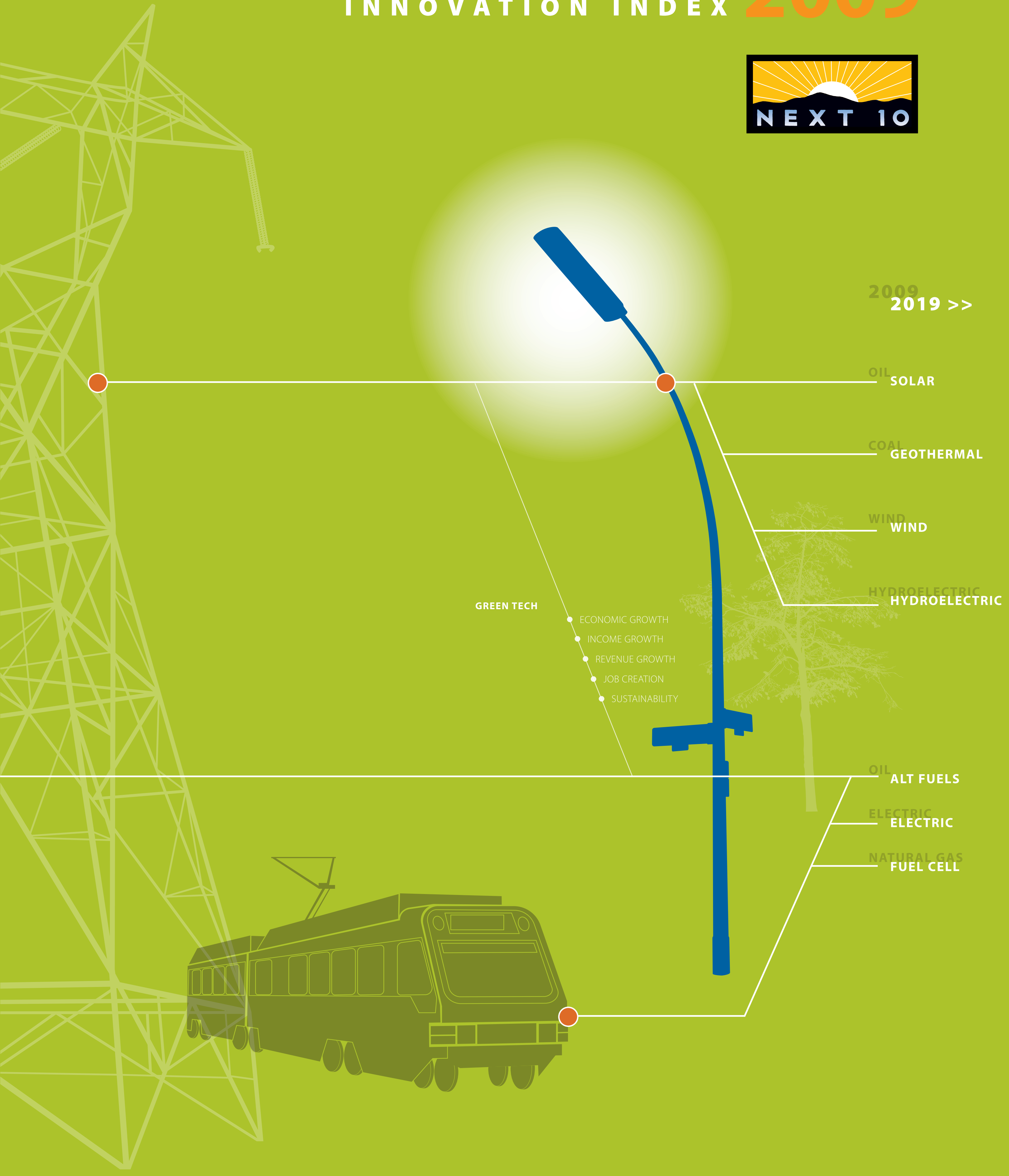
CALIFORNIA GREEN INNOVATION INDEX 2009

NEXT 10



Next 10 is a nonpartisan, nonprofit organization that educates, engages and empowers Californians to improve the State's future.

California was founded by pioneers driven by big dreams and unafraid to face difficult challenges. Like many of us, they came to California to create a better life for themselves and their families. While this legacy of the California dream continues today, many of us are concerned that the future will not be as bright as our children deserve.

Next 10 is focused on innovation and the intersection between the economy, the environment, and quality of life issues. We create tools and provide information that foster a deeper understanding of the critical issues affecting our state. Through education and civic engagement, we hope Californians will become empowered to affect change.

We call ourselves Next 10 because we are not here for the quick fix. Our sights are set on joining with others to improve the state over the next ten years, and the decades after that. The decisions we make together will affect California's economy, environment and quality of life for years to come. Together, we can create the brighter future we all want for ourselves and our children.

ADVISORS TO THE CALIFORNIA GREEN INNOVATION INDEX

Next 10 thanks the following expert Advisors for their generous time and guidance on this project:

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California Facts

California's Population

Population	Average Annual Growth	Population Projections
2007	2000-2007	2020
37,771,431	1.5%	44,135,923

Source: California Department of Finance

California's Economy

Gross Domestic Product (GDP) is a way of measuring the size of an economy, and is calculated by summing the value added from all industries in the economy. This measure can be used for a country as well as a state, in which case it can also be expressed as gross state product (GSP).

Total GDP	Average Annual Growth	Per Capita GDP	GDP Projections
2007	2000-2007	2007	2020
$ 1,812,968,000,000	2.7%	$47,998	$2,679,090,695,673

Inflation adjusted dollars (2007)
Sources: Bureau of Economic Analysis;California Department of Finance

Inflation adjusted dollars (2007)
Source: Moody's Economy.com

Assembly Bill 32, the "California Global Warming Solutions Act of 2006"

Assembly Bill 32 (AB 32) was signed into California law in 2006, mandating the first ever statewide cap on global warming pollution. AB 32 has put California at the forefront of the fight against global warming by requiring the state to reduce its greenhouse gas (GHG) emissions to 1990 levels by 2020. On December 11, 2008, the agency charged with the implementation of AB 32, California Air Resources Board, adopted the Scoping Plan that lays out the actions California must take to meet the GHG emissions reduction targets.

California's Greenhouse Gas Emissions

Gross GHG emissions includes fossil fuel CO2, with electric imports and international fuels (carbon dioxide only) and noncarbon GHG emissions (in CO2 equivalents). Noncarbon GHG emissions are made up of Agriculture (CH4 and N2O), Soils and Forests Carbon Sinks, ODS substitutes, Semi-conductor manufacture (PFCs), Electric Utilities (SF6), Cement, Other Industrial Processes, Solid Waste Management, Landfill Gas, and Wastewater, Methane from oil and gas systems, and Methane and N2O from Fossil Fuel Combustion.

Total GHG Emissions (Million Metric Tons of CO2 Equivalent)		Average Annual Growth	Per Capita GHG Emissions (Metric Tons of CO2 Equivalent)	AB 32 Targets Total GHG Emissions (Million Metric Tons of CO2 Equivalent)
1990	2006	2000-2006	2006	**2020**
433	486	1%	13	433

Note: 2006 data are preliminary
Sources: California Air Resources Board, "California Greenhouse Gas Inventory- by Sector and Activity"; California Department of Finance

California's Carbon Economy

The ratio of GHG emissions (million metric tons) to GDP (billion $)

		Meeting AB 32 Targets
1990	**2006**	**2020**
4.6	3.2	1.9

California Air Resources Board, "California Greenhouse Gas Inventory- by Sector and Activity"; Moody's Economy.com

Dear friend:

As the country moves quickly to put an economic stimulus package in place, we release the second annual California Green Innovation Index, which tracks California's effort to grow the economy while dramatically reducing greenhouse gas emissions as mandated by the California Global Warming Solutions Act (AB 32). The Index provides insight on a California culture that includes three decades of ambitious state environmental and energy policies, putting California on a path to energy independence and one of the lowest per capita carbon footprints in the nation, all the while growing one of the most vigorous economies in the world.

Research included in this 2009 Green Innovation Index provides further evidence of the powerful economic stimulus clean energy policy can provide. California's energy productivity, that is, the amount of Gross Domestic Product (GDP) produced per unit of energy, is 68% more productive than the rest of the nation. Energy efficiency policies forged by California over the last 35 years have saved consumers over $56 billion, creating 1.5 million fulltime jobs and $45 billion in payroll.

California is at the forefront of green innovation investment and jobs. New data presented in the 2009 Index shows that while total jobs increased by just one percent statewide, green jobs have increased by ten percent since 2005. Clean technology investment in California nearly doubled in 2008, reaching $3.3 billion. California is a national leader in solar, wind and battery patents. Still, more needs to be done in terms of both creation and adoption of new clean technology products and services to give California the leading edge in what is fast becoming a multibillion-dollar global clean technology market.

California's tradition of innovative policies can be a model for the rest of the nation that will help pave the way to economic growth and energy security while reducing global warming emissions.

Sincerely,

F. Noel Perry
Founder, Next 10

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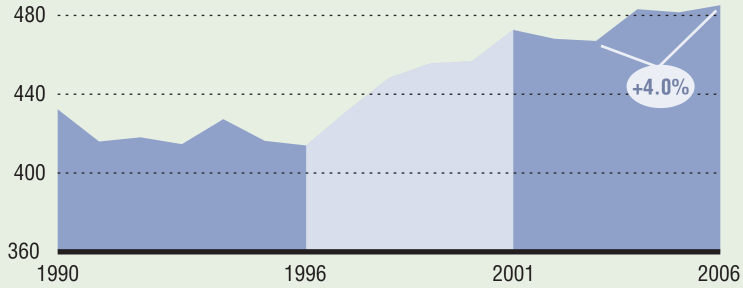
Table of Contents

The 2009 California Green Innovation Index presents a series of "dashboard" indicators that track changes over time and two in-depth features: Transportation and Renewable Energy. These areas are critical for meeting the emissions reductions targets laid out by the California Global Warming Solutions Act of 2006 (AB 32).

Index at a Glance

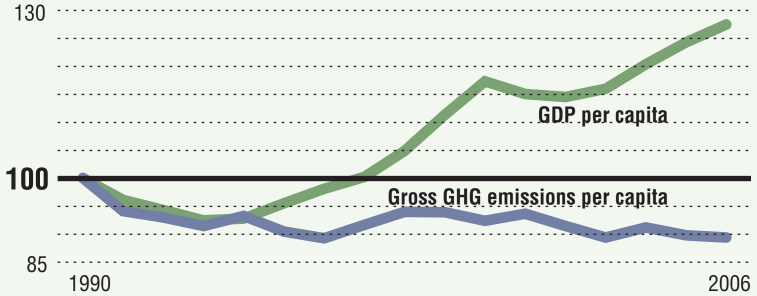


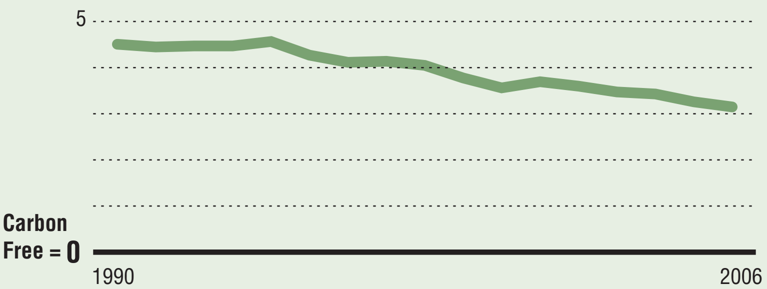
EMISSIONS

California's gross annual greenhouse gas emissions increased significantly after 1996 and at a slower rate since 2001. Total emissions increased by 4% from 2003 to 2006.

GDP & EMISSIONS

Over the long term and on a per-capita basis, California has made significant progress in delinking economic growth from GHG emissions.



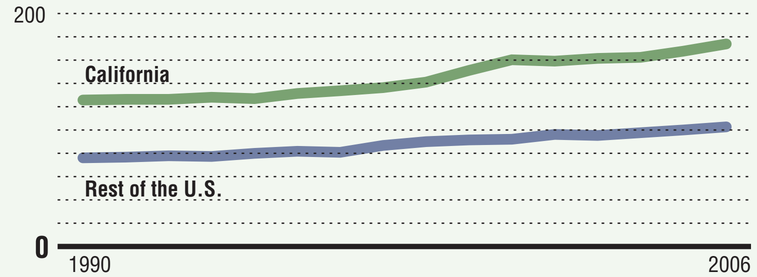


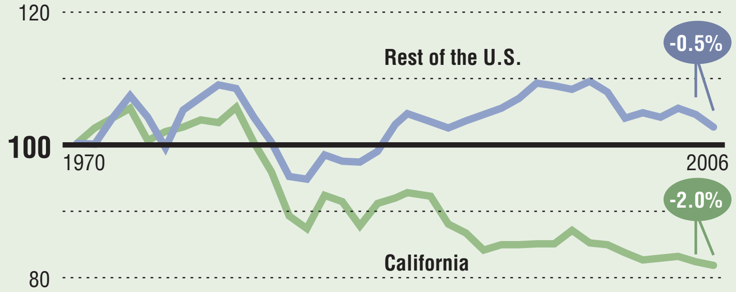
CARBON ECONOMY

California's Carbon Economy continues a gradual downward trend in the direction of a carbon-free economy.

PRODUCTIVITY

California's energy productivity is 68% higher than that of the rest of the country. Measured as the ratio of energy consumed (inputs) to GDP (economic output), growth in energy productivity equates to more dollars of GDP generated per unit of energy consumed.



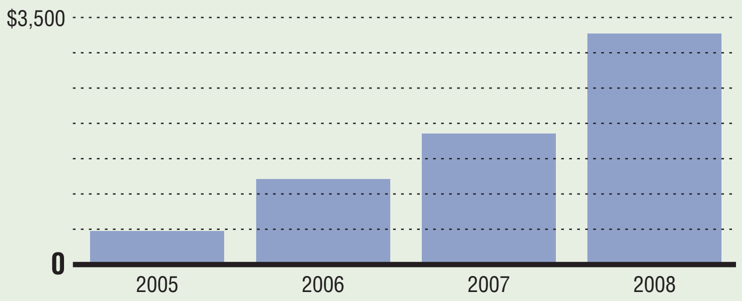


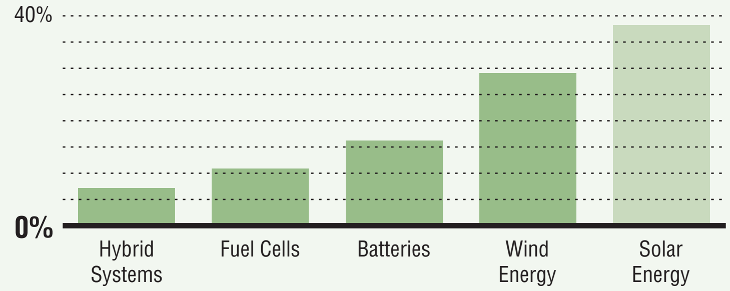
ENERGY

Relative to 1970, total energy consumption per capita in 2006 was 18% lower in California and 5% higher in the rest of the nation. From 2005 to 2006, total energy consumption per capita declined by almost 2% in California, and 0.5% in the rest of the U.S.

CLEANTECH VC

Clean technology investment in California achieved an all-time high in 2008 of $3.3 billion. Increasing nearly $1.5 billion over 2007, investment almost doubled in 2008.



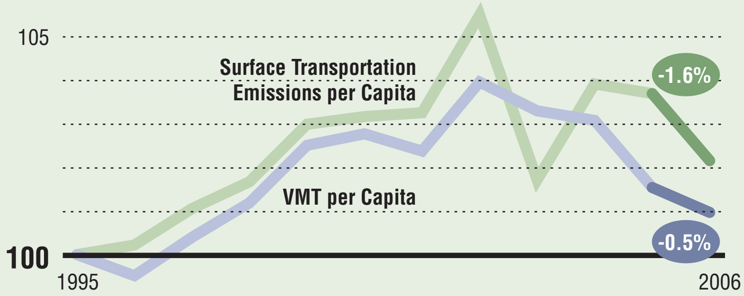


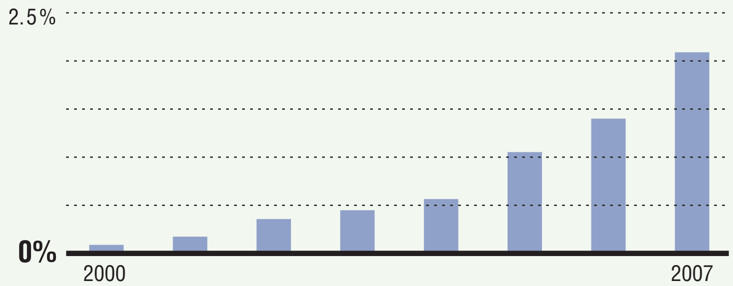
GREEN TECH

With 38% of nationwide solar energy patent registrations in recent years (2002–2007), California is increasingly the hub for solar energy technology development.

VMT & EMISSIONS

Compared to per capita levels in 1995, vehicle miles traveled and emissions from surface transportation have been scaling back to 1995 levels in recent years. In the most recent year, per capita emissions dropped by 1.6% and per capita vehicle miles traveled fell by 0.5%.



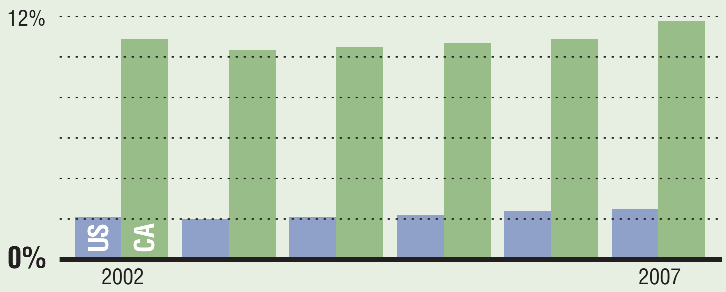


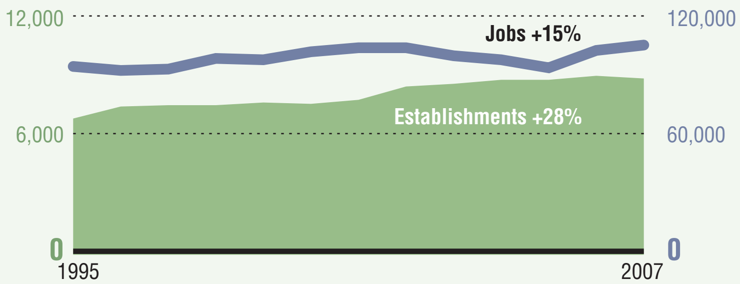
ALT FUEL VEHICLES

Since 2000, the number of newly registered vehicles that run on alternative fuels has grown by a factor of 26.

RENEWABLES

Compared to the nation, California generates a larger portion of its total power generation from renewable sources. In 2007, renewable energy sources accounted for 11.8% of California's total energy generation and 2.5% of the nation's.





GREEN JOBS

Over the past thirty years, California's economy has benefited from forward-looking energy efficiency policies which have created 1.5 million jobs with a total payroll of over $45 billion, and saved California consumers over $56 billion on energy costs. California's businesses have realized new markets in this policy climate, and businesses producing products and providing services that conserve resources and reduce environmental impacts have grown by 28% since 1995. Jobs in these businesses have increased by 15% while total statewide jobs grew only 10%.

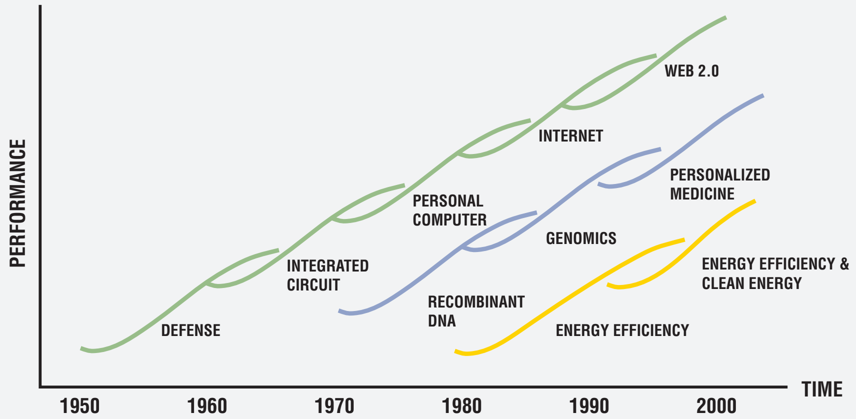
california past & future

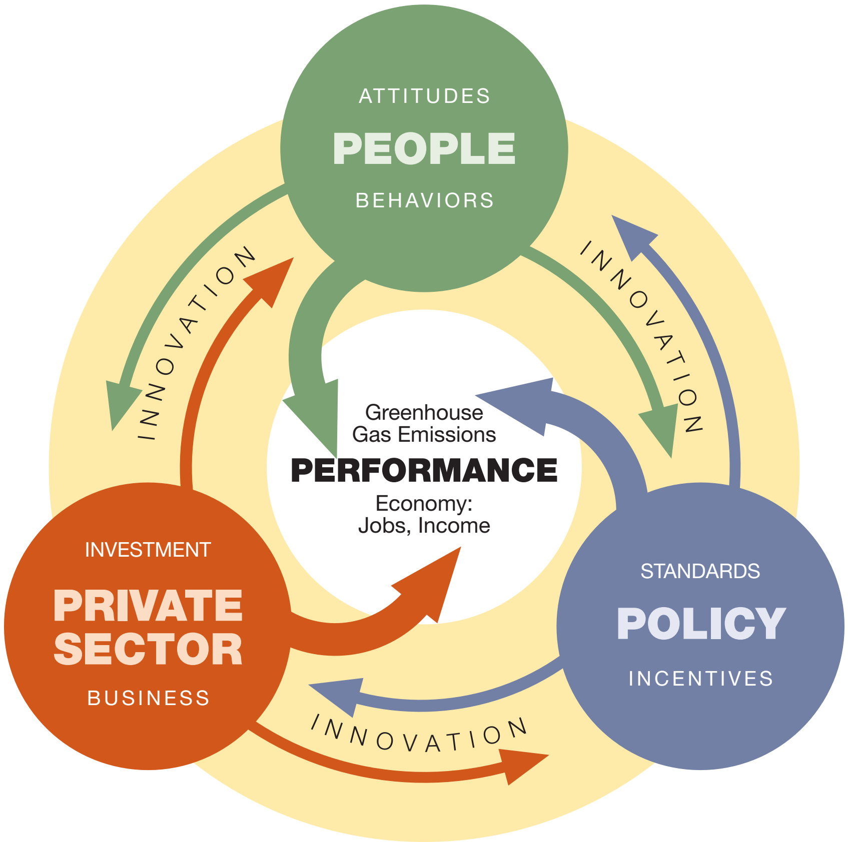
California's reputation for being on the cutting edge of cultural change and technological advance also applies to the realm of green innovation. The State's pioneering spirit is fueled in part by its world-class research and development talent, pioneering public policy, and forward-looking population. California continues to be a key driver of innovation in technology and policy related to the mitigation of climate change.

Waves Of Innovation: Technology And Policy

The California Way: Waves of Innovation

California has a tradition of innovation in areas as diverse as information technology, biotechnology, agriculture, entertainment, communications, and energy. In each of these areas, the State has helped drive waves of innovation, with each wave providing the basis and momentum for successive periods of innovation. California has consistently benefited from breakthroughs that have improved our quality of life and economic vitality. In the inaugural California Green Innovation Index published last year, we began to measure how the State is entering a new wave of innovation in energy efficiency and clean energy. This year we examine how California is doing, and introduce the "Green Innovation Dashboard" to monitor the State's overall progress, including features on transportation and renewable energy, and providing a fuller accounting of the range of economic benefits from green innovation in California.





The Virtuous Cycle of Green Innovation

Actions that push the envelope trigger novel actions by people and groups with different scopes of influence. The interaction that emerges builds momentum and becomes self-reinforcing. Individuals, the private sector (including business and community organizations) and government leaders are the key contributors to this process. Recognizing this, green innovation is a shared responsibility.

Government adopts policy innovations, which create an environment that encourages both private sector and individual innovation. At the same time, government policy is influenced by the emergence of new technologies, products, and business practices in the marketplace, which demonstrate what could be possible on a larger scale. Elected officials also pursue policy innovations in response to growing concerns from the public—interests shaped by the media, consumer experience, and personal values as much as by government information and incentives.

Private sector businesses respond to government mandates and incentives, but also to global market forces (like the price of oil). Businesses pursue innovations to meet emerging industry and consumer demand for new green products and practices. These innovations not only help the bottom line of California businesses, but also create jobs and help inform policy and change individual behavior by offering tangible applications of green innovation.

The private sector also includes a diverse mix of non-profit groups that promote changes in government policy, business practices, and individual behaviors. This "independent sector" of organizations is an important catalyst for green innovation.

Individuals not only respond to government incentives and availability of new products, but also influence the direction of policy through the political process, and generate demand for new green products in the marketplace.

Much like the test pilot pushes the flight envelope to reach higher levels of aeronautical performance, the expectations and targets set by Californians, our private sector and our policymakers combined can drive California's success in attaining new heights in resource efficiency and economic prosperity.

Challenges Ahead: Public Views & Meeting AB 32 Targets

Sense of Urgency Remains in an Uncertain Economic Environment

A large majority of Californians remain concerned about the impact of global warming on the State's quality of life and economy. A Next 10/Field Research Organization survey from September 2008 found that statewide, seven in ten registered voters believe that global warming poses a serious threat to both the State's economy (69%) and the overall quality of life in California (73%). In every region of California—from the San Francisco Bay Area to Los Angeles, the Inland Empire to San Diego, the Central Valley to the North State—no fewer than six in ten registered voters hold these views.

Among registered voters, larger percentages of Latinos and African Americans felt that global warming was a serious threat to California's economy and quality of life. This is also true of those in younger age groups (aged 18–29) and lower income groups (annual incomes of $40,000 or less).

Despite a year of economic turbulence in California, the proportion of registered voters believing that global warming is a serious threat to the economy has decreased only slightly (69% in 2008 compared to 74% in 2007); the proportion believing that global warming is a serious threat to the State's quality of life has followed a similar pattern (73% in 2008 compared to 79% in 2007).

A large majority of registered voters (74%) also continues to believe that it is possible for California to reduce greenhouse gases that contribute to global warming, while creating jobs and building economic prosperity at the same time. This majority did decline from 83% in 2007. Yet, seven in ten registered voters across all age and ethnic groups, educational and income levels, and regions of California believe that it is possible to produce economic and environmental benefits from green innovation.

Recent Developments: California Climate Change Scoping Plan

The California Global Warming Solutions Act, Assembly Bill 32 (AB 32) was signed into California law in 2006. This groundbreaking legislation has put California at the forefront of the fight against global warming by requiring the state to reduce its greenhouse gas (GHG) emissions to 1990 levels by 2020.

In order for California to meet these GHG reduction targets, the California Air Resources Board (CARB), which serves as the lead agency for the implementation of AB 32, released a Proposed Scoping Plan that outlines a set of actions for reducing GHG emissions.

The measures adopted by CARB (see table) December 11, 2008 in the Proposed Scoping Plan include a combination of policy standards, incentives, and technology innovations to increase energy efficiency and renewable energy generation, and reduce GHG emissions in the residential, commercial, industrial, and agriculture sectors.

Before the adoption in December of the final Plan, CARB hosted a series of seminars and workshops throughout the summer of 2008 to gather public input regarding the reduction measures. This feedback informed the revised Plan proposed in October and adopted in December. The adopted measures will continue to be developed and go into effect by 2012.

RECOMMENDED GREENHOUSE GAS REDUCTION MEASURES

Recommended Reduction Measures	Reductions Counted Towards 2020 Target ($MMTCO_2E$)
ESTIMATED REDUCTIONS RESULTING FROM COMBINATION OF CAP AND TRADE PROGRAM AND COMPLEMENTARY MEASURES	**146.7**
California Light-Duty Vehicle Greenhouse Gas Standards • Implement Pavley standards • Develop Pavley II light duty vehicle standards	31.7
Energy Efficiency • Building/appliance efficiency, new programs, etc. • Increase Combined Heat and Power (CHP) generation by 30,000 GWh • Solar Water Heating (AB 1470 goal)	26.3
Renewables Portfolio Standard (33% by 2020)	21.3
Low Carbon Fuel Standard	15.0
Regional Transportation Related GHG Targets*	5.0
Vehicle Efficiency Measures	4.5
Goods Movement • Ship Electrification at Ports • System Wide Efficiency Improvements	3.7
Million Solar Roofs	2.1
Medium/Heavy Duty Vehicles • Heavy Duty Vehicle GHG Emission Reduction (Aerodynamic Efficiency) • Medium and Heavy Duty Vehicle Hybridization	1.4
High Speed Rail	1.0
Industrial Measures (for sources covered under cap and trade program) • Refinery Measures • Energy Efficiency & Co-Benefits Audits	0.3
Additional Reductions Necessary to Achieve the Cap	34.4
ESTIMATED REDUCTIONS FROM UNCAPPED SOURCES/SECTORS	**27.3**
High Global Warming Potential Gas Measures	20.2
Sustainable Forests	5.0
Industrial Measures (for sources not covered under cap and trade program) • Oil and Gas Extraction and Transmission	1.1
Recycling and Waste (landfill methane capture)	1.0
TOTAL REDUCTIONS COUNTED TOWARDS 2020 TARGET	**174**

Other Recommended Measures	Estimated 2020 Reductions ($MMTCO_2E$)
State Government Operations	1–2
Local Government Operations	TBD
Green Buildings	26.0
Recycling and Waste • Mandatory Commercial Recycling • Other measures	9.0
Water Sector Measures	4.8
Methane Capture at Large Dairies	1.0

Source: California Air Resources Board. "Proposed Modifications to Climate Change Proposed Scoping Plan and Appendices." December 11, 2008
* This number represents an estimate of what may be achieved from local land use changes. It is not the SB 375 regional target. ARB will establish regional targets for each Metropolitan Planning Organization (MPO) region following the input of the Regional Targets Advisory Committee and a public consultation process with MPOs and other stakeholders per SB 375.

California Timeline and Policy Update: Climate Change, Standards, Incentives, Mandates and Investment

Over the years, California has established itself as a leader in innovative environmental public policy. Responding to the energy crisis in the 1970s, Californians set off down a path toward improving energy efficiency and have demonstrated that consuming energy in a smarter way can be achieved while also growing the economy. The State continues to provide leadership on this course.

The OPEC oil embargo in 1973 served as a major force in spurring policy and technology innovation relating to energy efficiency. The next year, the State established the California Energy Commission to implement energy policy and planning, and Lawrence Berkeley National Laboratory established the Center for Building Science to research means for improving energy efficiency. In an early contribution to the cause, the Center developed a computer program that modeled the energy performance of buildings. This program established the basis for the groundbreaking legislation on energy efficiency standards for appliances and buildings (Title 20 and Title 24). Enactment in California was followed by the enactment of similar standards across the United States and other countries. By 1987, a uniform national standard for efficiency in appliances was in place.

The California energy crisis in 2000 and 2001 provided another major force in spurring policy and technology innovation relating to energy efficiency. A result of the failed attempt at utility market deregulation, rolling black-outs characterized the two-year period. As in 1973, this crisis provided a fresh impetus for policy and technology innovation targeting improved energy efficiency in California. Ensuing policy innovations included broad-based energy efficiency campaigns, incentives for renewable energy sources, investment in technology research, and standards that reduce greenhouse gas emissions.

Recent policy innovations include the following:

- ***California's Renewables Portfolio Standard*** *was established with the goal of increasing the percentage of power generation from renewable energy sources in the State's electricity mix of investor-owned utilities (IOUs) to 20% by 2017. This goal has since been accelerated to be achieved by 2010. In November 2008, Governor Schwarzenegger signed an Executive Order to accelerate the RPS target to 33% by 2020.*

- ***Californiaís Clean Cars Law of 2002 (AB 1493)*** *requires carmakers to reduce global warming emissions from new passenger cars and light trucks beginning in 2009. First in the world to reduce global warming pollution from cars, this law has now been adopted by 11 other states. Affecting nearly one-third of the U.S. market, global warming emissions in 2020 will be reduced by more than 64 million tons of carbon dioxide a year.*

California Policy Innovations Over Time (Regulatory, Investment, Incentives)

- **1947** ⬢ Los Angeles Air Pollution Control District created; first air pollution agency in the US.
- **1959** California Motor Vehicle Pollution Control Board created to test automobile emissions and set standards.
- **1967** ⬢ California Air Resources Board established
- **1974** CA Energy Commission is created
- **1977** ⬢ Efficiency Standards for appliances (Title 20)
- **1978** Efficiency Standards for new buildings (Title 24)
- **1980 - 1983** Efficiency Standards for appliances - Florida, Kansas and New York
- **1982** ⬢ California PUC orders removal of financial barriers to utilities and energy efficiency investments
- **1986** Efficiency Standards for appliances - Massachusetts
- **1989** California Integrated Waste Management Act (AB 939)
- **1997** California Energy Commission's Public Interest Energy Research (PIER) Program Established
- **9/2000** ⬢ CA Climate Action Registry established (SB 1771)
- **2001** Flex Your Power initiated
- **2001** Adopted by Oregon

⬢ First in United States

- ***The California Global Warming Solutions Act of 2006 (AB 32)*** *is the first law in the nation to comprehensively limit greenhouse gas (GHG) emissions at the state level. Five Western states (Washington, Oregon, Utah, Arizona, and New Mexico) have joined California to combine efforts toward reducing GHG emissions with the Western Regional Climate Action Initiative.*

- ***Green Collar Jobs Council (AB 3018)*** *was established as an intergovernmental effort to develop strategies for the new workforce needs related to California's growing green economy.*

- ***A new solar loan law (AB 811)*** *was enacted to allow cities and counties to make low-interest loans to homeowners and businesses making efforts to save energy. Participants use the loans to install a solar roof, energy efficient air conditioners, or other energy-saving improvements. Then they pay back the loans through their property taxes. Local governments can now directly increase citizens' access to what may otherwise be prohibitively expensive energy solutions.*

- ***The California Energy Commission updated Title 24 with new standards known as the 2008 Building Energy Efficiency Standards.*** *The new standards include code regulations for new construction, and are expected to save as much energy as a large (500 megawatt) power plant by 2013.*[1]

- ***A smart growth/land use bill (SB 375)*** *was adopted to ensure that the emission reduction goals of AB 32 are met. The legislation requires the California Air Resources Board to set regional targets for reducing greenhouse gas emissions by September 2010. Under the bill, incentives will be given to smart growth projects such as high-density housing projects near transportation.*

Innovative policies and approaches are also emerging from California's cities, counties, and regions. Throughout the State, green initiatives are budding from the ground up:

- *In 2007, San Jose established Green Vision, a 15-year roadmap to reduce the city's carbon footprint and stimulate economic opportunity. Some of the strategy's ten goals include creating 25,000 clean tech jobs, reducing per capita energy consumption by 15%, and receiving 100% of electric power from renewable sources.*

- *Sonoma Mountain Village (SMV) is a new sustainable community that is currently being developed in Rohnert Park, California by Codding Enterprises. SMV will be zero-carbon and zero-waste, and will be one of the most sustainable communities in the world. One of the goals of the project is to use energy efficiency to reduce greenhouse gas emissions from buildings by 100% by 2020. The businesses in Sonoma Mountain Village will be powered by a 1.14 megawatt solar installation, and will house the world's first carbon neutral data center.*

- *A coalition of sustainability professionals throughout the State joined together in 2007 to create Green Cities California (GCC). Under GCC, represented cities are working together to accelerate local, regional, national, and international sustainability efforts. Participating cities currently include Berkeley, Los Angeles, Pasadena, Oakland, Sacramento, San Diego, San Francisco, San Jose, Santa Barbara, Santa Monica, and the County of Marin, which collectively account for over eight million California residents.*

- *A public funding program for residential solar was adopted by the city of Berkeley in 2008. Berkeley is the first U.S. municipality that offers residents direct public financing for solar installations and energy efficiency improvements.*

- *The city of San Francisco approved green building standards in 2008 to help meet the city's goal of reducing greenhouse gas emissions (GHG) to 20% below 1990 levels by 2012. The green standards apply to new and existing buildings, will reduce emissions by 60,000 tons, and will save 220,000 megawatt hours of electricity.*

[1] *California Energy Commission. "News Release: Energy Commission Approves New Energy Efficient Measures for California Homes and Businesses." April 23, 2008.*

2002
California Climate Action Registry is mandated (SB 812)

CA Renewables Portfolio Standard (RPS)

California Clean Cars Law (AB 1493) sets standards for emissions of CO2 and other greenhouse gases from automobiles and light duty trucks

2004
Governor's Green Building Initiative Executive Order (S-20-04)

2005
Governor's Executive Order S-3-05 set greenhouse gas emission reduction targets

2006
California Global Warming Solutions Act of 2006 (AB 32)

California Greenhouse Gas Performance Standards for Power Plants (SB 1368)

8/2006
California Solar Initiative

2007
Western Regional Climate Action Initiative

9/2007
California PUC approves incentives for investor-owned utilities in meeting energy savings goals

9/2007
California Renewable Energy Transmission Initiative is formed

10/2007
CEC adopts energy efficiency standards for general purpose lighting

California requires electric utilities to record energy consumption data for all non-residential buildings to which they provide service. Building owners will be required to share the data with prospective buyers and leasers (AB 1103)

Solar Water Heating and Efficiency Act of 2007 is established with a goal of installing 200,000 solar water heaters by 2017 (AB 1470)

12/2007
California Independent System Operator approves the Location Constrained Resource Interconnection, a new financing tool that improves grid access for new clean energy projects

2/2008
CPUC approves feed-in tariff to incentivize the development of small scale solar installations (AB 1969)

4/2008
California Energy Commission revises Title 24 to add new energy efficiency measures

7/2008
California adopts green building codes

California adopts solar loan law (AB 811)

9/2008
CPUC adopts the California Long Term Energy Efficiency Strategic Plan for 2009 to 2020

Green Collar Jobs Council established (AB 3018)

Land use strategy requirements mandated to reduce GHG emissions (SB 375)

12/2008
California Air Resources Board adopts proposed Scoping Plan

2004
Adopted by Idaho

2007
Adopted by Maryland

california green innovation

Tracking California's progress in green innovation illustrates how well the State is maintaining its pacesetter position and indicates the new paths that are emerging in the areas of green innovation. The Dashboard Indicators below measure progress in environmental quality, resource efficiency, and technological advance, and are statistically measurable over time. Following the Dashboard Indicators are two Features that delve into deeper detail: *Surface Transportation and Renewable Energy.*

dashboard indicators

The Dashboard Indicators encompass the areas of The Carbon Economy, Energy Efficiency, and Green Technology Innovation.

Dashboard Indicators

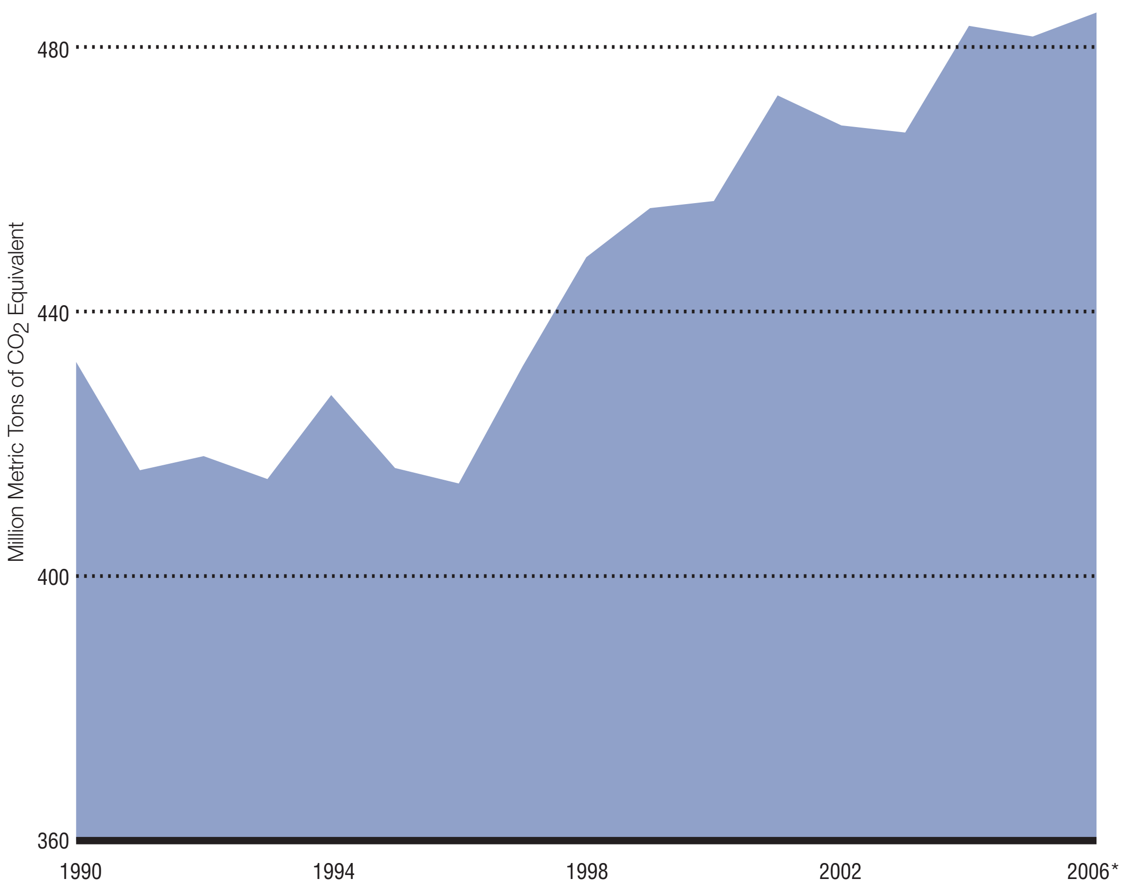
THE CARBON ECONOMY

Indicators relating to the Carbon Economy help illustrate the relationship between economic performance (i.e., gross domestic product) and the generation of greenhouse gases. In several indicators, California is compared to the rest of the U.S. (i.e., excluding California) and other large states.

California's gross annual greenhouse gas emissions represented in ***Figure 1*** depict a significant increase since 1996 and a slowing rate since 2001. While 2003 was followed by a moderate jump, a leveling-off has followed in the years since. Several factors explain the variability in the recent years. The peak in 2004 is due primarily to the low snowpack that year. Because of the limited capacity for hydroelectric generation, more power was generated by natural gas or coal plants. At the end of 2005, a coal plant located in Nevada and serving Southern California was shut down, and replacement power came from an in-state natural gas plant.

1 Total California Greenhouse Gas Emissions

*Gross annual emissions***



*Data for 2005 and 2006 are preliminary.
**Gross greenhouse gas emissions (GHG) includes fossil fuel CO2, with electric imports and international fuels (carbon dioxide only) and noncarbon GHG emissions (in CO2 equivalents). Noncarbon GHG emissions are made up of Agriculture (CH4 and N2O). Soils and Forests Carbon Sinks, ODS substitutes, Semi-conductor manufacture (PFCs), Electric Utilities (SF6), Cement, Other Industrial Processes, Solid Waste Management, Landfill Gas and Wastewater, Methane from oil and gas systems, Methane and N2O from Fossil Fuel Combustion.

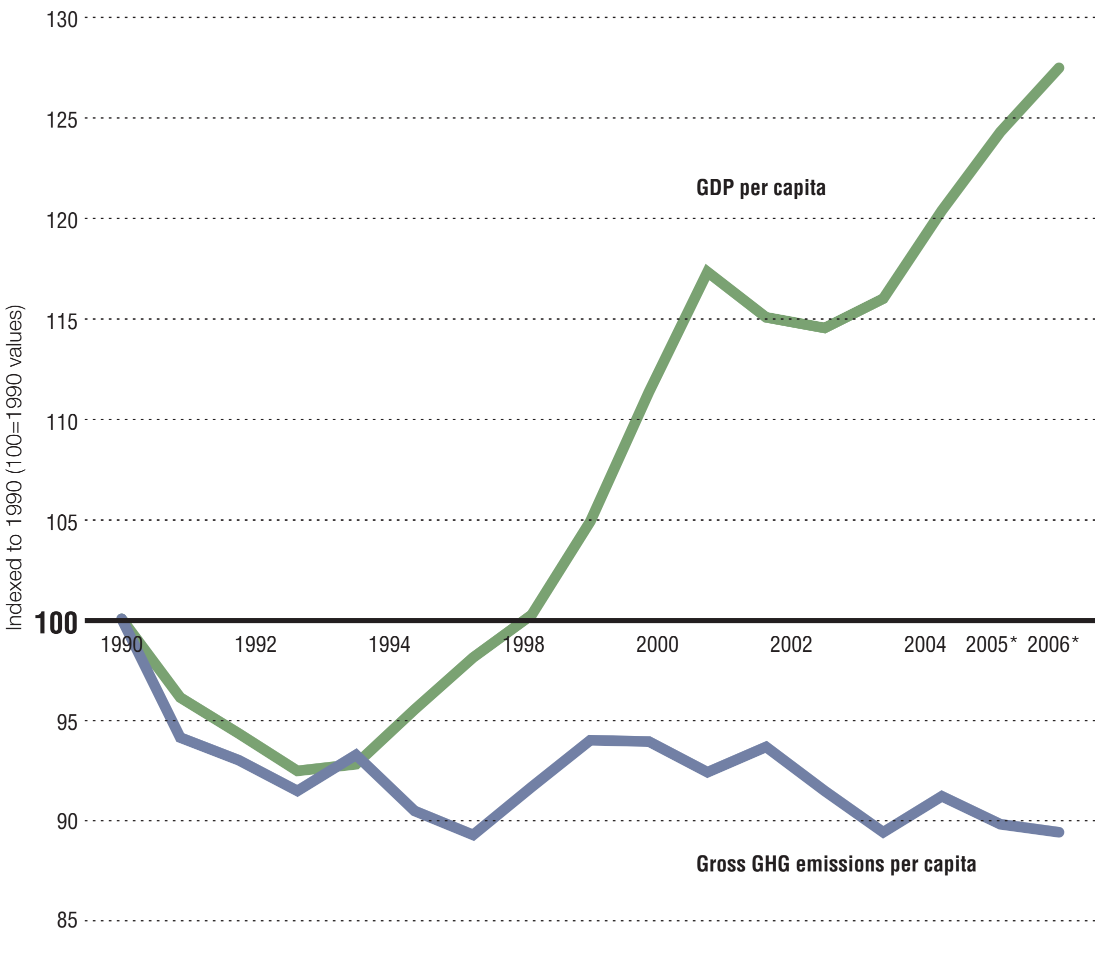
Source: California Air Resources Board, California Greenhouse Gas Inventory–by Sector and Activity
Analysis: Collaborative Economics

Over the long term and on a per-capita basis, California has made significant progress in delinking economic growth from GHG emissions. ***Figure 2*** illustrates the diverging trend lines of GDP per capita and GHG emissions per capita relative to 1990. While GDP per capita has increased by 28% in 16 years, gross emissions per capita are 10% lower than in 1990. Essentially, California's experience demonstrates that it is possible to increase economic prosperity while also reducing greenhouse gas emissions.

2

GHG Emissions and Gross Domestic Product

California's relative trends since 1990 —
Gross GHG emissions and GDP dollars per capita (per million people)



*Emissions data for 2005 and 2006 are preliminary
Source: California Air Resources Board, California Greenhouse Gas Inventory–by Sector and Activity; Bureau of Economic Analysis, U.S. Department of Commerce; California Department of Finance
Analysis: Collaborative Economics

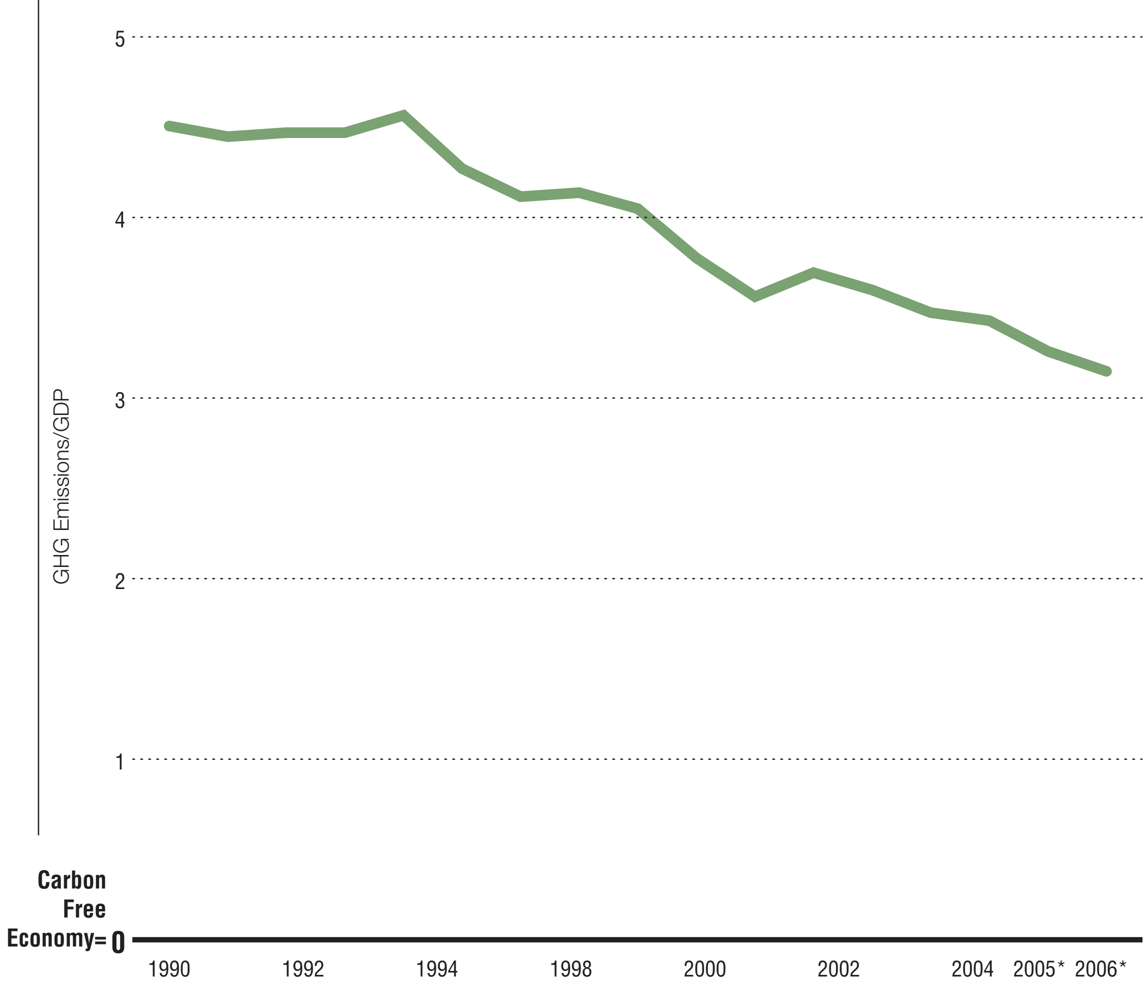
Dashboard Indicators

The Carbon Economy

California's Carbon Economy continues a steady downward trend in the direction of a carbon-free economy ***(Figure 3)***. In simple terms, this downward trend could mean either that the State's economy is growing at a faster rate than GHG emissions or that emissions are decreasing at a faster rate than the economy is growing.

3 The Carbon Economy

Gross emissions relative to Gross Domestic Product — California



*Emissions data for 2005 and 2006 are preliminary
Source: California Air Resources Board, California Greenhouse Gas Inventory–by Sector and Activity; Bureau of Economic Analysis, U.S. Department of Commerce; California Department of Finance
Analysis: Collaborative Economics

2005 National Ranking	Lowest GHG Emissions per Capita	Highest GDP per Capita	Share of Total U.S. GDP
California	2	11	13.5%
Texas	39	18	7.6%
Florida	10	33	5.4%

*Note: In 2005, Rhode Island ranked as the #1 state with the lowest GHG emissions per capita.

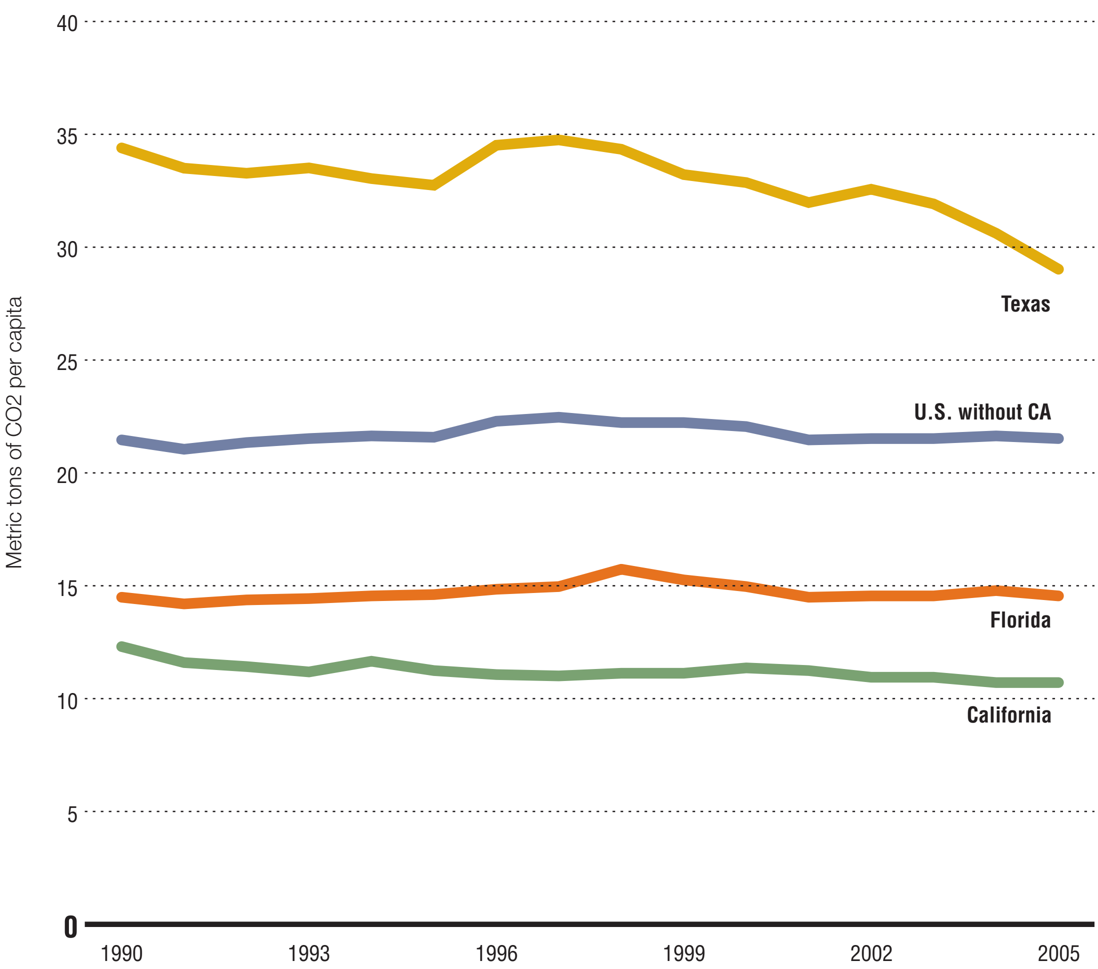
Percent Change 2004-05	GHG Emissions per Capita	GDP per Capita
California	-1.8%	+5.0%
Texas	-5.1	+1.5
Florida	-0.5	+1.1
US w/o CA	-0.3	+0.1

National Carbon Economy Ranking	
2005 Lowest Carbon Economy (Emissions/GDP)	
New York	1
Connecticut	2
California	3
Florida	15
Texas	37

Source: Energy Information Administration, U.S. Department of Energy; Bureau of Economic Analysis, U.S. Department of Commerce; Population Division, U.S. Census Bureau; California Department of Finance
Analysis: Collaborative Economics

4 GHG Emissions in California and Other States

CO2 emissions from fossil fuel combustion – metric tons of CO2 equivalent (MTCO2) per capita



Source: Energy Information Administration, U.S. Department of Energy; U.S. Census Bureau; California Department of Finance
Analysis: Collaborative Economics

Dashboard Indicators

The Carbon Economy

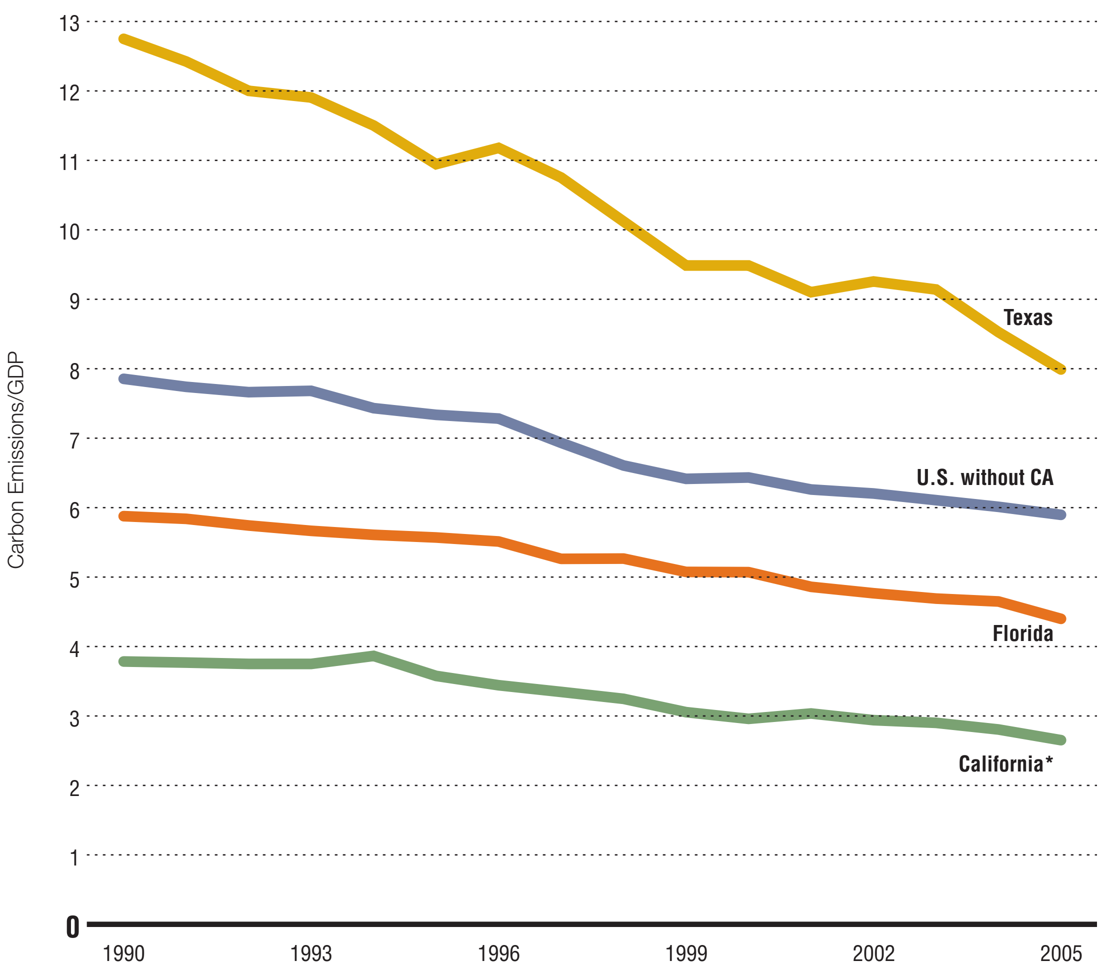
California's per-capita carbon-based GHG emissions in 2005 achieved their lowest level since 1990.[2] In comparison, California's emissions per capita were half the level of the rest of the country and roughly one-third the level of Texas ***(Figure 4)***. Overall, California has the second lowest level of GHG emissions per capita, and the eleventh highest GDP. GHG emissions per capita in California continue to decline while the economy grows. From 2004 to 2005, Californians reduced GHG emissions by approximately 2%, while the California economy grew by 5%. Per capita, California is reducing emissions and growing the economy at a faster rate than the rest of the nation.

Other states are also making progress toward a less carbon-intensive economy but are far from closing the gap with California. In 2005, California was ranked in the U.S. as the state with the third-lowest-level carbon economy. Carbon emissions per GDP over time is illustrated in ***Figure 5*** for California, Florida, Texas and the U.S. without California. Compared to Texas, California's economy is one third as carbon intensive, and less than half as carbon intensive as the rest of the U.S.

[2] *Emissions data for comparisons across other states is maintained by the U.S. Energy Information Agency and is limited to carbon-based GHG emissions which make up roughly 73% of total GHG emissions.*

5 **The Carbon Economy in California and Other States**

Carbon emissions relative to GDP



*GHG emissions data that allows for state-level comparison is from the Energy Information Administration, and is limited to carbon emissions (fossil fuel combustion). Therefore, data represented here differs from analyses represented in other charts of total greenhouse gas emissions for California.

Source: Energy Information Administration, U.S. Department of Energy; U.S. Census Bureau; Bureau of Economic Analysis, U.S. Department of Commerce; California Department of Finance

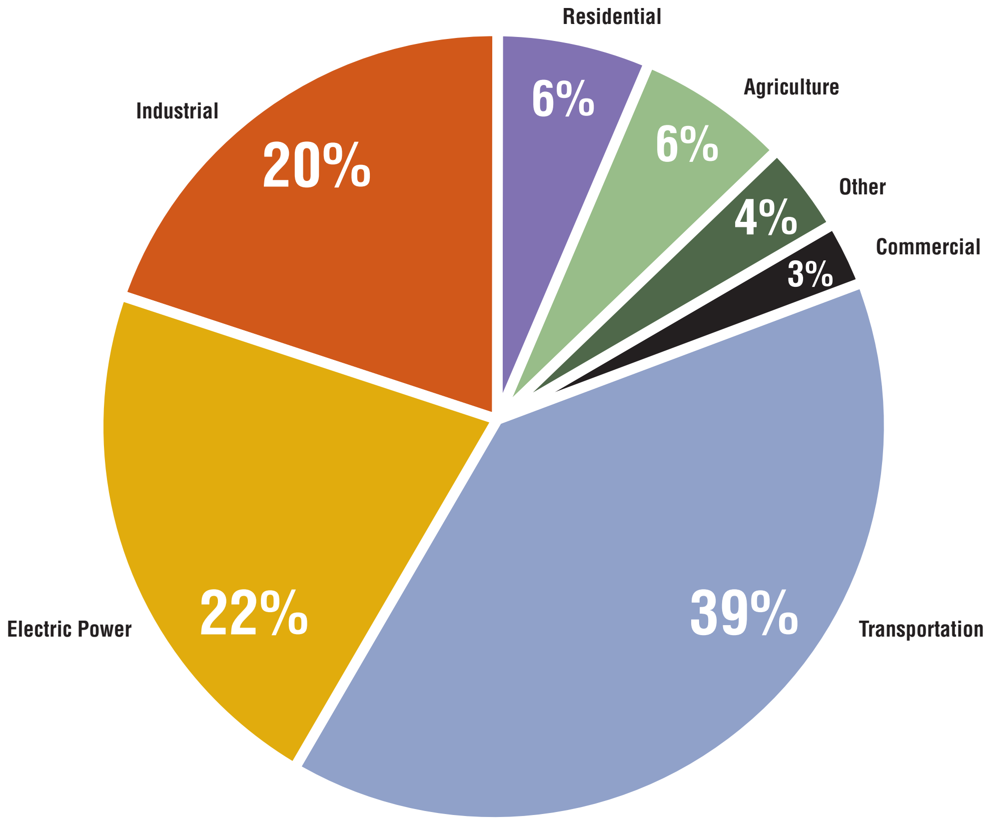
Analysis: Collaborative Economics

Sources related to transportation, electric power generation, and industrial activities are the top producers of GHG emissions and, combined, constitute 81% of all GHG emissions ***(Figure 6)***. Transportation accounts for 39% of all GHG emissions, while electric power generation accounts for 22%, and industrial activities 20%.

The California Air Resources Board collects greenhouse gas emissions data by direct source of emissions rather than by end-user. ***Figure 7*** depicts California's greenhouse gas emissions by detailed source.

Transportation emissions include the following sources: on-road passenger vehicles, on-road heavy duty trucks, ships & boats, locomotives, non-road transportation, and domestic (in-state) aviation. Emissions from all transportation sources account for 39% of California's total greenhouse gas (GHG) emissions, and would account for 46% if emissions from petroleum refining (in the industrial sector) were included. The majority (71%) of transportation emissions are from on-road passenger vehicles.

6 Greenhouse Gas Emissions by Source
California 2006



Note: Data for 2006 are preliminary
Source: California Air Resources Board, California Greenhouse Gas Inventory–by Sector and Activity
Analysis: Collaborative Economics

Electric power emissions encompass total emissions related to electricity, including electricity used by the commercial and residential sectors. Fifty-three percent of electric power emissions are from natural gas generation, and 33% are from coal generation, while only 2% of electric power related emissions are from renewable sources of energy.

Emissions from Industrial sources come from petroleum refining, oil and gas extraction and supply, industrial manufacturing, cement plants, landfills, domestic sewage, industrial wastewater, and industrial fugitive emissions. Twenty percent of California's emissions are from industrial activities.

GHG emissions in the Residential and Commercial sectors are created from fuel combustion when fuel is burned to heat houses and buildings, prepare food, and for hot water.[3] Combined, residential and commercial sectors account for 9% of total GHG emissions in California.

Emissions from Agriculture account for 6% of California's total emissions, and are from livestock, soil preparation and fertilizer application, tractors, agricultural pumps and other fuel use, and crop growth and harvesting.

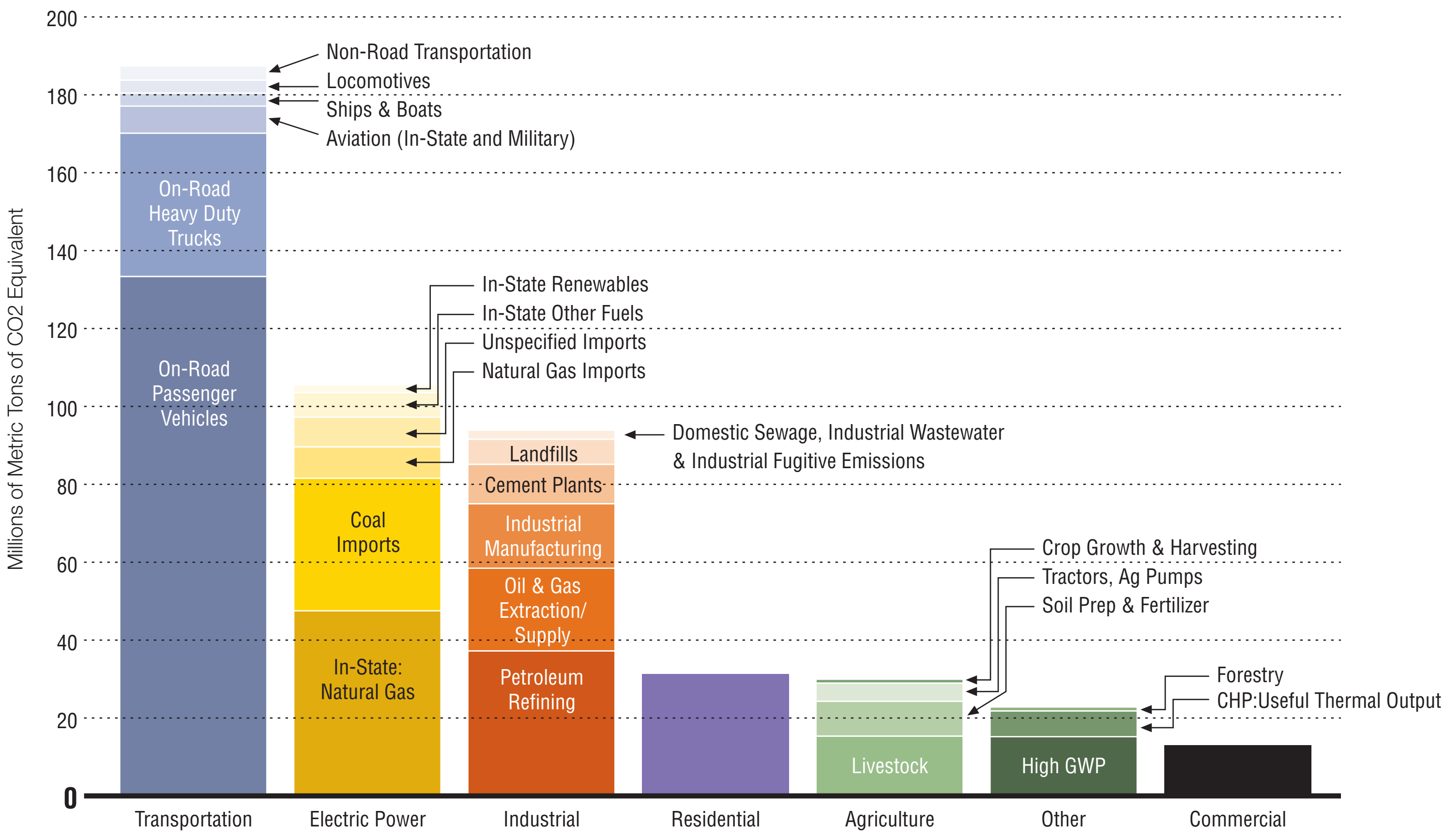
Other sources of emissions are from high Global Warming Potentials (GWP), Combined Heat and Power Plants (CHP), and Forestry. Together, these sectors account for 4% of California's total GHG emissions.

[3] *California Air Resources Board. "Staff Report: California 1990 Greenhouse Gas Emissions Level and 2020 Emissions Limit." November 16, 2007*

7

Greenhouse Gas Emissions by Detailed Source

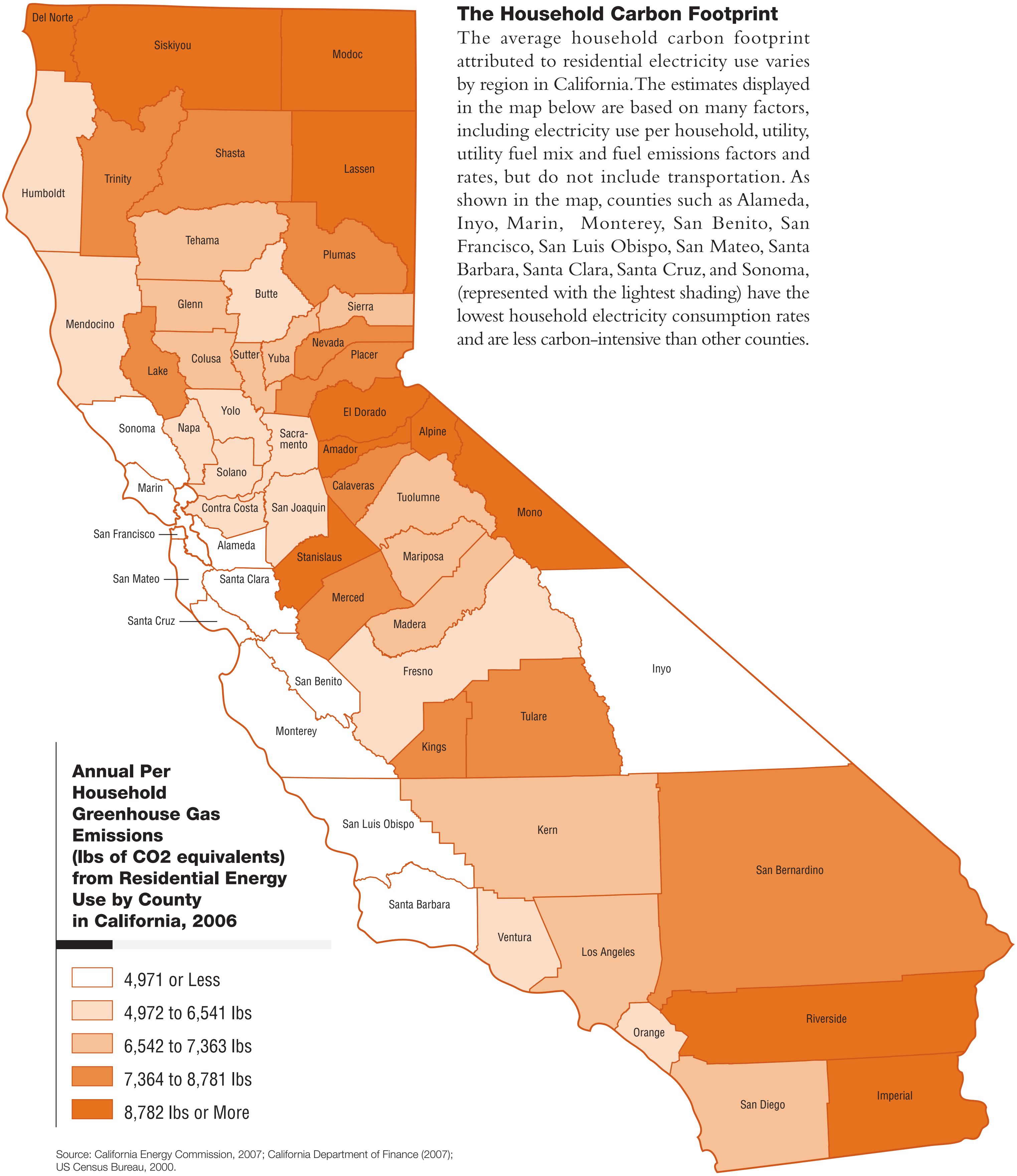
California 2006



Note: Data for 2006 are preliminary
Source: California Air Resources Board, California Greenhouse Gas Inventory–by Sector and Activity
Analysis: Collaborative Economics

The Household Carbon Footprint

The average household carbon footprint attributed to residential electricity use varies by region in California. The estimates displayed in the map below are based on many factors, including electricity use per household, utility, utility fuel mix and fuel emissions factors and rates, but do not include transportation. As shown in the map, counties such as Alameda, Inyo, Marin, Monterey, San Benito, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, and Sonoma, (represented with the lightest shading) have the lowest household electricity consumption rates and are less carbon-intensive than other counties.



Annual Per Household Greenhouse Gas Emissions (lbs of CO2 equivalents) from Residential Energy Use by County in California, 2006

Source: California Energy Commission, 2007; California Department of Finance (2007); US Census Bureau, 2000.

Energy Efficiency

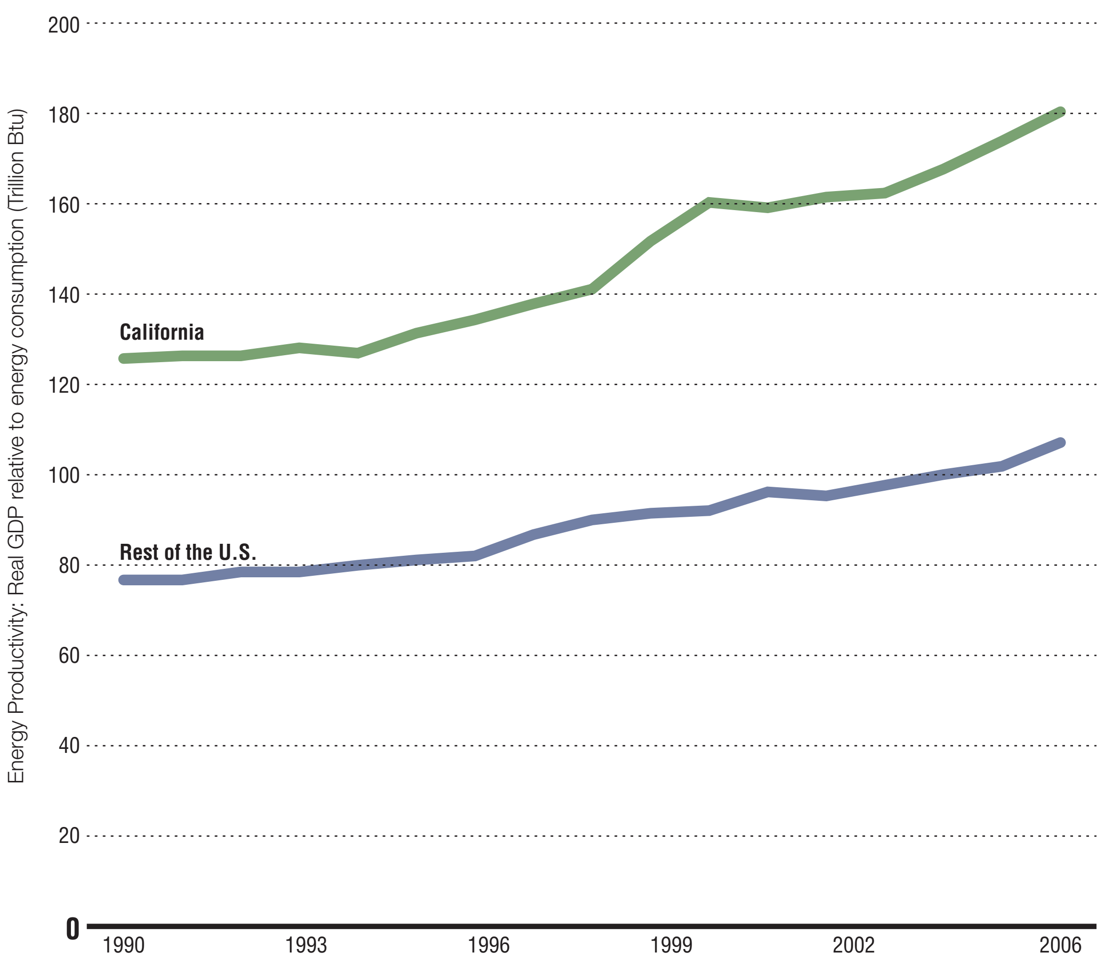
Energy Productivity is higher in California than the rest of the country. While gains were similar from 2005 to 2006, the gap in energy productivity between California and the rest of the U.S. remains with California's energy productivity 68% higher than the U.S. ***(Figure 8***). Measured as the ratio of energy consumed (inputs) to GDP (economic output), growth in energy productivity equates to more dollars of GDP generated per unit of energy consumed.

In 2006, California produced $2.17 of GDP for every 10,000 BTU of energy consumed. In comparison, the rest of the United States produced $1.29 for every 10,000 BTU of energy consumed. Therefore, the difference in energy productivity between California and the rest of the U.S. is about 88 cents per 10,000 BTU of energy consumed.

Percent Change in Energy Productivity	
2005-2006	
California	+3.5%
Rest of the US	+4.3%

8 Energy Productivity

GDP relative to total energy consumption



Source: US Department of Energy, Energy Information Administration; US Department of Commerce, Bureau of Economic Analysis
Analysis: Collaborative Economics

Improving energy productivity will free up resources that can, in turn, be redirected toward consumption or investment in other areas or toward the creation of new jobs. McKinsey & Company makes the case: "Rather than seeking explicitly to reduce end-use demand, we should focus on using the benefits of energy in the most productive way."

McKinsey Global Institute. "The Case for Investing in Energy Productivity" McKinsey & Company (February, 2008).

Total energy consumption relative to levels in 1970 has been leveling off since 2004 in California and in the rest of the country; however, total consumption for both remains 50% higher than in 1970. In the same period, California's population has grown by 88%. Total energy consumption encompasses all forms: petroleum, natural gas, electricity retail sales, nuclear, coal and coal coke, wood, waste, ethanol, hydroelectric, geothermal, solar, and wind energy.

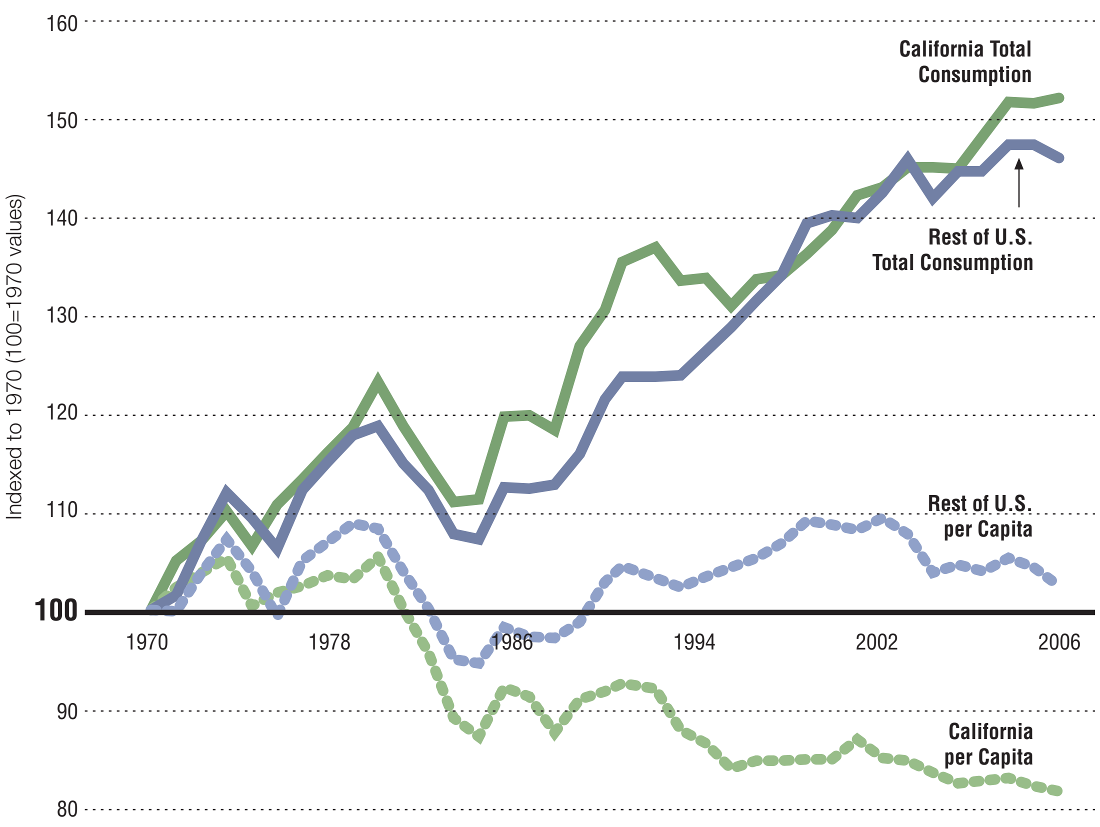
In terms of total energy consumption per capita in California, consumption is declining, and at a faster rate than in the rest of the U.S. ***(Figure 9)***. In 2006, energy consumption per capita in California was 18% lower than 1970 levels, whereas energy consumption per capita for the rest of the country remained above 1970 levels.

Energy Consumption per Capita (BTUs)

	2005	2006	Change
California	227	226	-0.5%
Rest of U.S.	355	348	-1.9%

9 Total Energy Consumption Relative to 1970

California and rest of the U.S.



Source: Energy Information Administration, U.S. Department of Energy; Population Division, U.S. Census Bureau, California Department of Finance
Analysis: Collaborative Economics

What Might it Cost?

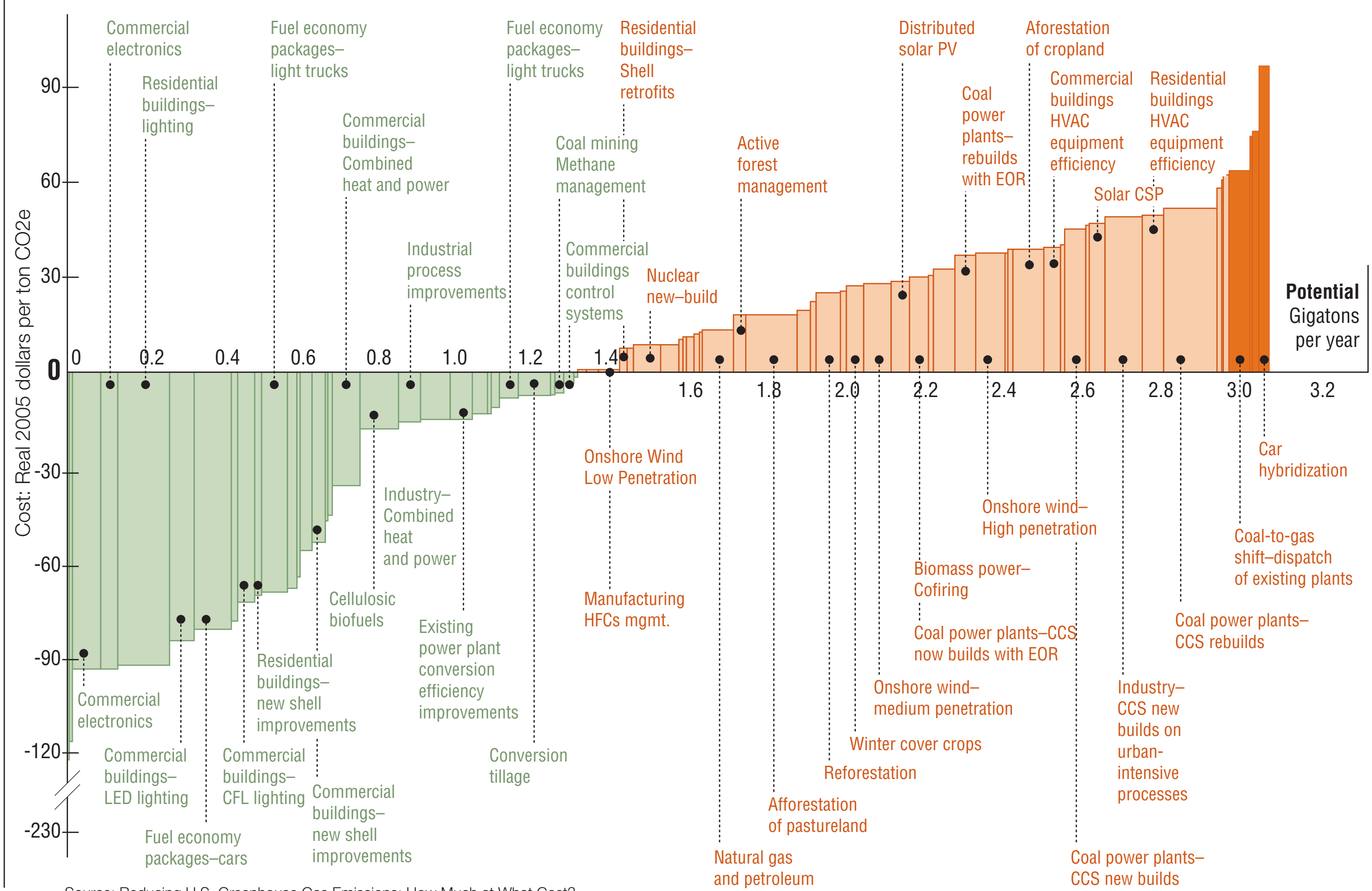
In terms of meeting the emissions reduction targets laid out by AB 32, considerably more needs to be done beyond California's achievements thus far in improving energy efficiency. Reversing the growth in greenhouse gas emissions will require a wide array of efforts with varying abatement potential and investment costs. Developed by McKinsey & Company, ***Figure 10*** illustrates a wide range of possible actions for reducing GHG emissions and the marginal cost and abatement potential associated with each.[4] The width of each bar represents the abatement potential (CO_2e per year) estimated for the year 2030. Examples of high-potential options include afforestation of pastureland, and lighting in residential buildings. The height (vertical axis) displays the average cost of avoiding one ton of CO2e, and the green bars all have an abatement cost below $50 per ton of CO2e. The options on the left side of the curve below zero indicate a net benefit. The low-cost actions on the left side include efficiency improvements primarily to electronics, lighting and buildings. These actions could produce a positive return on investment due to savings in energy costs.[5] The bars increasing toward the right depict progressively higher cost abatement measures.

[4] *Creyts, J., A. Derkach, S. Nyquist, K. Ostrowski, J. Stephenson. 2007. "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?" McKinsey & Company. Page 20.*

[5] *Eric Beinhocker, et al. 2008. "The carbon productivity challenge: Curbing climate change and sustaining economic growth." McKinsey Climate Change Special Initiative, McKinsey Global Institute. Page 15.*

10 U.S. Mid-Range Abatement Curve
2030

Abatement cost >$50/ton <$50/ton net benefit



Source: Reducing U.S. Greenhouse Gas Emissions; How Much at What Cost?, Executive Report, McKinsey & Company, December 2007

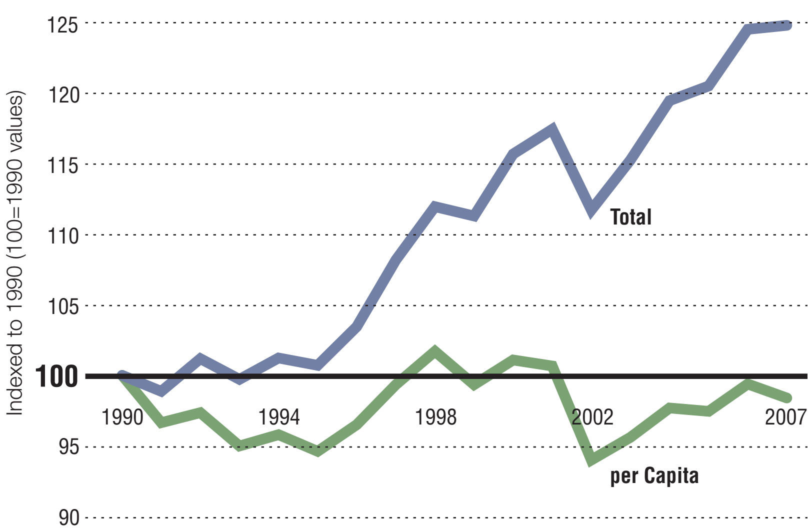
Trends in California's Electricity Consumption

For the most part, Californians have been able to keep electricity consumption per person below 1990 levels, with the exception of 1998, 2000, and 2001 ***(Figure 11)***. From 2006 to 2007, per capita electricity consumption declined 1% in California. Total electricity consumption leveled off from 2006 to 2007, representing the smallest annual increase since 2002.

11

Electricity Consumption Relative to 1990

Total and per capita – California



Source: Energy Information Administration, U.S. Department of Energy; Population Division, U.S. Census Bureau, California Department of Finance
Analysis: Collaborative Economics

Planning for Peak Demand

Although California has been able to continue improving efficiency levels in electricity consumption (as measured by per capita consumption), the State's population and total electricity demand continue to rise. Communities must plan ahead to prepare for future power demand and irregular peak load demand. Peak electricity demand is the maximum load in a specified period of time which typically arises during months with high temperatures when there is significant demand on the electrical grid. As temperature fluctuations become more dramatic and high temperatures rise, peak demand rises. There are smarter alternatives to the typical method of building more power plants or firing up old, inefficient, and dirty power plants for meeting the periodic surges in demand. Through public policy, demand-based price mechanisms, and advanced communications and metering technology, electricity consumption can be reduced or shifted during peak demand periods. Developing a smart grid would leverage technology to improve efficiency through load management. A smart grid is an electricity transmission and distribution network using two-way communications, advanced sensors, and distributed computers to improve the efficiency, reliability and safety of power delivery and use. An innovative approach to managing peak demand is Flex Your Power's **Flex Alert**[1] notification system which informs consumers via email, text message and other media to reduce their demand in peak-load periods.

[1] *Initiated in 2001, Flex Your Power is a partnership of California's utilities, residents, businesses, institutions, government agencies and nonprofit organizations working to save energy. www.fypower.org*

Market Share of Energy Star Appliances

The market penetration of Energy Star dishwashers and clothes washers in California is on the rise. In 2006, roughly 95% of dishwashers purchased in California were Energy Star-qualified—an increase in market share of 5% since 2005 ***(Figure 12)***. Over 50% of clothes washers purchased in 2006 were Energy Star-qualified.

Refrigerators accounted for 49% of market share of Energy Star appliances in California. In 2001 and 2004, changes were made to the Energy Star Standard for refrigerators, including higher energy-efficiency requirements. The drops in market share in 2002 and 2006 for Energy Star-qualified refrigerators are likely attributable to the new standard requirements.

How Many Light Bulbs Does it Take to Change California? *New Information on the Level of Adoption of CFLs in the State*

In a September 2008 survey of registered voters, Field Research Corporation asked respondents what percentage of their home light fixtures use energy-saving compact fluorescent (CFL) bulbs. Three in ten respondents (29%) said that more than 75% of their lighting fixtures now use CFLs. Another one-third of respondents said that between 25% and 75% of their fixtures use CFLs. Notably, only 12% replied that they use no CFLs whatsoever.

In the 2007 Next 10/Field Research Corporation survey, 78% of registered voters said they were using CFLs. In 2008, that percentage had grown to 86%.

CA Market Share of Energy Star Qualified Units

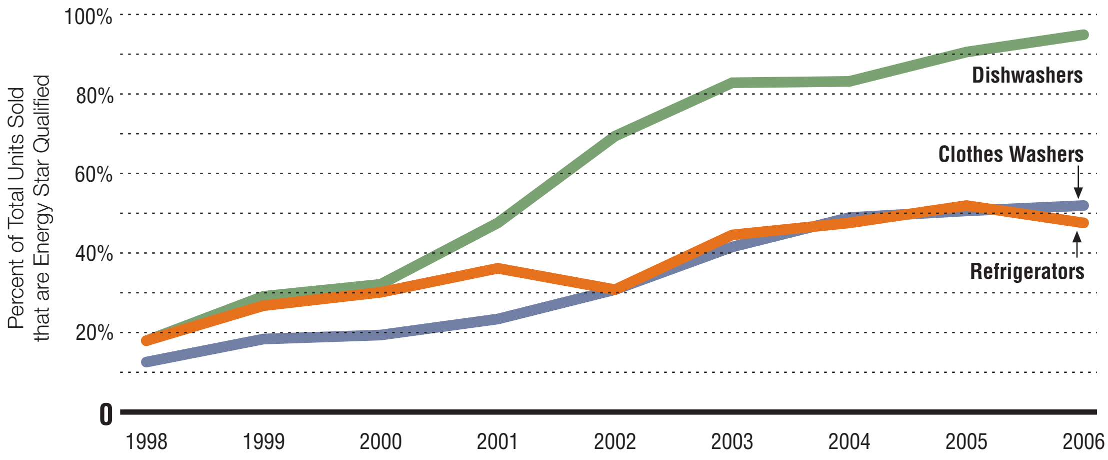
	1998	2006	Growth '98-'06
Clothes Washers	12%	52%	+40%
Dishwashers	17%	95%	+78%
Refrigerators	17%	49%	+31%

Percent of CA Home Light Fixtures with CFL Bulbs

Percent of Fixtures Using CFLs	Percent of Homes
More than 75%	29%
Between 50%-75%	16%
Between 25%-50%	18%
Between 1%-25%	23%
None	12%
Don't Know	2%

Source: Field Research Corporation "Survey of California Registered Voters About the Threat of Global Warming." September 2008

12 California Market Share of Energy Star Appliances



Source: California Measurement Advisory Council (CALMAC)
Analysis: Collaborative Economics

Commercial Electricity Consumption

As the commercial sector continues to grow, total commercial electricity consumption has been rising. However, commercial electricity consumption per square foot of floor space has increased marginally due to efficiency efforts. Between 2004 and 2005, total commercial electricity consumption rose by 3%, but per square foot, consumption increased by only 1% ***(Figure 13)***. While building and appliance standards (Title 24 and Title 20) have contributed to increased efficiency, this progress has been offset in part by the overall increase in the density of equipment such as computers and air conditioners in the commercial sector.

Commercial electricity consumption patterns vary by industry ***(Figure 14)***. While large offices represent the largest segment by square footage, annual electricity consumption per square foot in large offices is half that of food stores, restaurants and hospitals, which are the largest consumers per square foot. Since the mid-1990s, there has been little progress in efficiency in these commercial spaces. In fact, consumption per square foot has increased among the top consumers.

Although they are increasing in number and power intensity, large-scale data centers, also known as server farms, are not represented in ***Figure 14***. The growing demand for downloaded photos, music and videos from the internet, and for sending photos and other files by cell phone, has resulted in demand for more server farms with more bandwidth to store data and handle increasing web traffic. According to Jonathan Koomey, environmental engineering professor at Stanford University, "Aggregate electricity use for servers doubled over the period 2000 to 2005 both in the U.S. and worldwide."[6] Koomey further explains that total power used by servers, including that used for cooling and auxiliary infrastructure, represents 1.2% of total U.S. consumption, and that in 2005 this demand was equivalent (in capacity terms) to about five 1000 MW power plants for the U.S. (and 14 for the world).[7]

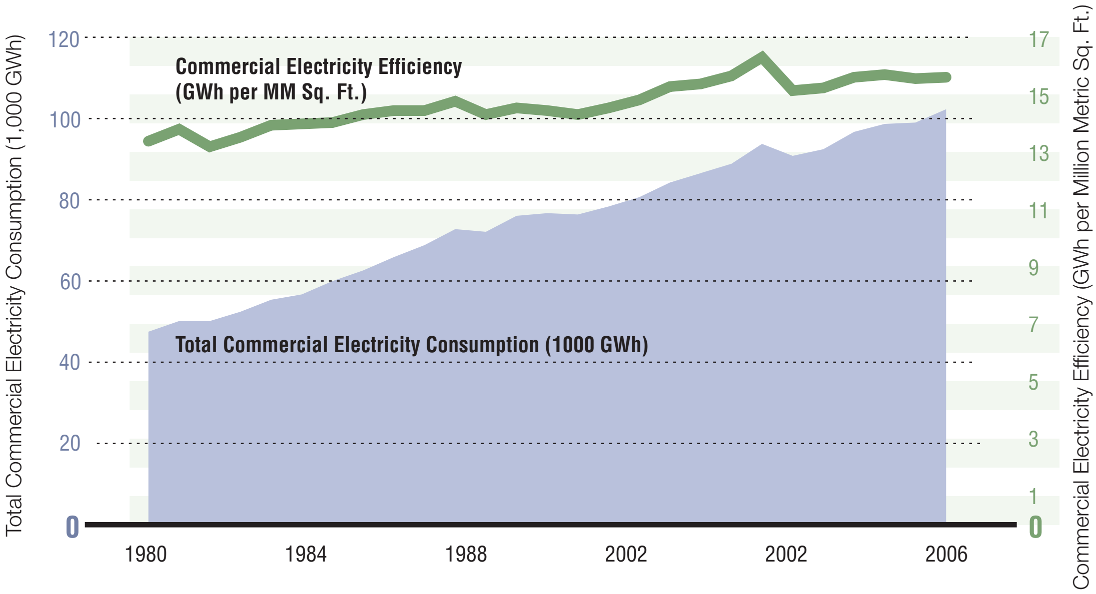
[6] *Jonathan G. Koomey, Estimating Total Power Consumption by Servers in the U.S. and the World. February 15, 2007*

[7] *Ibid.*

Change in Commercial Electricity Consumption	
2005-2006	
Total	**+3%**
Per Sq. Ft.	+1%

13 California Commercial Electricity Consumption and Efficiency

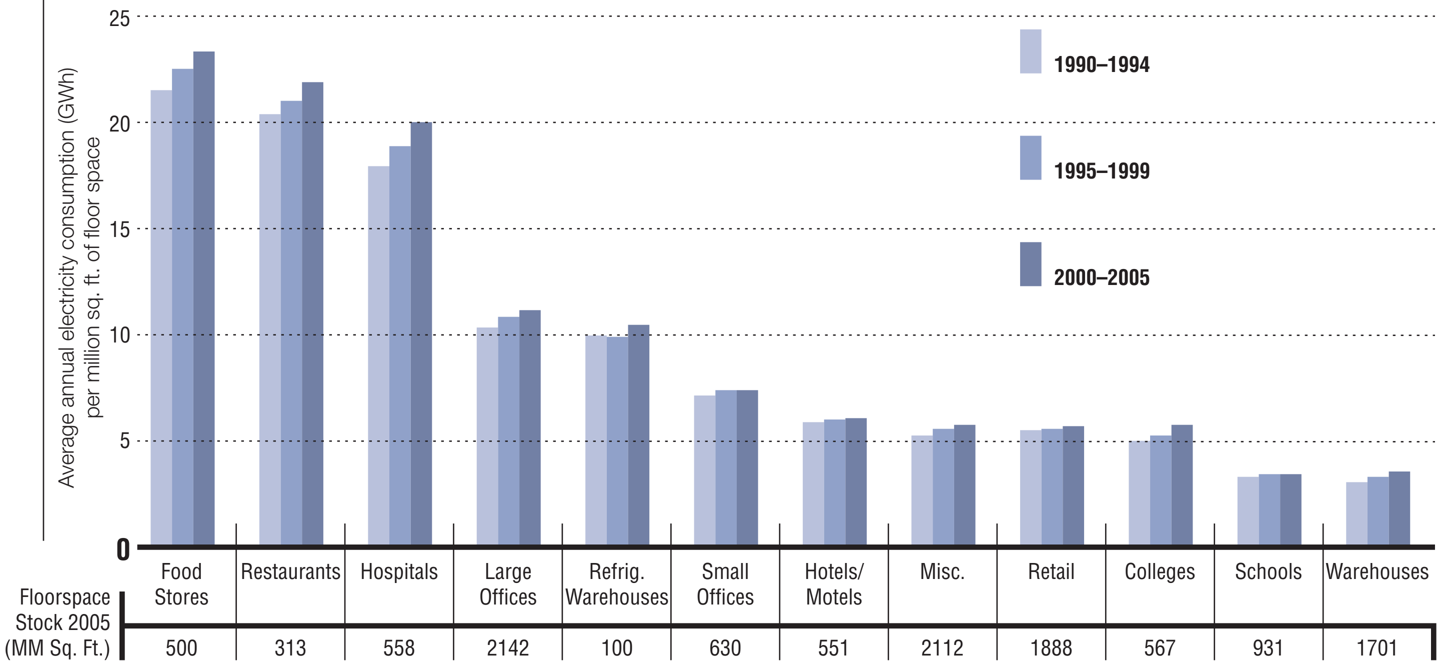
Total consumption and consumption per million metric square foot



Source: California Energy Commission
Analysis: Collaborative Economics

14 Commercial Office Building Electricity Consumption by Industry

Average annual electricity consumption per square foot of floorspace



Source: California Energy Commission
Analysis: Collaborative Economics

Challenges Facing Submetering in Commercial Buildings

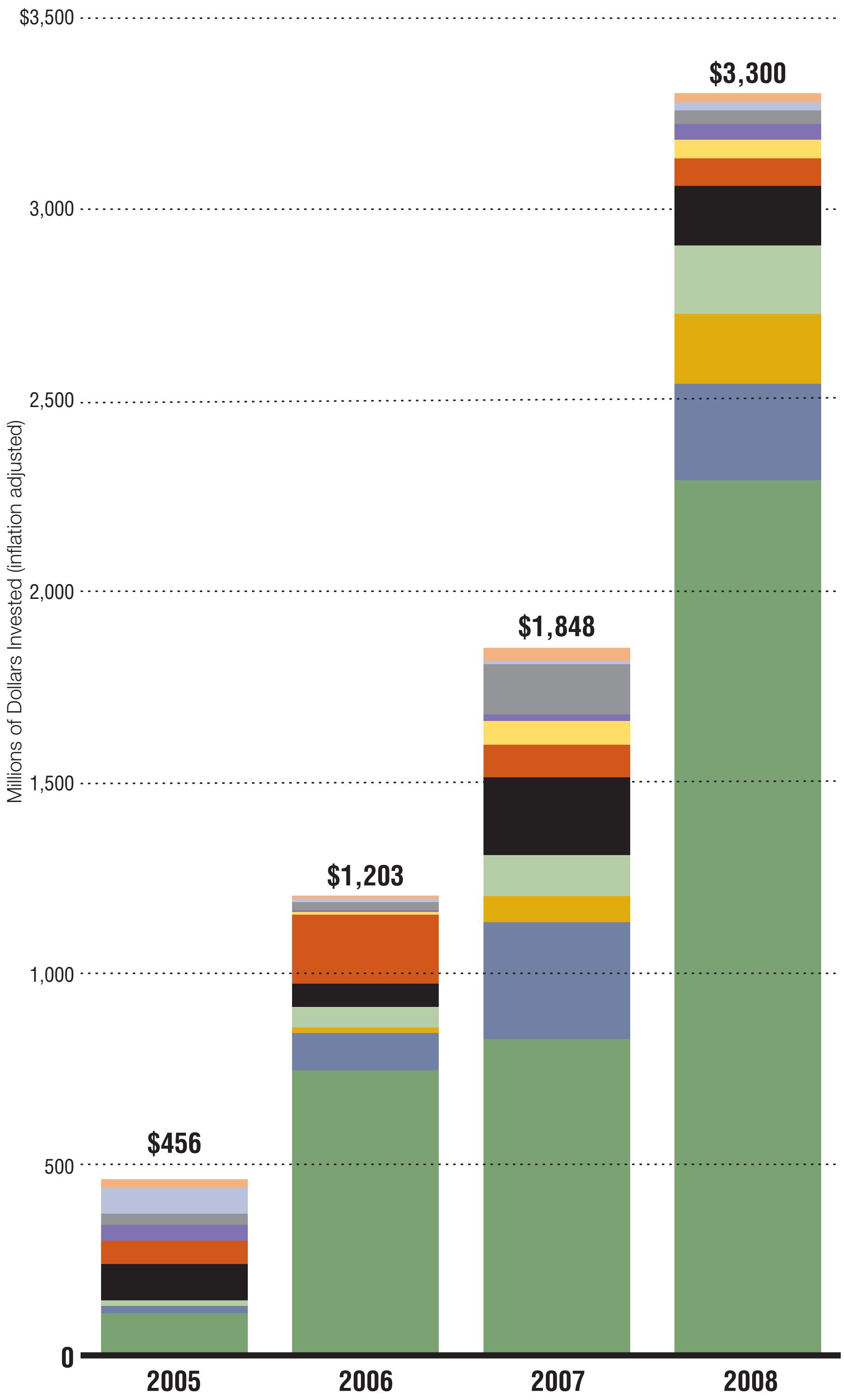
As energy volatility and electricity shortages have stricken California and the nation over the last several years, there has been an increase in attention to building energy efficiency as a means to reduce energy demand. However, improvements in energy efficiency are in part dependent on knowledge of current energy use—data that are not always available under current utility submetering rules. Since 1962, commercial California tenants who do not have individual utility-owned electric meters have typically paid for electricity costs on the basis of square footage, and do not have direct control over their energy costs. [1]

On September 6, 2007, the California Public Utilities Commission (CPUC) adopted new rules for Pacific Gas and Electric Company (PG&E) that allow building owners to submeter their tenants in high-rise commercial buildings, subject to tenant lease agreement.[2] As this decision resulted from an agreement between PG&E and the Building Owners and Managers Association (BOMA), submetering is currently authorized only in PG&E's service territory; Southern California Edison and San Diego Gas & Electric would require separate authorization from the CPUC before similar programs could be adopted.

[1] *Allen, Peter V., Lacourciere, Paul C., Richard M. Shapiro. 2007. "United States: Submetering Of Electricity for Commercial Buildings." Thelen Reid Brown Raysman & Steiner LLP. 13 November 2007. www.mondaq.com/article.asp?articleid=54272*

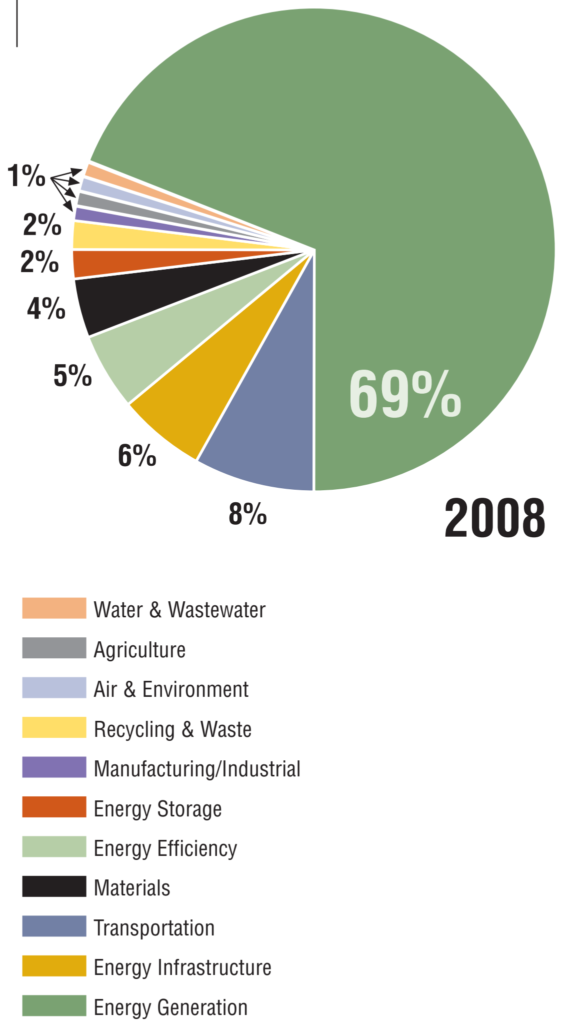
[2] *California Public Utilities Commission. 2007 "PUC Decision Gives Commercial Building Tenants a Tool to Lower Power Bills and Increase Energy Efficiency and Demand Response." Docket #:A.06-03-005. 6 September 2007. http://docs.cpuc.ca.gov/Published/News_release/72431.htm*

15 VC Investment in Clean Technology
by cleantech segment – California



Source: Cleantech Group™, LLC (www.cleantech.com)
Analysis: Collaborative Economics

16 California VC Investment
Distributed by cleantech segment



Venture Capital Investment in Clean Tech

	2008 Investment Total	Percent of Total U.S. Investment
California	**$3,300,096,886**	**57%**
Massachusetts	589,113,942	10%
Maryland	156,162,333	3%
Texas	67,154,638	1%

Note: Investment values are adjusted for inflation
Source: Cleantech Group™, LLC (www.cleantech.com)
Analysis: Collaborative Economics

GREEN TECHNOLOGY INNOVATION

Venture Capital Investment in Clean Technology

Venture capital (VC) is a leading indicator of innovation. Because companies have to meet a high standard for potential success to receive VC funding, the amount of VC invested and the types of firms supported are predictors of future job and revenue growth.

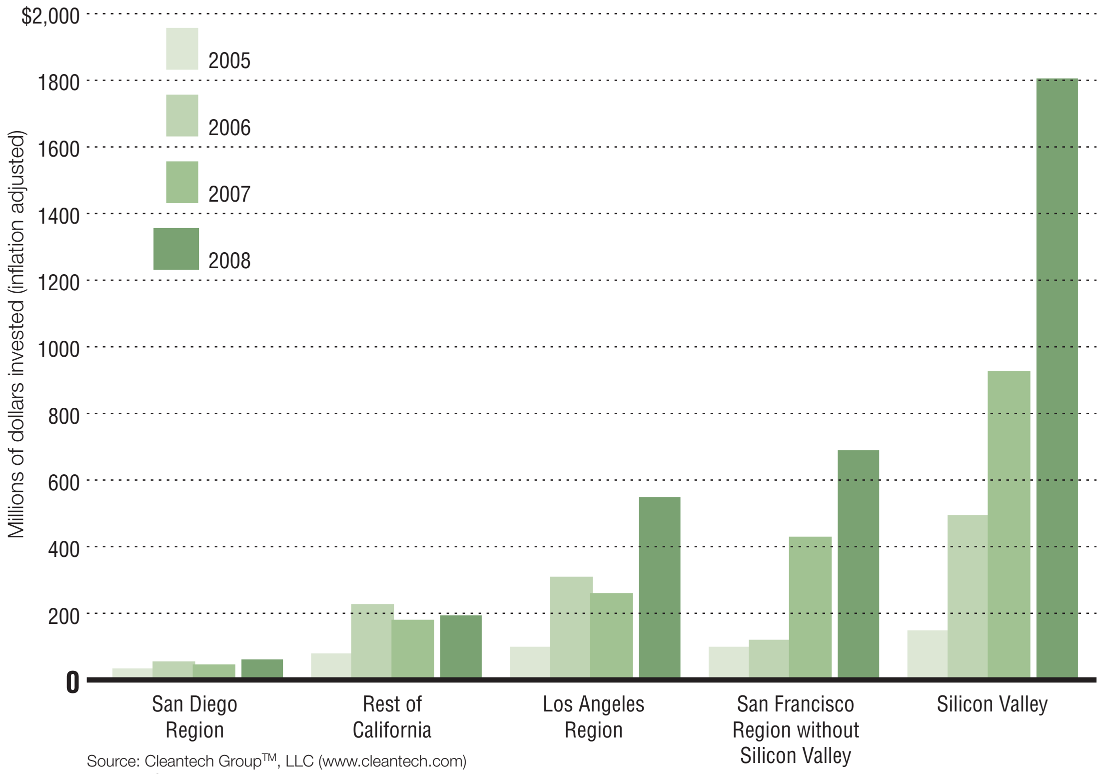
According to the Cleantech Group, California has clearly emerged as the national leader in clean technology investment. Clean technology investment in California achieved an all-time high in 2008 of $3.3 billion. Increasing nearly $1.5 billion over 2007, investment almost doubled in 2008 ***(Figure 15)***. California attracts the largest share of cleantech VC investment in the U.S., accounting for 57% of total national cleantech VC investment in 2008. Accounting for 69% of total VC investment, energy generation is by far the largest segment ***(Figure 16)***. Energy generation includes investments in such areas as wind, solar, hydro/marine, biofuels, combined heat/power, and geothermal.

Attracting $1.8 billion in 2008, Silicon Valley received more VC funding in cleantech than the rest of the state. Cleantech investment also more than doubled in the Los Angeles Area, and grew 62% in the San Francisco Bay Area (excluding Silicon Valley). Both Silicon Valley and the San Francisco Bay Area now top the second-ranking state, Massachusetts, in cleantech VC funding.

17

VC Investment in Clean Technology

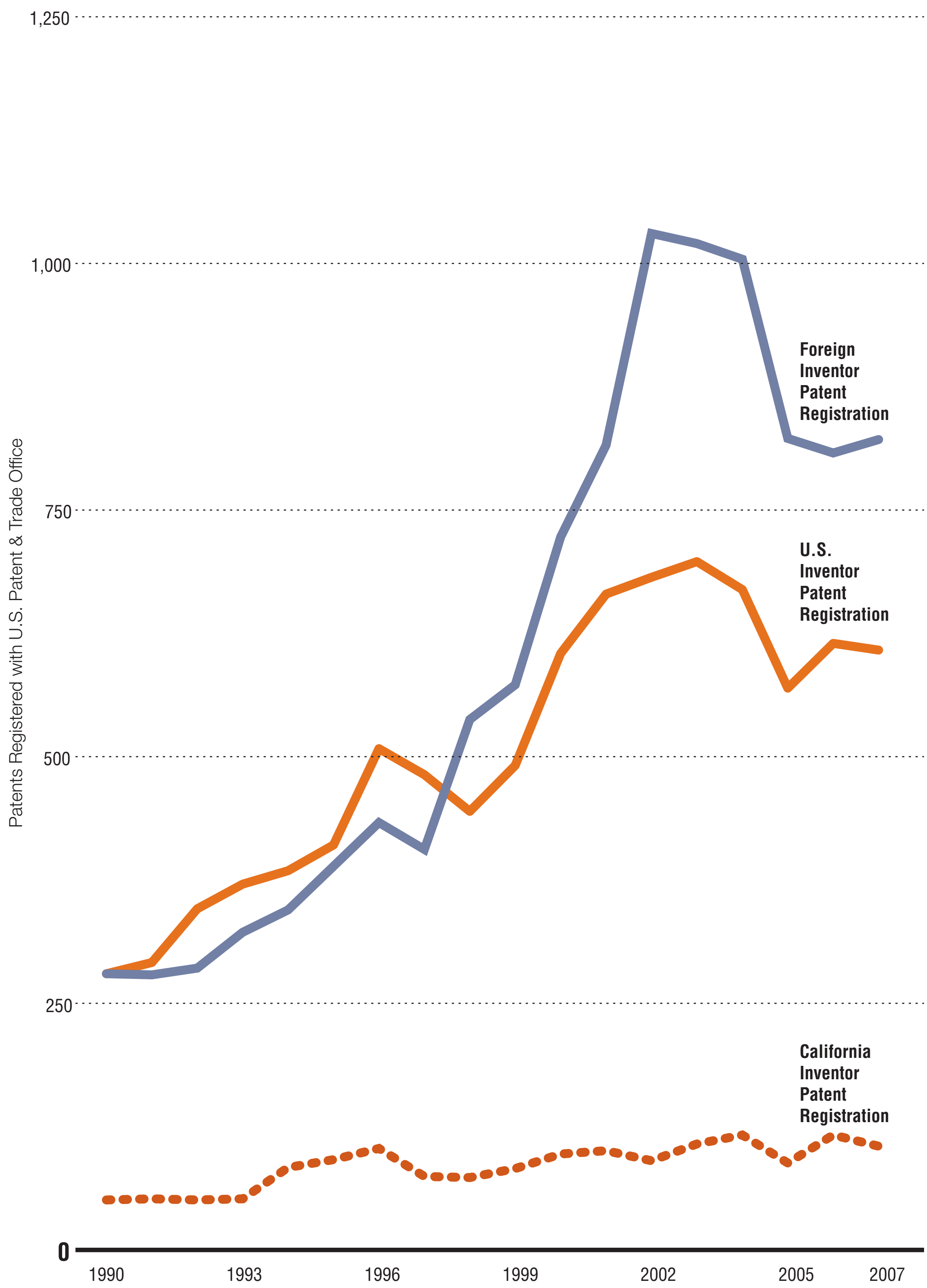
California, by region



Source: Cleantech Group[TM], LLC (www.cleantech.com)
Analysis: Collaborative Economics

18 Green Technology Patent Registrations

By primary inventors



Source: 1790 Analysis, Patents by Technology; USPTO Patent File
Analysis: Collaborative Economics

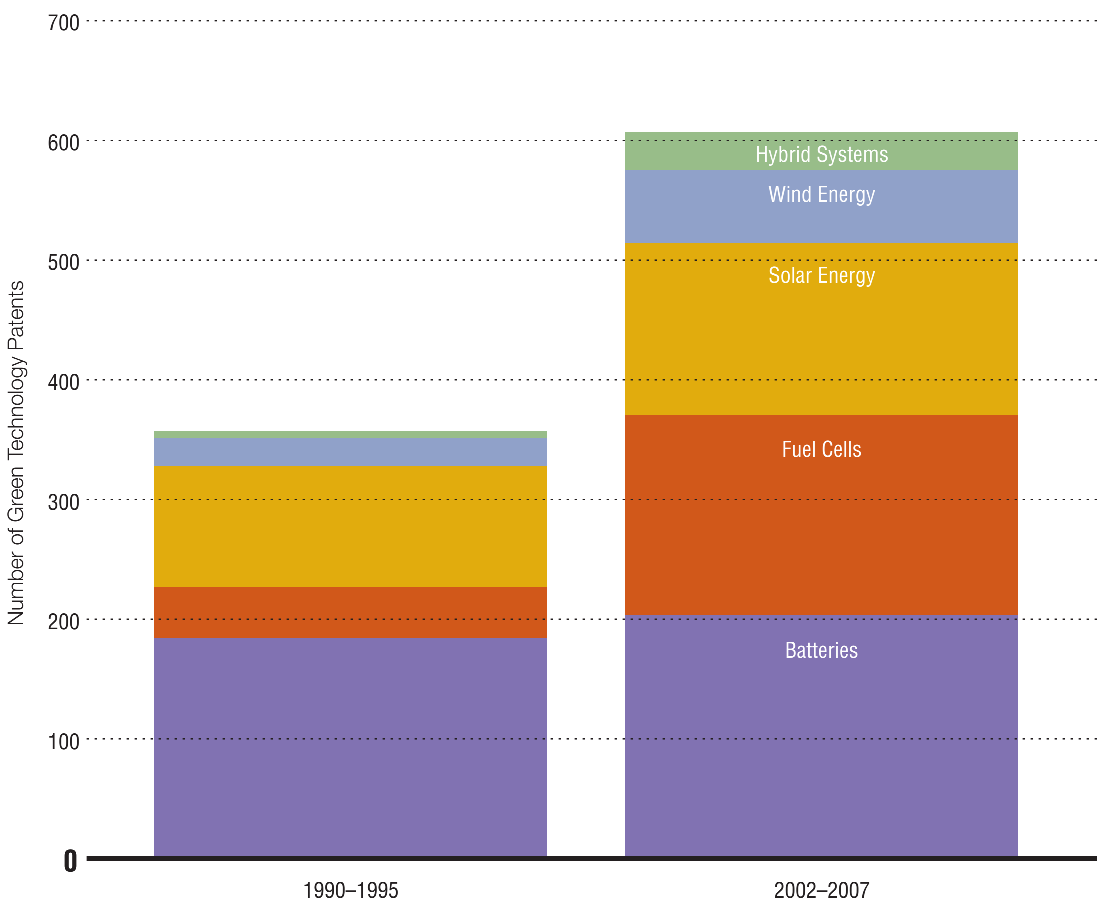
GREEN TECHNOLOGY INNOVATION

Green Technology Patent Registrations

Often motivated by the desire to protect an innovation that may have commercial potential, patents reflect the initial discovery and registry of innovative ideas. The generation of patents is also an indicator for the level of and return on R&D investment. The ability to generate and protect new ideas, products, and processes is also an important source of competitive advantage. In this regard, the United States has fallen behind, as green technology patents registered by foreign inventors has continued to outpace registrations by U.S. inventors for a decade. The narrowing gap since 2005 illustrated in ***Figure 18*** reflects a drop in registrations by foreign inventors rather than an increase in registrations by U.S. inventors.

Compared to earlier years, patent registrations in green technologies by Californian inventors are increasing in all categories ***(Figure 19)***. The number of green technology patents registered in California from 2002-2007 was 70% higher than in 1990-1995. The largest share of California's green patents was in the area of battery technology, with growing numbers of patent registrations in fuel cell and solar energy.

19 **California Green Technology Patents by Technology**

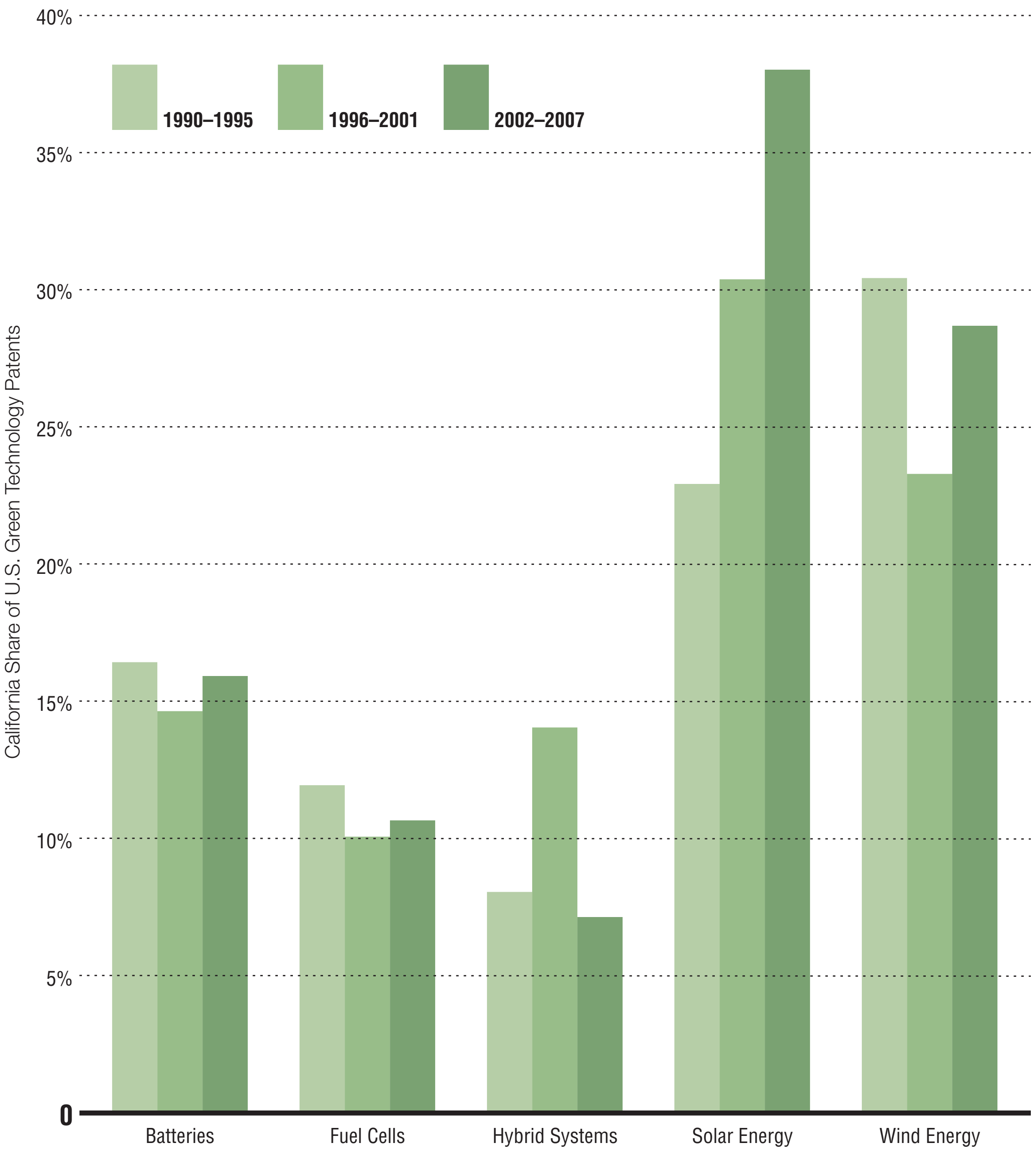


Source: 1790 Analysis, Patents by Technology; USPTO Patent File
Analysis: Collaborative Economics

California provides a large share of U.S. green patent registrations ***(Figure 20)***. With 38% of nationwide solar energy patent registrations from 2002 to 2007, California is increasingly the hub for solar energy technology development. Nationally, California was the top-ranking state for green patents registrations during the period 2002-2007.

In the area of green technology, California ranks number one in three of the five fields: solar, wind and battery patents. Michigan leads in hybrid technology by a wide margin. In fuel cell technology, New York leads, followed by Connecticut. In both of these fields, California is ranked third.

20 California Shares of U.S. Green Technology Patents by Technology



Source: 1790 Analysis, Patents by Technology; USPTO Patent File
Analysis: Collaborative Economics

Green Technology

Innovation

Total Green Tech Patents
Top Ranking States in Patents Registered

	# of Patents Registered	Ranking	
	2002–07	2002–07	1990–1995
California	**607**	**1**	**1**
New York	539	2	7
Michigan	444	3	7
Connecticut	273	4	10
Massachusetts	174	5	3
Ohio	143	6	2
Texas	126	7	12
New Jersey	118	8	6
Illinois	100	9	11
Pennsylvania	100	9	5

Solar Technology
Top Ranking States in Patents Registered

	# of Patents Registered	Ranking	
	2002–07	2002–07	1990–1995
California	**148**	**1**	**1**
Colorado	24	2	7
New York	21	3	5
Massachusetts	18	4	2
New Jersey	15	5	11
Texas	15	5	4
New Mexico	14	7	20
Arizona	13	8	16
New Hampshire	11	9	38
Pennsylvania	10	10	9

Battery Technology
Top Ranking States in Patents Registered

	# of Patents Registered	Ranking	
	2002–07	2002–07	1990–1995
California	**203**	**1**	**1**
New York	133	2	7
Massachusetts	80	3	6
Michigan	74	4	9
Ohio	72	5	2
New Jersey	52	6	5
Texas	50	7	11
Connecticut	49	8	16
Georgia	43	9	24
Minnesota	43	9	10

Hybrid System Technology
Top Ranking States in Patents Registered

	# of Patents Registered	Ranking	
	2002–07	2002–07	1990–1995
Michigan	266	1	1
Indiana	44	2	12
California	**31**	**3**	**4**
New York	14	4	2
Ohio	10	5	18
Colorado	9	6	18
Pennsylvania	8	7	3
Wisconsin	8	7	18
Tennessee	5	9	18
Washington DC	4	10	18

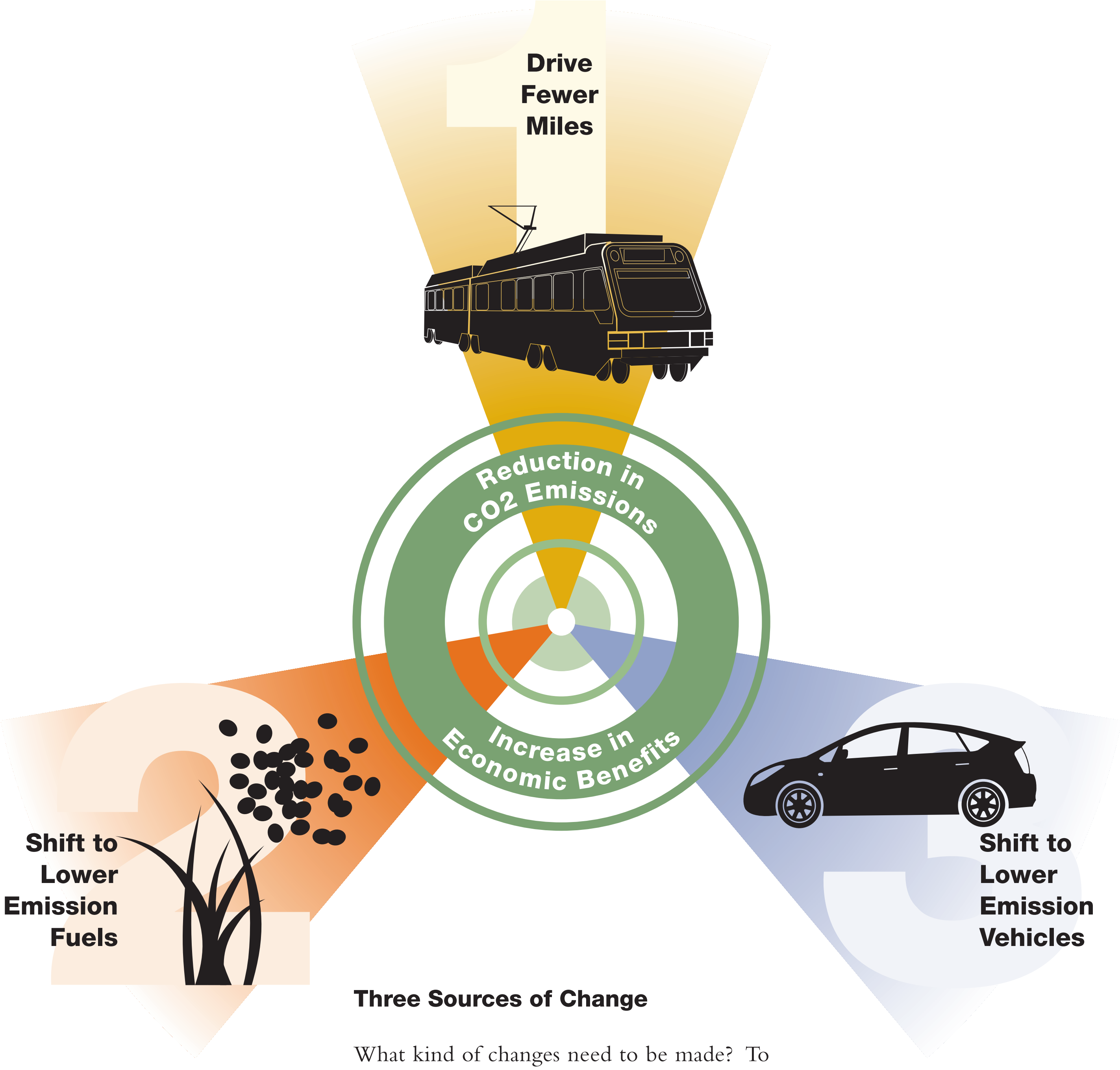
Fuel Cell Technology
Top Ranking States in Patents Registered

	# of Patents Registered	Ranking	
	2002–07	2002–07	1990–1995
New York	351	1	8
Connecticut	215	2	1
California	**164**	**3**	**2**
Michigan	88	4	13
Oregon	84	5	29
Massachusetts	67	6	6
Ohio	53	7	5
Texas	48	8	10
Washington	47	9	20
Pennsylvania	45	10	4

Wind Technology
Top Ranking States in Patents Registered

	# of Patents Registered	Ranking	
	2002–07	2002–07	1990–1995
California	**61**	**1**	**1**
New York	20	2	6
Texas	12	3	3
Nevada	11	4	16
Illinois	10	5	10
Michigan	7	6	6
Florida	6	7	24
Massachusetts	6	7	2
Washington	6	7	16
New Jersey	5	10	24
Virginia	5	10	6
Wyoming	5	10	24

Source: 1790 Analysis, Patents by Technology; USPTO Patent File Analysis: Collaborative Economics



Three Sources of Change

What kind of changes need to be made? To reduce greenhouse gas emissions from transportation sources, Californians can drive fewer miles (by cutting back on trips and using alternatives such as public transit) and shift to lower-emission vehicles and fuels. The most recent data suggest that California is moving in the right direction in these areas—but that much more will need to be done to produce major reductions in greenhouse gas emissions.

Feature

Focus On Surface Transportation

Moving in the Right Direction, But Many Miles to Go

Emissions from all transportation sources account for 39% of California's total greenhouse gas (GHG) emissions. If the emissions from oil refineries were included, this number would be 46%. Responsible for the bulk of these emissions (35% of total GHG emissions in California),[8] surface transportation encompasses passenger vehicles, as well as light and heavy trucks, buses, and motorcycles.

Passenger vehicles alone represent 71% of total emissions from transportation sources ***(Figure 21)***. On-road heavy-duty trucks make up the second largest segment (20%). In addition to the greenhouse gases they produce, these trucks emit diesel particulate matter, which has become a serious public health concern, especially at major transportation hubs and corridors across the State.

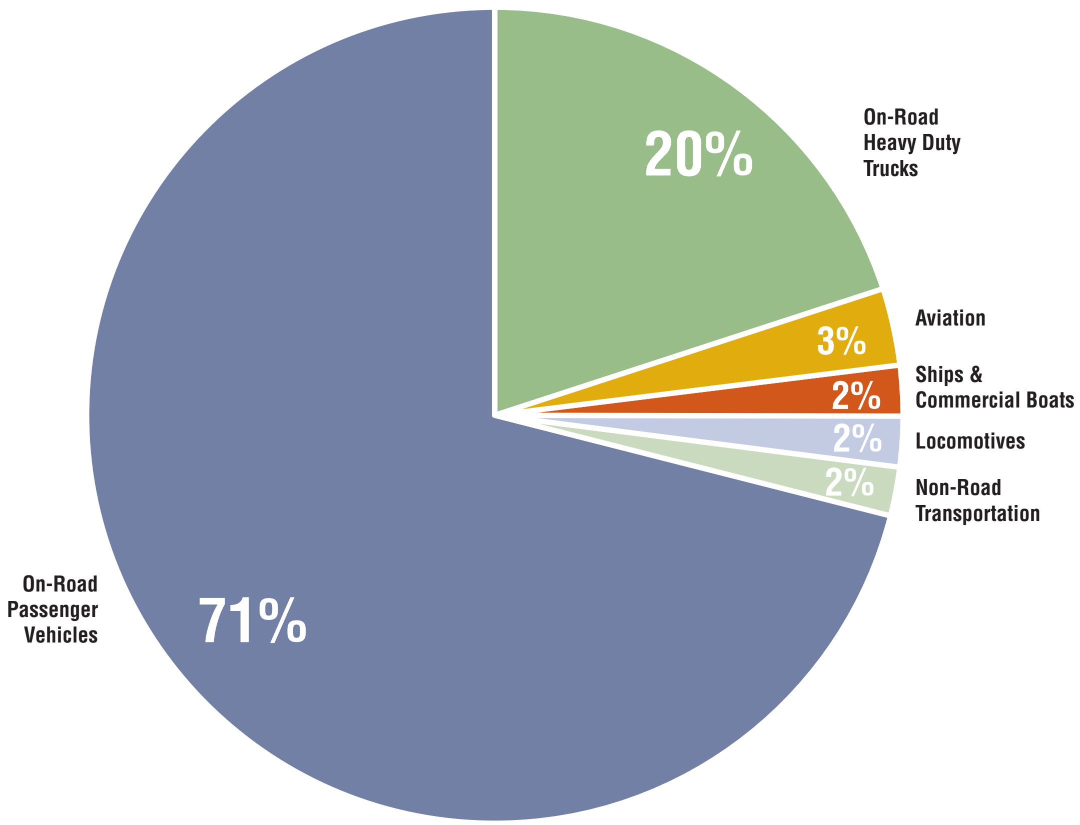
Without major changes in how Californians travel along roads and highways, it is unlikely that enough reductions can be achieved in other areas to meet the emissions goals of AB 32.

[8] *California Air Resources Board. 2008. "California Greenhouse Gas Inventory-by Sector and Activity." January 2009.*

21

GHG Emissions from Transportation by Source

California 2006

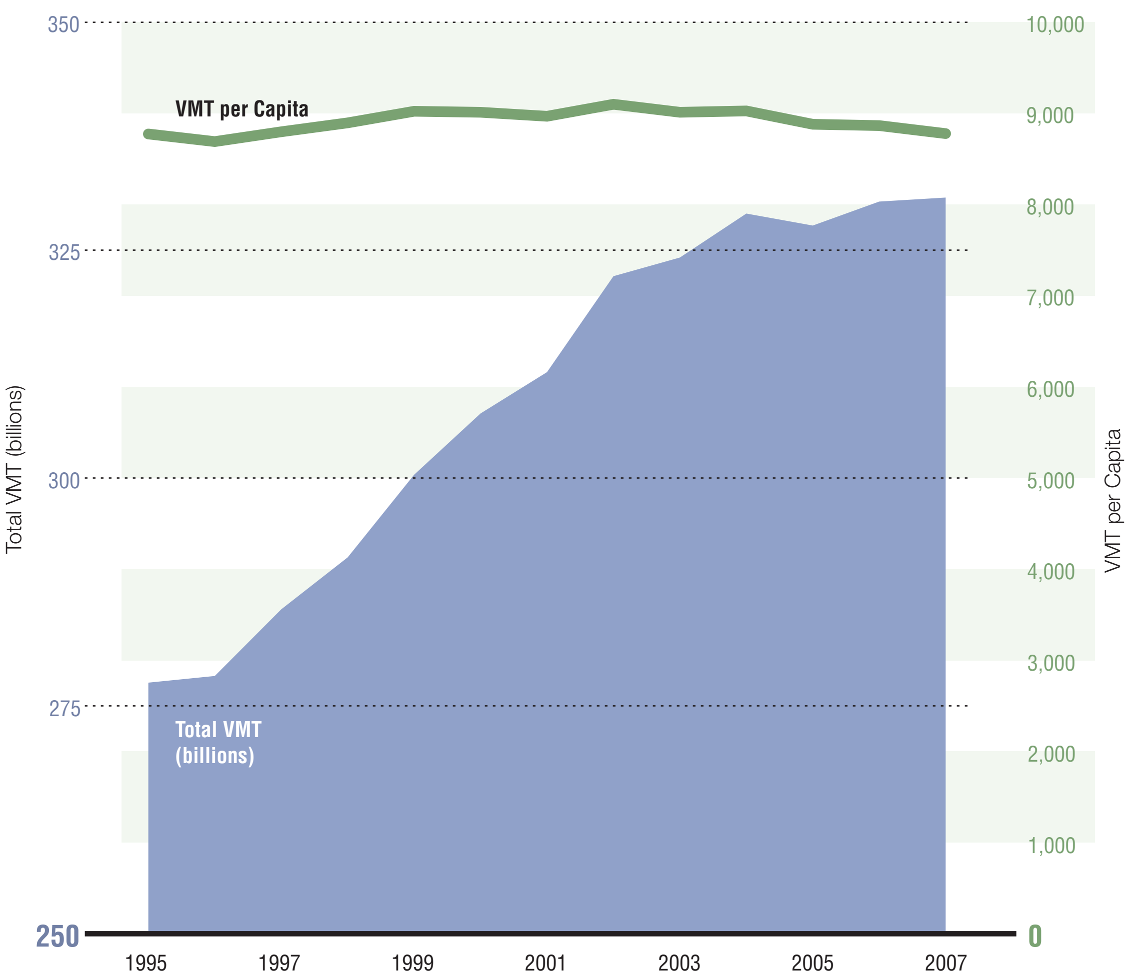


Note: Data for 2006 are preliminary
Source: California Air Resources Board, California Greenhouse Gas Inventory–by Sector and Activity
Analysis: Collaborative Economics

VMT Percent Change 2006–2007	California	Rest of U.S.
Total	**+0.2%**	**+0.6%**
per Capita	-1.0%	-0.4%

Source: California Department of Transportation; United States Department of Transportation - Federal Highway Administration; California Department of Finance; Population Divison, U.S. Census Bureau
Analysis: Collaborative Economics

22 California Vehicle Miles of Travel



Note: Includes VMT on state highway systems and other public roads
Source: California Department of Transportation; California Department of Finance
Analysis: Collaborative Economics

Californians Are Driving Fewer Miles

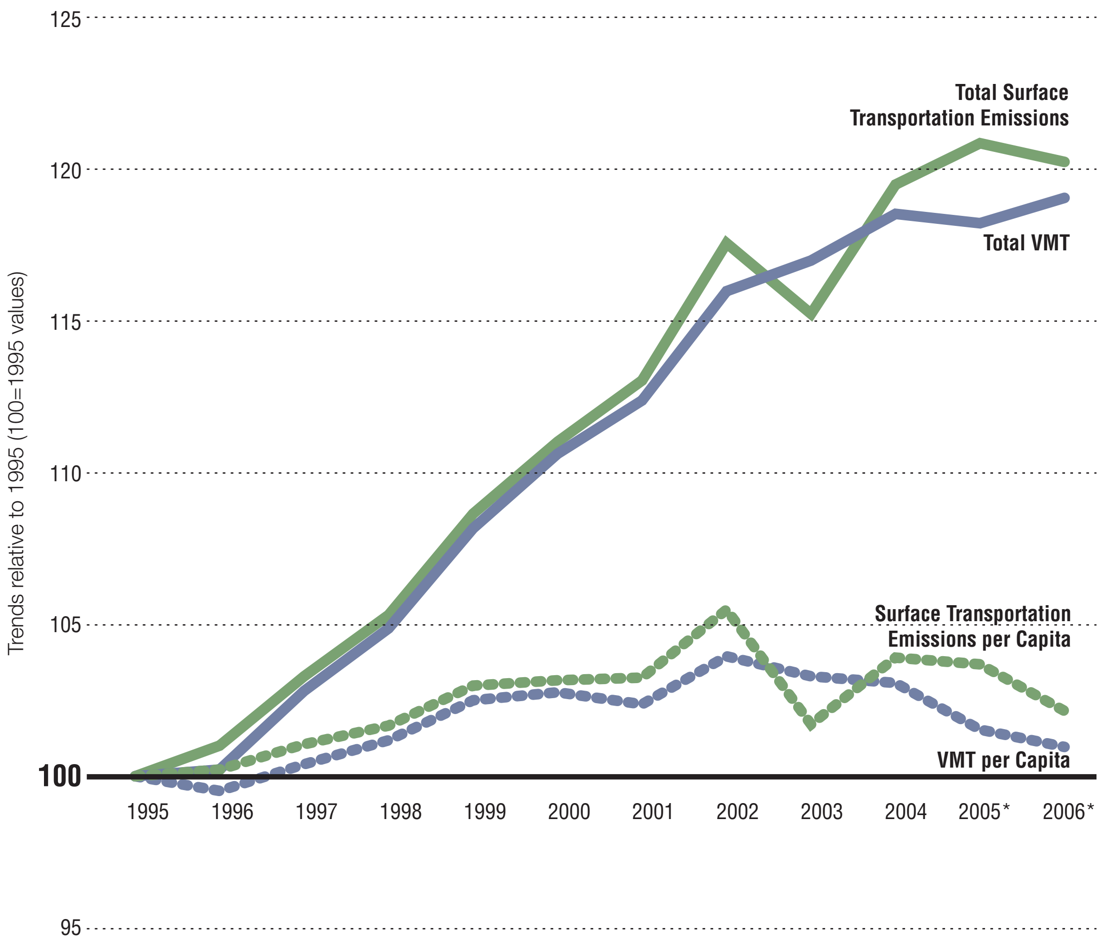
On a per capita basis, Californians have been driving fewer miles. Since 2001, vehicle miles traveled (VMT) per capita dropped 2%, and half of this progress was achieved between 2006 and 2007 alone. In contrast, per capita VMT in the rest of the nation increased by 3% between 2001 and 2007. Despite California's dependence on the automobile, trends displayed in ***Figure 22*** reveal a longer-term reduction in VMT per capita. From 2001 to 2007, in 29 of the State's 58 counties per capita VMT dropped. Over this period, however, total VMT (driven in part by population growth) has continued to rise, albeit at a slower rate in recent years.

Californians may be driving less, but due to population growth, total vehicle miles of travel and total greenhouse gas emissions from surface transportation have risen significantly relative to levels in 1995. Total VMT and total transportation emissions have increased nearly 20% since 1995. On a per capita basis, VMT as well as emissions from surface transportation have been scaling back to 1995 levels in recent years ***(Figure 23)***.

23

Trends in Vehicle Miles of Travel and GHG Emissions from Surface Transportation

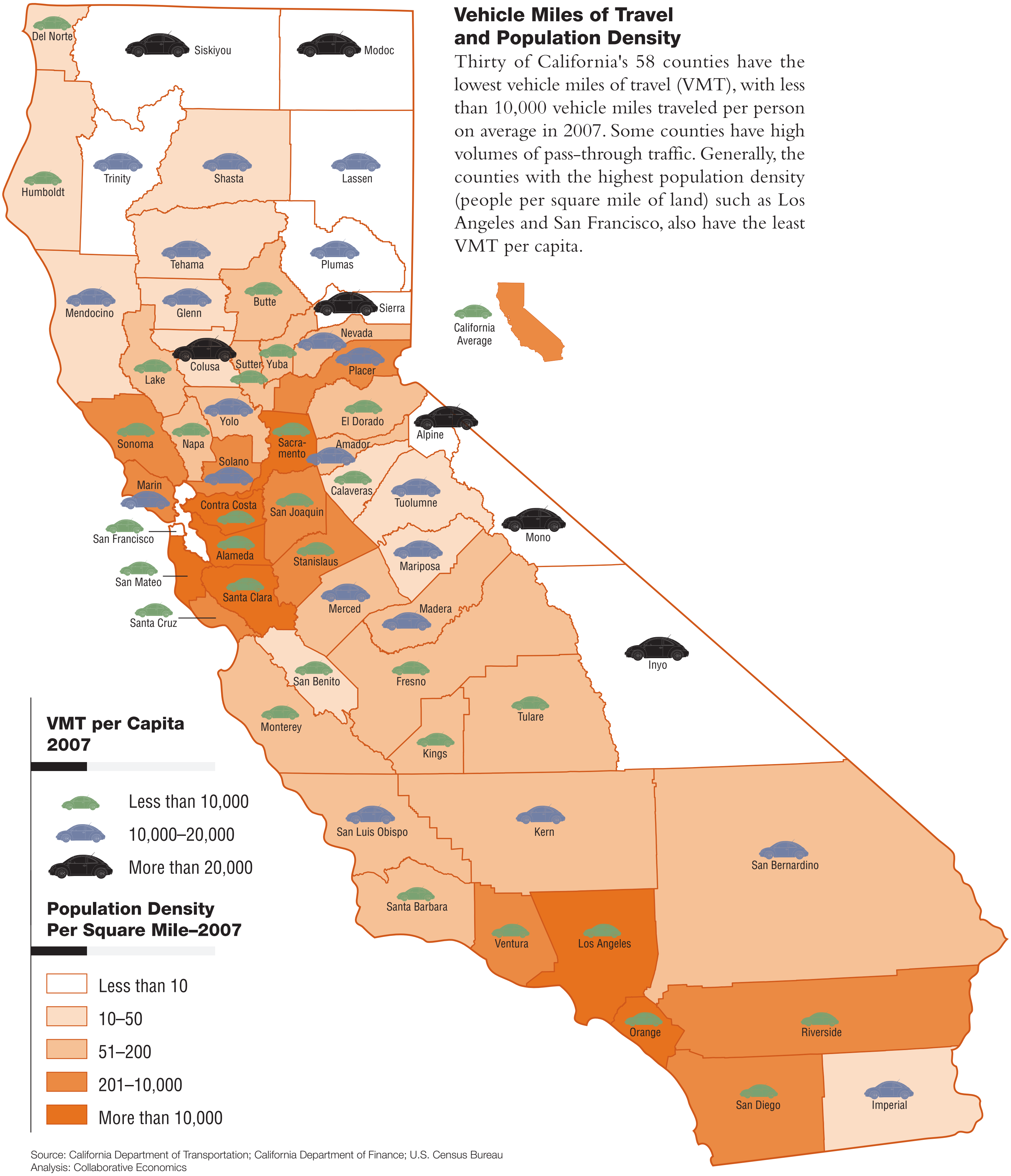
Total and per capita trends relative to 1995 – California



*Emissions data for 2005 and 2006 are preliminary
Source: California Air Resources Board, California Greenhouse Gas Inventory–by Sector and Activity; California Department of Transportation; California Department of Finance
Analysis: Collaborative Economics

Vehicle Miles of Travel and Population Density

Thirty of California's 58 counties have the lowest vehicle miles of travel (VMT), with less than 10,000 vehicle miles traveled per person on average in 2007. Some counties have high volumes of pass-through traffic. Generally, the counties with the highest population density (people per square mile of land) such as Los Angeles and San Francisco, also have the least VMT per capita.



Source: California Department of Transportation; California Department of Finance; U.S. Census Bureau
Analysis: Collaborative Economics

Clearly, rising gasoline prices have encouraged many Californians to make changes. The Field Research Corporation completed a survey in July 2008, repeating and expanding on a series of questions last asked during a spike in gasoline prices in August 2005.[9] The most recent survey found that:

- **78%** *of registered voters in California report that they are "driving less around town or shortening weekend or vacation car trips"—compared with* **59%** *in 2005.*

- **28%** *are "moving closer to (their) job (or) taking a job closer to home"—compared with 20% in 2005.*

- **27%** *are "adjusting work hours so they do not commute as often to their worksite (of those employed outside the home)"—about the same proportion (***28%***) making similar adjustments in 2005.*

As gasoline prices skyrocketed, the volume of gasoline sold also fell in California. Since 2004, both California and the rest of the nation have witnessed declining trends in total gasoline sales as well as on a per-capita basis. Between 2007 and 2008, gasoline sales per capita declined by 3% in California, and total gasoline sales dropped by 2%.

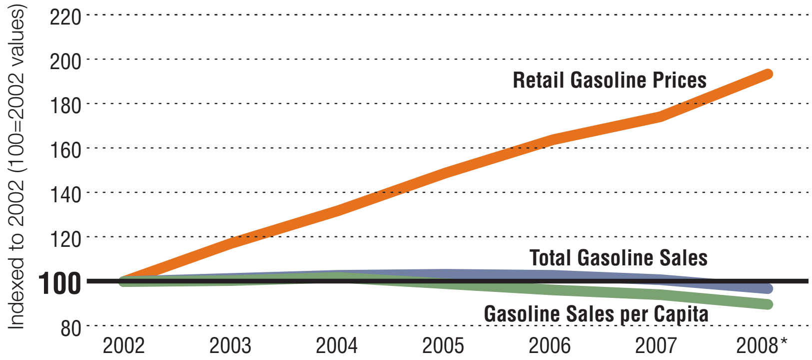
Relative to 2002, while prices in 2008 climbed 92% higher, total California sales dropped back to 2002 levels and gasoline sales per capita dropped 10% lower ***(Figure 24)***. While gasoline prices in the rest of the nation also skyrocketed, the drop in per capita sales relative to 2002 has not been as strong ***(Figure 25)***.

[9] Field Research Corporation. 2008. The Field Poll #2277, "Reactions to Rising Gas Prices." July 17, 2008

24

California Trends in Gasoline Sales and Prices

Total gasoline sales, gas sales per capita, and gas prices relative to 2002



*2008 annual gasoline sales figures are estimates based on January–September sales data
Source: California State Board of Equalization; Energy Information Administration, California Department of Finance
Analysis: Collaborative Economics

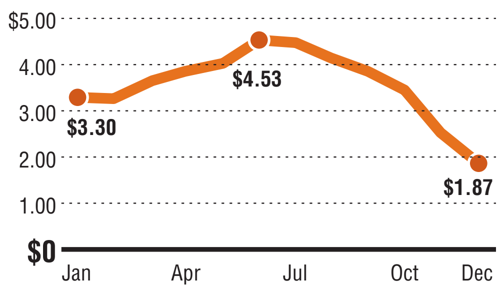
California Trends in Gasoline Sales & Prices

	2008	Percent Change 2007–2008
Gallons of Gasoline Sales per Capita	395	-5%
Price of Gasoline per Gallon	$3.57	+10%

Note: Gasoline sales estimates based on 2008 January–September data
Source: California State Board of Equalization; Energy Information Administration, California Department of Finance
Analysis: Collaborative Economics

California Monthly Retail Price per Gallon

2008

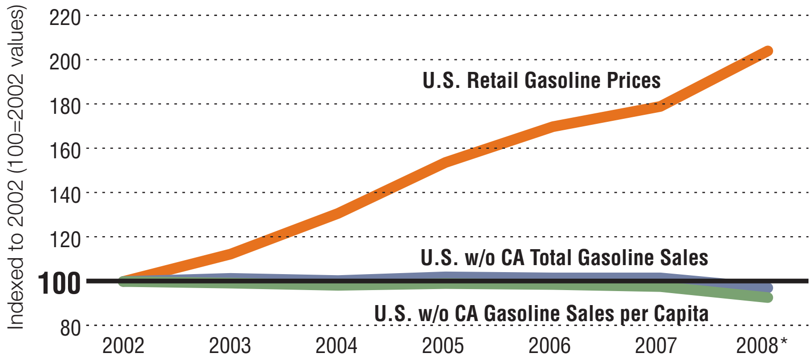


Source: Energy Information Administration, U.S. Department of Energy
Analysis: Collaborative Economics

25

U.S. Trends in Gasoline Sales and Prices

Total gasoline sales, gas sales per capita, and gas prices relative to 2002



*2008 annual gasoline sales figures are estimates based on January–September sales data
Source: California State Board of Equalization; Energy Information Administration, California Department of Finance
Analysis: Collaborative Economics

While some Californians can and have made adjustments to reduce their gasoline consumption (and the number of miles they drive), for many Californians, it may be difficult to reduce the largest source of their VMT—their commute to work. Many residents must commute from areas with more affordable housing but fewer jobs to areas with more jobs but less affordable housing. Many cannot easily move closer to their job or take a comparably paying job close to home—or adjust their work hours to reduce how many times a week they must commute.

Although gains are being made statewide in building more affordable housing in job-rich areas and adding more jobs in housing-rich regions, these shifts are not yet substantial enough to have major impacts on travel patterns. Thus, large numbers of Californians experience limits to how much they can reduce their VMT. For many residents, shifting to more energy-efficient vehicles or using alternatives to driving alone are likely to be more realistic options.

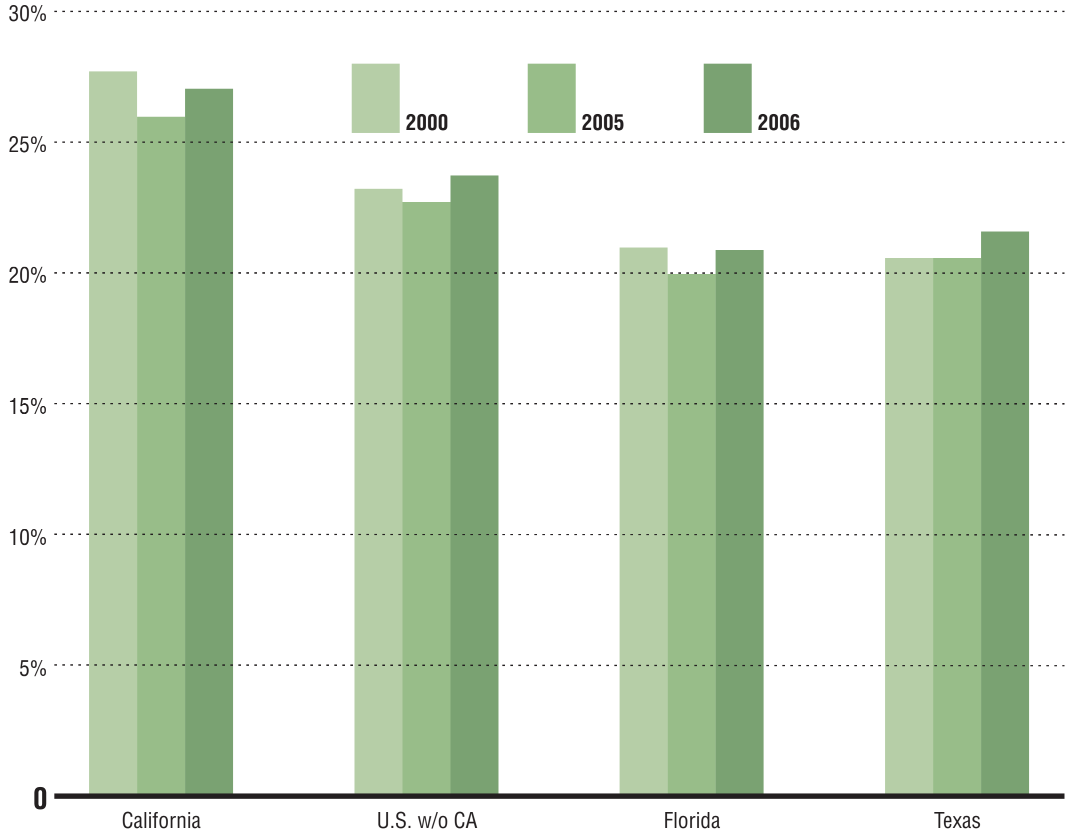
Almost three in ten working Californians use alternatives to driving alone, including carpools, public transportation, motorcycles, bicycles, and walking from home to work ***(Figure 26)***. This fraction has stayed between 26% and 28% since 2000—consistently higher than that of the nation and of other large states such as Florida and Texas. In addition, according to the survey from Field Research Corporation, 59% of registered voters are doing some "carpooling to and from work or to shop" to save on the amount of gasoline they consume, while only 54% did so in 2005.

26

Alternative Means of Commute

Share of Commuters Who Did Not Drive Alone

Carpool, Public Transportation, Walked, Taxicab, Motorcycle, Bicycle, Worked From Home, or Other Means



Source: U.S. Census Bureau, American Community Survey
Analysis: Collaborative Economics

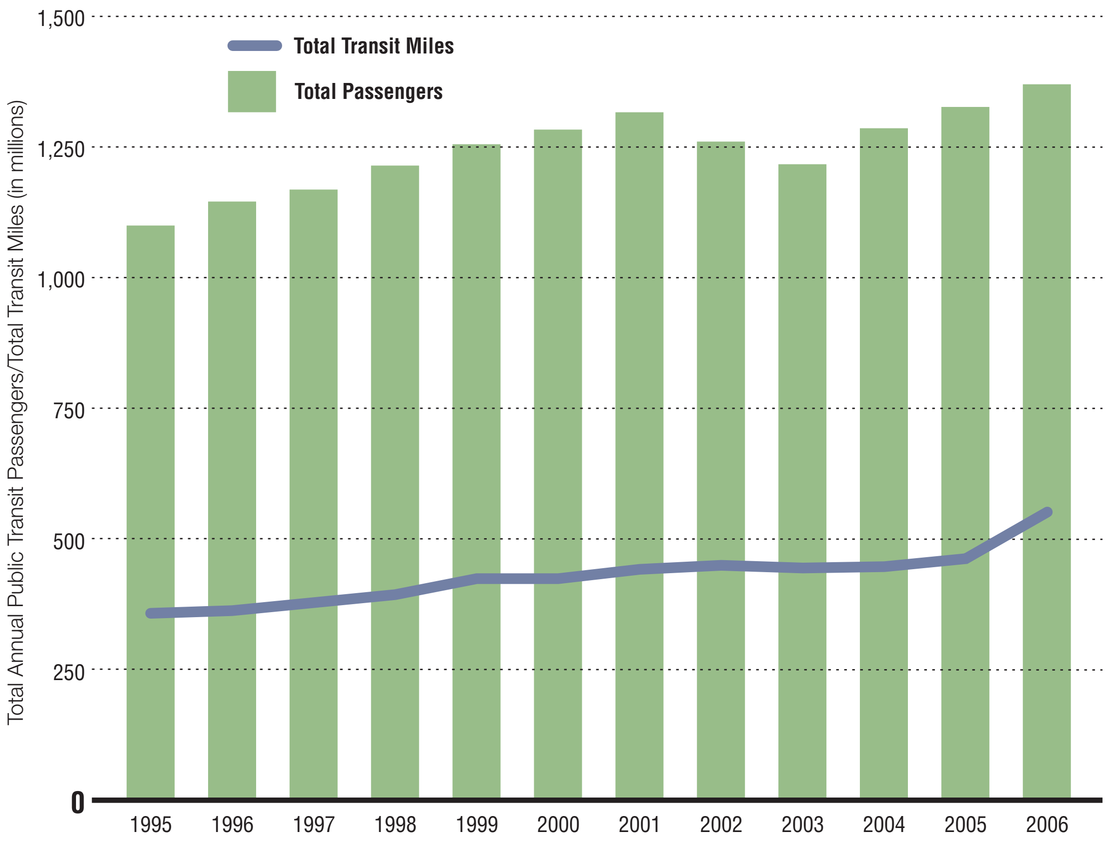
The use of public transportation in California has consistently increased since 2003, and as of 2006 was higher than it has ever been in terms of ridership ***(Figure 27)***. The total number of annual public transit passengers increased by 12% between 2003 and 2006. Moreover, public transportation in California is becoming available to more of the State's population, with more vehicle miles covered than ever before. Half of California's counties experienced increases in per-capita transit ridership between 2005 and 2006—and some of these major gains occurred in relatively rural counties *(see Appendix)*.

Despite these gains and despite growing traffic congestion in many places, the share of commuters using alternatives has not changed much over the past decade. Public transit use is higher than it has ever been, but decades of largely auto-dependent, suburban development patterns have made it particularly challenging for Californians to adopt alternatives to driving alone to work. While more use of alternatives is possible, there are likely limits on how much impact these alternatives will have on changing the travel behavior of Californians.

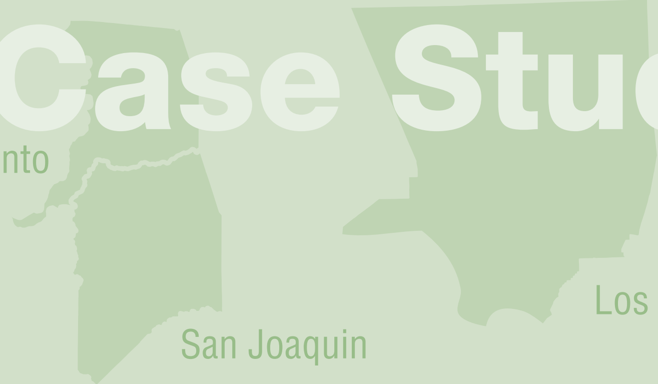
27

Public Transit Use and Availability in California

Total annual passengers and transit vehicle miles



Source: California State Controller's Office
Analysis: Collaborative Economics



A Tale of Three Regions

Prepared by Sophia Monroe

California's diverse regions share a common problem: transportation is the largest source of carbon emissions. Annually, the state produces 484 million metric tons of carbon equivalent, of which approximately 38% comes from transportation.[1] Many regions in California have taken action to mitigate the growth in carbon emissions by limiting vehicle miles traveled (VMT) and increasing public transit ridership.

Between 2001 and 2007, the **Los Angeles region** reduced its VMT per capita by 6% and increased its public transit ridership per capita by 7%. To help expand upon these initial achievements, the Southern California Association of Governments created the Regional Transportation Improvement Plan, which calls for rail capacity improvements, dedicated freeway lanes for clean technology trucks, and the addition of new Metro light rail lines. Extending light rail into outlying cities could reduce VMT and bring new business into town. Extending the Metro Gold Line to Pasadena is estimated to reduce 8,100 daily auto trips.[2] To capitalize on the availability of convenient transit (the line makes 13 stops between LA and Pasadena), the city of Pasadena shifted to transit-oriented development (TOD). Del Mar Station, a high-density housing complex built along the Gold Line, is a model of TOD. The 347-home complex is bisected by the train, providing residents with transportation at their doorsteps. Apartments are situated above retail space, creating a mixed-use development that renders cars obsolete.

Compared to the rest of the State, **San Joaquin County** boasts a relatively low carbon footprint attributable to private transportation. Many cities throughout the County are changing their views of public transit and are striving to bring more bus routes, railways and other pollution-free options to their residents. Lodi was a recipient of multiple grants, including grants from the California Department of Transportation, to refurbish its transit station, build a parking garage, and plan downtown housing to encourage commuters to use public transit. The Lodi Transit station serves five bus lines and Amtrak, allowing riders to travel anywhere in the San Joaquin Valley without turning a key.

As a result of the Sacramento Blueprint Project, the **Sacramento region** reduced its per capita VMT by 6%. The Blueprint Project outlines projects and strategies that the region can undertake to reduce its carbon footprint. Starting with Base Case scenarios, the Project outlines smart growth principles as keys to achieving the Preferred Scenario. The Project proposed eight transportation projects for Lincoln, a small town outside Sacramento, in order to reduce per capita VMT and increase transit ridership by 2%. Until the projects are complete, Lincoln has found a way to counteract the high VMT of the commuter residents by focusing on changing commute patterns within their city limits. Lincoln has instituted plans for city-wide Neighborhood Electric Vehicle (NEV) routes. The goal for these routes is to "enable any resident to travel from their home to downtown Lincoln" while reducing emissions.[3] The city's plan calls for special parking areas and charging stations at most local stores, NEV lanes, NEV signage and specified NEV routes throughout the city. The 200 NEVs currently operating in Lincoln save 720 lbs of air pollutants annually.

[1] *California Air Resources Board. 2008. "California Greenhouse Gas Inventory- by Sector and Activity." September 2008.*

[2] *Wanek, Mischa. Railway Track and Structures. "Going for gold: MTA brings Pasadena a train ride closer to Los Angeles, as well as promises eased gridlock with its Gold Line light rail system.(Metropolitan Transportation Authority)." September 2003.*

[3] *MHM Engineers & Surveyors. 2006. "City of Lincoln NEV Transportation Plan." http://www.ci.lincoln.ca.us/pagedownloads/Final%20NEV%20Transportation%20Plan.pdf*

Case Study

A Tale of Two Households

Prepared by Somerset Perry

Transportation accounts for 39% of California's greenhouse gas emissions.[1] Californians can help reduce emissions by choosing to take public transportation, drive fuel-efficient cars, and plan trips more wisely. Using the carbon calculator at CoolCalifornia.org,[2] a family can determine its carbon footprint and learn how to reduce it. The following two examples show some of the ways that a household's emissions from transportation can be reduced.

The Pines are a family of five with a household income between $60K and $80K, living in the Los Angeles area. The family's total carbon footprint is 56.4 tons of CO2 per year, 19.1 tons of which are attributed to transportation. They own three cars—two sedans and a larger car—which they drive approximately 30,000 miles per year. They use public transit to travel about 300 miles per year. In order to reduce their carbon footprint, Mr. Pine decides to take the bus to work while Mrs. Pine buys a hybrid vehicle. The kids decide to reduce their miles traveled by going to and from school all together instead of making multiple trips. Also, the family makes sure to check the cars' tires regularly and keep them properly inflated. By taking these steps, the family halved their emissions from transportation—to 9.8 tons per year—and reduced their total emissions by 16.5%, to 47.1 tons per year.

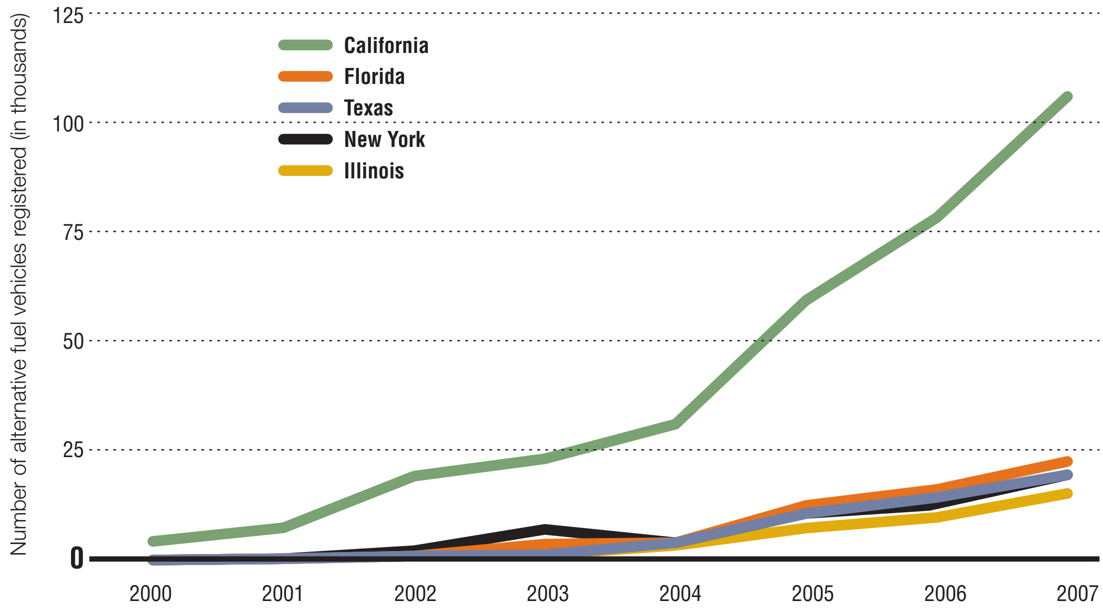
The Oak Family consists of two parents and a child who live in the San Francisco Bay Area. They have an income of between $100K and $120K, and they emit 61.2 tons of CO2 per year, 20.6 tons of which are due to transportation. They also own three cars, which they drive a little over 25,000 miles per year cumulatively, and they use public transportation to travel about 800 miles per year. Conscious of the great role transportation emissions play in climate change, the family sells one of their cars and Mrs. Oak decides to take public transportation to work. Mr. Oak, who commutes to Silicon Valley, decides to buy a hybrid and to leave the house 15 minutes earlier each day so that he can drive 5 mph slower on the highway. They both decide to go for runs around the neighborhood instead of driving to the gym and using treadmills. In these simple ways, they were able to reduce their transportation emissions by 65%, to 7.3 tons per year, thereby reducing their total carbon emissions to 47.9 tons per year. By making choices such as these, any Californian family can take concrete steps toward reducing their carbon footprint and reversing the effects of climate change.

[1] *California Air Resources Board. 2008. "California Greenhouse Gas Inventory- by Sector and Activity." September 2008.*

[2] *Cool California. 2008. http://coolcalifornia.org/*

28 Growth in Newly Registered Alternative Fuel Vehicles (New and Used)

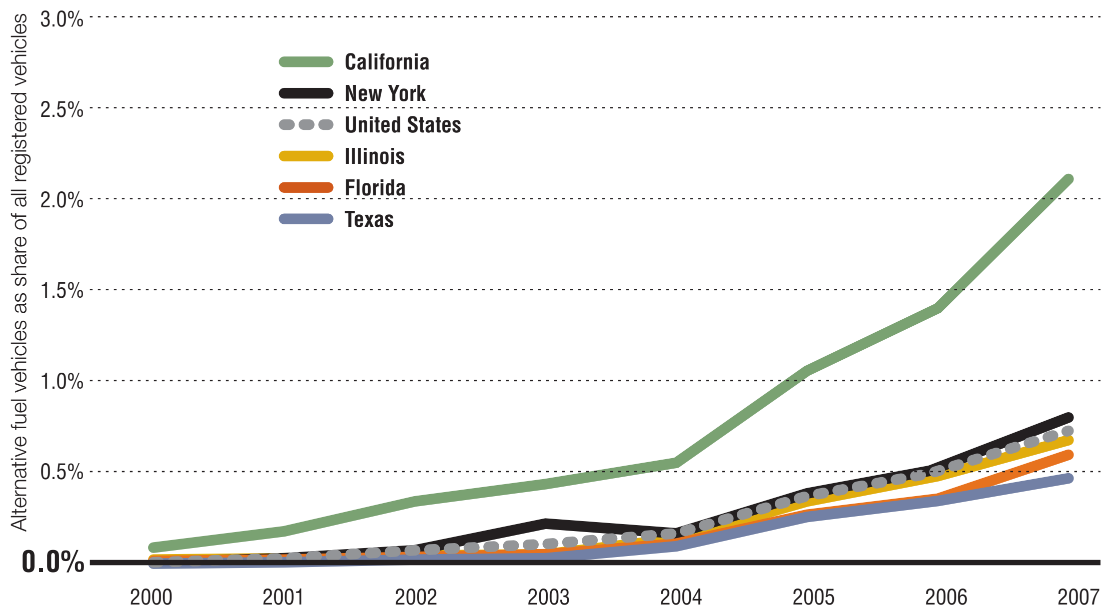
Hybrid, electric, and natural gas vehicles – California and other top alternative fuel vehicle states



Note: Includes hybrid and electric vehicles as well as vehicles running on natural gas
Source: R.L. & Polk Co.
Analysis: Collaborative Economics

29 Newly Registered Alternative Fuel Vehicles (New and Used)

As share of total vehicles registered – California and other top alternative fuel vehicle states



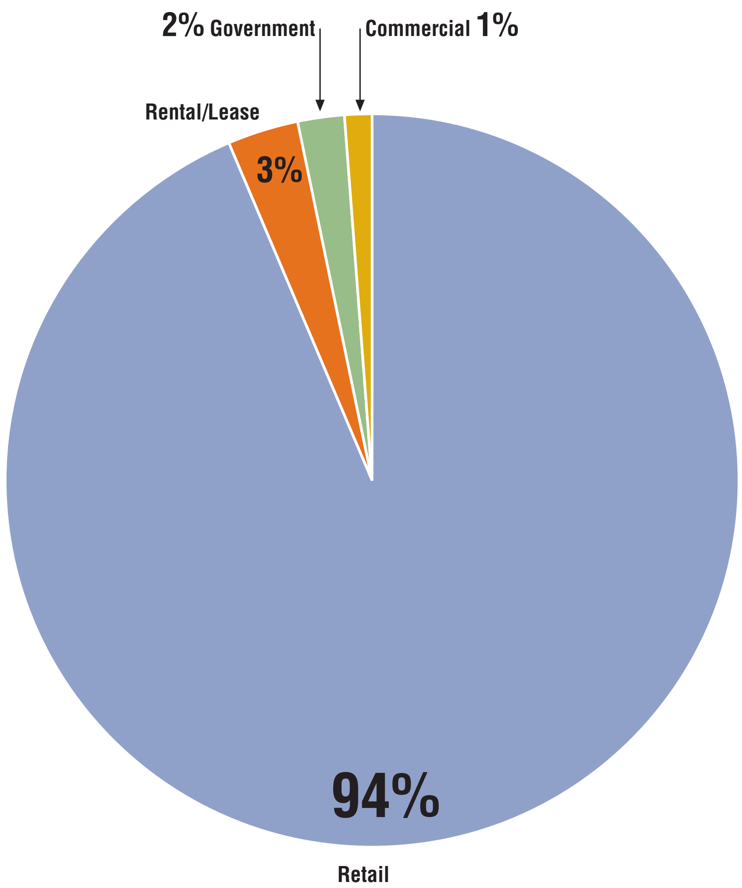
Note: Includes hybrid and electric vehicles as well as vehicles running on natural gas
Source: R.L. & Polk Co.
Analysis: Collaborative Economics

Californians Are Shifting to Higher Efficiency Vehicles

Californians lead the nation in shifting to lower-emission vehicles—perhaps partly because other options such as driving less and using commuting alternatives are less realistic for many residents. Nationally, California is the top-ranking state in alternative fuel vehicle registrations, which include hybrid and electric vehicles, and vehicles that run on natural gas. From 2006 to 2007, registrations of new and used alternative fuel vehicles jumped 36%—surpassing 100,000 vehicles for the first time ***(Figure 28)***. The number of alternative fuel vehicle registrations in California is now more than four times that of any other state, and is growing at a rate far surpassing that of other large-population states. As a share of total registrations, alternative fuel vehicles exceed 2% in California and remain below 1% in other states ***(Figure 29)***. Registrations have grown rapidly not only among vehicles bought on the retail market, but also those categorized as rental/lease, government and commercial ***(Figure 30)***.

30 Distribution of Newly Registered Alternative Fuel Vehicles (New and Used)

California, by Registration Type — 2007



Note: Includes hybrid and electric vehicles as well as vehicles running on natural gas
Source: R.L. & Polk Co.
Analysis: Collaborative Economics

Newly Registered Alternative Fuel Vehicles (New and Used) by Registration Type in California

	Number of Vehicles 2007	Growth 2006–2007
Retail	97,424	+33%
Rental/Lease	3,421	+351%
Government	2,142	+47%
Commercial	1,035	+37%

Note: Includes hybrid and electric vehicles as well as vehicles running on natural gas
Source: R.L. & Polk Co.
Analysis: Collaborative Economics

Californians are shifting to greener transportation options in many ways. According to Field Research Corporation, two-thirds (67%) of registered voters are "using their more fuel-efficient vehicle more frequently." Almost three in ten (28%) surveyed report that they have "replaced a car or truck with a more fuel-efficient vehicle." Most of the new alternative fuel vehicle registrations are for hybrid automobiles. In 2007, three of the top ten hybrid metropolitan markets were in California; Los Angeles (#1), San Francisco (#2), and Sacramento (#9) metropolitan areas accounted for over 20% of new hybrid registrations in the United States. In metropolitan areas as well as rural regions with high volumes of pass-through traffic, cleaner transportation options mean cleaner air.

For all these impressive gains, alternative fuel vehicles in California have not yet made a major impact on the State's overall fuel economy. Although increasing from 0.1% at the beginning of the decade, alternative fuel vehicles in 2007 accounted for 2.1% of all registered vehicles in California. The average fuel economy for California passenger vehicles in 2006 was less than 20 miles per gallon (19.9), a number that has not changed appreciably during the rapid rise in alternative fuel vehicle registrations and rising gas prices.[10] In fact, the United States as a whole has a higher average fuel economy of passenger vehicles (20.1 mpg) than California.[11]

[10] *California Air Resources Board. The EMission FACtors (EMFAC) 2007.*

[11] *U.S. Department of Energy., Energy Efficiency and Renewable Energy. "Transportation Energy Data Book, Edition 27." June 30, 2008*

Top 10 Hybrid Metro Markets
2007

Rank	Metro Market	New Hybrid Vehicle Registrations	Share of U.S. Hybrid Volume	Vehicle Increase from 2006
1	Los Angeles	40,634	11.6%	31.1%
2	San Francisco	27,292	7.8%	32.3%
3	New York	20,692	5.9%	12.2%
4	Washington D.C.	12,744	3.6%	45.2%
5	Seattle	11,098	3.2%	53.2%
6	Chicago	10,611	3.0%	39.2%
7	Boston	10,438	2.8%	14.6%
8	Philadelphia	8,670	2.5%	26.4%
9	Sacramento	7,871	2.2%	59.9%
10	Phoenix	7,829	2.2%	85.4%

Source: R.L. & Polk Co.

Californians are Shifting to Lower Emission Fuels

Another way to reduce emissions is to shift new and existing vehicles in the State to using lower-emission fuels. California's Low Carbon Fuel Standard, established by Executive Order in 2007, and to be adopted and implemented by 2010, requires fuel providers to reduce the carbon intensity of transportation fuels sold in California. The goal of the Standard is to reduce the carbon intensity of California's passenger vehicle fuels by at least 10% by 2020. Thus, in addition to the shift to more efficient vehicles, Californians will reduce emissions through the use of lower-emission fuels.

Since 2000, the number of vehicles that run on alternative fuels has grown by a factor of 26 ***(Figure 31)***. While this growth has been primarily due to the growth in hybrid vehicles, there is growing demand for low-emissions fuels for conventional combustion engine vehicles. As the downsides to corn-based ethanol become increasingly evident, the search for other scalable green innovations, such as cellulosic and algal fuels, is underway in California *(see case study on next page)*.

Also taking place in California are advances in power storage and plug-in hybrid technology. A plug-in hybrid (PHEV) is a hybrid electric automobile with more battery capacity and the ability to recharge from a standard outlet. PHEVs offer all-electric local travel and some offer fuel efficiencies in excess of 100 mpg.[12] Although costly, custom after-market plug-in conversions are a burgeoning green market. In support of the widespread adoption of this technology, CalCars, a charitable non-profit organization, focuses efforts in public policy, technology development and buyer demand.[13] In addition, during the 2008 presidential campaign, both presidential candidates promised a $5,000+ national tax credit for PHEVs.[14]

[12] *US News & World Report. 2006. "A Plug for Hybrids." October 1, 2006.*

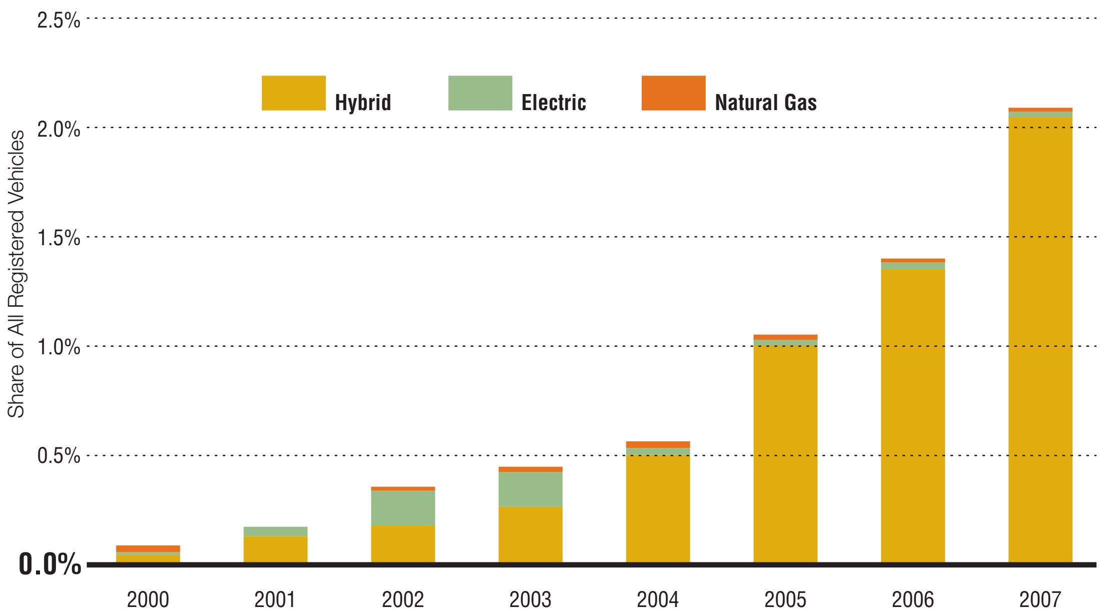
[13] *The California Cars Initiative. 2008. "About the CalCars Initiative." http://www.calcars.org/about.html*

[14] *The Detroit News. 2008. "Obama Vows Tax Credits, Aid to Automakers for Hybrid Cars." August 4, 2008. Reuters UK. 2008. "McCain to Push New Measures to Lower Auto Emissions." June 22, 2008. http://uk.reuters.com/article/latestCrisis/idUKN2240931620080623*

31

Newly Registered Alternative Fuel Vehicles by Type

As share of vehicles registered in California



Source: R.L. & Polk Co.
Analysis: Collaborative Economics

california green innovation

A Tale of Two Fuels — Cellulosic Ethanol and Algal Biofuels in California

Over the last several years, rising oil prices have led to a renewed interest in the development of a domestic alternative fuel infrastructure. Ethanol production in the United States has more than tripled since 2000 (1,630 million gallons to 6,500 million gallons),[1] while the production of biodiesel has surged from 2 million gallons in 2000, to an estimated 250 million gallons in 2006.[2] The rise of biofuels however has not been without controversy— as global grain supplies fluctuated in 2007 and 2008, international debate emerged over the use of agricultural commodities to manufacture fuel, and the extensive land conversion required by this.[3] In this landscape of food vs. fuel, cellulosic ethanol- and algae-based biofuels (technologies under development by several companies in California) show promise as alternatives to the traditional biofuel supply chain.

Unlike traditional ethanol, produced from the fermentation of carbohydrates found in grains, cellulosic technologies convert cellulose, the main component of plant cell walls and the most common organic compound on Earth,[4] into its carbohydrate components, which are then fermented into ethanol.

Breaking down cellulose is a difficult process, and several companies are working to develop enzymes and processes to enhance the efficiency of ethanol production from cellulose. In California, Novozymes, an enzyme company with a research center in Davis, is working with the U.S. Department of Energy on projects to reduce enzyme cost and increase enzyme life and durability.[5] On the production end, BlueFire Ethanol, based in Irvine, is currently constructing the first commercial-scale cellulosic ethanol plant in the United States. The plant is to be built near Lancaster, California, and will utilize organic landfill waste (wood chips, grass cuttings, urban trash, etc.) as feedstock.[6] Fresno-based Pacific Ethanol, a long-time leader in conventional ethanol production with operations in Madera and plants under construction in Imperial and Stockton, is also developing cellulosic technology, though the company has not yet announced a plan for commercial production from cellulose.

Similar to cellulosic ethanol, algae is a second-generation biofuel feedstock that is emerging from the startup phase. Algae is unique in that it can be used as a feedstock for both biodiesel and ethanol; algae can be up to 50% oil by body weight (compared to just 20% in oil-palm trees),[7] while any remaining glucose and cellulose content can be fermented into ethanol. Algae also has the advantage of a small physical footprint relative to other sources of biodiesel and is expected to produce 10,000 gallons per acre per year. In comparison, on average, oil palm trees produce 650 gallons per acre per year, canola produces 150 gallons per acre per year, and soy only 50 gallons.[8] In addition, the production of algal fuels does not compete for drinking water, because it can be grown in brackish water.[9]

California-based algal biofuel producers include Sapphire Energy, a Sonoma based start-up that has raised over $100 million in funding, and Aurora Biofuels in Alameda, with $20 million through two rounds of funding. Solazyme, a South San Francisco startup, is developing algal biodiesel through a partnership with Chevron, and is also working to develop algae-based foods and cosmetics; Solazyme raised $45.4 million in Series C funding in August of 2008.[10]

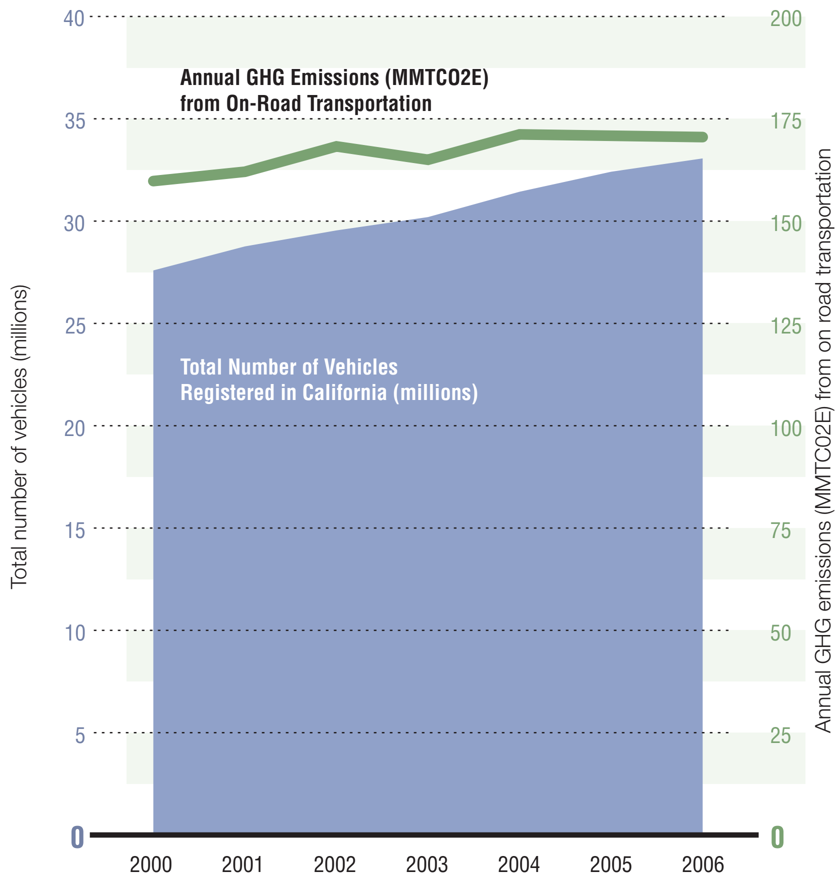
[1] *"Historic US Fuel Ethanol Production." Renewable Fuels Association. Industry Statistics.*
[2] *Carriquiry, Miguel. "U.S. Biodiesel Production: Recent Developments and Prospects." Iowa Ag Review Online. Spring 2007. Volume 13, Number 2.*
[3] *T. Searchinger et al. 2008. "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use." Science. (Feb. 7, 2008).*
[4] *"Cellulosic Ethanol." Renewable Fuels Association. Resource Center.*
[5] *Ibid*
[6] *McDermott, Matthew. 24 July 2008. "First Commercial-Scale Cellulosic Ethanol Plant Approved for California." TreeHugger.com.*
[7] *Leigh Haag, Amanda. "Pond-Powered Biofuels: Turning Algae into America's New Energy." Popular Mechanics, 29 March 2007.*
[8] *Ibid.*
[9] *J. Sheehan, T. Dunahay, J. Benemann, P. Roessler. 1998. "A Look Back at the U.S. Department of Energy's Aquatic Species Program-Biodiesel from Algae." National Renewable Energy Laboratory. Prepared for U.S. Department of Energy's Office of Fuels Development. Page 11*
[10] *Sims, Bryan. "Solazyme Recieves Funding to Expand." Biodiesel Magazine.*

From Making a Difference to Reaching the Goal

Californians are beginning to transform transportation and make a difference in reducing GHG emissions. They are driving less, using more alternatives to driving alone, and shifting to lower-emission vehicles and fuels. Together, these changes produced a 0.2% reduction in CO2 emissions from California's total vehicle fleet between 2005 and 2006 ***(Figure 32)***.

32 **Total Vehicles and GHG Emissions**

California



Note: Total number of vehicles are for all vehicles registered in California including trucks, buses and motorcycles.
*Emissions data for 2005 and 2006 are preliminary
Source: California Air Resources Board, California Greenhouse Gas Inventory
– By Sector and Activity; Federal Highway Administration, U.S. Department of Transportation
Analysis: Collaborative Economics

Local Innovation in Monterey County

With oil prices on a long-term upward trend, the search for cheap alternative fuels needs to be multi-faceted. Although they may not always offer options scalable for the nation as whole, local communities can come up with locally-based solutions that meet their own needs. Monterey-Salinas Transit (MST) has identified mustard seed as an alternative transportation fuel solution. MST is taking innovative steps to be the nation's first transit agency fueled by locally produced biodiesel. This year MST is testing biodiesel yield of mustard plants.[1] Mustard is an off-season cover crop, so it will not replace other agricultural products. It also requires little to no irrigation or tending. Once harvested, the seeds will be processed locally at a Gonzalez biodiesel plant. One acre of mustard seed typically requires ten gallons of fuel to plant and harvest and will produce sixty gallons of biodiesel.[2] Additionally, a byproduct of the process, "spicy" mustard meal, can be used as a biopesticide and fertilizer.

[1] *Monterey Salinas Transit. 2008. "MST Partners with San Bernabe Winyards to Plant Mustard Seed For Locally Sustainable Biodiesel Fuel." Press Release. February 13, 2008.*

[2] *Pacific Biofuel Inc. 2007. "Mustard Gas." Press Release. August 15, 2007. http://www.pacfuel.com/press.htm*

What If...

In 2006, surface transportation accounted for 35% of California's greenhouse gas emissions.[15] Under the requirements of AB 32, total greenhouse gas emissions in California must be reduced to 1990 levels by 2020. If reductions were made equally across all types of emissions sources,[16] emissions from surface transportation would need to be reduced from 171 million metric tons of CO2 equivalent (MMTCO2E) to 138 MMTCO2E by 2020 in order for California to meet the targets set by AB 32 (dotted line in ***Figure 33***). This means that California's emissions from surface transportation would need to achieve a reduction of 24% between 2007 and 2020. While Californians have begun making some progress by driving less, and shifting to lower emission vehicles and fuels, achieving the AB 32 requirements will clearly require more innovation.

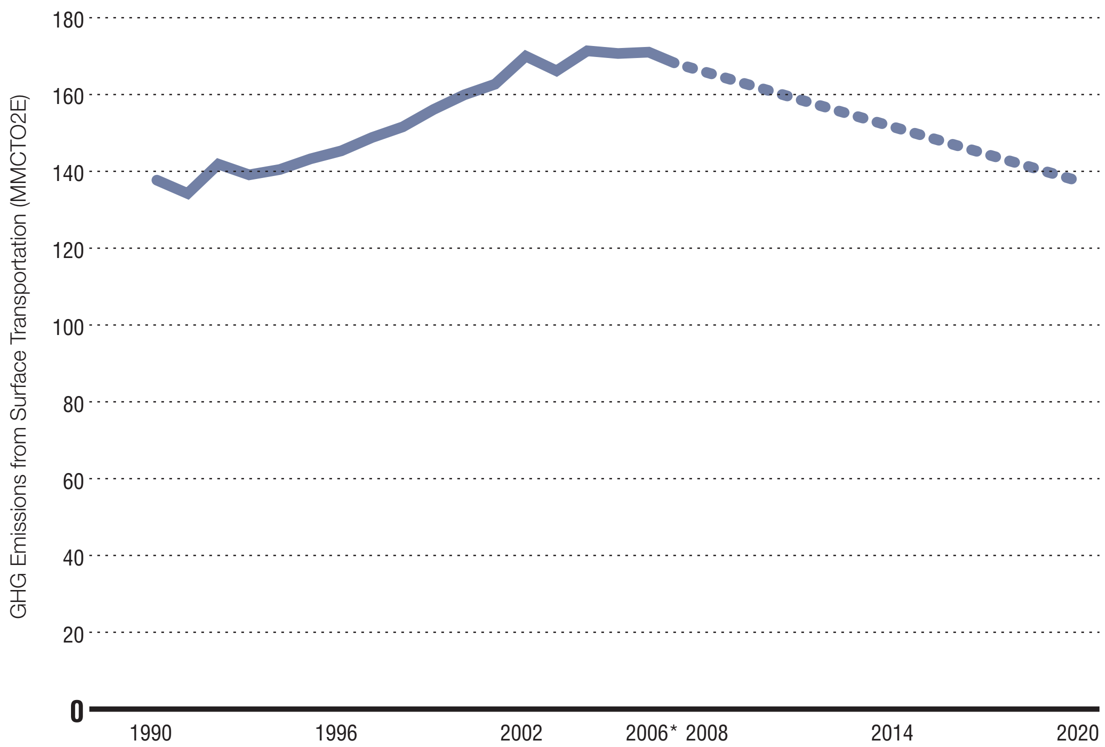
The challenge—and opportunity—facing California is to transform transportation in ways that reduce emissions but simultaneously increase economic benefits. Using less gasoline will certainly save Californians money. But new jobs and revenues from the development of technology (e.g., hybrid systems, battery storage), low-emissions vehicle and parts manufacturing (e.g., Tesla), vehicle sales and maintenance, and other areas critical to increasing fuel-efficient vehicle production and use could also create payoffs for California.

[15] *California Air Resources Board. 2008. "California Greenhouse Gas Inventory- by Sector and Activity." January 2009.*

[16] *In actuality, the recommended emissions reduction strategies laid out by the Scoping Plan vary by sector and type of source (see Part 1).*

33 **GHG Emissions from Surface Transportation**

1990–2006 trends, and 2020 reductions required by AB 32 – California



*Data for 2005 and 2006 are preliminary
Source: California Air Resources Board, California Greenhouse Gas Inventory–by Sector and Activity
Analysis: Collaborative Economics

Feature

Focus On Renewable Energy

Unmistakable Progress, But Not yet a Transformation

The generation of electrical power (both in-state and imported from other states) is currently a major source of greenhouse gas emissions, directly accounting for 22% of the California total.[17] Where do these emissions come from? Most (85%) come from two sources: 53% of emissions from electrical power generation stem from natural gas sources, and 32% are generated from coal-based power plants.

Different sources of electricity, however, produce very different levels of emissions. Although coal accounts for 32% of emissions, it produces just 17% of California's electricity. Natural gas generates 45% of the State's electricity while producing 53% of its emissions. At the same time, renewable sources now generate 12% of California's electricity, but only 2% of its emissions.The 2% of California's GHG emissions from renewable electricity generation is from geothermal power generation.[18] Thus, a major way to reduce greenhouse gas emissions is to reduce California's dependence on coal-based electricity generation.

Since renewable energy sources like geothermal, small hydroelectric, wind, biomass, and solar are much lower producers of greenhouse gas emissions, they offer an important opportunity to replace coal as a source of electricity generation and help meet the goals of AB 32. At the same time, renewable energy sources are also providing a growing source of economic benefits for California—generating new investment in technologies, equipment, and infrastructure, and growth of companies and jobs in California (see Part 3).

The opportunity to ramp up renewable energy should focus on electricity imports as well as in-state generation. Even though California imports only 22% of its total electricity, imports account for approximately half of its greenhouse gas emissions from electricity.[19] California's imported electricity is more carbon-intensive than its locally produced electricity because a large amount of imported electricity is generated at coal-fired power plants.

Long term, California is likely to gain more economic benefits by replacing coal-based electricity generation (almost all of which takes place outside California) with renewable sources (which can scale up inside California). Renewable sources also seem likely to produce more economic benefits for California over the long term than no-emission alternatives like nuclear or large-scale hydroelectric power (which face larger obstacles to in-state implementation). For both economic and environmental reasons, renewable energy sources are an important part of California's approach to addressing global warming.

[17] *California Air Resources Board. 2008. "California Greenhouse Gas Inventory- by Sector and Activity." January 2009.*

[18] *Ibid*

[19] *California Air Resources Board. 2008. "Climate Change Draft Scoping Plan: A Framework for Change. June 2008 Discussion Draft."*

California is increasingly generating more energy from renewable sources. Although total energy generation in California has also been on the rise, the generation from renewable sources is growing at a faster rate. From 2002-2007, California's total energy generation grew by 11%, while power generation from renewable sources increased by 19% ***(Figure 34)***.

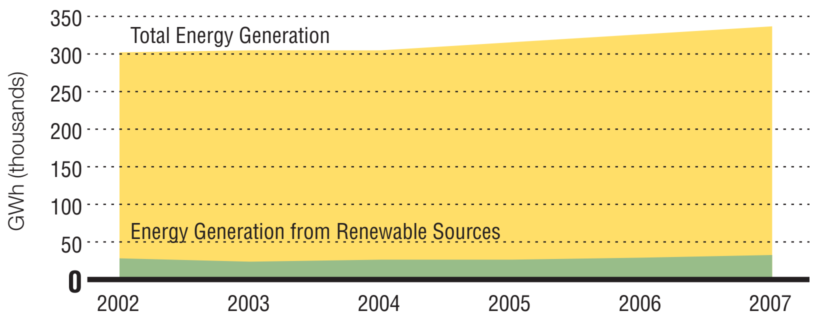
Compared to the nation, California generates a larger portion of its total power generation from renewable sources ***(Figure 35)***. In 2007, renewable energy sources accounted for 11.8% of California's total energy generation and 2.5% of the nation's ***(Figure 36).*** It is important to note that the definition of renewable energy used by the State of California includes only small-scale hydro (systems generating up to 30 megawatts). Large-scale hydro accounted by 6% of total power generation for the U.S. in 2007.

Growth 2002–2007

	Renewable Energy Generation	Total Energy Generation
California	19%	11%
U.S.	2%	8%

34 California Energy Generation

Total energy generation and energy generation from renewable sources



Note: California renewable sources of energy include geothermal, wind, biomass, solar, and small hydroelectric
Source: California Energy Commission
Analysis: Collaborative Economics

36 Percent of Total Energy Generation from Renewable Sources

Source: California Energy Commission; Energy Information Administration, U.S. Department of Energy
Analysis: Collaborative Economics

FOCUS ON RENEWABLE ENERGY

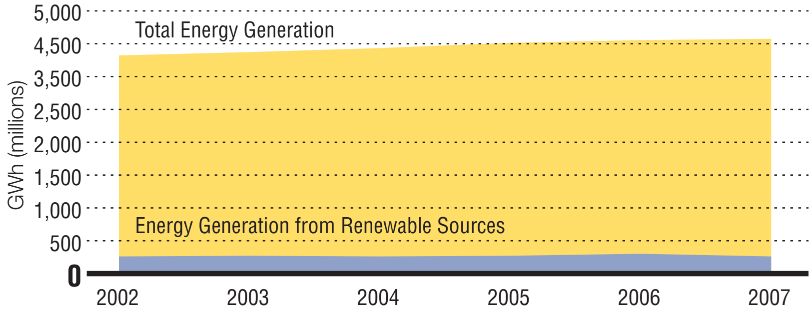
California's power generation from renewable sources is on the rise and rose 24% between 2003 and 2007 alone, as illustrated in ***Figure 37***. Of all sources, the fastest growing renewable source in the State is wind. Since 2003, the power wind generated for California increased 95%. Wind is now responsible for about 2.3% of California's total energy generation—compared to just 1.3% six years ago—and has become the third-largest renewable source of electricity in the State.

Small hydroelectric energy generation is also growing in the State. As with wind power, electricity generated for California by small hydroelectric has more than doubled since 2003. It has become the second-largest renewable source of power in the State.

Geothermal is the largest renewable source of electricity generation in California and accounts for 5% of the State's total energy generation. The actual number of gigawatt hours of electricity generated from geothermal sources has remained fairly stable over the last five years, while power generation from other renewable sources continues to grow. The same is true of biomass, which was the second largest source in 2003, but has since dropped to fourth.

35 U.S. Energy Generation

Total Energy Generation and Energy Generation from Renewable Sources

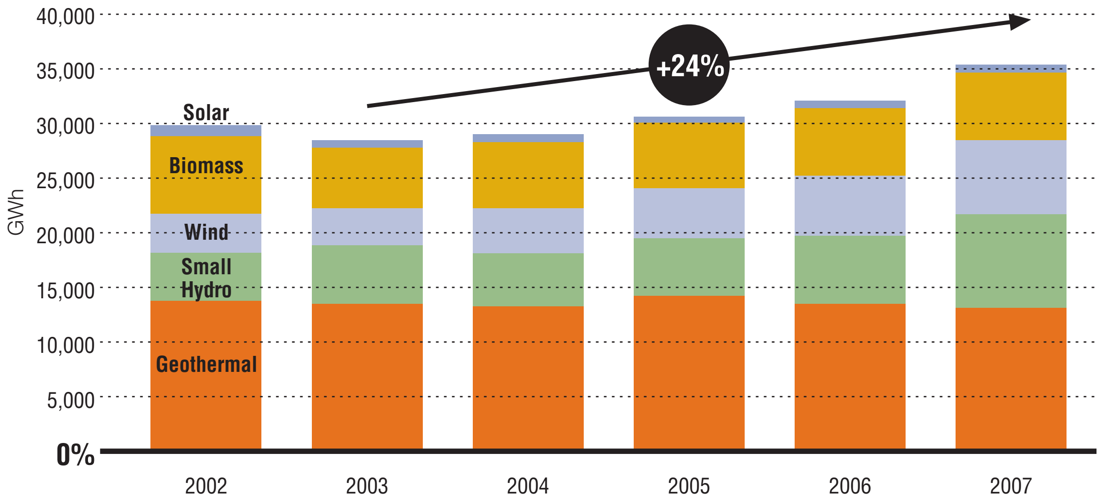


Source: California Energy Commission; Energy Information Administration, U.S. Department of Energy
Analysis: Collaborative Economics

Note: The State of California's definition of renewable energy does not include large-scale hydroelectric power. Since the Energy Information Administration does not differentiate between small and large-scale hydro, data represented here for the U.S. does not include any hydro. In 2007, all hydro represented 6% of total U.S. energy generation. According to the Bureau of Reclamation, in 2006 small hydro accounted for 2% of total hydroelectric power generation.

37 California Renewable Energy Generation

Gigawatt hours by source



Note: Data reflects actual renewable energy generation
Source: California Energy Commission
Analysis: Collaborative Economics

Major Sources of Renewable Energy

Solar Power

Conversion of solar energy to electric energy takes two main forms: photovoltaic, encompassing polysilicon and thin film solar cells, and solar thermal technologies, also known as "concentrated solar power" (CSP). In a solar thermal plant, the heat of the sun is focused on water or another liquid, which is then used to turn a turbine or pump a piston and generate energy. Solar thermal energy plants are large installations located in hot, sunny areas, such as deserts. The current largest plants generate up to 64 megawatts (MW) of renewable electricity, though several projects exceeding 500 MW are currently under development in the Mojave Desert. In a PV cell, photons in sunlight, rather than the sun's heat, are used to directly generate electrical current. PV installations are small to medium size and are most often installed on rooftops. However, utility scale systems in the 10-20 MW range are becoming common in Europe, and large-scale installations of 40-300 MW have been proposed in the United States and abroad.

Biomass Power

Biomass refers to biological material that can be used as fuel. It is considered a renewable energy resource because it can be grown. While carbon dioxide is released when the biomass is used for energy, it is considered a clean energy source because biomass consumes carbon dioxide when growing as a plant. Biomass is either converted directly into energy or into liquid fuels such as ethanol and biodiesel.

Wind Power

Wind power converts the kinetic energy of wind into electrical energy, typically through the rotation of a turbine. In 2007, total wind power capacity in the U.S. increased 46%, mostly in the middle of the country. American wind farms generate just over 1% of U.S. electricity supply. Texas is the leading wind power developer, followed by California.

Small Hydroelectric Power (Small Hydro)

Small hydro converts kinetic energy of moving water into electrical energy, typically through the rotation of a turbine. Small hydro plants generate up to 30 MW of power, compared with large hydro, which, in the United States, can produce up to the 6,809 MW generated by the Grand Coulee Dam on the Columbia River in Washington state. Smaller plants are considered less environmentally intrusive. Small hydro has been most widely applied in rural China, and is also used in Japan and the U.S.

Geothermal Power

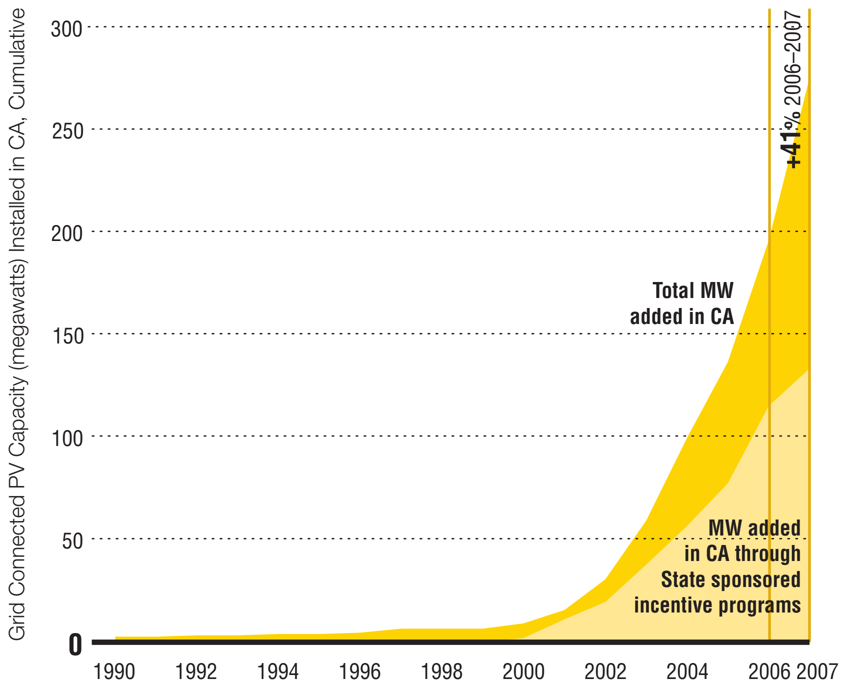
Geothermal generation of electricity occurs when water is pumped into hot areas of the Earth's crust. The resulting steam is used to generate electricity. Some modern geothermal plants then pipe the hot water for use in municipal water systems, considerably increasing the generating capacity of the system. While the U.S. is the leading geothermal energy producer in the world, less than 1% of national energy demand is met through geothermal power.

http://www.nrel.gov/docs/fy08osti/43025.pdf
http://www.awea.org/newsroom/releases/AWEA_Market_Release_04_011708.html
http://ecoworldly.com
http://www.geoenergy.org/publiations/reports/Environmental%20Guide.pdf

Solar power still represents a small fraction of the total electricity generated by renewable sources in California—but that fraction may increase over the next decade. In the past five years, there has been a leap in the amount of electricity generated from solar installations connected to the state's electrical grid, including a 41% increase between 2006 and 2007 ***(Figure 38)***. A large percentage of this new capacity has been made possible through state-sponsored incentive programs, although the share of solar-generated electricity not associated with these programs has also increased in recent years.

38 **Energy From Solar Installations in CA**

Grid-connected solar photovoltaics



Source: California Energy Commission
Analysis: Collaborative Economics

Government–Private Industry Collaboration for Renewable Energy Generation

Geothermal power, electricity generated from heat beneath the earth, is not a novel source of clean energy. In fact, the United States has been generating geothermal electricity since the early 1900s. Today, the U.S. is the world's largest producer of geothermal energy.[1] Five of the eight geothermal power plants in the U.S. are located in California.

The Coso Geothermal Field in China Lake, California, has been generating geothermal energy since 1987, and is currently the second largest producer of geothermal energy in the U.S.[2] Managed by the U.S. Navy's Geothermal Program Office, the project is located at the U.S. Naval Air Weapons Station.

The history of the Coso project began in the 1960s, when Dr. Carl Austin, a research rock mechanics scientist, started a campaign to persuade the Navy that there was valuable geothermal potential under the Coso Range, and that it was of vital interest for the Navy to develop the means to harness the geothermal energy. At the time, it was not widely believed that the geothermal resource would be economically worth pursuing. Another main component of Dr. Austin's campaign was to convince those in the private sector that the U.S. Navy was a reliable partner for this business venture.

In 1977, a scientific and engineering investigation of Coso's geothermal power was started. By 1979, the investigation showed that Coso was home to viable geothermal capacity, and a third-party company was brought in to generate the geothermal electricity. In 1987, the first geothermal electricity from Coso was delivered to the Southern California Edison power grid. As a result of government and private industry collaboration, the Coso project has generated over 270 MW to date, and sells the electricity into the local utility grid.

[1] *Geothermal Energy Association. 2008. "All About Geothermal Energy- Basics." August, 2008. www.geo-energy.org/aboutGE/currentUse.asp#_ftnref*

[2] *Francis C. Monastero, Geothermal Program Office, U.S. Naval Air Weapons Station, China Lake. 2002. "Model for Success: An Overview of Industry-Military Cooperation the Development of Power Operations at the Coso Geothermal Field in Southern California." (September/October 2002).*

Technological Breakthroughs are Bringing Down the Cost of Solar

Nanosolar, a Silicon Valley-based solar manufacturer, has developed a new type of solar technology that is expected to provide the world's lowest-cost solar panel. The copper indium gallium diselenide (CIGS) thin-film solar panels do not use silicon. Applying advances in nanotechnology, the company has developed an ink that enables the fast and cost-effective printing of the CIGS semiconductor onto various materials. Primarily focusing on the large-scale power plant market, Nanosolar plans to build solar power stations of up to 10 MW in size. According to Erik Oldekop, a manager at Nanosolar, the power plants "can be up and running in six to nine months, compared to ten years or more for coal-powered stations and 15 years for nuclear plants. Solar can be deployed very quickly."[1] This new breakthrough in solar technology will make solar electricity more cost-efficient, possibly lowering the cost of solar to 99 cents per watt.[2]

[1] *Vidal, John. 2007. "Solar Energy 'Revolution' Brings Green Power Closer." The Guardian. December 9, 2007.*

[2] *Gregory Nemet, "Behind the learning curve: Quantifying the sources of cost reductions in photovoltaics," June 1, 2006.*

Energy Cost per Kilowatt Hour – 2007

Coal	$ 0.01
Gas	$ 0.03
Oil	$ 0.05
Solar	$ 0.38

Source: Energy Information Administration, U.S. Department of Energy; Greeneconometrics research

Incentivizing Renewable Energy: Innovations in Net Metering

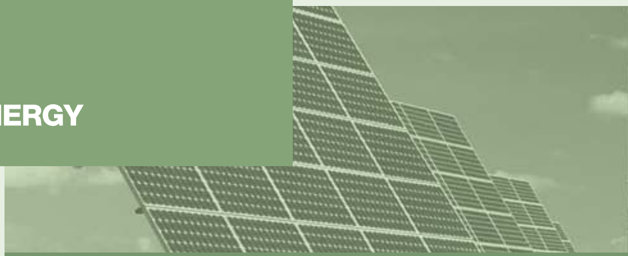
Net metering allows small-scale renewable energy producers to feed their power into the grid, and in some cases receive credit for generating more energy than consumed. California's net metering program is the largest in the world, and is made up almost entirely of solar installations (99%).[1] In California, the net metering program can be used for solar systems with a capacity of 1 MW or less. During a one-year period, if consumers generate more electricity than they consume, their electricity bills will be $0. If consumers use more electricity than they generate, they pay the difference.

Net metering laws differ from state to state, as well as nationally. In the U.S., New Jersey and Colorado have some of the most advanced net metering policies, through which utilities pay consumers for annual surplus generation.[2] Internationally, Spain and Germany are on the cutting edge of net metering policies with feed-in tariffs that pay consumers for any renewable electricity they generate. Incrementally, options for feed-in tariffs are emerging in California. In 2006, California enacted legislation (AB 1969) requiring utilities to purchase electricity from renewable energy systems owned and operated by public water facilities. In February 2008, the CPUC expanded the availability of feed-in tariffs to include all generators up to 1.5 megawatts.[3] This move allows small producers to participate in the Renewables Portfolio Standard Program (RPS) and count toward the State's RPS goals. Though still in committee, the California Solar Surplus Act of 2008 (AB 1920) would legislate similar action.

[1] *California Public Utilities Commission. 2005. "Update on Determining the Costs and Benefits of California's Net Metering Program as Required by Assembly Bill 58."*

[2] *Interstate Renewable Energy Council. 2008. "Model Net Metering Rules." www.irecusa.org/index.php?id=88*

[3] *California Public Utilities Commission. 2008. "CPUC Approves feed-in tariffs to Support Development of Onsite Renewable Generation." Press Release February 14, 2008, Docket #: Res E-4137.*



Big Opportunities for Utility-Scale Solar but Challenges with Transmission Lines

Large-Scale Solar Thermal

On April 1, 2008, PG&E announced contracts with Oakland firm BrightSource for the development of three solar plants near the Mojave Desert National Preserve.[1] However, instead of photovoltaic panels, these plants will use the sun to create heat to generate electricity. Solar thermal plants use a field of curved mirrors to focus sunlight on a special liquid that under low pressure reaches a boiling point at a very low temperature. The heated liquid generates steam, which turns a turbine, generating electricity. Solar thermal generation provides energy when it is needed most, during peak midday summer periods. With hot summer temperatures exceeding 130°F, the Mojave Desert provides a perfect setting.

The Mojave location successfully confronts two challenges of solar thermal energy generation: land use and transmission. Solar thermal power covers a larger land area than some other methods of energy generation. However, compared with the land area required for a hydroelectric dam or for coal mining for coal power, solar thermal uses considerably little space. Furthermore, the desert locations of solar thermal plants are not in high demand for other development purposes.

These desert locations with high solar-thermal potential face a second challenge, namely the transmission of power to population centers. Transmission lines and infrastructure linking generators to population centers cost about $1.5 million per mile.[2] The Mojave plants will benefit in part from existing power infrastructure originally developed for a nearby dormant coal-powered plant.

When fully operational, these solar thermal plants will generate enough electricity to power more than 375,000 homes. Current solar thermal costs are expected to be around 12 cents per kilowatt hour (kWh). The average U.S. cost per kWh of coal in 2004 was 7.62 cents.[3]

Large-Scale PV Solar Panel Installation

Southern California Edison plans to operate what may be the world's largest solar panel installation. When complete in 2013, it will cover two square miles of unused commercial rooftops in the fast-growing Inland Empire, the southeastern corner of California consisting of San Bernardino and Riverside Counties. Three and a half million photovoltaic panels will generate enough electricity to serve 162,000 homes.[4] The first 33,000 panels have been installed on a leased warehouse rooftop in Fontana, California. The clean power is fed directly into neighborhood distribution circuits, offering green energy stability in the nation's fastest growing urban areas. Land use impacts are negligible because panels will utilize existing rooftop area. Costs are expected to be around 20 cents per kWh.

Large-scale solar panel installations of record-breaking size are also underway by Northern California utilities. In August 2008, PG&E announced two new contracts to develop 800 megawatts of photovoltaic panel installations that will deliver 1.65 billion kWh of electricity a year, enough capacity to serve the electricity needs of 250,000 homes. Both solar power plant projects will be developed in San Luis Obispo County. PG&E will contract SunPower to build a 250 MW installation that will begin to generate electricity by 2010. PG&E's second contract includes plans to purchase 550 MW of power from Topaz Solar Farms, which will be built by OptiSolar and use thin-film solar panels.

[1] *San Francisco Chronicle. 2008. "PG&E Back 3 Solar Plants in the Mojave." April 1, 2008.*

[2] *USA Today. 2008. "Wind Energy Confronts Shortage of Transmission Lines." February 26, 2008.*

[3] *Expanded Online Kentucky Coal Facts. 2004. http://www.coaleducation.org/ky_coal_facts/electricity/average_cost.htm*

[4] *MSNBC. 2008. "Warehouse Getting 33,000 Solar Panels." July 16, 2008.*

[5] *City of Fresno. 2008. "Fresno Yosemite International Airport and WorldWater & Solar Technologies Host Dedication Ceremony to Showcase the Largest Solar Airport Installation in the Nation." July 17, 2008.*

Alternative Forms of Financing Renewable Energy Projects

The sizable costs associated with the installation of a renewable energy system pose a significant barrier to the wide-spread adoption of these technologies. Creative public policy and private business efforts are being implemented to help consumers invest in clean energy options. In addition to state and federal tax credits as well as state-funded rebates, Californians are benefiting from new forms of financing renewable energy projects.

A new California state law (AB 811) signed into law July 2008 will allow cities and counties to make low-interest loans to homeowners and businesses for the purpose of reducing energy use. Participants use the loans to install a solar system, energy-efficient air conditioners, or other energy-saving improvements. Then they pay back the loans through their property taxes. If they move, the loan stays with the house or business, eliminating any individual loss of investment. If interested, local governments can directly increase citizens' access to what may be prohibitively expensive energy solutions.

The City of San Jose is taking a slightly different approach to financing efficiency and making it possible for residents to install solar power at a fraction of the cost of a full $40,000 photovoltaic system. After responding to the challenge posed by San Jose Mayor Chuck Reed to local solar companies to come up with a viable solar financing plan within 60 days, San Jose solar companies designed an innovative leasing program to break down the cost barriers of solar.[2] San Jose residents can now spread the cost of installing solar over the lifetime of the system through financing options. A power bill can be replaced by a lower monthly payment for the rooftop system, saving consumers money.

In another response to the Mayor's challenge, SolarCity, Inc., a San Jose solar installer, offered some customers a 0% trial lease through the month of July. Under this agreement, SolarCity would operate and maintain the solar panels for a monthly lease payment that the company claims is "usually lower than what you are currently paying the utility company."[3] Other companies are offering similar agreements: REGrid Power, a solar company based in Campbell, offers solar loans with 15-, 20-, or 25- year terms. Some expect that financing options will open the solar field to thousands of new customers. SolarCity is expecting at least 100 new customers in the next three months. It's an innovative start towards one part of San Jose's ambitious green vision: 100,000 solar rooftops over the next 15 years.[4]

The long-term Power Purchase Agreement is another alternative form of financing, in which a third party builds, operates and manages the solar power system, allowing the consumer to enjoy the benefits of renewable energy without the capital expense. The largest solar installation at a U.S. commercial airport was realized through this financing structure at the Fresno Yosemite International Airport. Through a contract with WorldWater & Solar Technologies, 11,700 solar panels were installed on 9.5 acres of land, with a total capacity of 2 MW. Forty percent of the airport's energy use will be supplied by the solar installations. The airport will use the solar electricity to decrease their overhead costs, as the new installations are projected to save the airport approximately $13 million throughout the next 20 years.[5]

1 *Los Angeles Times. 2008. "California Adopts Innovative Solar Loan Law." July 22, 2008.*

2 *Metroactive. 2008. "New financial programs make solar energy affordable." July 9, 2008. www.metroactive.com/metro/07.09.08/news-0828.html*

3 *SolarCity. 2008. "Solar 101: About SolarLease." http://solarlease.solarcity.com/SolarCityAbout.aspx*

4 *San Jose Mercury News. 2008. "Solar Sales Increase with San Jose Mayor's Challenge." June 21, 2008.*

5 *City of Fresno. 2008. "Fresno Yosemite International Airport and WorldWater & Solar Technologies Host Dedication Ceremony to Showcase the Largest Solar Airport Installation in the Nation." July 17, 2008.*

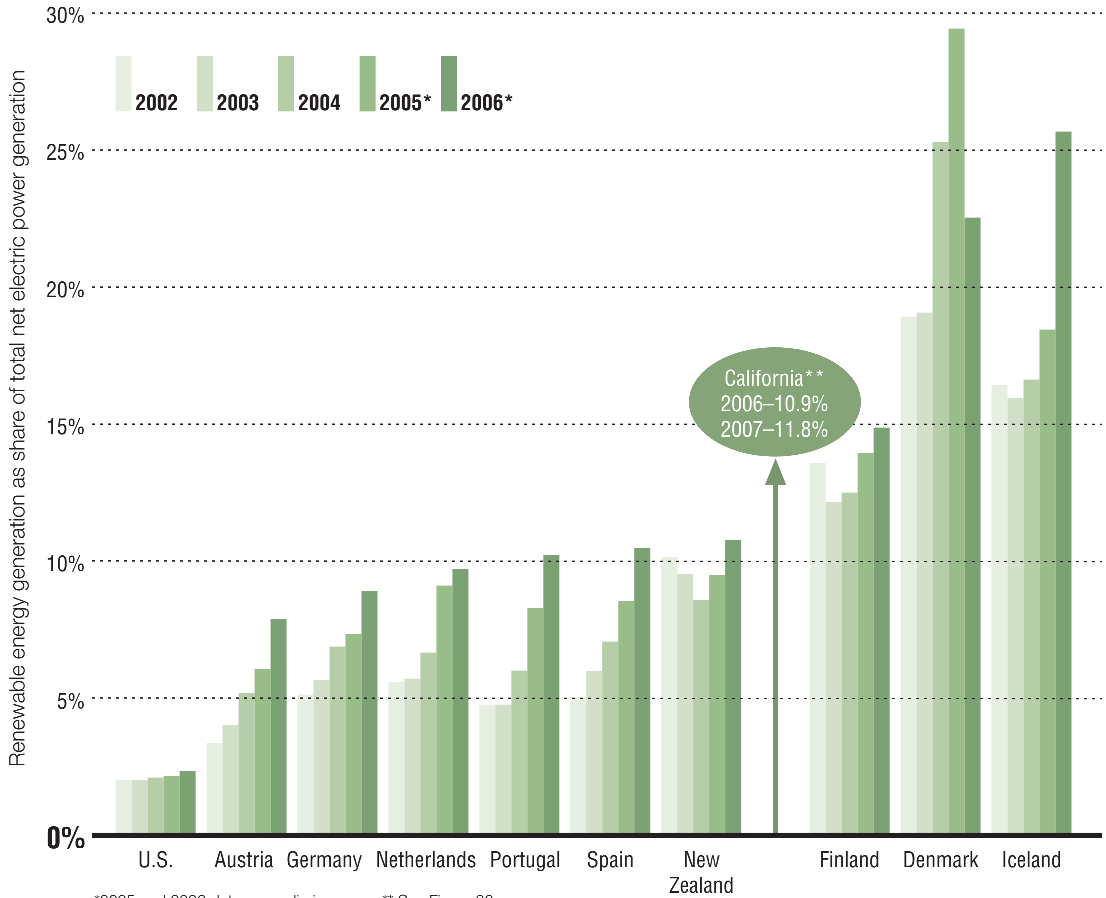
With 12% of its power derived from renewable energy sources, California ranks among the top countries in the world in clean power production. With the exception of the northern European tier of Finland, Denmark, and Iceland, the State generates a much larger percentage than the rest of the United States and many top renewable energy generating European countries. ***Figure 39*** displays the top countries in renewable power as a percentage of total energy generation (not including hydro). Iceland led the world with 26% in 2006, followed by Denmark with 23% and Finland with 15%. California, similar to New Zealand, followed with nearly 11% in 2006, well ahead of the U.S. as a whole at 2.4% ***(See Figure 36)***.

As an indicator of California's leadership, a recent national survey by the Solar Electric Power Association found that the State's three major investor-owned utilities—PG&E, Southern California Edison, and San Diego Gas and Electric—ranked in the top five in the United States in solar capacity.[20] In addition, the municipally-owned Los Angeles Department of Water and Power ranked among the top five of all utilities in the amount of customer-generated solar capacity.

[20] *Solar Electric Power Association. 2008. "SEPA'S First Annual Top Ten Utility Solar Integration Rankings, Results of the 2007 U.S. Utility Solar Electricity Market Survey." August 4, 2008, Updated Version*

39 Global Renewable Energy Generation

Geothermal, solar, wind, wood and waste electric power generation as share of total net power generation
California and other countries with the highest shares of renewable generation



*2005 and 2006 data are preliminary ** See Figure 36
Source: U.S. Department of Energy, Energy Information Administration
Analysis: Collaborative Economics

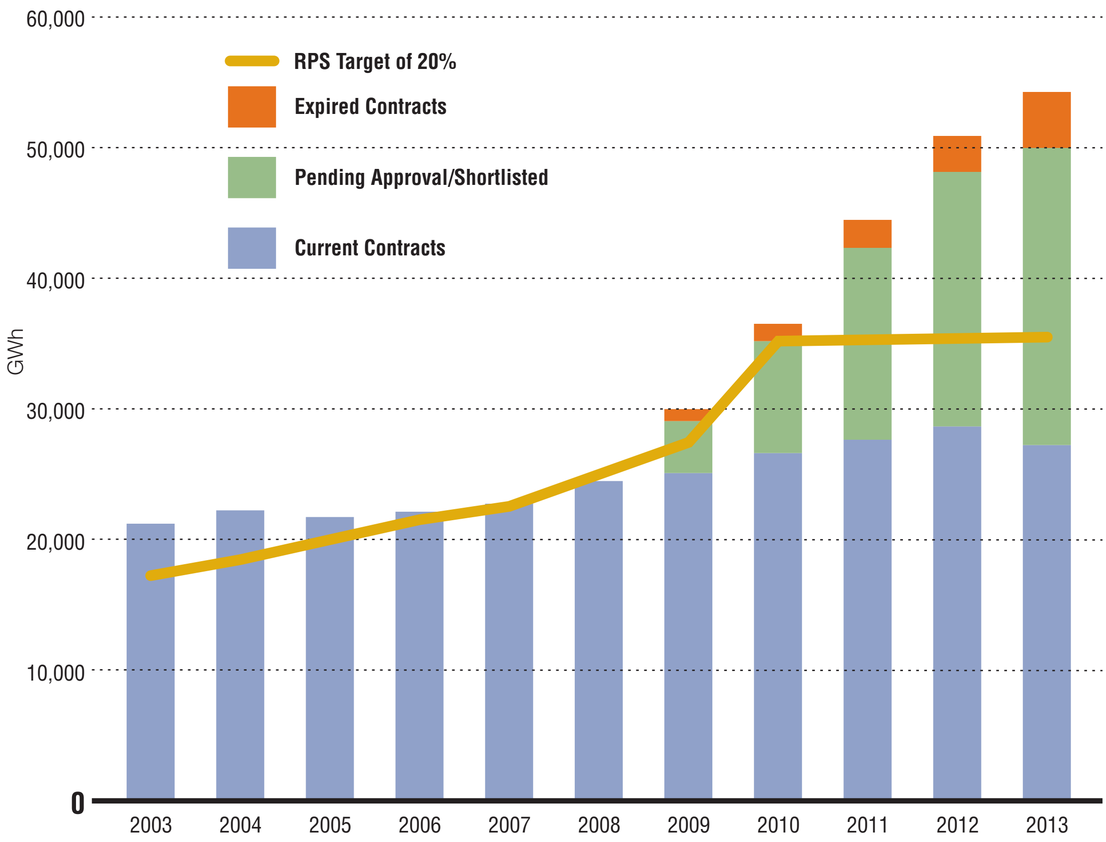
Under California's Renewables Portfolio Standard (RPS), California State law requires a 20% target for electricity procurement from renewable sources for investor-owned utilities (IOUs) in the State by 2010. (Under RPS, publicly-owned utilities are encouraged but not mandated to accelerate renewable energy procurement.) By Executive Order in November 2008, Governor Schwarzenegger increased the RPS to 33% by 2020.

RPS is measured in terms of energy delivered, and because of lagging project development, overall RPS progress has been sluggish. Since the adoption of the RPS program, the CPUC has approved contracts for 5,900 MW which if online by 2010, would be capable of producing enough electricity to exceed the RPS target; however 4,480 MW from these contracts is from new capacity.[21] While each year the number of approved RPS contracts continues to rise, increasing energy demand and obstacles to project development constrain California's ability to meet the targets for 2010 laid out by AB 32. Displayed in ***Figure 39*** below are current contracts as well as contracts pending approval, under negotiation and set to expire. The pace of project development is slowed by barriers including limited transmission lines, permitting challenges and developer inexperience.[22]

[21] *California Public Utilities Commission. 2008. "Renewables Portfolio Standard Quarterly Report." July 2008. Page 4.*

[22] *California Public Utilities Commission. 2008. "Renewables Portfolio Standard Quarterly Report." January 2008. Page 4.*

40 IOU Actual and Forecasted RPS Generation



Note: In November 2008, Governor Schwarzenegger signed an Executive Order to accelerate the RPS target to 33% by 2020.
Source: Public Utilities Commission, Renewables Portfolio Standard Quarterly Report, January 2008
Analysis: Collaborative Economics

WHAT IF...

In 2006, electric power (both in-state generated and imported) accounted for 22% of California's greenhouse gas emissions.[23] From 2005 to 2006, California's emissions from electric power decreased by 0.4%. Under the provisions of AB 32, total greenhouse gas emissions in California must be reduced to 1990 levels by 2020. Assuming reductions were made equally across all sources, California's total greenhouse gas emissions would need to be reduced by 12% by 2020.[24] In order to achieve a 12% reduction in emissions from electric power by 2020, California would have to reduce emissions from 2006 of 106 million metric tons of CO2 equivalent (MMTCO2E) to 93 MMTCO2E by 2020. While Californians have begun making some progress by investing in renewable energy sources, achieving the AB 32 requirements will clearly require more innovation.

To achieve a faster rate of change, it will be necessary to shift to lower-emission sources of electricity. One way is to shift from coal to natural gas. Efforts to reduce energy generation from high-emission sources are already under way. In September 2006, Senate Bill 1368 was signed into law, establishing a standard for baseload energy generation procured by California utilities of 1,100 lbs of CO2 per megawatt-hour. By limiting generation from high-emitting power plants, SB 1368 could stimulate the development of power plants to meet California's energy demand and minimize greenhouse gas emissions.

At the end of 2005, the Mojave Generation Station, a coal plant in Nevada that generates electricity for California, shut down. To replace the power that once came from this plant, additional renewable energy and in-state natural gas was generated. By replacing some of California's higher-emission power supply (coal) with a lower-emission power supply (natural gas), California reduced emissions by 2 million metric tons of CO2 equivalent, and achieved a net reduction in electric power emissions.

Clearly, a faster way to achieve emissions reductions would be through a shift to very low-emission sources like renewable energy sources. Today, when comparing the relative impact of each in terms of total electricity generation to total emissions, renewable energy comes out far ahead. Renewable energy accounts for 12% of California's electricity generation and only 2% of total GHG emissions from power production.[25] In contrast, natural gas is the source of 42% of the State's electric power and accounts for 53% of emissions from power generation.

California clearly has much more to do if it is to make this fundamental shift to renewable sources. However, the recent acceleration towards renewable sources is attracting investment, spawning innovation, and producing economic benefits for the State. Today, over two-thirds of the rapidly-growing pool of venture capital investment in clean technology is in energy generation, storage, and infrastructure. California is the national leader in wind and solar patents. And business establishments in solar energy systems, energy infrastructure and consulting, and related areas continue to grow. In light of the current global financial crisis and falling fuel prices, it remains to be seen how strongly this growth will continue.

[23] *California Air Resources Board. 2008. "California Greenhouse Gas Inventory- by Sector and Activity." January 2009.*

[24] *In actuality, the recommended emissions reduction strategies laid out by the Scoping Plan vary by sector and type of source (see Part 1).*

[25] *The 2% of California's GHG emissions from renewable electricity generation is from geothermal power generation. California Air Resources Board. 2008. "California Greenhouse Gas Inventory- by Sector and Activity." January 2009.*

economy-wide impact of california's green innovation

There are many ways that green innovation not only reduces California's carbon footprint, but leaves an "economic footprint" at the same time. There are both macro and micro impacts of green innovation that play out across the California economy. This final section describes the dimensions of green innovation's economic footprint, providing a fuller accounting of the economic impacts than has been assembled to date.

Macro Impacts

Perhaps the most basic economic impact of green innovation is cost savings due to innovations in energy efficiency. Although California has some of the highest residential electricity rates in the country, the average monthly residential electricity bill is lower than in approximately half of the states in the country. As displayed in ***Figure 41*** below, the average monthly residential electricity bill for a Californian household in 2006 was 56% that for a Texan household.

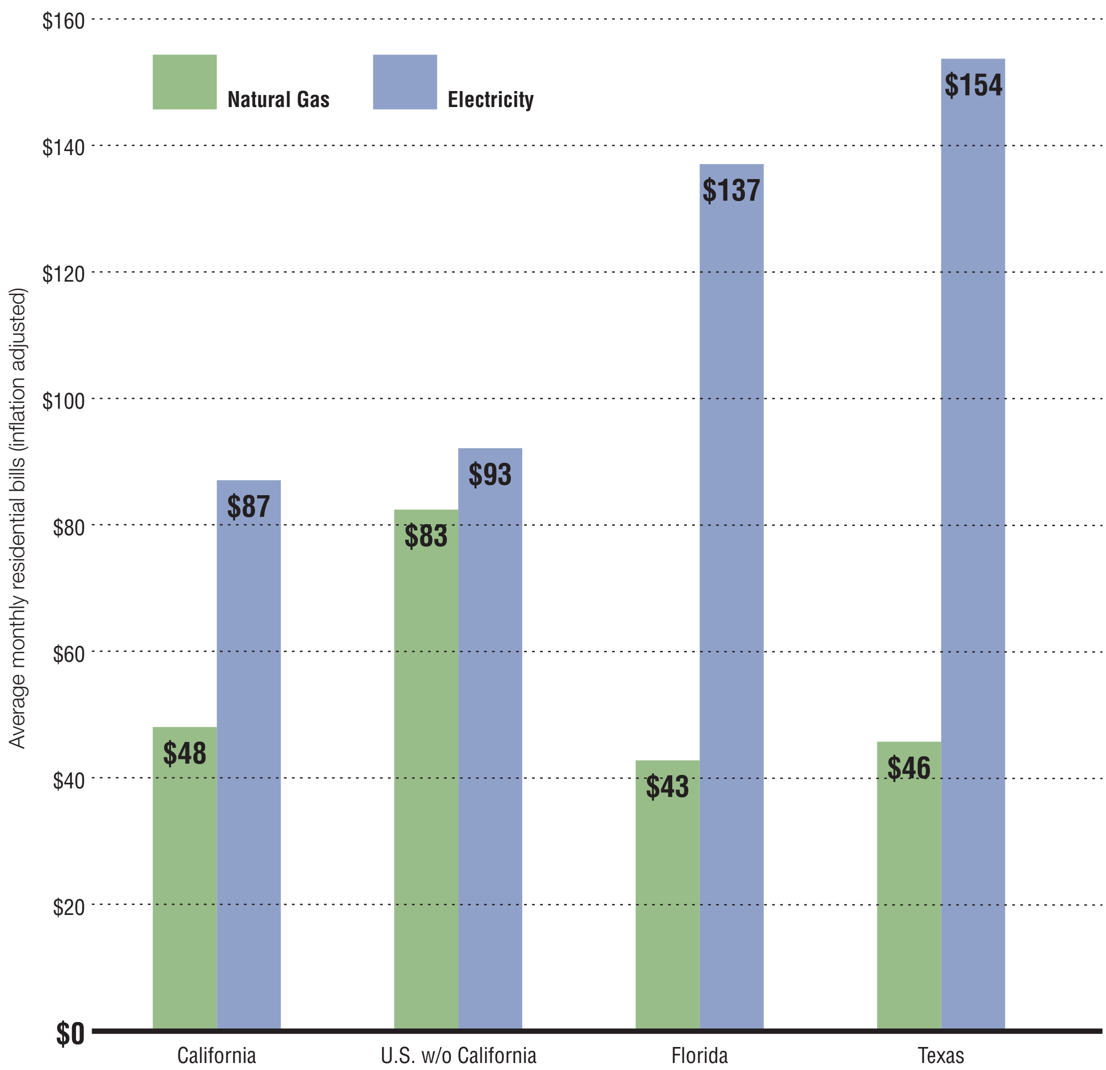
2006 Residential Electricity

	Price (cents per Kwh)	Average Monthly Kwh consumed per customer
California	$ 0.15	590
Florida	$ 0.12	1176
Texas	$ 0.13	1161

41

Average Monthly Residential Natural Gas & Electricity Bills

2006

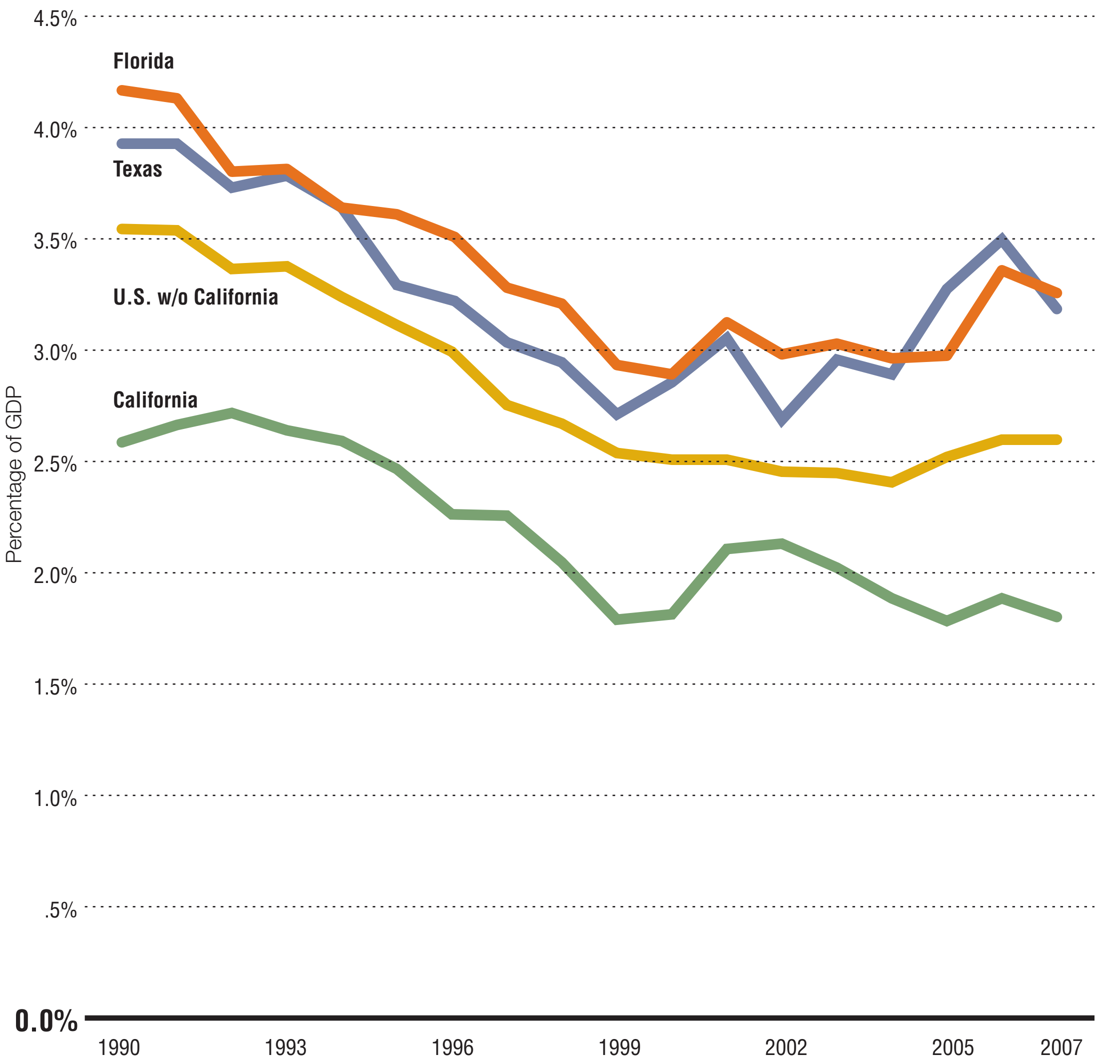


Source: Energy Information Administration, U.S. Department of Energy; Bureau of Economic Analysis, U.S. Department of Commerce
Analysis: Collaborative Economics

Nationwide, California has the fifth-lowest electricity bill as a fraction of GDP. In 2007, California's total electricity bill as a fraction of the state economy was approximately 1.8% ***(Figure 42)***. This means that, for example, Californians have almost $25 billion more annually to spend on other uses—dollars that would have gone to energy costs if California operated at the same rate of efficiency as Texas (i.e., electricity bills as a fraction of state GDP).

42

Statewide Electricity Bill as a Fraction of GDP



Source: Energy Information Administration, U.S. Department of Energy; Bureau of Economic Analysis, U.S. Department of Commerce
Analysis: Collaborative Economics

The Economics of Climate Change: Assumptions of an Economic Model

How will reducing CO2 emissions impact the U.S. economy? Myriad economic models with various assumptions have been used to determine the economic impacts of reducing CO2 emissions. Yale Professor Robert Repetto performed a meta-analysis, based on more than 1,400 policy simulations, to develop a model that determines the economic costs and benefits of policies to reduce CO2 emissions. All available simulations were synthesized to identify key assumptions and the effect of each on the projected economic costs of reducing CO2 emissions. The result was the identification of seven crucial assumptions that account for the majority of the differences among model predictions.

Repetto's Key Assumptions:

1) *How likely is it that over a period of decades, firms and households in the U.S. would adjust efficiently to higher energy prices to minimize their impacts on costs?*

2) *How likely is it that if the U.S. adopts a national policy to limit carbon emissions, it will use the mechanisms for international trading of carbon permits established in the Kyoto Protocol?*

3) *How likely is it that renewable energy technologies, such as wind and solar energy, will be available at stable prices and will be able to compete with fossil fuels once fuel prices rise far enough?*

4) *How likely is it that climate change will result in economic damages to the United States if U.S. emissions are not reduced?*

5) *How likely is it that reducing carbon dioxide emissions will also reduce emissions of other air pollutants that cause economic damages, such as sulfates, nitrogen oxides, mercury, and fine particulates?*

6) *How likely is it that national policies that make carbon fuels more expensive will stimulate technological innovation that raises energy efficiency or makes renewable energy alternatives less expensive?*

7) *How likely is it that a national policy to reduce carbon emissions will yield government revenues, either from a carbon tax or auction sales of emissions permits, that will be used to offset impacts on the economy?*

From his model, Repetto developed an interactive tool that allows the public to decide which of the seven assumptions are most realistic. By choosing their preferred assumptions, users can see how reducing emissions is likely to affect the U.S. economy. Repetto's tool is available at:
http://climate.yale.edu/seeforyourself/index.php

Robert Repetto. 2007. See for Yourself How Reducing Greenhouse Gas Emissions will Affect the American Economy. Yale University

Macro-Economic Analysis: Impact of Energy Efficiency on Job Creation

In 2008, a report was released by the University of California at Berkeley that highlights the impact of energy efficiency on the California economy. In a detailed analysis of historical efficiency patterns, author David Roland-Holst shows that California's energy efficiency standards and programs have spurred employment growth, creating more than one million new jobs since 1972.

This retrospective report examines efficiency measures and "indicates that every efficiency measure has created more jobs than it might have displaced." Household consumption is the primary driver of economic activity in the state, as it accounts for more than 70% of California's GDP. Similarly, residential energy consumption is a strong contributor to the State's overall energy use. The Roland-Holst study uses original estimation techniques to elucidate the linkage between household energy efficiency and job creation.

Roland-Holst finds that over the last 30 years, household energy efficiency contributed 1.5 million new fulltime jobs to California, for total payrolls of over $45 billion. The newly created jobs "have been concentrated in less energy-intensive service sectors, further reducing the state's carbon footprint and reinforcing its transition to a post-industrial, greener, and more sustainable future." Roland-Holst notes that "energy supply chains are not job-intensive, and for California they mainly include capital-intensive refining, conveyance, and electric power generation. Other consumer spending is concentrated mainly on job-intensive services, retail consumer goods, and foodstuffs. Thus, expenditure diversion from energy to other consumption results in net job creation."

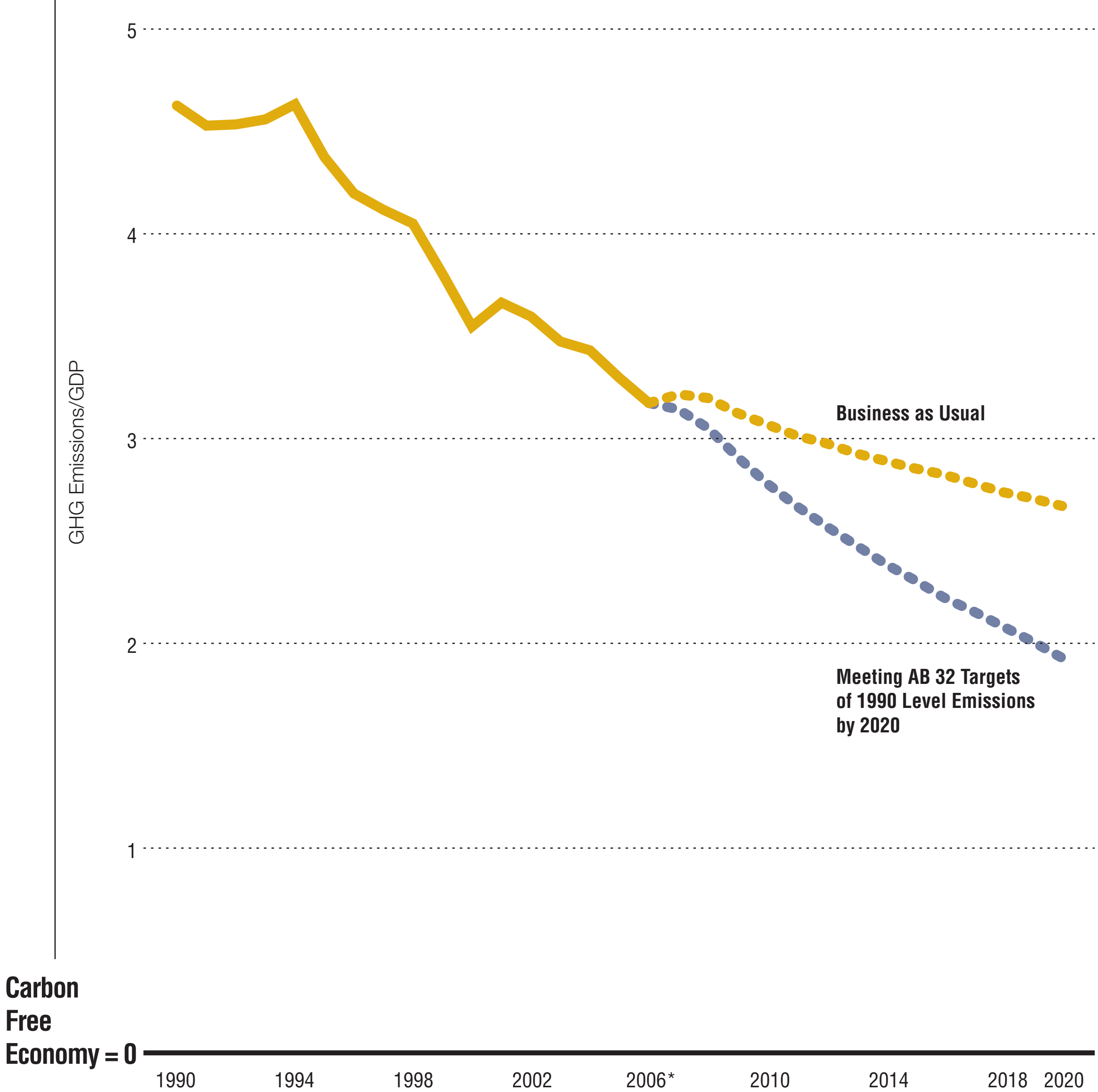
David Roland-Holst. "Energy Efficiency, Innovation and Job Creation in California." October 2008

Despite the favorable downward trend in the relationship of California's emissions to its GDP, the rate of change in reducing the carbon intensity of the State's economy will slow if no action is taken to reduce the production of greenhouse gases. Furthermore, business as usual will not achieve the targets required by the California Global Warming Solutions Act (AB 32) of reducing emissions to 1990 levels by 2020. In ***Figure 43***, the yellow dotted projection line illustrates the leveling trend we can expect if no successful efforts are made toward reducing GHG emissions★. The blue dotted line represents the path we need to take in order to reach the target set by AB 32 to reach 1990 emissions levels by 2020.

★This trendline is based on projections for California's GDP produced by Moody's Economy.com.

43 The Carbon Economy

Gross greenhouse gas emissions relative to gross domestic product – California



*Data for 2005 and 2006 are preliminary
Source: California Air Resources Board, California Greenhouse Gas Inventory– by Sector and Activity; Economy.com GDP Projections
Analysis: Collaborative Economics

The economic footprint of green innovation is multidimensional and the economic impacts are far-reaching. Green business activities span across industries and therefore do not exist as a single sector.

What do we mean by the "Green Economy"?

Innovation – in the form of new technologies, new processes or new public policies – can have a far-reaching impact well beyond its immediate point of creation. This is exactly the case with *green innovation*. The direct providers of green products and services enable the "greening" of every other industry thereby increasing energy and resource productivity and freeing up resources for new investment or new jobs.

Just as the spread of information technology dramatically increased labor productivity and transformed the economy, the spread of technologies and practices that conserve resources, produce clean energy, and reduce pollution have the potential to rejuvenate sectors of the economy, create new markets, and vastly improve energy and resource productivity.

Micro Impacts

Many Shades of Green

As the economy transitions from carbon-based to clean energy sources, demand will grow for products and services that enable businesses, consumers and public entities reduce their environmental impacts. While other studies may choose narrower definitions, this analysis defines the **core green economy** as business activities providing products and services that leverage renewable energy sources, conserve energy and natural resources, reduce pollution, and repurpose waste cover a broad spectrum of business activities and value networks.[26] This definition is based roughly on the definition of "cleantech" by the Cleantech Group LLC; however, while their focus is limited to *new* products and *new* processes, this analysis encompasses the vast realm of activities related to the application of these new products and services as well as those which are tried and tested that serve the same of aim of reducing negative environmental impacts. We refer to this set of business activities as the **Core Green Economy.**

Growth in the Core Green Economy translates into growth throughout the economy. From R&D to investment, commercialization, distribution, installation and maintenance, each stage requires specific products and services. As the demand for green technologies grows, the demand on the related networks of suppliers, distributors and service providers also grows, creating a multiplier effect that ripples across the economy. Additionally, as these green products and services permeate the reaches of the economy, the benefits of energy and resource conservation and pollution mitigation are also economy-wide resulting in the emergence of the green economy.

Green Jobs: Diverse and Locally Based

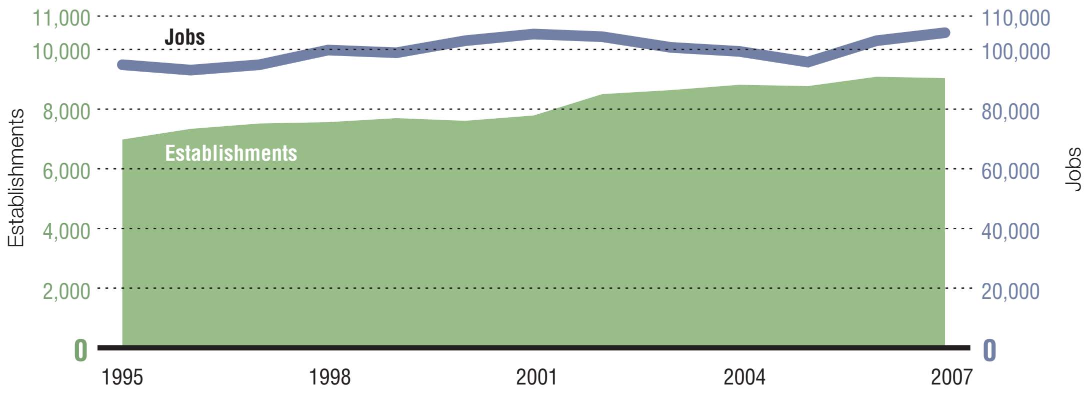
While a technological breakthrough often takes place in an R&D center employing scientists and engineers, the commercialization process brings in professionals from a variety of business, marketing and sales services. Once the new product is sold, often some form of on-site installation as well as ongoing maintenance is required. This is the case with solar technology and many energy efficiency products and services. As an industry develops, production facilities may shift locations, but the installation, maintenance and management service activities and the jobs associated with them will always remain locally based.

[26] *Business activities related to services and goods that enhance energy efficiency, reduce or eliminate negative ecological impacts, or improve the productive and responsible use of natural resources are scattered across the economy and grouped together with business activities that are not considered green. Therefore, it is not possible to simply define these activities as "the green industry" or green industry cluster.*

44

Green Business Establishments and Jobs

California



Source: Green Establishment Database
Analysis: Collaborative Economics

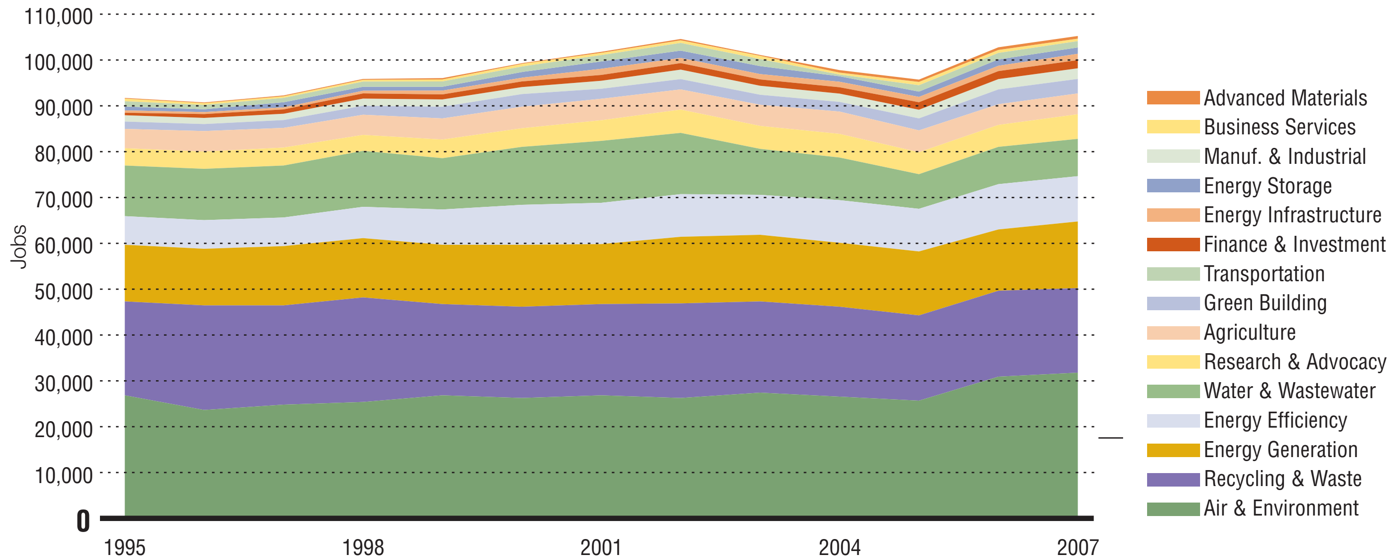
1995–2007	
Jobs	+15%
Establishments	+28%

California's businesses that provide products and services that conserve resources and reduce environmental impacts have increased in number by 28% since 1995. Jobs in these businesses have grown 15%. Just since 2005, green job growth has continued at 10%, and business establishments at 2%. Over this period, total statewide job growth was only 1%.

By Green Segment, job growth since 2005 has been strongest in Advanced Materials (28%) followed by Transportation (23%), Air & Environment (22%), and Green Building (20%).

45 Green Business Establishments and Jobs

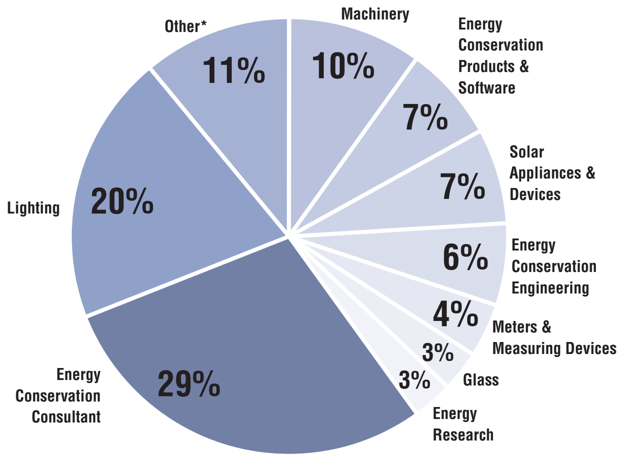
California



Source: Green Establishment Database
Analysis: Collaborative Economics

Jobs in Energy Efficiency

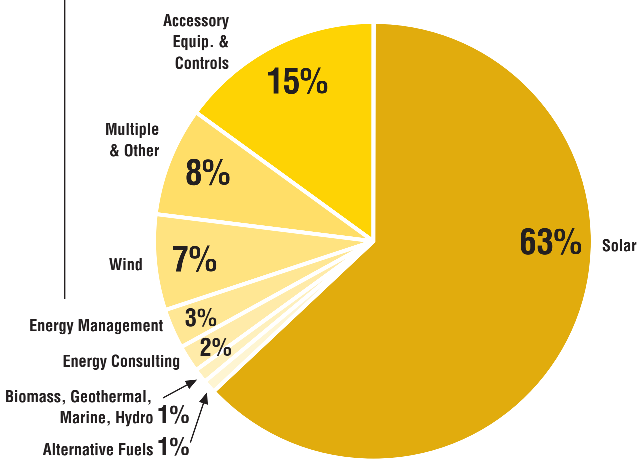
California 2007



*Other includes energy management controls and various services
Source: Green Establishment Database
Analysis: Collaborative Economics

Jobs in Energy Generation

California 2007



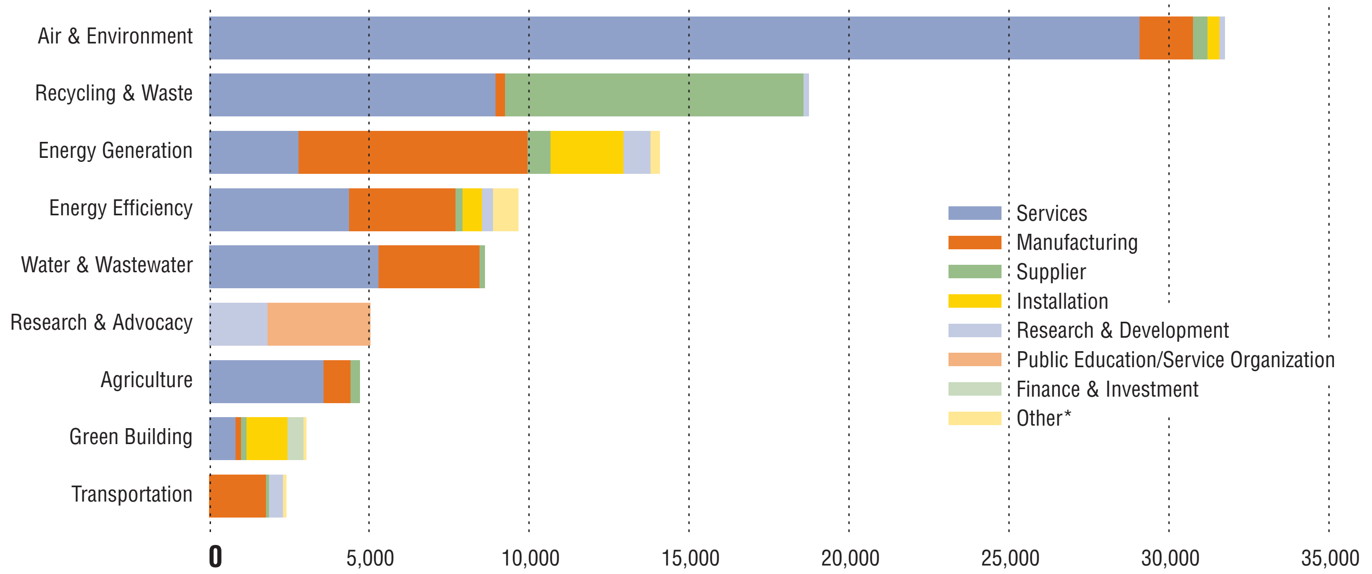
Source: Green Establishment Database
Analysis: Collaborative Economics

Each Green Segment encompasses a range of industries. In Energy Generation, 63% of jobs are related to the design and installation of solar technology. The largest employment segment of Energy Efficiency is in energy conservation consulting.

Individual businesses serve different roles along the value chain from product conception to delivery to the customer. In view of California's total green jobs, 54% are in services, 20% are in manufacturing, and 4% are in R&D. This distribution varies by Green Segment. While in Air & Environment, jobs are primarily in services, in Energy Generation, the bulk of jobs is in manufacturing.

46 Green Jobs by Establishment Type

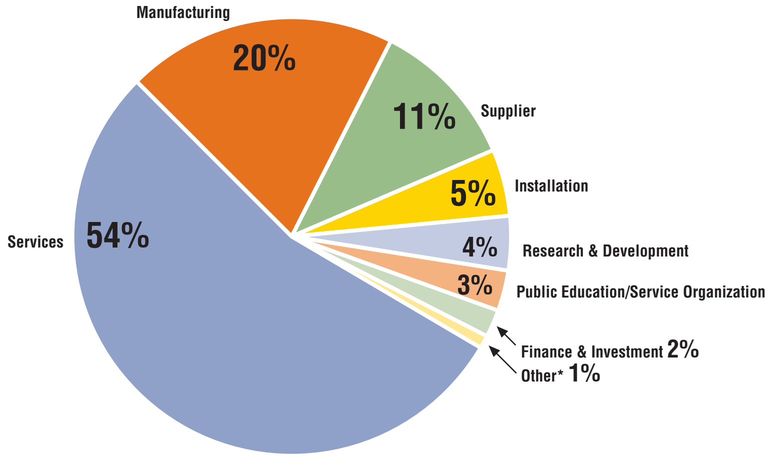
California — 2007



*Other includes: Sales, Business Associations and Public Administration
Source: Green Establishment Database
Analysis: Collaborative Economics

Green Supply Chain

Employment by Primary Role Across All Green Segments — 2007



*Other includes: Sales, Business Associations and Public Administration
Source: Green Establishment Database
Analysis: Collaborative Economics

GREEN SEGMENT	DESCRIPTION
1. Energy Generation	• Renewable energy generation (all forms of solar, wind, geothermal, biomass, hydro, marine & tidal, hydrogen, co-generation) • Associated equipment, controls, and other management software and services • Renewable energy consulting services • Research & Testing in renewable energy
2. Energy Efficiency	• Energy conservation consulting and engineering services • Building efficiency products and services • Alternative energy appliances (solar heating, lighting, etc.) • Energy efficiency research • Energy efficiency meters & measuring devices
3. Transportation	• Alternative fuels (biodiesel, hydrogen, non-corn-based ethanol) • Motor vehicles & equipment (electric, hybrid, and natural gas vehicles, diesel technology)
4. Energy Storage	• Advanced batteries (Li-Ion, NiMH) • Battery components & accessories • Fuel cells
5. Air & Environment	• Emissions monitoring & control • Environmental consulting (environmental engineering, sustainable business consulting) • Environmental remediation
6. Recycling & Waste	• Consulting services • Recycling (paper, metal, plastics, rubber, bottles, automotive, electronic waste and scrap) • Recycling machinery manufacturing • Waste treatment
7. Water & Wastewater	• Water conservation (control systems, meters & measuring devices) • Development and manufacturing of pump technology • Research and testing • Consulting services • Water treatment and purification products and services
8. Agriculture	• Sustainable land management and business consulting services • Sustainable supplies and materials • Sustainable aquaculture
9. Research & Advocacy	• Organizations and research institutes focused on advancing science and public education in the areas of: renewable energy and alternative fuels and transportation.
10. Business Services	• Environmental law legal services • Green business portals • Green staffing services • Green marketing and public relations
11. Finance & Investment	• Emission trading and offsets • Venture capital and private equity investment • Project financing (e.g. solar installations, biomass facilities, etc.)
12. Advanced Materials	• Bioplastics • New materials for improving energy efficiency
13. Green Building	• Design & construction • Building materials • Site management • Green real estate & development
14. Manufacturing & Industrial	• Advanced packaging • Process management • Industrial surface cleaning
15. Energy Infrastructure	• Consulting and management services • Cable & equipment

APPENDIX

California Green Innovation

The Carbon Economy

Gross greenhouse gas (GHG) emissions data from the California Air Resources Board include fossil fuel CO2, with electric imports and international fuels (carbon dioxide only), and noncarbon GHG emissions (in CO2 equivalents). Noncarbon GHG emissions are made up of Agriculture (CH4 and N2O), Soils and Forests Carbon Sinks, ODS substitutes, Semi-conductor manufacture (PFCs), Electric Utilities (SF6), Cement, Other Industrial Processes, Solid Waste Management, Landfill Gas, and Wastewater, Methane from oil and gas systems, and Methane and N2O from Fossil Fuel Combustion. Data for 2005 and 2006 are preliminary.

Total California Greenhouse Gas Emissions

GHG data are from the California Air Resources Board, "California Greenhouse Gas Inventory by Sector and Activity."

GHG Emissions and Gross Domestic Product

GHG data are from the California Air Resources Board, "California Greenhouse Gas Inventory by Sector and Activity." Gross Domestic Product data come from the Bureau of Economic Analysis, U.S. Department of Commerce, "Real GDP by State (millions of chained 2000 dollars)." The California Department of Finance's "Revised County Population Estimates, 1970-2007" were used to calculate per capita figures for California.

The Carbon Economy

GHG data are from the California Air Resources Board, "California Greenhouse Gas Inventory by Sector and Activity." Gross Domestic Product data come from the Bureau of Economic Analysis, U.S. Department of Commerce, "Real GDP by State (millions of chained 2000 dollars)."

GHG Emissions in California and Other States

Emissions data are from "CO2 Emissions from Fossil Fuel Combustion - Million Metric Tons CO2 (MMTCO2)," calculated by the Environmental Protection Agency based on Energy Information Administration, U.S. Department of Energy data. EPA developed state-level CO2 estimates using (1) fuel consumption data from the DOE/EIA State Energy Data 2005 Consumption tables and (2) emission factors from the U.S. Emissions Inventory 2008. EPA's data may differ slightly from state-authored inventories because of methodological differences, including scope of coverage, underlying data, emission factors or assumptions. The California Department of Finance's "Revised County Population Estimates, 1970-2007" were used to calculate per capita figures for California. Population estimates from the U.S. Population Division, U.S. Census Bureau were used to compute per-capita figures for other states and the rest of the U.S.

The Carbon Economy in California and Other States

Emissions data are from "CO2 Emissions from Fossil Fuel Combustion - Million Metric Tons CO2 (MMTCO2)," calculated by the Environmental Protection Agency based on Energy Information Administration, U.S. Department of Energy data. EPA developed state-level CO2 estimates using (1) fuel consumption data from the DOE/EIA State Energy Data 2005 Consumption tables and (2) emission factors from the U.S. Emissions Inventory 2008. EPA's data may differ slightly from state-authored inventories because of methodological differences, including scope of coverage, underlying data, emission factors or assumptions. The California Department of Finance's "Revised County Population Estimates, 1970-2007" were used to calculate per-capita figures for California. Population estimates from the U.S. Population Division, U.S. Census Bureau were used to compute per capita figures for other states and the rest of the U.S. Gross Domestic Product data come from the Bureau of Economic Analysis, U.S. Department of Commerce, "Real GDP by State (millions of chained 2000 dollars)."

Greenhouse Gas Emissions by Source

GHG data are from the California Air Resources Board, "California Greenhouse Gas Inventory by Sector and Activity."

Greenhouse Gas Emissions by Detailed Source

GHG data are from the California Air Resources Board, "California Greenhouse Gas Inventory by Sector and Activity."

APPENDIX

Energy Efficiency

Emissions from Electricity Consumption by county

Data and Analysis were provided by the Tech Coast Consulting Group and C. Scott Smith, Assistant Professor Northern Illinois University

Energy Productivity

Energy consumption data are from the U.S. Department of Energy, Energy Information Administration's State Energy Data System, 2005. Total energy consumption includes all of the following sources: petroleum, natural gas, electricity retail sales, nuclear, coal and coal coke, wood, waste, ethanol, hydroelectric, geothermal, solar, and wind energy. GDP data are real GDP by state (millions of chained 2000 dollars), from the U.S. Department of Commerce, Bureau of Economic Analysis. To calculate savings between California and the rest of the U.S., GDP data was adjusted into 2007 dollars, using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics.

Total Energy Consumption Relative to 1970

Energy data are from the U.S. Department of Energy, Energy Information Administration's State Energy Data System, 2005. Total energy consumption includes all of the following sources: petroleum, natural gas, electricity retail sales, nuclear, coal and coal coke, wood, waste, ethanol, hydroelectric, geothermal, solar, and wind energy. To compute per-capita values, Revised County Population Estimates, 1970-2007, December 2007 from the California Department of Finance for California and annual population estimates from the U.S. Census Bureau's Population Division were used for the Rest of the United States.

U.S. Cost Curve for Greenhouse Gas Abatement

Figure is from "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?" Executive Report. McKinsey & Company. December 2007 (page 20).

California Market Share of Energy Star Appliances

Data are from the May 2, 2008 "California Residential Efficiency Market Share Tracking: Appliances 2006" report prepared by Itron for Southern California Edison. The report is published on the California Measurement Advisory Council (CALMAC) website.

Commercial Electricity Consumption

Commercial electricity consumption data is from the California Energy Commission's "Statewide Electricity Consumption by Sector (GWh)" released in the California Energy Demand 2008-2018 Staff Revised Forecast. Also from this report, commercial floorspace data from "Planning Area Economic and Demographic Assumptions" were used.

Commercial Office Building Electricity Consumption by Industry

Commercial electricity consumption data by building type was provided by the California Energy Commission, and contains the summary model output used for the California Energy Demand 2008-2018 Staff Revised Forecast. Commercial floorspace data by building type is from the "Floor Space Stock Projections by Climate Zone and Building Type" released by the California Energy Commission in August 2007.

APPENDIX

Green Technology Innovation

Venture Capital Investment in Clean Technology

Data are provided by Cleantech Group™, LLC (www.cleantech.com) and includes disclosed Cleantech investment deal totals. Data is adjusted into 2007 dollars, using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics.

Green Technology Patents

Search criteria were defined for the five technology areas (solar and wind energy generation, energy storage, fuel cells, hybrid systems), and 1790 Analytics developed and performed the search of detailed U.S. Patent data from the U.S. Patent & Trade Office.

Focus on Surface Transportation

GHG Emissions from Transportation by Source

GHG data are from the California Air Resources Board, "California Greenhouse Gas Inventory- by Sector and Activity." Transportation sources include On-Road Passenger Vehicles, On-Road Heavy Duty Trucks, Ships & Commercial Boats (Within 24 Nautical Miles), Locomotives, Non-Road Transportation, and Domestic (In-State) Aviation.

California Vehicle Miles of Travel

Vehicle Miles Traveled (VMT) is defined as total distance traveled by all vehicles during selected time period in geographic segment. VMT estimates are from the California Department of Transportation's "2007 California Motor Vehicle Stock, Travel, and Fuel Forecast." Data includes annual statewide total VMT on State highways and non-state highways. In order to calculate VMT, Caltrans multiplies the road section length (length in miles along the centerline of the roadway) by Average Annual Daily Traffic (AADT). AADT are actual traffic counts that the city, county, or state have taken and reported to the California Department of Transportation. To compute per-capita values, Revised County Population Estimates, 1970-2007, December 2007 from the California Department of Finance were used.

Trends in Vehicle Miles of Travel & GHG Emissions from Surface Transportation

Vehicle Miles Traveled (VMT) is defined as total distance traveled by all vehicles during selected time period in geographic segment. VMT estimates are from the California Department of Transportation's "2007 California Motor Vehicle Stock, Travel, and Fuel Forecast." Data includes annual statewide total VMT on State highways and non-state highways. In order to calculate VMT, Caltrans multiplies the road section length (length in miles along the centerline of the roadway) by Average Annual Daily Traffic (AADT). AADT are actual traffic counts that the city, county, or state have taken and reported to the California Department of Transportation. GHG data are from the California Air Resources Board, "California Greenhouse Gas Inventory- by Sector and Activity." Surface transportation emission sources include On-Road Passenger Vehicles and On-Road Heavy Duty Trucks. 2005 and 2006 data are preliminary. To compute per-capita values, Revised County Population Estimates, 1970-2007, December 2007 from the California Department of Finance were used.

California County VMT related to Population Density

Vehicle Miles Traveled (VMT) is defined as total distance traveled by all vehicles during selected time period in geographic segment. VMT estimates are from the California Department of Transportation's "2007 California Motor Vehicle Stock, Travel, and Fuel Forecast." Data includes annual statewide total VMT on State highways and non-state highways. In order to calculate VMT, Caltrans multiplies the road section length (length in miles along the centerline of the roadway) by Average Annual Daily Traffic (AADT). AADT are actual traffic counts that the city, county, or state have taken and reported to the California Department of Transportation. To compute per-capita values, Revised County Population Estimates, 1970-2007, December 2007 from the California Department of Finance were used. To calculate population density, population data was divided by land area data. Land area data is from the U.S. Census Bureau, Census 2000 Summary File: Population, Housing Units, Area, and Density. Population data (2007) is from the California Department of Finance, Revised County Population Estimates, 1970-2007, December 2007.

APPENDIX

California Trends in Gasoline Sales and Prices

California gasoline sales data is from the California State Board of Equalization, "Taxable Gasoline Gallons 10 Year report." Data are for motor vehicle fuel net taxable gasoline gallons and do not include aviation gasoline. Gas prices come from the Weekly Retail Gasoline and Diesel Prices (Cents per Gallon, Including Taxes) dataseries reported by the U.S. Department of Energy, Energy Information Administration. Gas prices are All Grades All Formulations Retail Gasoline Prices (including taxes) and have been adjusted into 2007 dollars using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics. To compute per capita values, *Revised County Population Estimates, 1970-2007, December 2007* from the California Department of Finance for California were used. 2008 annual gasoline sales figures are estimates based on January-September 2008 data.

U.S. Trends in Gasoline Sales and Prices

U.S. gasoline sales data is from the Energy Information Administration, U.S. Department of Energy, "U.S. Total Gasoline All Sales/Deliveries by Prime Supplier." California gasoline sales data from the California State Board of Equalization, "Taxable Gasoline Gallons 10 Year report" were subtracted from U.S. gasoline sales to calculate gasoline sales for the rest of the U.S. Gas prices come from the Weekly Retail Gasoline and Diesel Prices (Cents per Gallon, Including Taxes) dataseries reported by the U.S. Department of Energy, Energy Information Administration. Gas prices are All Grades All Formulations Retail Gasoline Prices (including taxes) and have been adjusted into 2007 dollars using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics. To compute per-capita values, Revised County Population Estimates, 1970-2007, December 2007 from the California Department of Finance for California and U.S. population estimates from the U.S. Population Division, U.S. Census Bureau were used. 2008 annual gasoline sales figures are estimates based on January-September 2008 data.

Alternative Means of Commute

Data is from the American Community Survey, U.S Census Bureau. Alternative means of commute is made up of those who carpooled (car, truck, or van), used public transportation (excluding taxicab), walked, used taxicab, used motorcycle, used bicycle, worked at home, or used other means.

Public Transit Use and Availability in California

Total number of passengers and total vehicle miles data are from the California State Controller's Office, "Transit Operators and Non-Transit Claimants Annual Report," 1997-2006. The data in this annual report is based on unaudited reports submitted by various transit operators. Ten agencies did not report operating data. ***See table on right.***

Public Transit Ridership per Capita

	Rides per Person 2006	Percent Change 2001–2006
Tehama	1	+127%
Del Norte	2	+108%
Plumas	3	+63%
Calaveras	1	+60%
Lake	3	+41%
Merced	4	+38%
Glenn	2	+37%
Placer	4	+24%
San Luis Obispo	6	+24%
Lassen	2	+18%
Sutter & Yuba	5	+18%
Santa Barbara	22	+15%
Sacramento	24	+13%
Siskiyou	2	+11%
Tuolumne	1	+8%
Los Angeles	59	+7%
San Mateo	37	+6%
Imperial	2	+5%
Alameda	118	+3%
Orange	23	+2%
Ventura	6	+2%
Yolo	23	+2%
Humboldt	8	+1%
Sonoma	9	+1%
San Diego	31	+0.1%
Tulare	6	-1%
California State	**37**	**-3%**
Madera	1	-3%
Kings	5	-5%
Stanislaus	8	-5%
Monterey	11	-6%
Butte	5	-7%
Contra Costa	8	-8%
Fresno	14	-8%
Trinity	1	-9%
Mendocino	4	-10%
Napa	6	-12%
Santa Cruz	22	-13%
San Benito	3	-14%
San Francisco	256	-14%
Nevada	4	-15%
San Bernardino	8	-19%
El Dorado	4	-21%
Riverside	5	-21%
Mono	1	-23%
Santa Clara	23	-24%
Solano	8	-24%
Kern	9	-25%
San Joaquin	7	-26%
Shasta	4	-30%
Inyo	3	

Note: California State Controller does not report data for the following counties: Alpine, Amador, Colusa, Marin, Mariposa, Modoc, Sierra
Source: California State Controller
Analysis: Collaborative Economics

APPENDIX

Growth in New Alternative Fuel Vehicles Registered
Alternative fuel vehicle data are provided by R.L. Polk & Co.

Alternative Fuel Vehicles as Share of Total Vehicles Registered
Alternative fuel vehicle data are provided by R.L. Polk & Co.

California Distribution of Alternative Fuel Vehicles Registered by Registration Type
Alternative fuel vehicle data are provided by R.L. Polk & Co.

Top 10 Hybrid Metro Markets
Data are from *Table 2: Top 10 Hybrid Metro Markets*, published on an annual basis by R.L. Polk & Co.

Alternative Fuel Vehicles by Type
Alternative fuel vehicle data are provided by R.L. Polk & Co.

Total Vehicles and GHG Emissions
Vehicle registration data are from the Federal Highway Administration, U.S. Department of Transportation, "Highway Statistics" 2000-2006, Table MV-1. Total number of vehicles are for all vehicles registered in California including cars, trucks, busses, and motorcycles. On-road transportation GHG data are from the California Air Resources Board, "California Greenhouse Gas Inventory- by Sector and Activity." On-road transportation emission sources include On-Road Passenger Vehicles and On-Road Heavy Duty Trucks.

GHG Emissions from Surface Transportation
GHG data are from the California Air Resources Board, "California Greenhouse Gas Inventory- by Sector and Activity." Gross greenhouse gas (GHG) emissions includes fossil fuel CO2, with electric imports and international fuels (carbon dioxide only) and noncarbon GHG emissions (in CO2 equivalents). Noncarbon GHG emissions are made up of Agriculture (CH4 and N2O), Soils and Forests Carbon Sinks, ODS substitutes, Semi-conductor manufacture (PFCs), Electric Utilities (SF6), Cement, Other Industrial Processes, Solid Waste Management, Landfill Gas, and Wastewater, Methane from oil and gas systems, and Methane and N2O from Fossil Fuel Combustion. Surface transportation emission sources include On-Road Passenger Vehicles and On-Road Heavy Duty Trucks. 2005 and 2006 data are preliminary. Under the requirements of AB 32, total greenhouse gas emissions in California must be reduced to 1990 levels by 2020. In this chart, 1990 GHG levels from surface transportation were used as 2020 reductions required by AB 32.

Focus on Renewable Energy

California Energy Generation
Data is from the California Energy Commission, *"Net System Power Reports" 2002-2007, Table 2: 2007 Total System Power in Gigawatt Hours.* Total system power is the sum of all in-state generation and net electricity imports by fuel type. Each year, the total-system-power mix changes, in part, because hydroelectric generation can significantly vary from year to year and other resources will make up the difference.

U.S. Energy Generation
Total energy generation data is from the Energy Information Administration, U.S. Department of Energy, *Table 8.2a Electricity Net Generation: Total (All Sectors), 1949-2007.* Renewable energy generation data is from the Energy Information Administration, U.S. Department of Energy, *Table 1.11. Electricty Net Generation From Renewable Energy by Energy Use Sector and Energy Source, 2002-2007.* The State of California's definition of renewable energy does not include large-scale hydroelectric power. Since the Energy Information Administration does not differentiate between small and large-scale hydro, data represented here for the U.S. does not include any hydro. In 2007, all hydro represented 6% of total U.S. energy generation. According to the Bureau of Reclamation, U.S. Department of the Interior *(Hydroelectric Powerplants Fiscal Year 2006 Generation)* in 2006 small hydro accounted for 2% of total hydroelectric power generation.

APPENDIX

California and U.S. Growth in Energy Generation

California data is from the California Energy Commission, "Net System Power Reports" 2002-2007, *Table 2: 2007 Total System Power in Gigawatt Hours.* Total system power is the sum of all in-state generation and net electricity imports by fuel type. Each year, the total-system-power mix changes, in part, because hydroelectric generation can significantly vary from year to year and other resources will make up the difference. U.S. Total energy generation data is from the Energy Information Administration, U.S. Department of Energy, *Table 8.2a Electricity Net Generation: Total (All Sectors), 1949-2007.* U.S. Renewable energy generation data is from the Energy Information Administration, U.S. Department of Energy, *Table 1.11: Electricty Net Generation From Renewable Energy by Energy Use Sector and Energy Source, 2002-2007.* The State of California's definition of renewable energy does not include large-scale hydroelectric power. Since the Energy Information Administration does not differentiate between small and large-scale hydro, data represented here for the U.S. does not include any hydro. In 2007, all hydro represented 6% of total U.S. energy generation. According to the Bureau of Reclamation, U.S. Department of the Interior (Hydroelectric Powerplants Fiscal Year 2006 Generation) in 2006 small hydro accounted for 2% of total hydroelectric power generation.

California Renewable Energy Generation

Data is from the California Energy Commission, "Net System Power Reports" 2002-2007, *Table 2: 2007 Total System Power in Gigawatt Hours.* Total system power is the sum of all in-state generation and net electricity imports by fuel type. Each year, the total-system-power mix changes, in part, because hydroelectric generation can significantly vary from year to year and other resources will make up the difference.

Energy from Solar Installations in California

Data is from the California Energy Commission, "Amount (MW) of Grid-Connected Solar Photovoltaics (PV) in California, 1981 to 12/31/07," updated on April 1, 2008.

Global Renewable Energy Generation

Global data is from the Energy Information Administration, U.S. Department of Energy, *Table 6.3 World Total Net Electricity Generation, Most Recent Annual Estimates, 1980-2006* and *Table 2.8 World Net Geothermal, Solar, Wind, Wood and Waste Electric Power Generation, 1980-2006.* Estimates for 2005 and 2006 are preliminary. Global and U.S. Renewable energy includes geothermal, solar, wind, and wood and waste electric power. U.S. total energy generation data is from the Energy Information Administration, U.S. Department of Energy, *Table 8.2a Electricity Net Generation: Total (All Sectors), 1949-2007.* U.S. renewable energy generation data is from the Energy Information Administration, U.S. Department of Energy, *Table 1.11. Electricty Net Generation From Renewable Energy by Energy Use Sector and Energy Source, 2002-2007.* California data is from the California Energy Commission, "Net System Power Reports" 2006-2007, *Table 2: 2007 Total System Power in Gigawatt Hours.* In addition to geothermal, solar, wind, and wood and waste electric power, California renewable generation also includes small-hydro electric power.

IOU Actual and Forecasted RPS Generation

Data is from the California Public Utilities Commission "Renewables Portfolio Standard Quarterly Report," January 2008.

Economy-wide Impact of California's Green Innovation

Macro Impacts

Average Monthly Residential Natural Gas & Electricity Bills

Monthly residential gas bills were calculated by using Natural Gas Residential Price, Natural Gas Delivered to Residential Consumers, and Number of Natural Gas Residential Consumers from the Energy Information Administration, U.S. Department of Energy. Data used to calculate electricity bills are from *1990 - 2006 Number of Retail Customers by State by Sector (EIA-861), 1990 - 2006 Retail Sales of Electricity by State by Sector by Type of Provider (EIA-861), 1990 - 2006 Average Price by State by Type of Provider (EIA-861),* published by the Energy Information Administration, U.S. Department of Energy. Electricity and natural gas bills were adjusted into 2007 dollars, using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics.

Statewide Electricity Bill as a Fraction of GDP

Data used to calculate electricity bills are from *1990 - 2006 Number of Retail Customers by State by Sector (EIA-861), 1990 - 2006 Retail Sales of Electricity by State by Sector by Type of Provider (EIA-861), 1990 - 2006 Average Price by State by Type of Provider (EIA-861),* published by the Energy Information Administration, U.S. Department of Energy. Electricity bills were adjusted into 2007 dollars, using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics. GDP data are real GDP by state (millions of chained 2000 dollars), from the U.S. Department of Commerce, Bureau of Economic Analysis.

The Carbon Economy

GHG data are from the California Air Resources Board, "California Greenhouse Gas Inventory– by Sector and Activity." Gross greenhouse gas (GHG) emissions includes fossil fuel CO2, with electric imports and international fuels (carbon dioxide only) and noncarbon GHG emissions (in CO2 equivalents). Noncarbon GHG emissions are made up of Agriculture (CH4 and N2O), Soils and Forests Carbon Sinks, ODS substitutes, Semi-conductor manufacture (PFCs), Electric Utilities (SF6), Cement, Other Industrial Processes, Solid Waste Management, Landfill Gas, and Wastewater, Methane from oil and gas systems, and Methane and N2O from Fossil Fuel Combustion. Data for 2005 and 2006 are preliminary. Gross Domestic Product data is from Economy.com, 1947-2037 *GDP by Quarter (millions of chained 2000 dollars).* Under the requirements of AB 32, total greenhouse gas emissions in California must be reduced to 1990 levels by 2020. In this chart, 1990 GHG levels were used for "Meeting AB 32 Targets of 1990 Level Emissions by 2020." 2020 "Business as Usual" emission levels are from the California Air Resources Board, "Detailed Draft 2020 GHG Emissions Forecast and Methodology."

Micro Impacts

Green Jobs & Establishments

The accounting of green business establishments and jobs is based on multiple datasources for the classification of green businesses (such as New Energy Finance, Cleantech Group™, LLC and others) and leveraged also a sophisticated internet search process. The National Establishments Time-Series (NETS) database based on Dun & Bradstreet establishment data was sourced to extract business information such as jobs. The operational definition of green is based primarily the definition of cleantech defined by the Cleantech Network. This sample offers a conservative estimate of the industry in California.

APPENDIX

2008 California Green Innovation Index Survey Results

All 2008 survey results, unless otherwise noted, are from the September 2008 Field Poll. August 2007 survey results are based on 703 registered voters interviewed as part of the 2007 Field/Next 10 Global Warming Survey of Californians.

Field Research Corporation (Field), a San Francisco-based independent public opinion research organization, was responsible for overseeing all phases of the research effort. The survey was developed in partnership with Collaborative Economics, a strategic consulting group based in Mountain View, California.

The findings in this report are based on a random sample survey of 1,008 registered voters in California. Sampling error estimates applicable to any probability-based survey depend on sample size. The sampling error for results based on the overall sample of 1,008 registered voters is +/- 3.2 percentage points at the 95% confidence level. All interviewing was conducted by telephone in English and Spanish from a central location telephone interviewing facility during the period of September 5 - 14, 2008. In order to cover a broad range of issues and still minimize possible respondent fatigue, the overall sample was divided into two sub-samples, Forms A and B, on several questions. Households in the survey were sampled using a random-digit dial methodology, which randomly selects operating landline telephone exchanges within all area codes serving California households in proportion to population. Within each exchange, telephone numbers were created by adding random digits. This method gives each phone listing an equal chance of being selected and permits access to all landline telephone numbers statewide, both listed and unlisted.

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