ENERGY INNOVATION

MOVING TOWARD A CLEAN ENERGY FUTURE

CALIFORNIA ENERGY COMMISSION

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WHO WE ARE

The California Energy Commission is the state's primary energy policy and planning agency. Supporting energy innovation is a pillar of this work. The Energy Research and Development (R&D) Division is a team of engineers, scientists, and administrative and management professionals who collectively lead these innovation projects. The R&D Division manages investments that advance energy science and technology in the areas of energy efficiency, renewable and advanced clean generation, energy transmission and distribution, energy-related environmental protection, and transportation. Our work seeks to make California's electricity and natural gas less costly, more reliable, efficient, cleaner and safer.

THE SCIENCE OF INNOVATION: WHAT WE DO

Rigorous, strategic, and impartial energy investments diversify California's energy portfolio and move new and developing solutions through the energy innovation pipeline from concept to market. Managing research successfully requires experience and a deep understanding of the science of innovation. The Energy Commission's R&D programs are nationally recognized for their achievements.

How We Work

The Energy R&D Division is split into four offices. Each administers innovation projects that protect clean air and water and make energy safer and more reliable:

- *The Energy Efficiency Research Office* leads building, industrial, agricultural, and water efficiency and demand response R&D.
- *The Energy Generation Research Office* directs renewable energy and advanced clean generation R&D, transportation R&D, and research into the environmental aspects of energy.
- *The Energy Systems Research Office* oversees R&D into transmission and distribution, smart grid, storage, and other infrastructure that integrates renewable energy and other efficient advancements into energy systems.
- *The Energy Deployment and Market Facilitation Office* oversees innovations to remove non-technical barriers to emerging clean energy solutions. This includes providing commercialization assistance to entrepreneurs, investing in a trained and adequate workforce, and helping overcome regulatory or permitting hurdles that may unnecessarily stall clean energy projects.

WHY IS ENERGY INNOVATION IMPORTANT?

Economic vitality and social well-being depend upon affordable, safe, and reliable energy. Today, the energy we use and the ways we use it are rapidly changing. Innovation is the bridge that enables California to move from the unsustainable status quo to a clean energy future. Though the public sector cannot provide the entire innovation investment necessary for California's clean energy future, its role is critical.

Energy Commission innovation is essential because:

- Our work *complements corporate funding* by sharing results widely and eliminating the need for multiple innovators to reinvent the same wheel.
- Public innovation *reduces risk* to investors and accelerates the path to market for emerging technologies.
- Private and regulated energy sector investment is low relative to the complexities and challenges of transforming California's energy system. Our work *leverages investment* for maximum benefit.
- Energy infrastructure decisions have a broad impact on public safety and the economy, and our work helps create better policies and achieve current policy goals.

Innovation drives investment: Energy Commission-funded innovations have created billions of dollars in energy savings for California ratepayers, supported the creation of new businesses and thousands of jobs, and attracted billions of dollars in private and federal investment to California.

$884 million our investment

attracted

$1.4 billion match funding

RESEARCH AREAS

Reducing Energy Consumption: Energy Efficiency and Demand Response

California's buildings, industrial, agricultural, and water sectors consume more than 90 percent of the state's annual electricity and thus nearly all the state's natural gas. Energy efficiency continues to be the most important strategy for reducing energy use and cost, peak demand, greenhouse gas emissions, and other harmful impacts associated with the use of energy. Our energy efficiency research and innovation focuses on advancing technologies and strategies that will lay a foundation critical for a low-carbon, affordable energy future.

FROM JUST 19 R&D PROJECTS

Innovation creates savings: An estimated $10 billion in ratepayer savings will result from just 19 efficiency R&D projects whose public results led to upgrades in California's efficiency codes. That's a return on investment of $446 for every $1 invested in the projects.

The Goal: Energy consumption in buildings, industries, agriculture, and resource-intensive processes will be reduced significantly, preserving vital energy capacity and reliability while reducing pollution.

Efficiency innovation means:

Designing and demonstrating buildings that integrate advanced efficiency with renewable energy to approach zero net energy, with projects including a demonstration at a San Diego affordable housing complex that is reducing tenants' energy bills.

Reducing energy waste at energy-intensive sites such as data centers by pioneering intelligent cooling systems. These new approaches, tested at data centers throughout California, are saving 2.3 GWh of electricity per year and spreading rapidly throughout the market.

Advancing wireless smart lighting systems that reduce lighting costs. After demonstrations proving their effectiveness, smart lighting systems are achieving industry and market success.

Deploying automated demand response technologies that are now industry standards, AutoDR and OpenADR. These strategies are already avoiding 260 megawatts of peak load annually, saving California electricity ratepayers an estimated $16.5 million in 2012.

Reducing energy use in the industrial sector while improving products. A demonstration created a wine filtration technology that reduces energy consumption, wine loss, and processing time. The system is now commercially available.

Advancing Clean Energy: Renewables and Advanced Generation

Renewable and clean energy are critical building blocks for constructing California's energy future. For this reason, and to meet multiple policy goals, Energy Commission innovations target key technological, performance, and integration barriers of renewable resources. These resources include biomass, solar, wind, and geothermal energy. Advanced generation R&D focuses on improving distributed generation and combined heat and power technologies.

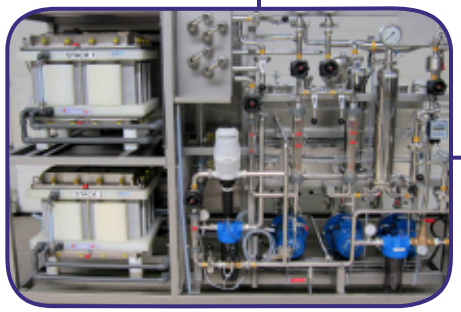
The Goal: Low carbon, sustainable, local, and diverse resources will make California's power portfolio more secure, independent, and flexible.

Clean energy innovation means:

Lowering the cost of renewable energy systems, with demonstrations that cut life cycle costs of a solar PV tracking system by nearly 20%, helping drive the commercialization of solar PV panels.

Proving waste can power industry with demonstrations that road-tested solutions such as the Advanced Energy Recovery System used by Gill's Onions to power its processing plant and save about $700,000 annually.

Testing a breakthrough engine that provides **efficient, low-emission heat and electricity** for on-site energy security. After demonstrating the technology, the system is now being deployed in a utility microgrid pilot.



Advanced energy for communities and industry: Our work helped move forward technologies that now power one of the largest waste-to-energy systems in the nation, and that filter wine efficiently to reduce costs at California vineyards.

Energy Systems: The Architecture of Innovation

Advancements in energy efficiency, renewable generation, and other energy areas require infrastructure improvements. Aging transmission and distribution systems must be upgraded for two-way electricity flows, renewable natural gas, energy storage, and modern communications technologies to provide safer, smarter power.

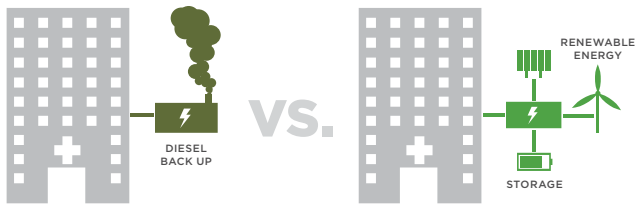
The Goal: Power will be reliably managed by advanced, automated, and self-learning technologies; more generation will be distributed; renewable power will be well-integrated; and modern improvements will reduce environmental impacts.

Infrastructure innovation means:

Demonstrating smart microgrids. The University of California, San Diego microgrid uses advanced technologies to integrate solar power, fuel cells, electric vehicles, and energy storage and meet 92 percent of campus energy needs.

Using faster batteries to integrate wind power in the Central Valley. Validating new technologies boosts investment, with California energy storage companies such as Primus Power growing from a small startup into a nationwide provider of advanced sodium-sulfur batteries.

Reducing outage risks by developing an ultra-fast grid monitoring system that has helped prevent outages in California and is now used by all major grid operators; this system also helps integrate power from variable wind and solar into the grid.



Traditional Backup | Microgrid

Infrastructure innovation protects public safety: Energy Commission grid technology innovations provide power at hospitals, military bases, and the state's third largest jail, keeping people safe and making the electric grid more reliable.

Moving Forward: Transportation

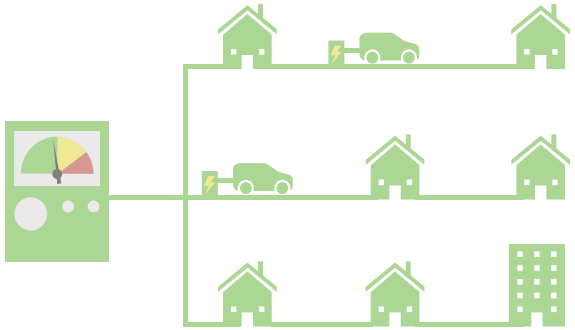
Transportation has the largest carbon footprint of any sector in California, making it a critical area for innovation. Energy Commission R&D focuses on developing and advancing state-of-the-art electricity and natural gas-fueled transportation solutions that reduce fossil fuel consumption, greenhouse gas emissions, and air pollutants in the state's transportation sector.

Transportation innovation means:

Driving the market for clean natural gas-fueled heavy-duty vehicles. Our demonstrations have helped **three new natural gas engines** for heavy duty trucks come to market, helping manufacturers such as Cummins Westport advance cleaner products and providing trucking industry leaders such as United Parcel Service lower cost fuel options and cut pollution.

Partnering with defense agencies in the largest demonstration of vehicle-to-grid technologies, transforming Los Angeles Air Force Base's entire non-tactical fleet into electric vehicles that securely provide clean, reliable energy storage to the base.

The Goal: Vehicles and transportation systems will be efficient, use sustainable and alternative fuels, and be well-integrated into California's energy infrastructure.



Transportation innovation makes energy more reliable: Our vehicle-to-grid demonstration projects are paving new ground. A major pilot project is connecting electric vehicles directly with the grid to be used for instant demand response and energy storage services when not being driven.

Proactive Sustainability: Energy-Related Environmental Research

While California builds its renewable energy portfolio to attain its envisioned energy future, it must also support its legacy of visionary environmental policy goals. The Energy Commission invests in research to identify the best ways to reduce the harmful impacts of energy use and to streamline the process for bringing lower-impact energy projects online.

Energy-related environmental innovation means:

Filling data gaps to help energy development become smarter and lower-impact, with ongoing research identifying threats and effects of energy projects to aid in environmental review and siting.

Protecting sensitive and endangered natural resources, with projects modeling habitat and improving mitigation success for federally-protected species near renewable energy projects.

The Goal: Energy will have reduced local and global environmental impacts and energy siting and permitting will be less costly and more efficient.

Protecting what Californians care about – California's unique beauty: R&D to facilitate renewable energy siting in the desert has protected vulnerable species. Research has also identified parts of our energy system that are vulnerable to climate change, particularly those on our coasts.

FUNDING PROGRAMS

The Energy Commission administers several R&D programs that drive innovation and advance science and technology.

The Natural Gas Research, Development and Demonstration program invests in improvements to California's natural gas systems. The Electric Program Investment Charge invests in improvements to the state's electricity systems.

EPIC: California's Investment in the 21st Century Electricity System

The Electric Program Investment Charge (EPIC) funds innovation investments in clean energy technologies and approaches for the benefit of electricity ratepayers of California's three largest electric investor-owned utilities. EPIC funding is initially authorized in the areas of applied research and development, technology demonstration and deployment, and market facilitation. With this funding, the Energy Commission will undertake an energy pipeline approach to creating new energy solutions, fostering regional innovation, and bringing clean energy ideas to the marketplace for the benefit of California's investor-owned utility ratepayers.

Energy Innovation Pipeline

The End of the Pipeline: Market Deployment

Technical performance alone does not guarantee new solutions reach their potential. For emerging technologies policy and market barriers often exist, and our market facilitation work helps the regulatory and financial worlds catch up with science and technology. This involves activities like regulatory assistance and streamlining, market research, education and outreach, and workforce development to support clean energy technology and strategy deployment.

FUNDING AND ENGAGEMENT OPPORTUNITIES

Energy Commission funding opportunities are regularly available and can be found on our website. Our solicitation and project management processes are dedicated to transparency and inclusiveness. Our investment plans are developed with the valuable input of stakeholders and the public. Information about funding opportunities, engagement and public comment opportunities, and our investment plans is available at:

http://www.energy.ca.gov/research/funding.html.

CONTACT US

We are dedicated to being an action-oriented catalyst for energy improvements and are continually working to strengthen the process that brings research from lab to life. We want to hear from you!

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