valuable finished agricultural product. California produces more than 90 percent of all U.S. wine production, making California the nation's largest wine producer and the world's fourth. The full economic impact of the wine industry on California totals \$45.4 billion each year, counting revenues to the wine industry and allied industries, direct, indirect, and induced economic benefits. Wine grapes are grown in 46 of California's 58 counties, covering 522,000 acres. Half of all the wineries in the United States are located in our state.

SUCCESS STORIES

ENERGY EFFICIENCY AND DEMAND RESPONSE

Watt Stopper

Watt Stopper/Legrand has been stopping energy waste in commercial facilities for more than 20 years, and is now turning its efforts to residential applications. The company has developed the first generation of home occupancy/vacancy sensors to automatically turn off lights in unoccupied rooms.

Lighting with Attitude

Working with the California Lighting Technology Center and the Energy Commission, Finelite developed a LED-based personal lighting system that achieves 70 percent savings over current task lighting and reduces the need for ambient office lighting. The Department of General Services and the Department of Motor Vehicles have adopted the sleek lighting in some state buildings, and the State Capitol is part of a demonstration project.

Look Ma, No Hands

Digital lighting controls that allow daylight harvesting, occupancy control, and personal control have not often been installed in existing facilities because they are expensive and disruptive. An innovative wireless lighting-control, monitoring, and management system developed by Adura Technologies provides significant energy savings and eliminates the costly and time-consuming installation of control wiring.

Smart SMUD

By integrating telecommunication and electricity, “smart grid” technologies can assist the state in meeting numerous goals. With smart grids, electricity transmission and distribution will become more reliable, as grid operators develop the tools to better monitor, isolate and correct problem in the grid. PIER is funding the Sacramento Municipal Utility District (SMUD) for the first phase of research to explore the installation of a Microgrid /Smartgrid at SMUD corporate headquarters in a single customer, multi-facility application.

Build a Better Computer

Merging laptop and desktop computer technology and using off-the-shelf components, researchers have developed a highly energy efficient hybrid computer that consumes up to 70 percent less energy than Energy Star® labeled computers. Ecos Consulting and PIER developed a prototype computer that consumes only 19 watts in sleep mode.

Cool Data

Data centers provide data storage for websites and databases and may use 100 times more electricity than a typical office building on a square foot basis – putting a strain on the electric grid, especially in summer months during peak periods. The California Franchise Tax Board data center has benefited from a PIER project – wireless temperature sensors and variable frequency drives. Lawrence Berkeley Laboratories has estimated that the FTB data center has reduced fan energy by 58 percent, electricity use by 310,000 kWh and energy costs by \$27,900 per year. With thousands more data centers in the state, the potential savings from research in this area are significant.

SUCCESS STORIES

RENEWABLE RESOURCES

Garbage In, Electricity Out

With funding from PIER, UC Davis is demonstrating waste conversion using an anaerobic digestion technology. The anaerobic digester will be used at Campbell Soup in Sacramento to demonstrate digestion of green and food, to process up to 25 tons of waste per day and generate electricity.

Waste Not, Want Not

Under a PIER grant, Makel Engineering of Chico developed and demonstrated a low-emissions generator system fueled by landfill gas at a landfill in Butte County. Makel's Homogenous Charge Compression Ignition (HCCI) is a hybrid of diesel and internal combustion engines, and may be considered a model for the engine of tomorrow. This technology generates electricity while achieving the Air Resources Board's 2007 performance standards. It allows harmful nitrogen oxide (NOx) emissions to be reduced as much as 20-to-1 as compared to a conventional engine without requiring expensive exhaust cleanup equipment.

Cows Rule

Happy cows live in California and currently make up 18 percent of all milking cows in the United States. The dairy industry represents a significant bioenergy resource (dairy manure or mixture of dairy manure with cheese wastewater, creamery wastewater, and food processing wastewater). PIER research supports engine generators at 10 dairies in the Central Valley (11 systems) producing a total of 3.3 megawatts.

Organic Power

The PIER Renewables Program is demonstrating a first-of-its-kind 50kW modular gasification system for grid-connected combined heat and power using biomass residue at Dixon Ridge Farms, the nation's largest handler of organic walnuts in Winters, California. This technology produces 40 percent of the farms' electricity needs (about \$30,000 annually) for shelling and freezer storage and 25 percent of the propane required for walnut dryers and heating of farm buildings during the winter.

SUCCESS STORIES

ADVANCED ELECTRICITY GENERATION

Tracking the Sun

The Golden State is blessed with abundant sunshine, an essential resource in the state's renewable energy future. PIER R&D has demonstrated a new improved tracker for solar PV systems that can reduce the capital costs, installation and maintenance time, and improve the reliability of solar tracker systems for utility and large-scale commercial applications.

This project reduced tracker life cycle cost by 29 percent, installation time by 58 percent, and material waste stream by 20 percent. Commercial systems have been installed at Alameda Public Works, Hayward; US Postal Service, San Francisco; and Napa Valley College, Napa.

Power to the System

A PIER R&D project has developed and demonstrated a partial oxidation gas turbine (POGT) that shows promise for unusually high efficiency electricity power generation in industrial heat and power systems applications. The project that modified a 200 kW gas turbine to the new POGT system has found significant potential for cost reduction and performance improvement:

- Turbine power output can be increased by more than 100 percent
- A 55 percent increase of electrical efficiency for steam simple cycles
- An 88 percent total efficiency for combined heat and power

TRANSMISSION AND DISTRIBUTION

No Sag Electricity

Excessive sagging of transmission lines during hot weather or high energy use impacts the electricity grid's efficiency and can lead to system failure such as what happened in 1996 when a major transmission line sagged into a tree sparking a transmission line failure that knocked out power to four million people in eight western states, including California. The Sagging Line Mitigator (SLiM) is a successful commercialized product that prevents excessive sagging of transmission lines during hot weather and high-energy use. The SLiM hardware provides solutions to routine utility problems, saving millions of dollars in economic losses that might result from power failures.

Collaborating in "Real Time"

The PIER Transmission Research Program brought together utilities, industry and the academic community to create a "Real-Time Transmission Line Rating System" allowing electric utilities to ease constraints on transmission line power transfers at critical localities on the grid. California field tests indicate that each one megawatt increase facilitated by this system could result in a net 14 megawatts increase in transmission capability – without having to add transmission lines or power plants. And these efficiencies are possible over 90 percent of the time in the summer months. To date, over 20 of these systems have been installed in California.

SUCCESS STORIES

CLIMATE SCIENCE AND ENERGY

Risks from a Changing Climate

Our Changing Climate: Assessing the Risks to California, a PIER research science study, provides a concise overview that addresses the serious risks continued global warming poses for the state and was one of the first documents to quantitatively evaluate the impacts of climate change on California. Topics range from climate change scenarios to the cost of climate change impacts on California's energy resources, public health, water, forests, economy, agriculture, and overall way of life.

Annual Climate Change Conferences

This annual event is the first state-sponsored research program on climate change in the nation, focusing on California-specific issues. The research presented complements federal efforts to produce scientific information on climate change policy. Conference presentations are tailored to share technical information in an easy-to-understand manner with policy makers, managers, climate change researchers, news media, and the general public. More than 300 people attended the 2008 conference and three times that number worldwide watched the presentations via streaming video.

TRANSPORTATION

Smells Like French Fries

A \$1 million investment from the California Energy Commission will fund San Francisco's first FOG (Fats, Oils and Grease)-to-biodiesel plant breaking new ground for sustainable fuel production in California. An additional U.S. EPA grant ensures the project serves as a tangible model – with a “how-to” manual or open source toolkit – for cities across the entire nation to replicate the project.

Though programs to turn yellow cooking oil into biofuel are increasingly popular, this project makes full use of the “brown grease” that is currently discarded as waste. Brown grease is the mix of used oils and food scrapings that flow down the sink drain during dishwashing, food preparation, and daily cleaning. Putting this previous waste-only product to use, the San Francisco biodiesel plant will refine brown grease collected from restaurants and residents and create multiple types of alternative energy.

PIER RESEARCH CENTERS

Plug-In Hybrid Electric Vehicles Research Center

Using \$3 million from the Energy Commission's PIER program budget, UC Davis is establishing Plug-in Hybrid Electric Vehicle (PHEV) Research Center to study clean vehicle technology.

California Lighting Technology Center

The California Lighting Technology Center at the University of California, Davis was established with funding from the PIER program to advance energy efficient lighting and daylighting technologies. The facility includes full-scale lighting and daylighting application laboratories for the development and demonstration of next-generation, emerging lighting and daylighting technologies.

Institute of Transportation Studies

The Institute, funded by the PIER program, provides research on emerging and important transportation issues, disseminating this research through conferences and scholarly publications, and enhancing the quality and breadth of transportation education. The Institute is the only research program in the UC system that hosts a matching graduate education program, and as such recognizes the value of interdisciplinary research and education.

California Climate Change Center

The California Climate Change Center is a virtual research and information website operated by the Public Interest Energy Research (PIER) program. This center is a one-stop resource for climate change research from state climate change agencies including the Climate Action Team, key federal agencies, academic and non profit groups.

Western Cooling Efficiency Center

The hot climates of California's high growth areas are causing increased energy use for cooling. Most California buildings experience large afternoon "load spikes" that are the major cause of electric load peaks. The Cooling Efficiency Center catalogs and supports a range of cooling strategies that together can significantly and cost-effectively reduce the impact of cooling systems on California's electricity grid. Several projects completed over the last ten years show the potential to reduce cooling energy consumption on California buildings by 50 to 90 percent with improved or equivalent comfort compared to conventional systems





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