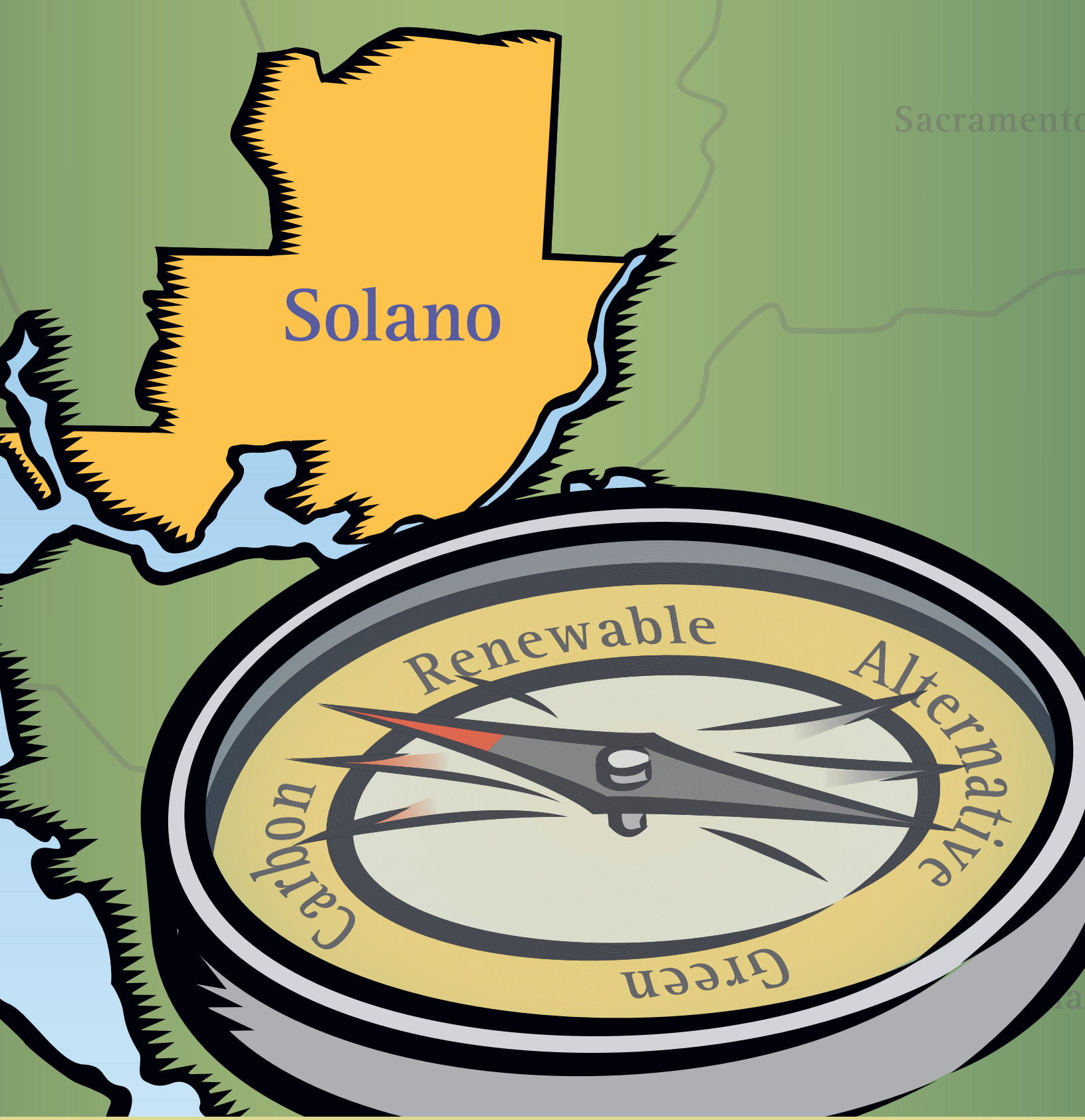


Solano County's Energy Cluster

Solano Economic Development Corporation

Prepared by Collaborative Economics • November 2009

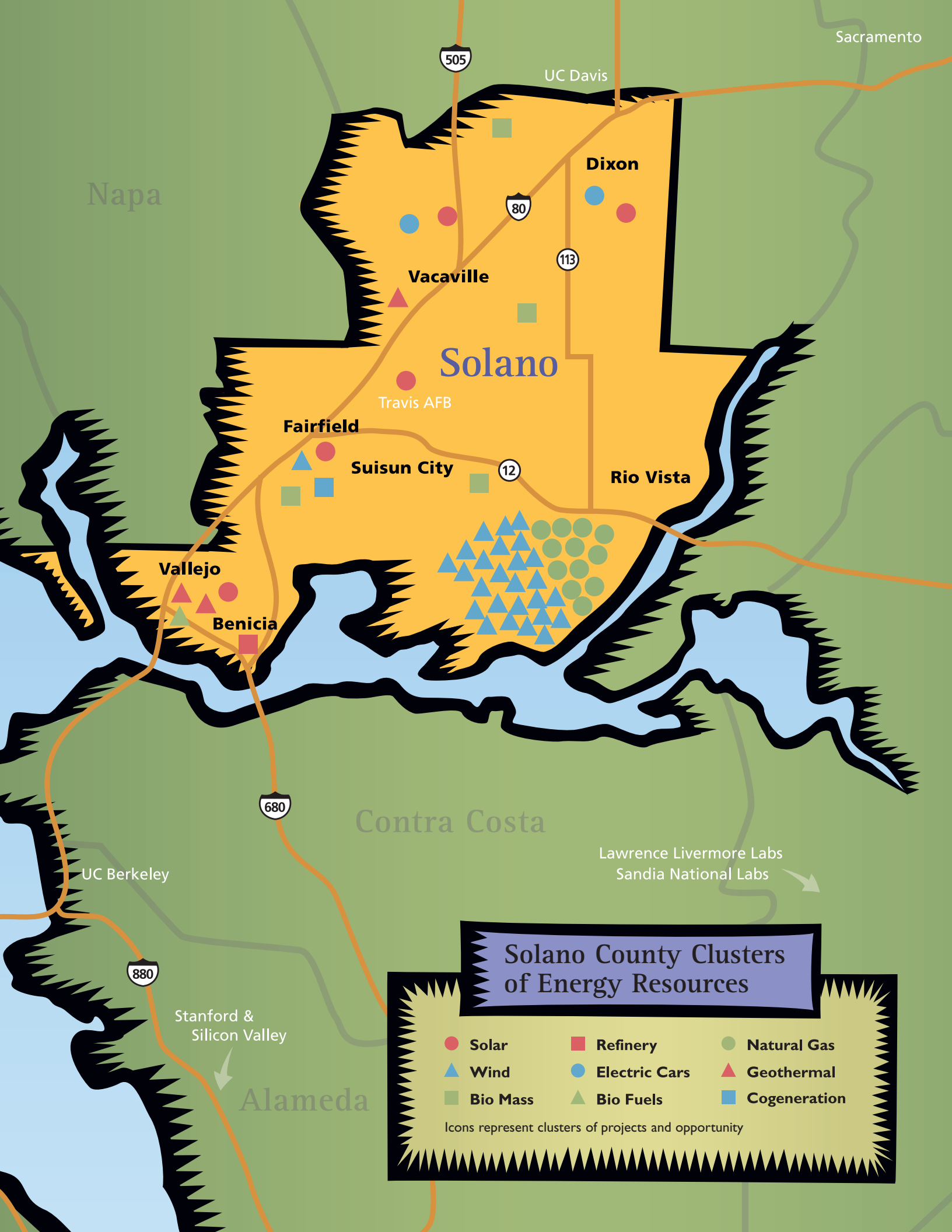

Sacramento
505
UC Davis
Napa
Dixon
80
113
Vacaville
Solano
Travis AFB
Fairfield
Suisun City
12
Rio Vista
Vallejo
Benicia
680
Contra Costa
UC Berkeley
Lawrence Livermore Labs
Sandia National Labs
880
Stanford &
Silicon Valley
Alameda
Solano County Clusters of Energy Resources
Solar
Refinery
Natural Gas
Wind
Electric Cars
Geothermal
Bio Mass
Bio Fuels
Cogeneration
Icons represent clusters of projects and opportunity

Table of Contents

On behalf of the Board of Supervisors and our community partners, I am pleased to present an in-depth analysis of Solano County's Energy Cluster, the second of several studies that are examining how the concentration of select industries are shaping the local economy.

This cluster study focuses on the emergence of a diverse local energy industry and its potential to produce an economic momentum in Solano County. This report builds upon the initial Solano County Index of Economic and Community Progress presented in November 2008 and the Life Science Cluster report presented in February 2009. As in those reports, the objective analysis presented gives policymakers, business leaders and community organizers the information they need to better understand a long-standing and continuously evolving industry.

Once again, we are happy to learn how Solano County takes center stage in the mega-economic region stretching from the Bay Area to Sacramento and beyond. Our nexus in the growing energy industry is the convergence of transportation arteries and transmission lines through the middle of the most favorable area in California for local energy production. We are also surrounded by billions of dollars in research and development investment that is creating an environment for energy innovation. From carbon-based to the myriad of green and renewable energy sources, we can easily say Solano County is energy opulent.

What we need is a comprehensive and integrated strategy that conveys to the world we have a plan in action that will enable us to live up to our exciting potential. Each community has accomplished impressive feats as they explore and implement projects that unravel their dependence on a single source of energy. The report confirms we are outpacing the state and the region on many fronts: growth in solar capacity, use of alternative fuel vehicles, and the addition of energy-related jobs.

This report brings us some much-needed good news, and our efforts to capitalize on it will bring us some positive economic energy. Together, we can build upon the significant investment already in the works from the public and private sectors in energy-related projects to accelerate a resurgence in our local economy. Our efforts will benefit us in the short-term and position to be a leader in the long-term.

I encourage you to be a part of our new energy future. Your expertise and commitment will turn this report from an exploration of what has been to a roadmap of what will be.

Sincerely,

John M. Vasquez
Chairman, Solano County Board of Supervisors

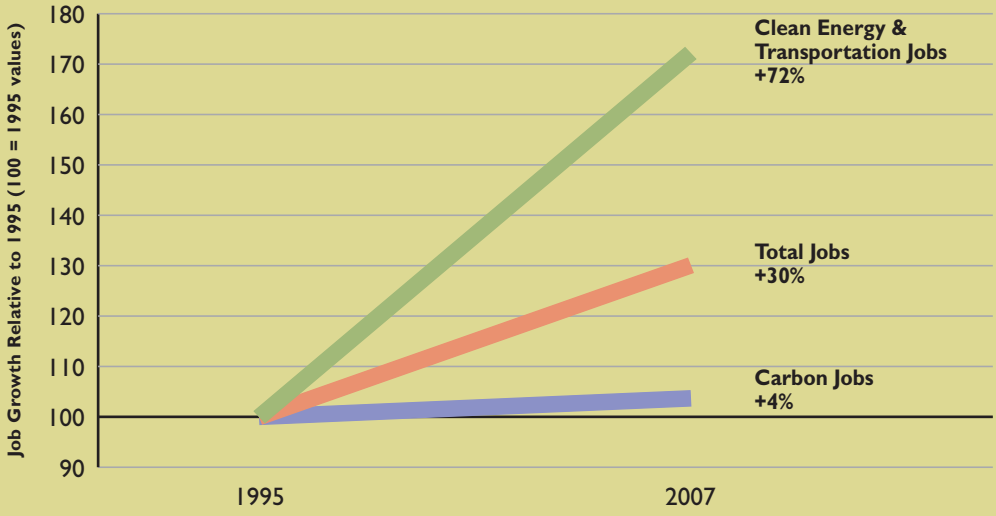
Executive Summary

This profile examines the growth and diversity of Solano County's energy cluster, trends in production and consumption, the development of new clean energy generation capacity, research centers and projects in and around the County, and opportunities to grow Solano County's energy cluster in the years ahead.

Solano County's energy cluster is rapidly transforming, creating new opportunities for economic prosperity and job growth. The cluster is diverse, with both carbon-based energy and clean energy sectors and businesses. Together, these sectors employ over 1,500 people across more than 60 establishments. The cluster is transforming in key ways:

- **Carbon-based energy remains the largest sector, but has experienced only two years of annual growth between 1995 and 2007.** The sector includes over 40 establishments in oil and gas drilling and petroleum refining, and energy generation and distribution.
- **Clean energy is a small, but fast growing sector, increasing 72 percent in employment between 1995 and 2007, a much faster rate than carbon-based energy sectors (4%), or even the Solano County economy as a whole (30%).** The sector includes nearly 20 establishments in clean energy generation (e.g., solar and wind), energy conservation products and services, and clean transportation. Solano County is diversifying its mix of clean sources for energy generation, and jobs in related industries are growing at a faster rate than the economy as a whole.

Clean Energy & Transportation Growth Relative to 1995
Solano County



Data Source: Green Establishments Database; National Establishment Time Series Database
Analysis: Collaborative Economics

Solano County benefits from favorable conditions for local energy generation—especially wind, but also solar, biofuels, and geothermal. Solano County benefits from some of the strongest inland winds in California, is well-suited for solar energy generation, has geothermal resources that have become more valuable with new technologies, and is already increasing its capacity for biofuels development and biomass-to-energy conversion. These resources could provide the fuel for future cluster growth.

Solano County is within 100 miles of billions of dollars of investment in energy innovation—stretching from the coastal Bay Area counties to the Sacramento region. Solano County's proximity to key institutions in energy innovation such as UC-Davis, UC-Berkeley, Stanford, and several national laboratories, as well as hundreds of energy-related companies, means that the county could participate in and capture the downstream benefits of innovation—in terms of energy cluster research, manufacturing, warehousing, and other operations. The county could provide an accessible location for the expansion of firms based in different parts of Northern California's energy innovation region.

Solano County is at the nexus of Northern California's electricity transmission lines and transportation arteries. As a growing generator of clean energy and central conduit of California's power system, Solano County is positioned to fill an important role in the state's energy economy and infrastructure, while growing its own energy cluster companies and jobs. Unlike other prime locations for wind turbines in the state, Solano County is located at the center of California's existing transmission network.

Solano County is also experiencing a burst of innovation as local governments, the military, and companies are making major investments in clean energy generation, use, and efficiency. Here are just a few examples:

- Rapid growth in renewable energy installations is taking place, and local businesses and government facilities (including Travis Air Force Base) are taking the initiative to install large-scale renewable energy systems as well as comprehensive energy efficiency systems.
- Local businesses are sponsoring creative efforts for repurposing waste and generating clean energy. In addition to its recent installation of solar panels, the Budweiser plant in Fairfield recently completed a system for converting wastewater into methane gas.
- To augment the generation variability of the growing renewable energy capacity in the county, plans are under way to build a new, highly flexible combined cycle natural gas electric generating station in Vacaville.
- The Potrero Hills Landfill in Suisun turns agricultural waste into energy through a combustion-based operation and is currently exploring options for replacing this system with a methane capture system which will generate more power and less pollution.
- Two Solano County hospitals have installed cogeneration systems to harness the energy in waste heat. Through this innovation, VacaValley in Vacaville and NorthBay Medical Center in Fairfield use the heat that is otherwise lost with the generation of electricity by the natural gas generators to heat water. This means they no longer pay for the natural gas for water heating. Together, the hospitals expect to save $3.8 million in over 10 years.

- Vacaville has become the first municipality in the nation to take federal air quality grant funding and not only help convert the city fleet to electric and compressed natural gas (CNG) vehicles, but to also provide a buy-down incentive for residents who adopt these vehicles. As of July 2009, 125 participants have taken advantage of this unique and innovative incentive program.

With its substantial natural assets, strategic location, positive industry trends, and innovative projects, Solano County is well-positioned to grow its energy cluster in the years ahead. With a purposeful economic development strategy focused on tapping into the region's strengths, while also supporting local company innovation, Solano County could grow its energy cluster in both size and diversity. Specific opportunities to grow the cluster include:

- **Capturing Regional Innovation:** Solano County can expand its role in bringing a wide range of Northern California energy innovations to market, creating a rapid-response energy cluster team to meet the needs of innovators as they emerge from institutions (e.g., UC-Davis, UC-Berkeley, national laboratories), as well as those companies looking to start-up or scale-up their operations, or add new functions (such as production). This also includes leveraging county strengths, such as wind and biofuels, to create more support businesses and jobs.

- **Expanding Local Markets:** Solano County can stimulate the local market for energy efficiency and transportation alternatives in ways that can also spur growth of the local energy cluster. The county's higher than average energy consumption suggests room for energy efficiency improvements that could stimulate business for local energy efficiency product and service providers, while also saving money for businesses, government, and residents. The county's large number of commuters and growing vehicle miles traveled also suggests a market opportunity for more efficient and alternative fuel vehicles.

- **Preparing Residents for Jobs and Careers in the Energy Cluster:** With an active, collaborative, and sustained effort to grow the energy cluster in Solano County, there could be much greater job growth in the future. To ensure that large numbers of local residents benefit from this success, it is imperative that the county work together now to define energy career pathways and orient education and training efforts in Solano County to prepare residents for these opportunities; integrate workforce preparation assistance and incentives into economic development efforts to attract, retain, and expand local energy cluster companies; and develop an energy career awareness and exploration strategy for the county's K-14 students.

A Solano County energy cluster team could spearhead a comprehensive strategy to capture regional innovation, build local markets, and prepare residents for growing opportunities in the energy cluster. This team would combine the efforts of the County, local cities, the Economic Development Corporation, local companies, research and educational institutions (from UC-Davis and other universities and national laboratories in the region to community colleges to K-14 education), and others. It would drive a long-term commitment to growing the energy cluster—producing economic, environmental, and social benefits for Solano County.

Energy Cluster Trends

Solano County's energy cluster is rapidly transforming, creating new opportunities for economic prosperity and job growth. The cluster is diverse, with both carbon-based energy and clean energy sectors and businesses. Together, these sectors employ over 1,500 people across more than 60 establishments. They include companies in oil and gas drilling and petroleum refining, as well as clean energy generation (e.g., solar and wind), energy conservation products and services, and clean transportation. Jobs in Solano County's energy cluster span a wide range of occupations at the high, medium, and entry levels, with many occupations important in both carbon-based and clean energy sectors.

Sectors, Jobs, Firms, Assets, and Innovations

Solano County's largest energy sector is carbon-based, employing more than 1,200 people in over 40 establishments. Solano County's carbon-based energy distribution & production cluster is comprised of Petroleum Refineries & Support Activities (52% of establishments), Oil and Gas Drilling & Support Activities (27%), and Energy Generation & Distribution (21%). Most of Solano County's carbon-based energy jobs are related to petroleum refining, and this subsector has also witnessed moderate growth in the number of businesses since 1995.

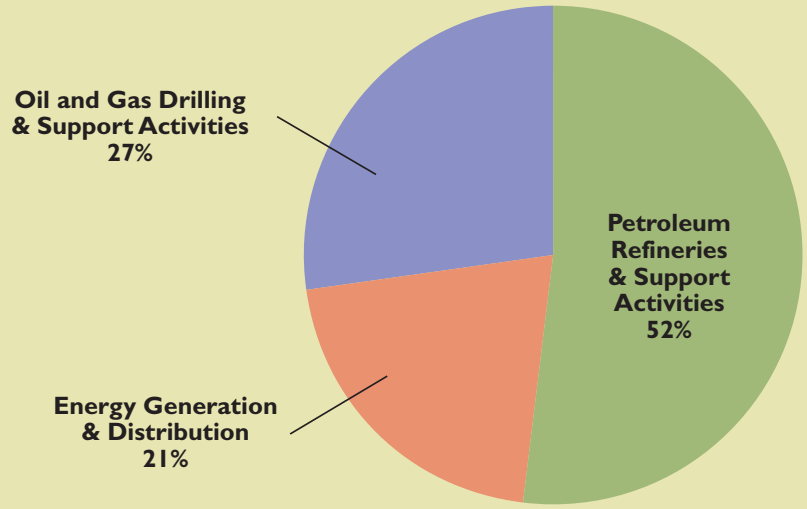
Between 1995 and 2007, the number of jobs in the overall carbon-based energy cluster fluctuated, but remained fairly stable. During this period, the sector experienced mostly years of declining employment, with the exception of a two-year growth spike in 2001-2002. Compared to the county economy overall—which grew 30 percent in employment during this time—the carbon-based energy sector expanded 4 percent.

Although decreasing over the long term, natural gas and condensate are still extracted and processed in Solano County. Gas was first extracted in 1936, and Rio Vista is currently the state's second largest operation. In 2004, natural gas production in Rio Vista accounted for 10 percent of California's total production and half of all production in Northern California. Although fairly stable since 1995, in general, the gas fields are mature, and the natural gas resource is declining.

In addition to natural gas, some of Solano's wells also produce condensate, which is a valuable natural gas liquid that contains larger amounts of heavy hydrocarbons than the gas form. According to the Division of Oil, Gas, & Geothermal Resources, condensate is produced at the following wells: Bunker, Denverton Creek, Lindsey Slough, Maine Prairie, Millar, Rio Vista, Ryer Island, and Van Sickle Island.

Carbon-Based Energy Distribution & Production Jobs

Solano County • 2007



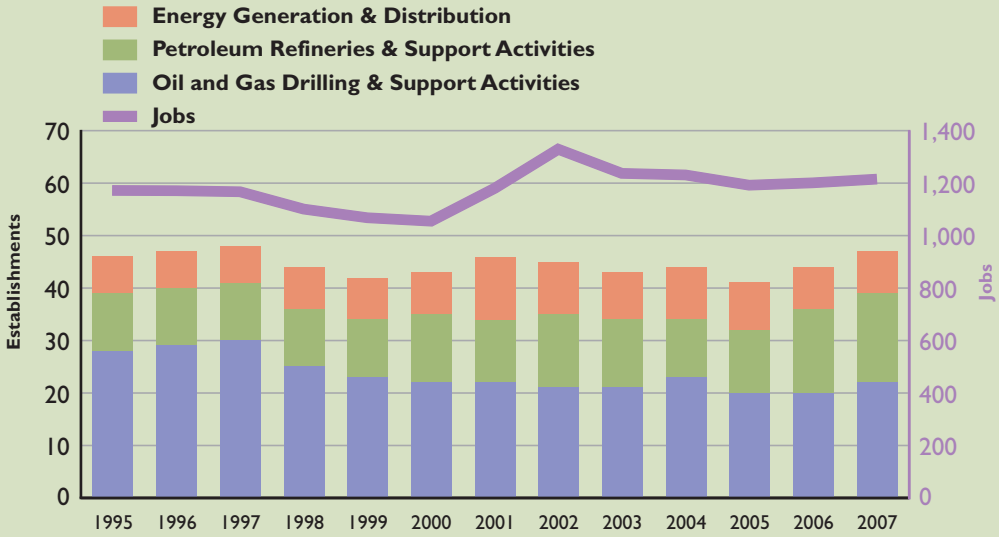
Data Source: National Establishment Time Series Database
Analysis: Collaborative Economics

Carbon jobs

Solano County has more than 40 establishments in carbon-based energy, with over half of the jobs in petroleum refining and support.

Carbon-Based Energy Distribution & Production

Business Establishments & Jobs • Solano County • 1995-2007



Data Source: National Establishment Time Series Database
Analysis: Collaborative Economics

Not growing

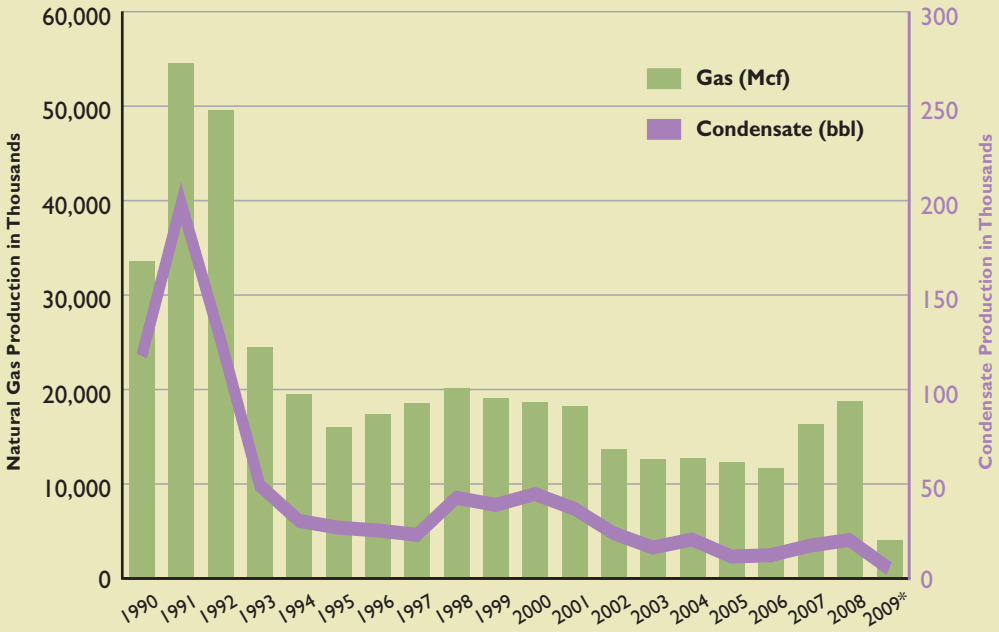
Job growth in carbon-based energy has remained relatively neutral since 1995 despite changes in technology and demand.

Production down

First extracted in 1936, natural gas and condensate production is at much lower levels than 20 years ago. Its presence, however, is expected to continue well into the future.

Natural Gas and Condensate Production

Solano County



Data Source: Online Production and Injection Query for State of California, Department of Conservation, Division of Oil, Gas, and Geothermal Resources.
Analysis: Collaborative Economics
* *Includes data through April 2009.*

Powered by Wind

Solano County benefits from some of the strongest inland winds in California. The county is also located at the center of California's existing transmission network, unlike other prime locations for wind turbines in the state. Over the years, several wind facilities have been developed in the county with more in the planning stages. In 2009, both the Montezuma Wind Project and a wind turbine project at Anheuser-Busch Fairfield Brewery received development approval. The Montezuma Wind Project is planned for 16 to 23 turbines, and the Anheuser-Busch project in Fairfield will consist of a 400-foot wind turbine that should generate 15 percent of its annual energy use. In addition, the Solano Wind Facility near Rio Vista is awaiting approval to expand operations beyond its current generation of 102 megawatts.

Although smaller in size, Solano County's clean energy sector is growing at a much faster rate than the carbon-based sector. Recent growth in the number of clean energy businesses has been strongest in Energy Efficiency. Most of these companies sell products or offer assistance to help conserve energy for residential, business, and government customers. More than half of firms in Renewable Energy are primarily in solar, providing equipment and services related to the use and installation of solar systems. In addition to the growth in energy businesses, jobs in the county's clean energy and transportation sector expanded to almost 350 jobs in 2007 from 200 jobs in 1995.

Solano County is rapidly increasing its solar energy resources. In 2008, Fairfield and Dixon led in solar capacity added through the California Solar Initiative; 1904 kilowatts (kW) and 936 kW respectively. In July 2009, the Northern California Energy Association ranked Vacaville second among medium-sized cities for the total amount of wattage generated by solar panels in town. In the same month, Suisun City has added the most solar capacity for the county with an addition of 1,000 kW over the prior year.

Local businesses are driving this growth in solar generation capacity. Solano County installed 746 kW in year 2009. In 2007, Meyer, a manufacturer of cookware and kitchen products, installed a 580 kW and Alza Corporation, a pharmaceutical and medical delivery systems firm, installed 1 megawatts (MW) of solar capacity. In 2009, Budweiser, an Anheuser-Busch brewery, installed 1.2 MW in solar capacity. Novartis, a biopharmaceutical company, announced plans in October 2009 to install a 1 MW solar array at its Vacaville facility that will provide at least 20 percent of the facility's electricity needs.

Wind energy is picking up in Solano County. Since 1982, Solano County has installed wind generation systems that produce a capacity of roughly 600 MW. The typical coal-fired power plant has a capacity of 500 MW. In addition, small hydroelectric generation produces approximately 12.5 MW of power in the county.

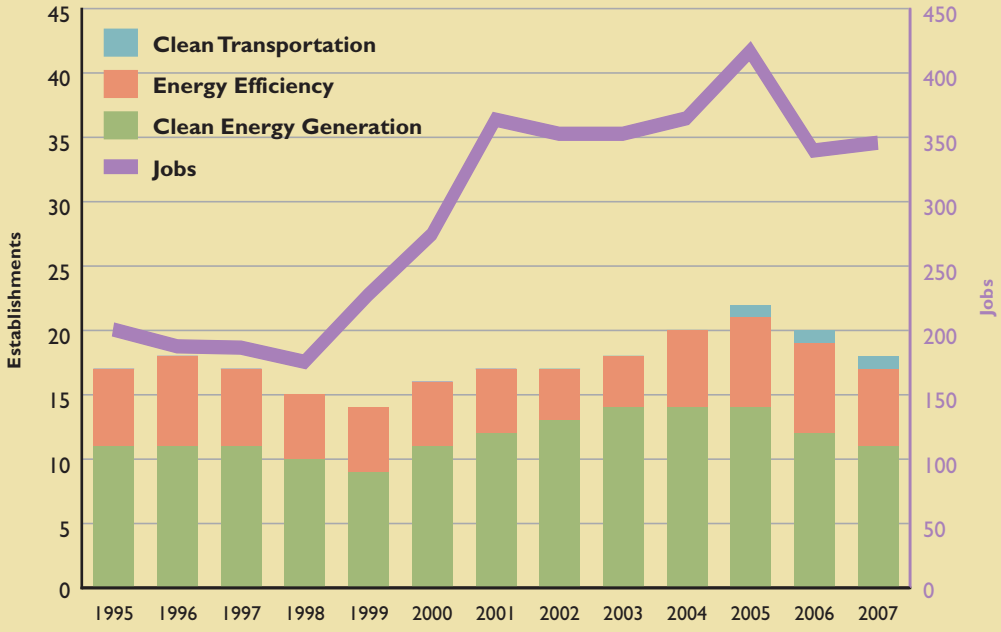
Solano County is exceptionally well situated for wind energy generation in close proximity to the state's transmission lines. Research conducted by the California Department of Energy indicates that the county has some of the most powerful wind in Northern California not along the coast.

Clean energy

In the past few years, clean energy has both grown and diversified in Solano County to include energy generation, energy efficiency, and clean transportation products and services.

Clean Energy & Transportation

Business Establishments & Jobs • 1995-2007



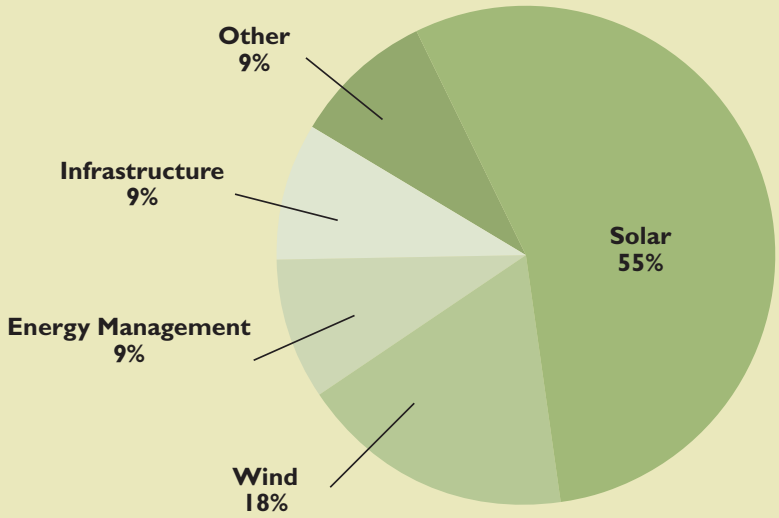
Data Source: Green Establishments Database
Analysis: Collaborative Economics

55%

Solar has emerged as Solano County's largest source of jobs and companies in clean energy generation.

Clean Energy Generation Establishments

Solano County • 2007



Data Source: Green Establishments Database
Analysis: Collaborative Economics

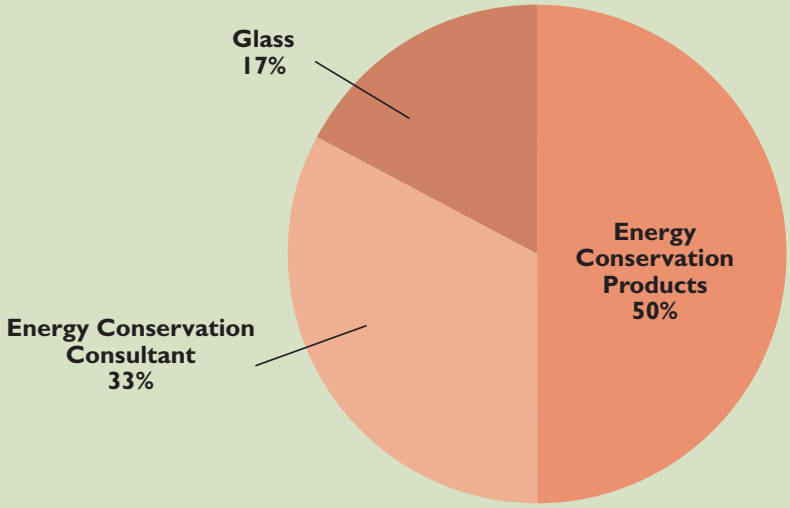
Clean Energy & Transportation

Green Segment	Description
Clean Energy Generation	• Renewable energy generation (all forms of solar, wind, geothermal, biomass, hydro, marine, tidal, hydrogen, and cogeneration) • Associated equipment, controls, and other management software and services • Renewable energy consulting services • Research and Testing in renewable energy • Energy Infrastructure consulting and management services • Cable and equipment
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 and measuring devices
Clean Transportation	• Alternative fuels (biodiesel, hydrogen, non-corn-based ethanol) • Motor vehicles and equipment (electric, hybrid, and natural gas vehicles, diesel technology)

Source: California Green Innovation Index 2009, Next 10.

Energy Efficiency Establishments

Solano County • 2007



Data Source: Green Establishments Database
Analysis: Collaborative Economics

Job growth

Both energy efficiency products and consulting services to government, corporate, and residential customers are growing sources of jobs in Solano County.

Renewables Portfolio Standard Facilities in Solano County

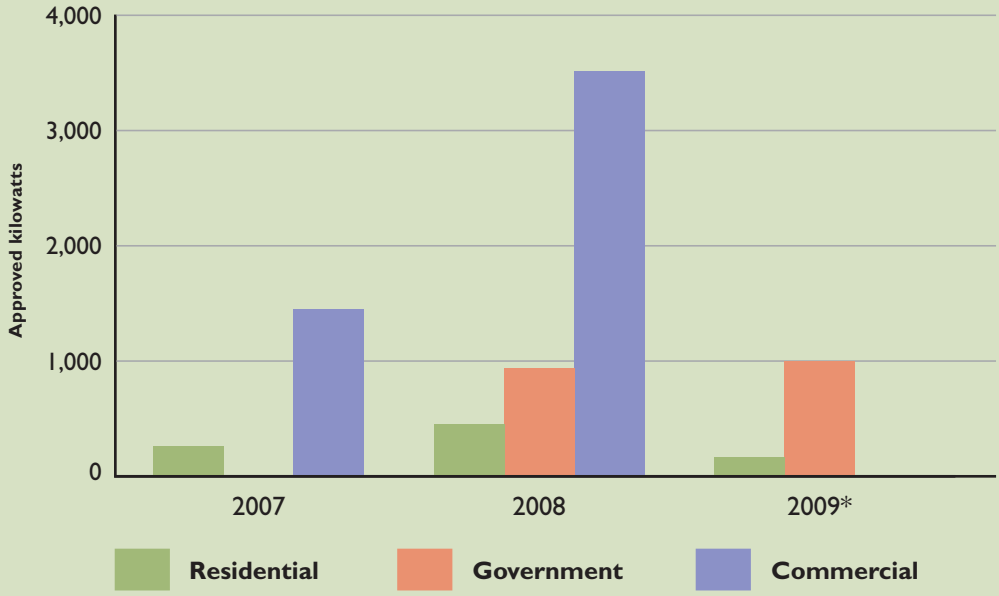
Facility Name	City	Commercial Operations Date	Capacity (MW)	Technology
Michael W. Stephens	Dixon	1982	0.01	Wind
High Winds Energy Center	Birds Landing	2003	162	Wind
Solano Wind Facility – Solano Wind Phase 1 & 2	Rio Vista	2003	102	Wind
Shiloh I Wind Project	Birds Landing	2006	150	Wind
Montezuma Wind Energy Center (FPL Energy Montezuma Wind, LLC)	Birds Landing	2007	34.5	Wind
Shiloh Wind Project 2, LLC	Rio Vista	2009	150	Wind
Solano Irrigation District (SID) – Monticello Dam	Vacaville	1983	11.9	Small Hydroelectric
City of Vallejo	Vallejo	1985	0.06	Small Hydroelectric

Data Source: California Energy Commission, California's Renewables Portfolio Standard (RPS) Eligible Facilities
Note: Other wind systems generating power exist in the county; however only the systems that are eligible for the Renewables Portfolio Standard are listed in the table.

Solar and wind energy systems do not produce power at a constant rate, because the energy from both sources shifts over the course of the day and time of the year. In order to augment the addition of the renewable energy capacity in the county, plans are under way to build a new, highly flexible combined cycle natural gas electric generating station in Vacaville. Developed by Competitive Power Ventures, the plant should become operational in 2013.

Solar Installations by Sector

Capacity (kW) added through the California Solar Initiative
Solano County



Data Source: California Public Utilities Commission, California Solar Initiative
Analysis: Collaborative Economics
** As of July 22, 2009.*

Growth in Solar Capacity

Capacity (kW) added through the California Solar Initiative

	2007-2008
Solano County	+187%
Rest of California	+38%

What Does this Mean?

Since 2007, local companies have been responsible for the largest increase in solar installations in Solano County. Programs that give companies access to inexpensive capital will increase spending on alternative energy and decrease the county's carbon footprint.

Solano County and nearby towns are attracting new research facilities in biofuels that serve to boost the county's role in the full biofuels value chain including research, production, and distribution. Some of these activities include the following:

- **The county is leveraging local assets to build a biofuels research center.** Go Green Biofuels is a 40,000-square-foot facility on 25 acres in Vallejo that will open in the future. Once fully operational, the facility will produce 30 million gallons of algae-based clean-burning fuel annually. The facility will be self-powered and generate enough extra power to feed back into the grid. The only bi-product from the production will be glycerin, a valuable product which is used in research labs as well as by the food processing, pharmaceutical, and personal care industries.
- **The Biomass Research Center in Woodland is a two-year, $3 million biofuel project conducted by researchers from around California.** The focus will be on the production of clean transportation fuels from local agricultural waste such as corn stalks, rice straw and tomato residues. West Biofuels LLC, a San Rafael-based energy technology start-up, will manage the center; and University of California researchers will operate the center.

Solano County is also increasingly converting biomass and waste to energy. Some of these activities include the following:

- **Local businesses are sponsoring creative efforts for repurposing waste and generating clean energy.** In addition to its recent installation of solar panels, the Budweiser plant in Fairfield recently completed a system for converting wastewater into methane gas. This facility will be the 11th Anheuser-Busch brewery to install such a Bio-Energy Recovery System.[1]
- **The Potrero Hills Landfill in Suisun currently operates a combustion-based transformation of agricultural waste to energy.** The facility is currently exploring options for replacing the system with a methane capture energy generation system that will generate more power and less pollution.
- **To harness the energy in waste heat, two Solano County hospitals have installed cogeneration systems.** VacaValley in Vacaville and NorthBay Medical Center in Fairfield no longer pay for natural gas for water heating. They use the heat that is otherwise lost with the generation of electricity by the natural gas generators to heat water. NorthBay Healthcare, which owns both hospitals, expects to save $3.8 million in over 10 years. The hospitals' cogeneration units were a project with Siemens Building Technologies Inc. that costs $2.6 million.[2]

[1] Budweiser plant in Fairfield: http://anheuser-busch.com/Press/2009/Apr/Solar-Panels-at-Budweiser-Brewery.html

[2] Hospital cogeneration units: http://solanocountybusinessnews.blogspot.com/2009/07/local-hospitals-going-green.html

The Clean Transformation of Travis Air Force Base

Travis Air Force Base is currently diversifying its energy sources, increasing its energy efficiency overall and cleaning up groundwater contamination on base. The base recently conducted comprehensive energy audits on more than two million square feet of covered facilities in order to target projects for gaining energy efficiencies and energy savings. Remote read electrical and gas meters have been installed in many buildings to monitor energy use and verify savings.

The base already uses biodiesel (B20) and is requiring increasing numbers of capable vehicles to use that grade of fuel only. Efforts are under way to also use E85 (a mix of ethanol and gasoline) on base.

Enlisting solar power, the base is cleaning up contaminated groundwater at two sites. One site makes use of solar powered pumps to extract the groundwater. At the second site, two extraction wells have been replaced by a solar powered bio-reactor that circulates groundwater through an iron, mulch and vegetable oil mixture to promote bacteria growth that attacks the contamination. Installed recently, a solar water heating system now heats the base pool, and solar power is also used to light the running track at night.

A growing number of Solano County residents are switching to alternative fuel vehicles. Of all newly registered (new and used) vehicles in Solano County in 2007, 1,400 were alternative fuel vehicles. This represents a significant increase from 34 alternative fuel vehicles in 2000. Adoption rates are similar to the state average. While new registrations for vehicles running on hybrid engines, fully electric power and compressed natural gas have been increasing, the number of newly registered conventional gasoline vehicles declined 7 percent over this period.

There are other signs that alternative transportation may be a growing part of Solano County's future. Efficient Drivetrains, Inc. opened a technology research and development center in Dixon in February 2009. The Palo Alto-based company provides components for plug-in electric (EV) and hybrid electric vehicles (PHEV). The technology was developed in partnership with the University of California. An example of a growing number of jurisdictions, Benicia has adopted an Air Friendly Vehicle Policy to replace existing government vehicles with cleaner alternatives. Vacaville has become one of the leading cities in the country promoting alternative vehicle adoption among its residents (see box below).

"Voltageville"

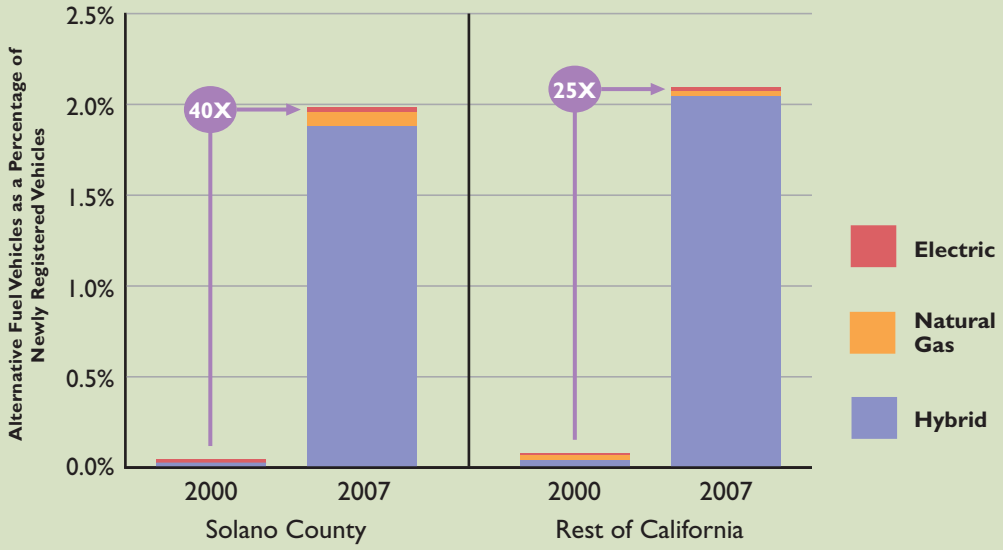
By raising public awareness and offering residents with viable incentives, the City of Vacaville has placed itself on the map as the national leader in residential alternative fuel vehicle incentive programs on a per capita basis. It is the first municipality in the nation to take federal air quality grant funding and not only help convert the city fleet to electric and compressed natural gas (CNG) vehicles, but to also provide a buy-down incentive for residents who adopt these vehicles. As of July 2009, 125 participants have taken advantage of this unique and innovative incentive program.

Vacaville has its own public refueling CNG station at the Pacific Gas & Electric service facility on Peabody Road. The station is open 24 hours a day, seven days a week, and vehicle owners need only obtain a refueling card, much like a credit card, from PG&E.

As a result of the city's efforts, EV World, has called Vacaville "America's EV Home Town" and given it the nickname "Voltageville." The city currently has plans to install more powerful electric vehicle rechargers in city park-and-ride lots that will be capable of repowering an electric vehicle within half an hour.

Alternative Fuel Vehicles as a Percentage of Newly (New & Used) Registered Vehicles by Fuel Type

Solano County and the Rest of California



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

Solano County % of California Newly Registered Alternative Fuel Vehicles (New and Used)

	2007
Hybrid	1%
Natural Gas	4%
Electric	2%

What Does this Mean?

In fact, while Solano County only represents 1 percent of the state's population, the county's residents account for 4 percent of all newly registered natural gas vehicles in the state and 2 percent of electric vehicles.

Potential exists for developing new geothermal energy in Solano County. Advances in technology are expanding opportunities for leveraging geothermal springs once considered too low in temperature for power generation. Solano County's low-temperature geothermal springs now being explored as new sources are Vallejo White Sulphur Springs, Tolenas Springs, and an unnamed spring in the eastern part of the county (see red marks on map). In addition, given Solano County's proximity to the geothermal activity in Napa and Sonoma Counties, new opportunities may emerge from an expanded geothermal region.

Low-Temperature Geothermal Sites

Source: Chena Hot Springs; Geothermal Energy Association; Geothermal Map of California, 2002, Division of Oil, Gas, and Geothermal Resources, California Department of Conservation

In sum, Solano County is building on multiple sources of renewable energy that together build and diversify the county's energy resources. In addition to solar, wind and biofuels, the county's public and private sectors, including Travis Air Force Base, are investing in innovative methods for harnessing clean energy in the county.

Compared to other regions in the state, Solano has one of the most favorable conditions of the state's Competitive Renewable Energy Zones (CREZs). These are regions found to be promising for cost-effective renewable energy development in terms of generation and transmission capacity. According to the nonprofit Center for Energy Efficiency and Renewable Technologies (CEERT): "The Solano County CREZ ranks as having the most economic renewable energy resources in the state by virtue of its abundant wind resources and access to transmission lines, and is the only region from Northern California to rank among the top ten CREZs."[3]

[3] Peter Asmus. 2009. *Harvesting California's Renewable Energy Resources: A Green Jobs Business Plan.* Center for Energy Efficiency and Renewable Technologies. 7 February 2009. Page 25.

Relative Specializations and Growth Within the Energy Cluster

Relative to California, Solano County has a high level of employment concentration in carbon-based energy production. In particular, employment in Petroleum Refineries & Support Activities is 4 times that of the state as a whole, and Oil & Gas Drilling is more than 1.5 times more concentrated. In both sectors, concentrations have increased since 1995. For example, the town of Rio Vista has a particularly high concentration of natural gas drilling and support operations.

Overall, Solano County's employment concentration in clean energy sectors is less than the California average—but this is changing. The largest clean energy sector in Solano County—Clean Energy Generation—is now 1.5 times more concentrated than the state as a whole, having almost doubled in concentration between 1995 and 2007.

More importantly, Solano County is growing jobs in Clean Energy and Transportation at a faster rate than the carbon-based energy, or even the overall economy. Overall, total jobs grew 30 percent from 1995 to 2007, while clean energy and transportation jobs grew 72 percent, to a total of almost 350 jobs. The bulk of the growth occurred in energy generation, which grew from an estimated 130 jobs to 300 jobs.

In contrast, job growth in sectors focused on the production and delivery of carbon-based fuels grew only by 4 percent.

Solano Country's Energy Workforce

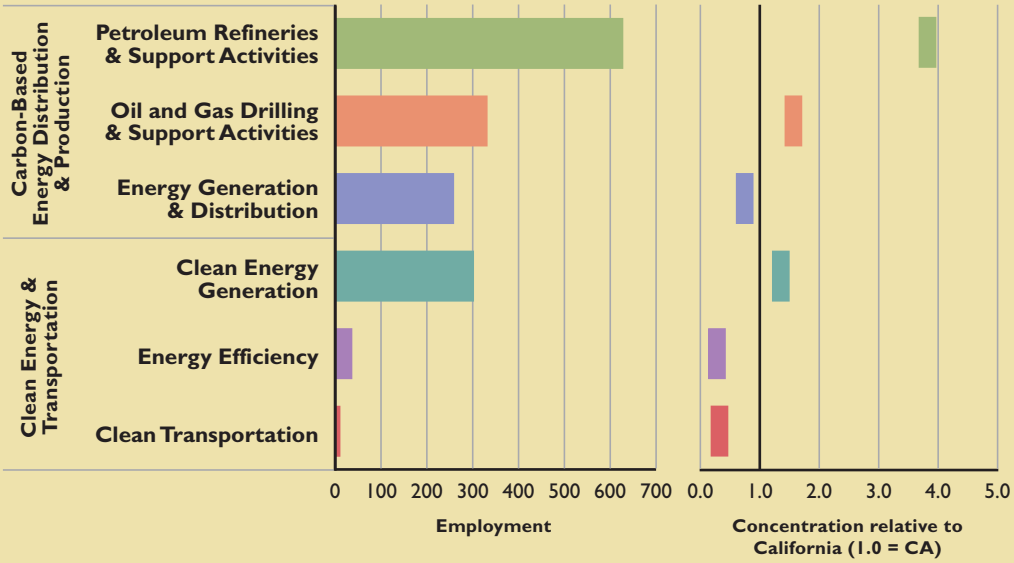
There is a wide variety of high, medium, and entry level jobs in the energy cluster, with substantial overlap in the occupations associated with carbon-based energy and clean energy sectors. These jobs represent many skilled trades, power management technicians, engineers, and general operations support. Based on industries located in Solano County, clean energy jobs include a variety of environmental science, technician and engineering occupations. Among the higher-skilled jobs, clean energy produces opportunities in materials science, biochemistry and biophysics. In terms of the differences in types of occupations between the clean and carbon-based energy sectors in Solano County, the range of earnings is similar between the two; however, while many carbon-based occupations require moderate-term on-the-job training, clean energy occupations more frequently require an associate degree.

Specializations

Solano County is typically more concentrated in carbon-based energy sectors than clean energy sectors compared to California as a whole—with one exception: clean energy generation is now 1.5 times more concentrated than California, more than doubling between 1995 and 2007.

Solano County's Energy Cluster

Employment and Concentration • 2007



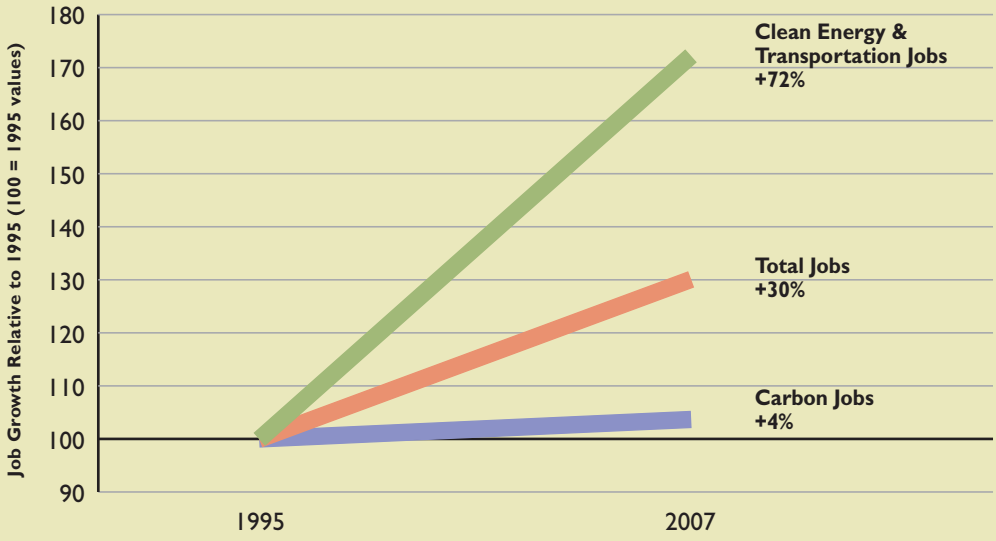
Data Source: Green Establishments Database; National Establishment Time Series Database
Analysis: Collaborative Economics

New opportunities

Clean Energy and Transportation jobs have grown more than twice as fast as the Solano County economy as a whole since 1995.

Clean Energy & Transportation Growth Relative to 1995

Solano County



Data Source: Green Establishments Database; National Establishment Time Series Database
Analysis: Collaborative Economics

Example Occupations in Solano County's Energy Sector

Clean Energy & Transportation Occupations		
Helpers – Electricians	$34,082*	Short-Term On-the-Job Training
Semiconductor Processors	$35,438*	Associate Degree
Environmental Engineering Technicians	$48,573	Associate Degree
Environmental Science & Protection Technicians, Including Health	$54,103*	Associate Degree
Mechanical Engineering Technicians	$55,159*	Associate Degree
Electrical & Electronics Repairers, Commercial & Industrial Equipment	$69,441	Post-Secondary Vocational Education
Industrial Engineers	$81,015	Bachelor's Degree
Environmental Scientists & Specialists, Including Health	$88,393	Bachelor's Degree
Materials Engineers	$94,625*	Bachelor's Degree
Biochemists & Biophysicists	$95,366*	Doctoral Degree
Carbon-Based Energy Distribution & Production Occupations		
Helpers – Extraction Workers	$37,788*	Long-Term On-the-Job Training
Roustabouts, Oil & Gas	$40,831*	Moderate-Term On-the-Job Training
Derrick Operators, Oil & Gas	$43,644*	Moderate-Term On-the-Job Training
Service Unit Operators, Oil, Gas, & Mining	$48,117*	Moderate-Term On-the-Job Training
Wellhead Pumpers	$50,099*	Moderate-Term On-the-Job Training
Rotary Drill Operators, Oil & Gas	$53,948	Moderate-Term On-the-Job Training
Control & Value Installers & Repairers, Except Mechanical Door	$62,982	Moderate-Term On-the-Job Training
Petroleum Pump System Operators, Refinery Operators, & Gaugers	$67,894*	Long-Term On-the-Job Training
Petroleum Engineers	$126,528*	Bachelor's Degree
Occupations in Clean & Carbon-Based Energy		
Receptionists and Information Clerks	$27,266	Short-Term On-the-Job Training
Helpers – Installation, Maintenance, & Repair Workers	$31,719	Short-Term On-the-Job Training
Outdoor Power Equipment & Other Small Engine Mechanics	$34,123	Moderate-Term On-the-Job Training
Construction Laborers	$38,466	Moderate-Term On-the-Job Training
Bill & Account Collectors	$39,937	Short-Term On-the-Job Training
Welders, Cutters, Solderers, & Brazers	$40,493	Post-Secondary Vocational Education
Maintenance & Repair Workers, General	$45,088	Long-Term On-the-Job Training
Pump Operators, Except Wellhead Pumpers	$45,229*	Moderate-Term On-the-Job Training
Chemical Equipment Operators & Tenders	$47,984*	Moderate-Term On-the-Job Training
Excavating & Loading Machine & Dragline Operators	$52,009	Moderate-Term On-the-Job Training
Meter Readers, Utilities	$54,262	Short-Term On-the-Job Training
Operating Engineers & Other Construction Equipment Operators	$62,934	Moderate-Term On-the-Job Training
Electrical & Electronic Engineering Technicians	$71,695	Associate Degree
Chemists	$72,106	Bachelor's Degree
Electrical & Electronic Repairers, Powerhouse, Substation, & Relay	$72,560*	Post-Secondary Vocational Education
Power Distributors & Dispatchers	$79,276*	Long-Term On-the-Job Training
Electrical Engineers	$79,628	Bachelor's Degree
Environmental Engineers	$88,733	Bachelor's Degree
Engineering Managers	$133,270	Work Experience, Plus a Bachelor's or Higher
Chief Executives	$210,674	Work Experience, Plus a Bachelor's or Higher

* *Statewide estimate for annual earnings.*
Data Source: California Employment Development Department, Labor Market Information Division, Occupational Employment Statistics (OES) 1st Quarter 2009
Analysis: Collaborative Economics

Opportunities to Grow Solano County's Energy Cluster

Solano County is building on multiple sources of renewable energy. Some of these current public and private efforts include commercial and research projects in biofuels, biomass, and low-temperature geothermal. Together, these projects build and diversify the county's energy resources. In addition, the county is increasing its economic and environmental resilience by improving energy efficiencies, diversifying its economic base, and positioning itself as a prime location for early adoption of clean technology.

Further, the county's strong position as an early adopter of new clean energy technology combined with it central location at the intersection of California's transportation and electricity transmission lines, makes Solano County a natural location for manufacturing and distribution of clean technology products designed in Silicon Valley and the Greater Bay Area. In many ways, Solano County has a significant role to play in California's evolving energy infrastructure.

Given the current composition of Solano County's energy cluster and its connections with its regional partners to the east and to the west, what opportunities exist to support growth of the energy cluster in Solano County? The following sections describe key opportunities to:

- **Capture Regional Innovation:** Expand Solano County's Role in the Northern California Energy Economy
- **Expand Local Markets:** Stimulate Demand for Energy Efficiency and Transportation Alternatives in Solano County
- **Prepare County Residents:** Prepare Residents for Growing Jobs and Careers in Solano County's Energy Cluster

Capture Regional Innovation: Expand Solano County's Role in the Northern California Energy Economy

Innovation drives economic success. More than just in technology products, innovation includes advances in business processes and business models. The ability to generate new ideas, products, and processes is an important source of regional competitive advantage. Examining venture capital (VC) investment and patent registrations provide some indication for the level of innovation taking place in a region.

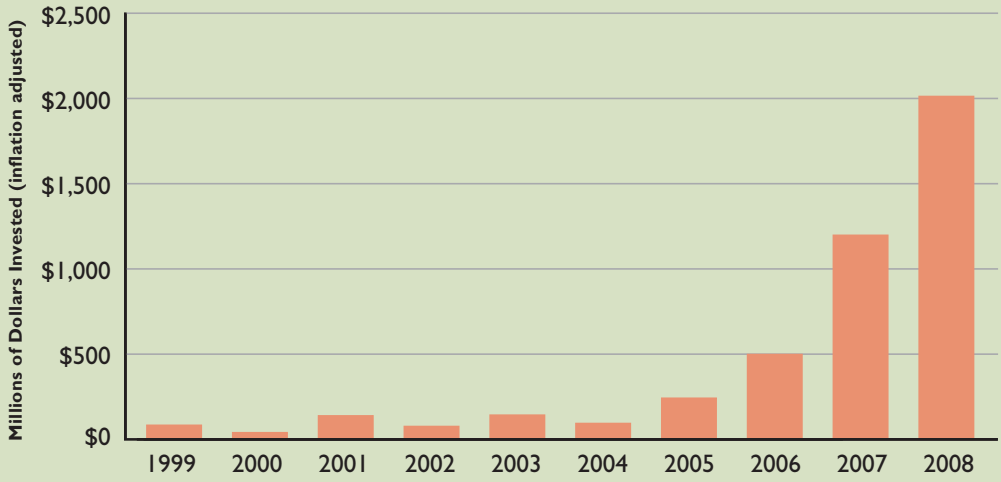
Solano County is in the middle of the Northern California's energy innovation hub. For example, venture capital investment in clean technology in the Bay Area increased 20 times between 2004 and 2008—valuing more than $2.0 billion in 2008.

In addition to being part of the Bay Area, Solano County has close ties with Yolo County and Sacramento. Combined, this area attracted nearly $30 million in cleantech venture capital funding in 2008.

Over this period, Solano County attracted one VC deal in 2007. Goldman Sachs invested $13 million in Optimal Technologies International, a provider of smart grid technology located in Benicia.

Venture Capital Investment in Clean Technology

Bay Area



Data Source: Cleantech Group™, LLC (www.cleantech.com)
Analysis: Collaborative Economics
Note: Bay Area includes Alameda, Contra Costa, Napa, Marin, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.

Bay Area hot spot

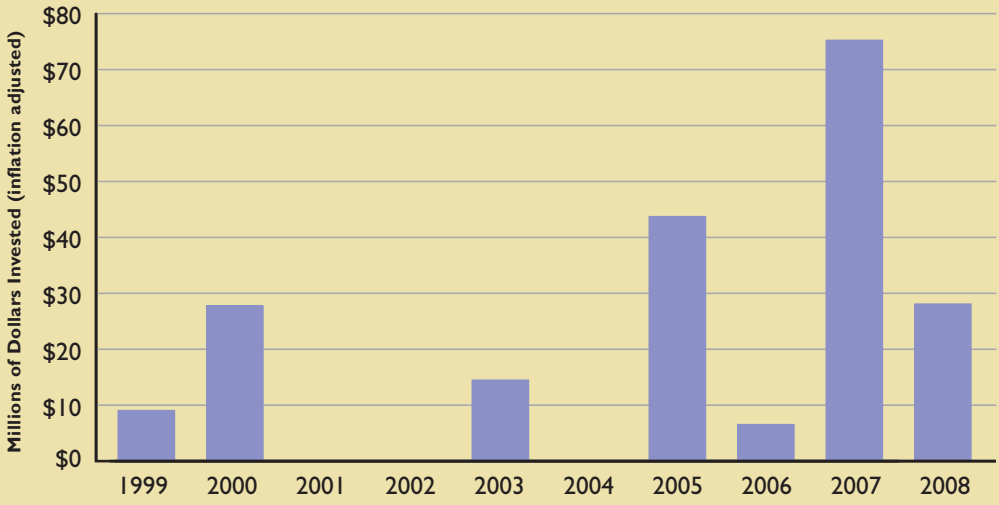
Venture capital investment in Bay Area clean technology companies topped $2 billion in 2008.

Growing clean

Since 2005, more than $150 million of venture capital has been invested in Sacramento and Yolo Counties' clean technology companies.

Venture Capital Investment in Clean Technology

Sacramento & Yolo Counties



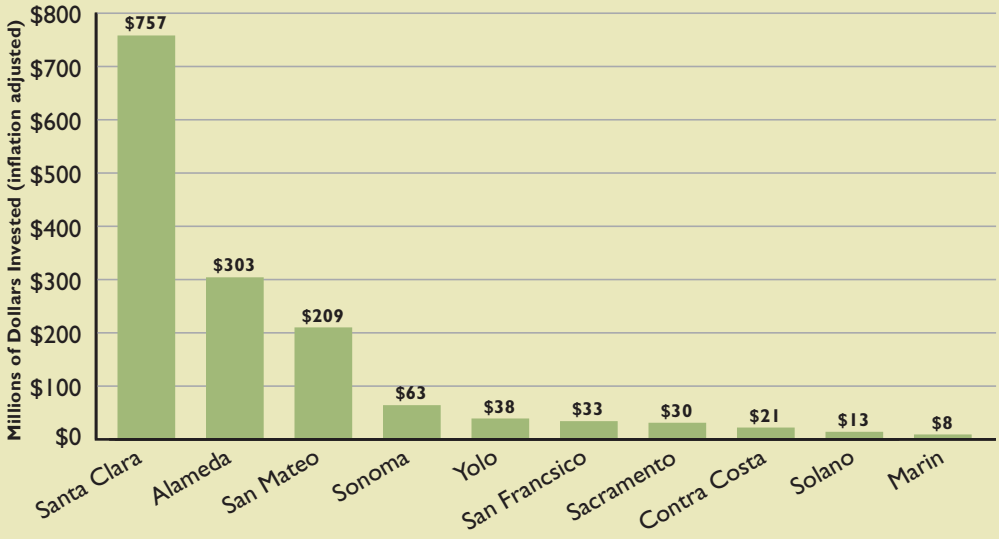
Data Source: Cleantech Group™, LLC (www.cleantech.com)
Analysis: Collaborative Economics

Proximity matters

While Solano County has yet to receive substantial venture capital funding in clean technology, it is within 100 miles of billions of dollars of investment in energy innovation.

Venture Capital Investment in Clean Technology

2007



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

In addition to venture capital funding, Northern California is a center for Green Research & Development (R&D). The Bay Area accounted for 48 percent of the green technology patent registrations in California in 2008. In Solano County, patent registrations in green technology have primarily been in battery technology. Looking eastward, patent registrations in green energy technology have been on the rise in Solano's neighbors in Yolo and Sacramento Counties since 1990. These patents have primarily been in technologies related to batteries, fuel cells and solar energy.

Green Technology Patents

Registered by Inventors based in Solano County

Patent Filed	Year	City of Primary Inventor
Hydro Power	1983	Vallejo
Wind Energy	1983	Vallejo
Batteries	1986	Benicia
Batteries	1987	Benicia
Hydro Power	1988	Vallejo
Batteries	1995	Suisun City
Batteries	1996	Vallejo
Batteries	1997	Fairfield
Batteries	2002	Fairfield

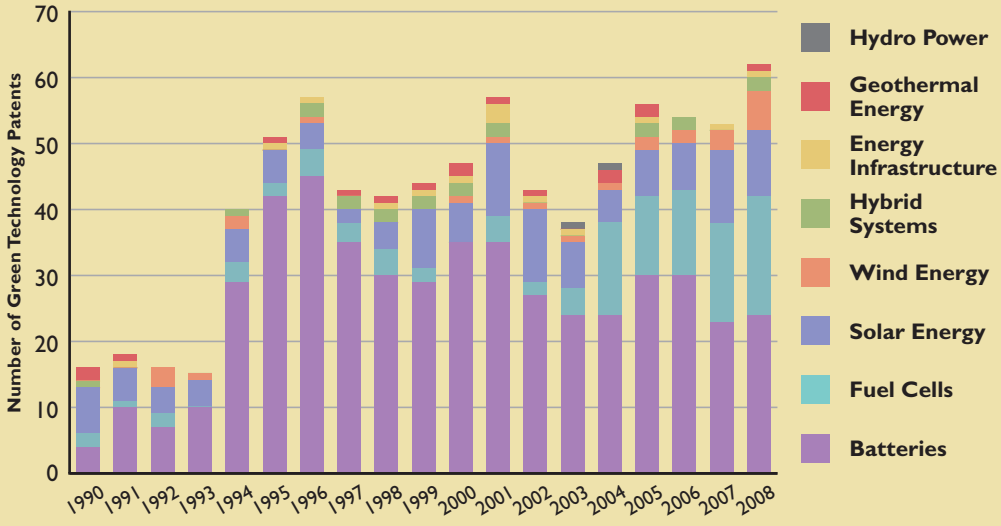
Data Source: 1790 Analysis, Patents by Green Technology; USPTO Patent File
Analysis: Collaborative Economics

48%

Nearly half of all California's green technology patents were registered in the San Francisco Bay Area in 2008. More than 300 patents have been registered in the region in the past five years—a diverse mix of innovations across eight major technology categories from batteries and fuel cells to solar and wind energy.

Green Technology Patents by Technology

Bay Area



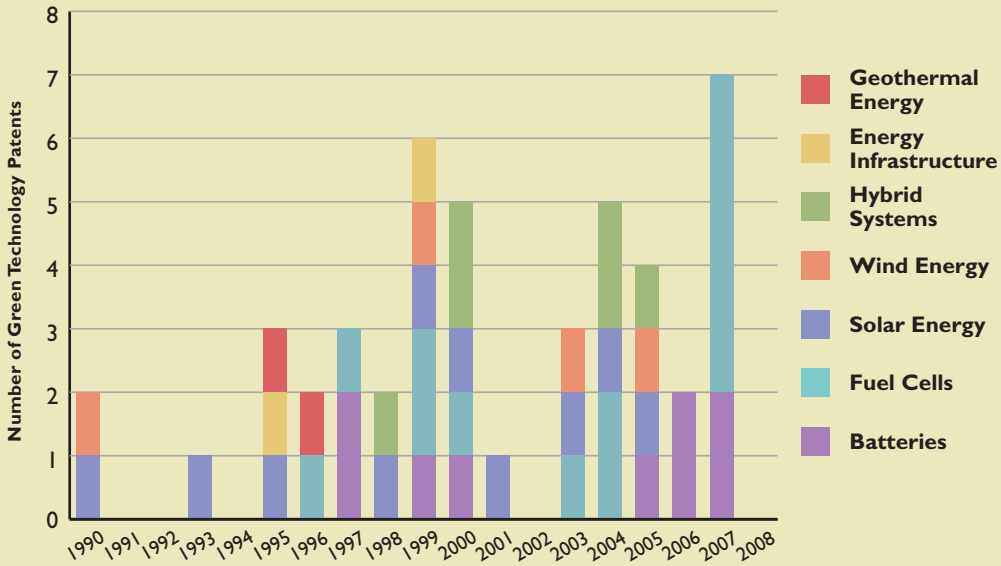
Data Source: 1790 Analysis, Patents by Green Technology; USPTO Patent File
Analysis: Collaborative Economics
Note: Bay Area includes Alameda, Contra Costa, Napa, Marin, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.

Green innovation

More than 20 patents for green technology have been registered in the Sacramento and Yolo Counties in the past five years, spanning four major technology categories.

Green Technology Patents by Technology

Sacramento & Yolo Counties



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

The bottom line? Solano County is less than 100 miles from billions of dollars of investment in energy innovation—and has only begun to benefit from that proximity. With a purposeful economic development strategy focused on tapping into the region's strengths, while also supporting local company innovation, Solano County could grow its energy cluster in both size and diversity. Specific opportunities include:

- **Expand Solano County's role in bringing a wide range of Northern California energy innovations to market.** Solano County can create a rapid-response energy cluster team to meet the needs of innovators as they emerge from institutions (e.g., UC-Davis, UC-Berkeley, national laboratories), as well as those of companies looking to start-up or scale-up their operations, or add new functions (such as production). Solano County can become a preferred location for growing, innovative energy companies—allowing them to remain within the Northern California hub, while finding affordable, flexible facilities and customized support (e.g., permitting, workforce, testing facilities).

- **Build out Solano County's biofuels value chain—from research to production and distribution.** Biofuels is a natural fit for Solano County, particularly with its well-developed agricultural economy. Not surprisingly, there is growing activity in biofuels in and around the county. Research in biofuels within the county (e.g., Go Green Biofuels in Vallejo), as well as nearby (e.g., Biomass Research Center in Woodland), combined with existing efforts to convert biomass into energy (e.g., Potrero Hills Landfill's transformation of agricultural waste to energy, Anheuser-Busch bio-energy recovery system) and other opportunities (e.g., growing use of biofuels at Travis Air Force Base, waste conversion potential of dairies, other agricultural uses, and municipal waste plants) provide a foundation on which to build.

- **Translate Solano County's unique energy resources into new sources of economic growth.** Solano County's strong wind resources are well documented. Several wind facilities have been developed. But, converting wind into energy (and storing and transmitting it) requires equipment composed of thousands of parts, and a variety of technical support activities—which can be supplied from within or outside Solano County. The county has just begun to tap the long-term potential for a more diverse wind energy industry: only 18 percent of the county's clean energy generation companies are currently wind-related. In addition, technological advances have made the county's low-temperature geothermal springs potentially a new source of energy—and contributor to Solano County's energy economy.

Specific actions that the energy cluster team could take include: developing a public-private sector marketing strategy, designating specific commercial/industrial land and facilities for clustering energy companies. Other actions that could be taken include creating demonstration space for new energy innovations, educating elected officials, regulators, and others about the benefits of innovation across both carbon-based and clean energy sectors.

Expand Local Markets: Stimulate Demand for Energy Efficiency and Transportation Alternatives in Solano County

Solano County can stimulate the local market for energy efficiency and transportation alternatives in ways that can also spur growth of the local energy cluster. The county's higher than average energy consumption suggests room for energy efficiency improvements that could stimulate business for local energy efficiency product and service providers, while also saving money for businesses, government, and residents. The county's large number of commuters and growing vehicle miles traveled also suggests a market opportunity for more efficient and alternative fuel vehicles.

Solano County has a growing market for energy efficiency as indicated by a higher than average consumption of electricity and natural gas. Compared to 1990 levels, total electricity consumption is 24 percent higher, roughly on par with the rest of California. While Solano's per capita consumption remains just below 1990 levels, since 2001, per capita consumption has increased by 17 percent—a far faster rate than the 5 percent increase for the rest of the state.

The county's non-residential sector accounts for 69 percent of total electricity consumption. Similarly, in the rest of the state, non-residential accounts for 68 percent of consumption.

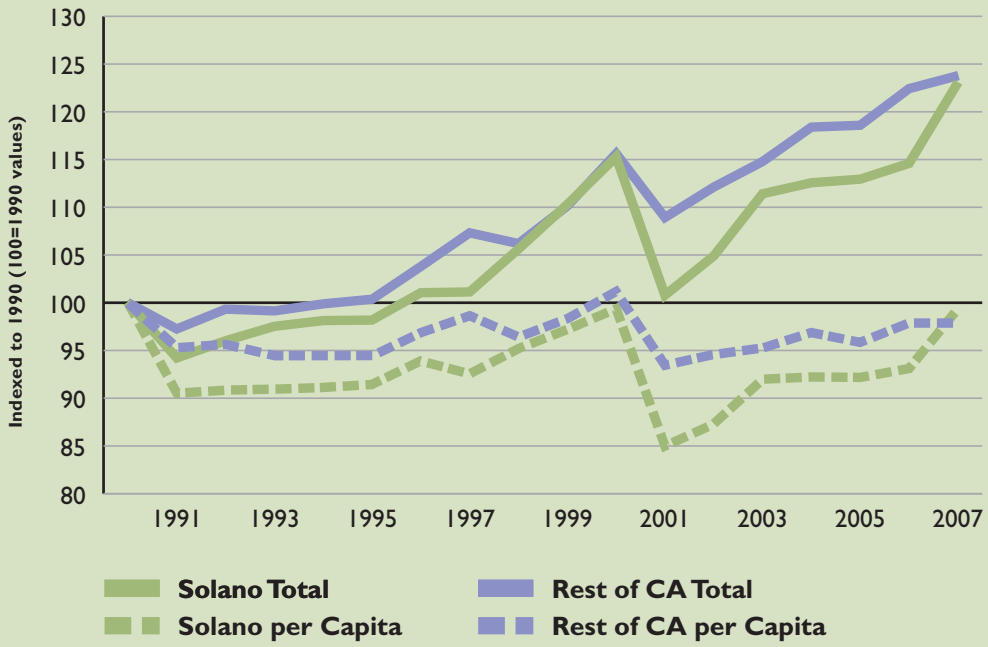
In terms of natural gas usage, Solano County ranks fourth in per capita consumption. The county follows Kern, Colusa and Contra Costa Counties with the highest consumption rates.

Over the 1990s, Solano's natural gas consumption rates were typically twice the rate for the rest of the state. In 2001, Solano County's per capita consumption nearly quadrupled while the rest of the state remained steady.

As of 2007, Solano County had reduced per capita consumption by 36 percent but remained 60 percent higher than the rest of the state. Compared to the prior year, residential consumption expanded as a share of total natural gas consumption in 2007.

Electricity Consumption Relative to 1990

Total and per Capita • Solano County



Data Source: California Energy Commission, QFER
Analysis: Collaborative Economics

What Does this Mean?

Solano County's growing electricity consumption is both a challenge and an opportunity. The county could lower its consumption through energy efficiency measures, generate financial savings for companies and residents, and stimulate growth of energy efficiency firms and jobs.

Electricity Consumption (kWh) per Capita

	2001	2007	% change
Solano County	6,690	7,824	+17%
Rest of California	7,202	7,541	+5%

Electricity Consumption by Sector

Solano County

Sector	2006	2007
Non-Residential	66%	69%
Residential	34%	31%

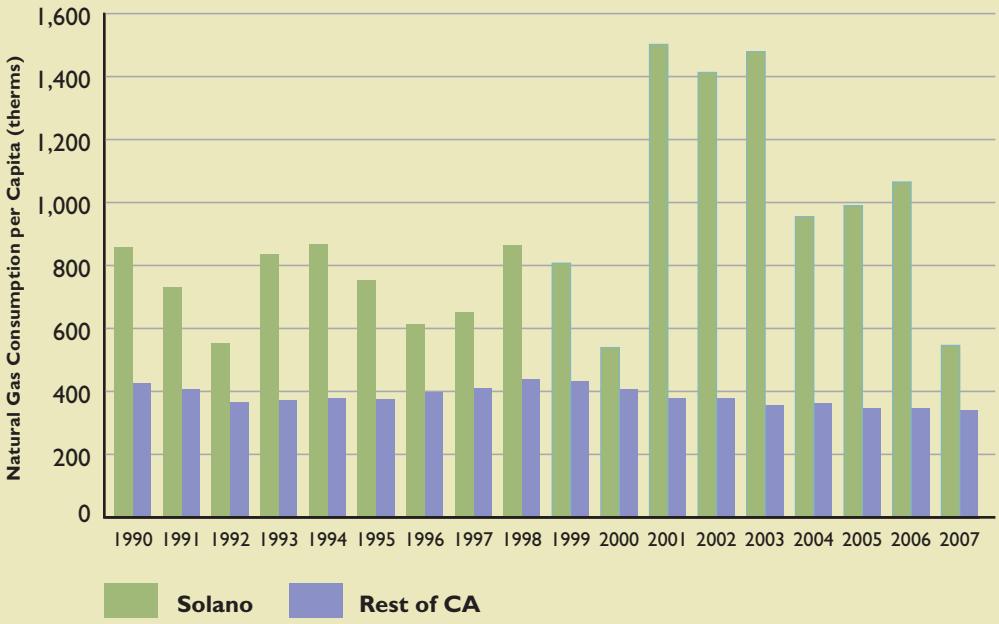
Data Source: California Energy Commission, QFER
Analysis: Collaborative Economics

High consumption

Solano County's above average natural gas consumption rate, like that for electricity, offers an opportunity for energy efficiency measures—and potential benefits such as financial savings and jobs.

Natural Gas Consumption per Capita

Solano County and Rest of California • 1990 - 2007



Data Source: California Energy Commission, QFER
Analysis: Collaborative Economics

Total Natural Gas Consumption by Sector

Solano County

Sector	2006-2007 % change
Non-Residential	-56%
Residential	-2%

Data Source: California Energy Commission, QFER
Analysis: Collaborative Economics

At the same time, Solano County has an emerging energy efficiency and conservation sector that could serve a growing local market. Already, the sector is the county's second largest clean energy sector after energy generation. The largest number of companies are providing energy conservation products (50%), followed by energy conservation consultants (33%) and glass providers (17%). The sector includes companies involved in building efficiency products and services, alternative energy appliances (e.g., solar heating and lighting), and energy efficiency meters and measuring devices. This sector could benefit from steps to encourage greater energy efficiency in government, business, and homes. In many cases Solano County is already supporting important efforts, and some cities have launched their own initiatives. For example:

- Expand energy efficiency retrofits of public buildings, including local and county governments, schools and colleges, and other agencies
- Improve access to centralized information or "one-stop" clearinghouse of local energy efficiency companies serving commercial, residential, and government markets, including energy audits, products, and services.
- Develop energy efficiency initiatives or campaigns focused on key industries—such as logistics, agriculture, food processing, retail, and others—that deliver energy savings and strong return-on-investment for building and other improvements.
- Continue to promote government policies that encourage greater energy efficiency in building construction and improvements (e.g., building codes, fast track permitting for more energy efficient projects, including solar installations).

Solano County also has a growing market for transportation alternatives with its large commuter population and increasing miles of travel. Since the beginning of the decade, Solano County residents have increased their vehicle miles traveled by 3 percent, while California residents as a whole have reduced their mileage by 3 percent. Even as gas prices rose 47 percent between 2000-2007, Solano residents did not cut their mileage substantially. The reasons are multiple and complex, but many residents must commute to jobs outside the county and have had few realistic alternatives to commuting by automobile. This dilemma means that Solano residents have had to absorb higher transportation costs.

Public transit is a viable alternative for some residents, but overall ridership has been declining even as transit miles have increased in recent years. Between 2002 and 2006 total annual transit vehicle miles increased by 21 percent; however, the total number of annual public transit passengers decreased by 17 percent. Clearly, other alternatives will also be important if Solano residents are to reduce their transportation costs and improve their productivity.

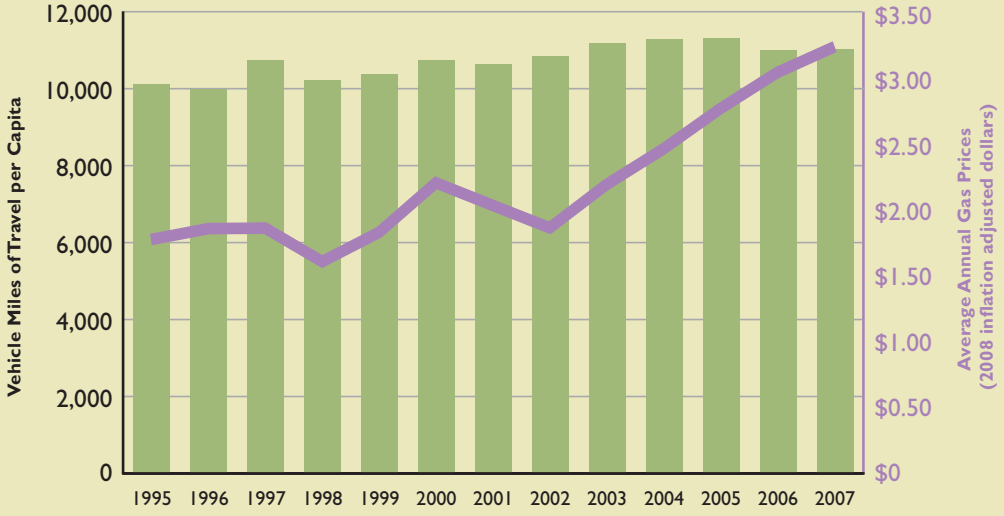
As stated earlier, Solano County residents are increasing their use of alternative fuel vehicles. Although still small in number, alternative fuel vehicle registrations in the county are growing at a much faster rate than California as a whole, an indication of the growing interest and receptivity of residents to transportation alternatives. At about 2 percent of new registrations, however, there is plenty of room for growth. On the other hand, as illustrated on page 17, county residents are demonstrating a willingness to use alternative fuel vehicles.

Transportation

The combination of a large commuter population that has continued to drive long distances even in the face of rapidly rising fuel costs suggests a potential market for alternative transportation—including not only public transit, but alternative fuel vehicles—which could generate both savings and jobs.

Vehicle Miles of Travel per Capita & Gas Prices

Solano County



Data Source: California Department of Transportation; Energy Information Administration, U.S. Department of Energy; California Department of Finance
Analysis: Collaborative Economics
Note: Gas prices are average annual retail gas prices for California

VMT per Capita Percent Change

2000 - 2007

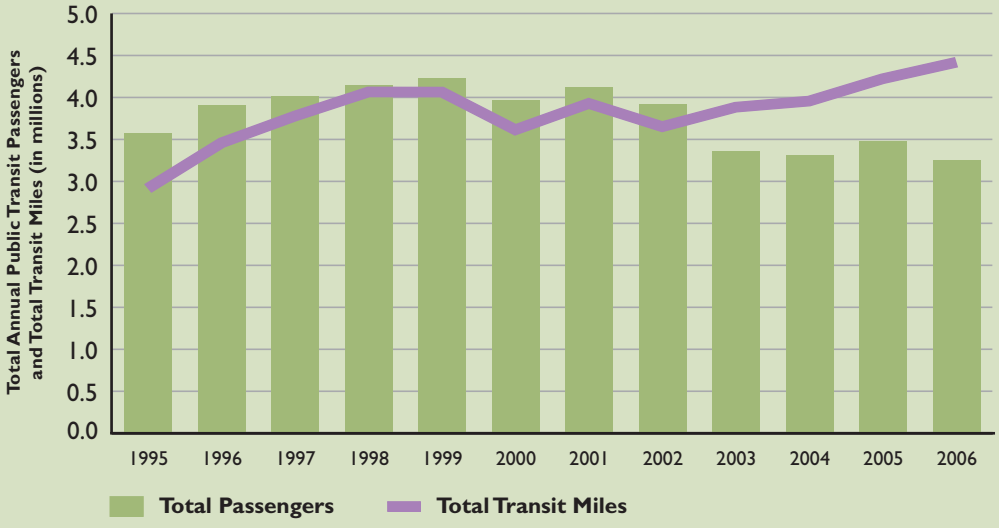
	% Change
Solano County	+3%
Rest of CA	-3%
CA Gas Prices	+47%

Solano County can stimulate the local market for transportation alternatives for residents, business, and government in several ways. For example:

- Use public procurement to substantially increase government fleets of alternative fuel vehicles, including joint purchasing across multiple jurisdictions and agencies. Expand innovative models such as Vacaville's resident buy-down incentive for purchasing alternative fuel vehicles.
- Expand the capacity and access to alternative fuel infrastructure (i.e., filling and charging stations) not only for public fleets, but also privately-owned vehicles, encouraging residents and businesses to move more quickly to transportation alternatives.
- Encourage alternative transportation and fuel providers to expand their efforts in Solano County, and promote the shift to new vehicles and fuels among businesses and residents.
- Continue to improve land use and transportation policies to expand transportation choices for residents and businesses, including reducing vehicle miles traveled by bringing jobs and housing closer together, orienting public transit routes and schedules to maximize ridership, and ensuring new development promotes greater transportation options (e.g., close proximity to public transit, alternative fueling stations).

Public Transit Use and Availability in Solano County

Total Annual Passengers and Transit Vehicle Miles



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

Transit options

Public transit provides one alternative to driving alone, but not for everyone. In fact, while total transit miles have steadily increased in Solano County since 2002—suggesting greater access for residents—total passenger numbers have actually dropped.

Land-Use Policy and Transportation

In addition to vehicle efficiency and clean-burning fuels, land-use planning plays a significant role in reducing overall miles of travel, fuel consumption and greenhouse gas emissions (GHG). For example, building more units per square acre and combining residential and commercial units reduces the length of travel. Concentrating commercial and residential development at nodes of public transit significantly cuts down on vehicles on the roads.

In September 2008, the State of California passed into law the most sweeping revisions to land-use policy since the California Environmental Quality Act. The legislation, SB375, authorizes the Air Resources Board (ARB) to set regional GHG reduction targets. As part of their Regional Transportation Plan process, regional planning agencies are required to develop Sustainable Communities Strategies for meeting the targets laid out by ARB.

For the first time, regional transportation planning will be linked with regional housing efforts. While the new Sustainable Communities Strategies do not trump local land-use authority, projects that conform with the Strategy but conflict with local plans will qualify for exemptions relating to requirements of California's Environmental Quality Act.

The Solano County energy cluster team can convene multiple jurisdictions to encourage a coordinated approach to setting standards, developing incentives, streamlining permitting processes, and investing energy efficiency and related funding—together growing the local market for energy innovation and leveraging additional private sector investment.

Prepare County Residents for Growing Jobs and Careers

Occupational projections for industries associated with Solano County's Energy Cluster suggest that there will be growing demand for a wide range of jobs in the years ahead. This demand will be in new jobs as well as net replacement jobs, that open as a result of normal patterns of job changes and retirements. With the growing number of baby boomer retirements, replacement jobs could be a major source of economic opportunity for Solano residents.

The bulk of job openings will be in occupations that exist in both carbon-based and clean energy. The findings illustrated in the chart on the next page display the number of annual job openings estimated until 2016. In particular, new job growth will be the strongest in Operating Engineers with typical annual earnings of $60,000. Meanwhile, the demand for replacement jobs will be the highest for Construction Laborers ($32,000) and Receptionists ($24,000).

Some differences exist between the carbon-based and clean energy sectors in terms of projected occupational growth and earnings. For occupations exclusively in carbon-based energy, annual growth will be primarily in replacement jobs for Petroleum Pump Operators (earnings are unavailable) and Control & Valve Installers with annual earnings of $55,000. In clean energy, new as well as replacement job growth is expected in four occupations with strong earnings potential. These growing occupations include Electrical & Electronic Repairers with annual earnings of $69,000, Environmental Scientists ($66,000), and Industrial Engineers ($78,000).

These projections are likely conservative, mostly an extension of current trends. They do not account for strategies that Solano County might successfully employ to capture regional innovation or expand local markets for energy cluster products and services. With an active, collaborative, and sustained effort to grow the energy cluster, there could be much greater job growth. The creation of a Solano Energy Cluster Team could act as the focal point for collaborative actions, such as:

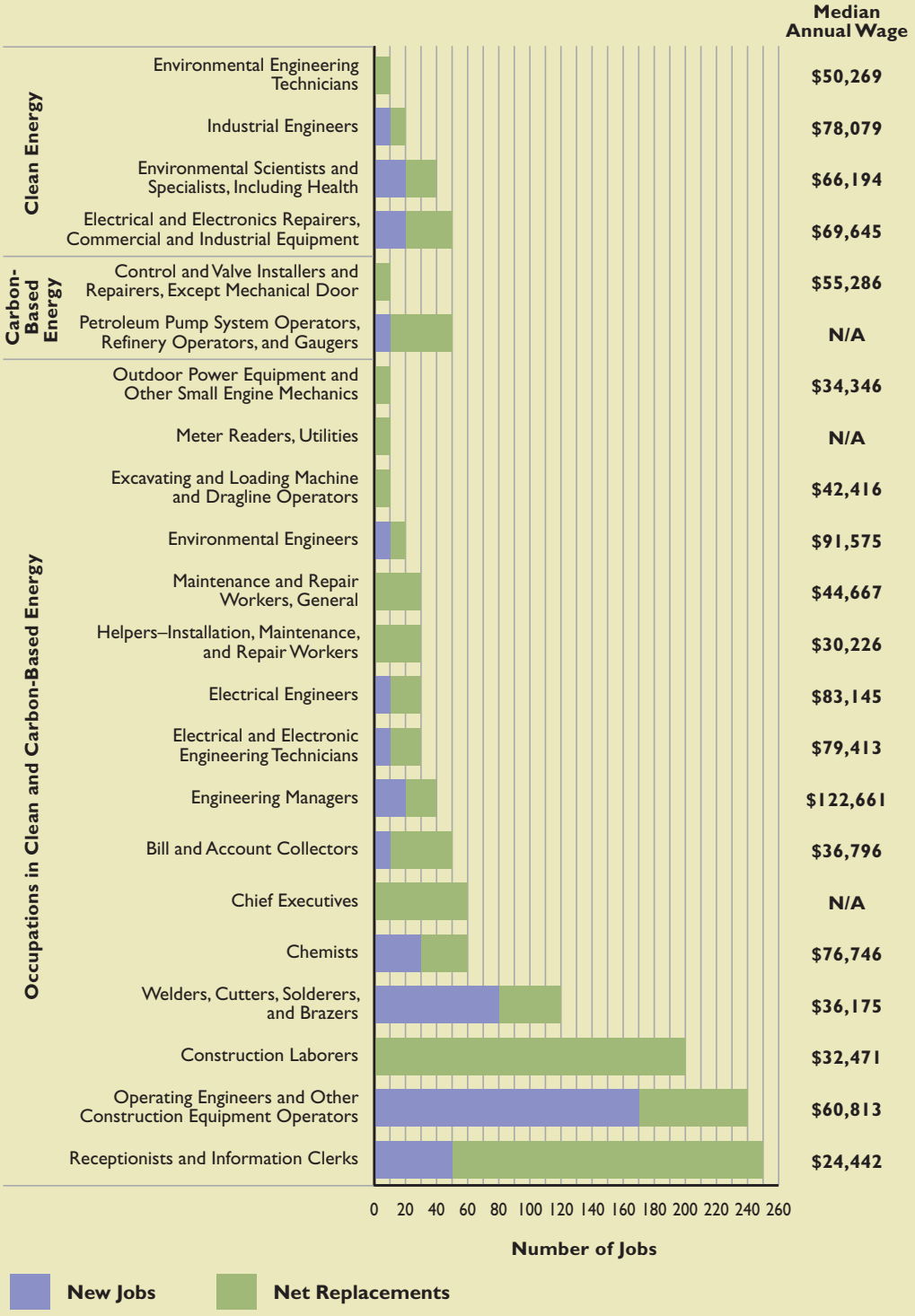
- Education and training institutions, the Workforce Investment Board, the Solano EDC, in collaboration with the energy cluster team, should continue working to further develop energy career pathways and orient education and training efforts in Solano County to prepare residents for these opportunities.
- Maintain close and ongoing relationships with both carbon and clean energy companies to ensure educational programs are adaptable and up-to-date as markets and products rapidly evolve.
- Integrate workforce preparation assistance and incentives into economic development efforts to attract, retain, and expand local energy cluster companies (including tapping into state and federal funding for training in energy-related fields). For example, in October 2009, Solano College received a state grant of $418,751 to develop a curriculum for clean energy and energy efficiency technicians.
- Develop an energy career awareness and exploration strategy for the County's K-14 students, working with cluster employers to provide a continuum of opportunities including industry speakers, company tours, internships, and the like.

What Does this Mean?

Most projected job openings will actually be in occupations that exist in both the carbon-based and clean energy sectors. The majority of openings will be net replacements—that is, mostly openings created from retiring baby boomers over the next decade. These new openings will include positions at all levels.

Projected 10-year Job Growth

2006-2016



Data Source: California Employment Development Department, Labor Market Information Division, Occupation Employment Statistics
Analysis: Collaborative Economics

What's Next?

The immediate opportunity is to create a Solano Energy Cluster Team that can develop implementation plans for each of the three major strategic areas: capturing regional innovation, building local markets, and preparing residents for growing jobs and careers in the energy cluster. The team should focus on steps to develop and deploy innovative energy technologies across both the carbon-based and clean energy sectors, producing multiple benefits—in terms of financial savings, jobs and company growth, environmental improvement, and a better quality of life for residents. The team should be multi-sector (public, private, non-profit), as well as multi-jurisdictional (cities, county) in order to assemble the leadership and resources necessary to make a long-term commitment to growing Solano County's energy cluster.

The Solano EDC will enthusiastically take this report and tell Solano County's energy story – from its traditional roots in natural gas and oil to its new-found emphasis on renewable energy production and greening our businesses and homes.

It's a great story to tell, and we've seen it come forward with newspaper headlines about completed energy projects and from new business prospects checking out Solano County.

Over the past three years alone, we have fielded inquiries from companies representing a vast array of energy technologies, including solar, wind, natural gas turbine generators, electric vehicles, biomass, algae, battery technology, and carbon sequestration. With this document in hand, we can share a comprehensive insight into our diverse and growing energy cluster.

This report also underscores a notion we have felt for some time – Solano County has reached an "opportunistic density" with its cluster of natural resources, innovation, regulatory and subsidy incentives and venture capital that will enable us to grow this industry quickly. In the past outside factors, such as the fluctuating cost of natural gas and oil to federal and state climate change initiatives, have shaped and then reshaped this industry. Moving forward, it will be our commitment and resolve to work in concert with the external business markets and regulatory forces that will create new job opportunities and "green" the overall Solano energy cluster.

Our public policymakers have made a strong start though a significant commitment to shift the county and its communities toward a balanced energy portfolio that is both independent and environmentally sound. At the same time, the business community is continuing to invest in new renewable energy options that will reduce their long-term costs of doing business while benefiting the environment.

The key question before us is "Can we seize this opportunity?"

We can with the creation of a Solano Energy Cluster Team. Business, government and community leaders will be working together to establish and act upon long-term strategic goals that position existing businesses and attract new businesses to capture our share of the abundant regional innovation. This team will be the guiding leadership force that will enable us to benefit from the emerging research and efforts to scale up new renewable energy portfolios to serve regional markets. They will also be charged with helping us prepare the labor force to enter a growing energy industry that all this new investment will bring to Solano County.

You have the commitment of the Solano EDC to be the facilitator that brings this Solano Energy Cluster Team to reality. I look forward to working with this team and our regional partners as we hold each other accountable in the unending pursuit of growing a vibrant local economy.

Sincerely,

Mike Ammann
President, Solano Economic Development Corp.

Venture Capital Investment in Clean Technology

Data was provided by Cleantech Group™, LLC and represents disclosed clean tech investment deal totals. The Cleantech Group™ describes cleantech as new technology and processes, spanning a range of industries that enhance efficiency, reduce or eliminate negative ecological impact, and improve the productive and responsible use of natural resources. San Francisco Bay Area includes Alameda, Contra Costa, Napa, Marin, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.

Green Technology Patents & Green Technology Patents by Technology

Collaborative Economics designed the search parameters for each of the technology areas (solar & wind energy generation, energy storage, fuel cells, hybrid systems), and 1790 Analytics conducted the search of patent registrations from the U.S. Patents & Trade Office. The San Francisco Bay Area includes Alameda, Contra Costa, Napa, Marin, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.

Clean Energy & Transportation Establishments & Jobs

The accounting of green business establishments and jobs is based on the methodology originally developed on behalf of Next 10 for the *California Green Innovation Index*. This database has been built through the use of multiple data sources for the identification and classification of green business (such as New Energy Finance, Cleantech Group™, LLC and others) and leveraged 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 job estimates. The operational definition of green is based primarily on the definition of "cleantech" established by the Cleantech Group™, LLC. This sample offers a conservative estimate of the green industry in Solano County.

Energy Distribution & Carbon-Based Energy Production Establishments & Jobs

Data provided by the National Establishments Time-Series (NETS) database based on Dun & Bradstreet establishment data was sourced to extract business information such as jobs. Certain industries were selected based on the North American Industrial Classification System (NAICS) and then establishments and jobs in those industries were summed. The following NAICS codes are included in the analysis: 213111, 213112, 22111 (not including 221119), 221122, 221210, 237120, 237130, 324110, 333132, 424710, 424720, 486910, and 532412.

Example Occupations in Solano County's Energy Sector

Employment and wage data are from the Occupational Employment Statistics (OES) provided by the California Employment Development Department, Labor Market Information Division (LMID) and is the survey dated the 1st Quarter 2009. The OES survey is a semiannual survey, measuring occupational wage rates and employment in nonfarm establishments. The California occupational staffing pattern provided by LMID was used to analyze the occupations in the clusters.

Natural Gas and Condensate Production

Data provided by the Department of Conservation, Division of Oil, Gas, and Geothermal Resources in the Online Production and Injection Query for State of California database. Data includes data through April 2009.

Solar Installations by Sector

Data is from the California Solar Initiative, July 22, 2009 extract. Data covers approved rebates, and rebates that were cancelled or withdrawn are not included.

Renewables Portfolio Standard Facilities

Data is from the California Energy Commission through the California's Renewables Portfolio Standard (RPS) Eligible Facilities.

Electricity and Natural Gas Consumption

Electricity and natural gas consumption data provided by the California Energy Commission in the Quarterly Fuel and Energy Report (QFER) data. Population estimates are from the California Department of Finance, E-6 Population Estimates and Components of Change by County July 1, 2000-2008.

Vehicles Miles of Travel per Capita & Gas Prices

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 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, Department of Finance E-6 Population Estimates were used. Gas prices are average annual retail gas prices for California, and 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 Formulations Retail Gasoline Prices (including taxes) and have been adjusted into 2008 dollars using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor statistics.

Public Transit Use and Availability

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.

Alternative Fuel Vehicles Registered

Alternative fuel vehicle data are provided by R. L. Polk & Ca. Data includes newly registered vehicles for new and used vehicles.

Acknowledgements:

1790 Analytics

California Department of Finance

California Department of Transportation

California Employment Development Department

California Energy Commission

California Public Utilities Commission

California State Controller's Office

City of Benicia

City of Dixon

City of Fairfield

City of Rio Vista

City of Suisun City

City of Vacaville

City of Vallejo

Cleantech Group™, LLC (www.cleantech.com)

Competitive Power Ventures

County of Solano

Division of Oil, Gas, and Geothermal Resources, California Department of Conservation

Energy Information Administration, U.S. Department of Energy

enXco

National Establishment Time Series Database

PG & E

Pittsburg Power Company

Potrero Hills Landfill

R. L. Polk & Co.

Republic Services

Rosetta Resources, Inc.

SMUD

Solano Transportation Authority

Travis Air Force Base

Solano EDC

The Mission of the Solano EDC is to attract, grow and retain business and industry in Solano County that enhance the economic vitality and quality of life in our communities. We serve as the facilitator of countywide and regional discussions on how to improve the way we work together and take action on critical employer, transportation, and education issues.

Collaborative Economics

Collaborative Economics is a nationally-recognized consulting firm specializing in developing regional indexes, working with private and public sector leaders to develop innovative solutions to pressing economic and community challenges, and advising civic entrepreneurs across the country and globally.

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