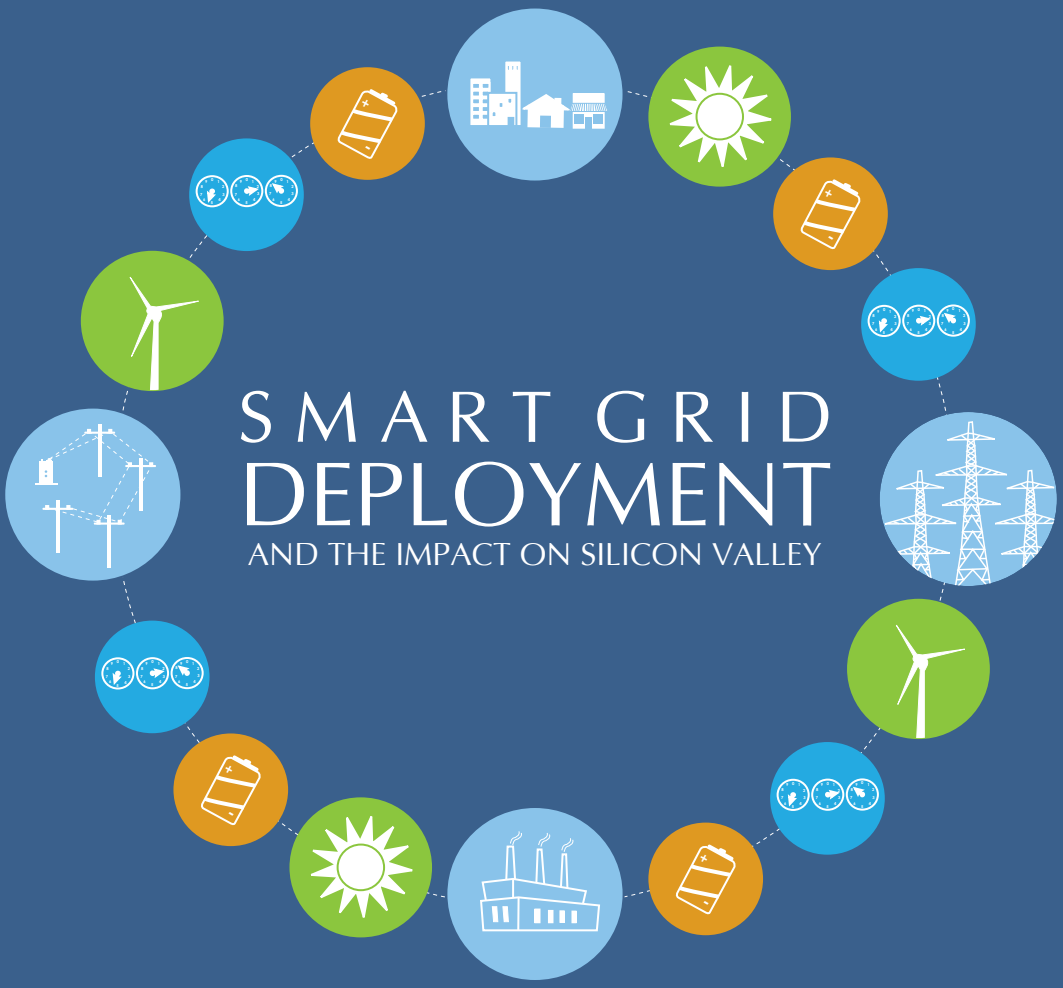

SMART GRID DEPLOYMENT

AND THE IMPACT ON SILICON VALLEY

Silicon Valley Smart Grid Task Force

2011

The Silicon Valley Smart Grid Taskforce was established in June, 2010 by the City of San Jose, the Silicon Valley Leadership Group, and Pacific Gas & Electric Company (PG&E). Representing the public and private sectors, the Taskforce is co-chaired by Mayor Chuck Reed of the City of San Jose, Carl Guardino, President and CEO of the Silicon Valley Leadership Group, and Chris Johns, President of Pacific Gas & Electric Company. The group brings leaders from industry, the public sector, non-profits and academia together to better educate the public about smart grid technology and its importance in aiding California's long-term environmental sustainability and economic development.

As a first step, the Smart Grid Task Force commissioned this study to examine how the roll out of the smart grid nationally will impact Silicon Valley locally. The advisory board for this research effort included representatives from the following companies and organizations: City of San Jose, Silicon Valley Leadership Group, Pacific Gas & Electric Company, IBM, Wells Fargo, Silver Spring Network, Joint Venture: Silicon Valley Network, Echelon, Environmental Defense Fund, Green Charge Networks, Coulomb Technologies, eMeter Corporation, Sol Focus, Demand Response and Smart Grid Coalition.

Prepared by
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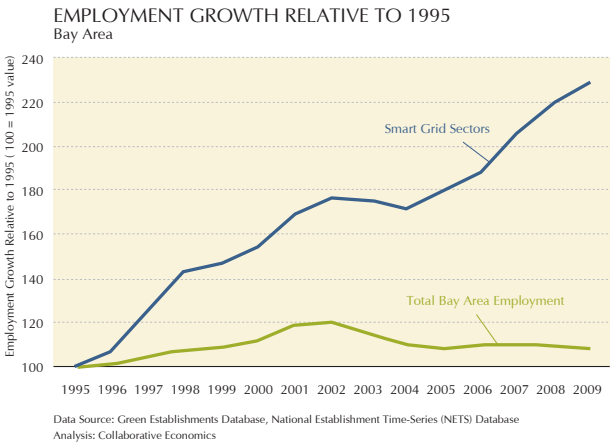
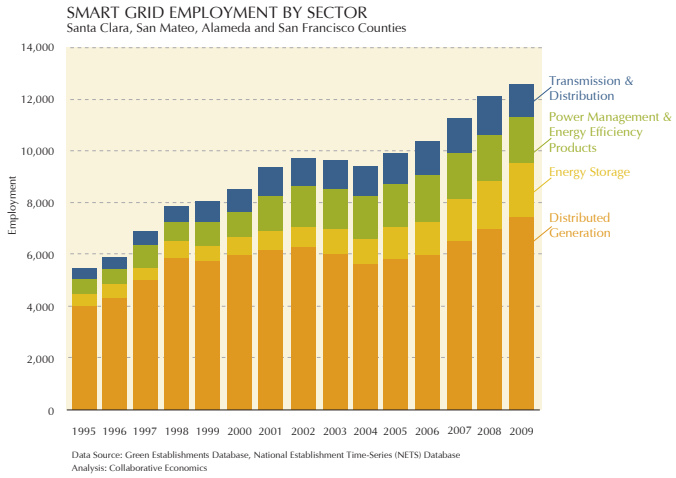
AT A GLANCE:

Smart Grid Deployment and the Impact on Silicon Valley

The deployment of the smart grid nationally will transform the electrical power system, increase energy efficiency, create demand for smart grid technology, empower consumers with information, choices and control, and drive new demand for a broad set of information technology. Silicon Valley, and the broader Bay Area, is well positioned to be a leader in the development and deployment of smart grid-related technology and to reap the economic benefits of both. The Bay Area is host to a high concentration of talent, companies, and research centers active in the growing space of smart grid-related products and services. Additionally, the region's culture of early adoption of new technology can help drive innovation in these industries in the region.



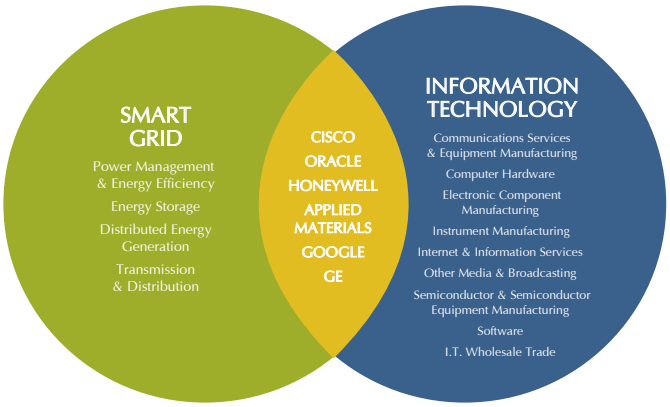
The Bay Area's smart grid-related industries are highly concentrated and growing. In 2009, smart grid sectors accounted for 12,560 jobs in the Bay Area. Despite the recession, smart grid jobs grew by four percent from 2008 to 2009. While the employment estimates reported in this analysis are current as of January 2009, recent job trends indicate that Silicon Valley and the broader Bay Area were spared much of the blow and the Valley in particular is recovering at a faster rate than the state or nation. This suggests that growth related to the smart grid should continue as well.



Since 1995, employment in smart grid-related sectors increased 129 percent in the Bay Area while total employment rose only eight percent. Smart grid-related industries are categorized into four sectors: Power Management & Energy Efficiency Products, Energy Storage, Distributed Energy Generation, and Electricity Transmission & Distribution.

Since 1995, manufacturing jobs have represented at least 50 percent of total smart grid employment in the Bay Area.

Silicon Valley's IT industry plays a significant role in the development of the region's smart grid industry. Some of the region's biggest players in smart grid are large IT companies with a diverse portfolio of products and services. The dynamism and high employment concentration in IT industries in Silicon Valley and a culture of early adoption of new technology positions Silicon Valley well to establish itself as a global leader in the development and deployment of smart grid technology.



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Executive Summary

The deployment of the smart grid nationally will transform the electrical power system, create demand for smart grid technology, empower consumers with information, choices and control, and drive new demand for a broad set of information technology. Silicon Valley, and the broader Bay Area, is well positioned to be a leader in the development and deployment of smart grid-related technology and to reap the economic benefits of both. The Bay Area is host to a high concentration of talent, companies, and research centers active in the growing space of smart grid-related products and services. Additionally, the region's culture of early adoption of new technology can help drive innovation in these industries in the region.

SMART GRID EMPOWERS CONSUMERS, STRENGTHENS THE ELECTRICAL GRID AND OFFERS NEW ECONOMIC BENEFITS

Through the introduction of new layers of communications, metering and power management technology to the conventional grid, smart grid significantly improves the reliability and resilience of the system and opens new paths for boosting energy efficiency and reducing negative environmental impacts.

- In-home and in-building applications engage consumers and other energy users in monitoring their power use, conserving power, and performing electricity-intensive activities during off-peak hours.
- Power quality, reliability and overall grid optimization increase greatly through the use of sensors and data management applications that pinpoint and anticipate problems, thereby preventing costly electricity disturbances and blackouts.
- Grid security against physical and cyber attacks is elevated through advanced communication and decision-making interfaces.
- Smart grid networks can more easily accommodate a greater variety of generation and storage technologies, smoothing the integration of variable renewable energy sources and easing peak load demands.
- Deploying smart grid infrastructure creates new product and service markets and enables varied pricing structures that can help shape consumer demand to reduce consumption during peak times.
- Given the high concentration of smart grid and information technology companies, the Bay Area economy will benefit from the national roll out of the smart grid.
- The environmental benefits of smart grid result primarily from the increased efficiency gained throughout the system and the streamlined integration of distributed renewable energy generation. The real-time information and responsiveness empowers consumers to better manage their electricity use. The efficiency gains result in the reduction of greenhouse gas emissions and the deferment or elimination of the need for "peaker plants" which are brought on line to help meet demand peaks.

THE BAY AREA'S SMART GRID-RELATED INDUSTRIES ARE HIGHLY CONCENTRATED AND GROWING

These industries are diverse and span four sectors of products and services: Power Management & Energy Efficiency Products, Energy Storage, Distributed Energy Generation, and Electricity Transmission & Distribution. While the employment estimates reported in this analysis are current as of January 2009, recent job trends indicate that Silicon Valley and the broader Bay Area were spared much of the blow; and the Valley in particular is recovering at a faster rate than the state or nation. This suggests that growth related to the smart grid should continue as well.

- Businesses providing smart grid products and services grew 138 percent from 1995 to 2009, while the total economy grew 82 percent. From January 2008 to 2009, smart grid establishments increased five percent with the addition of over 30 businesses.
- Employment in smart grid-related industries accounted for 12,560[1] jobs in the Bay Area in 2009.
- Energy Storage was the fastest growing sector between 2008 and 2009, expanding by 13 percent with the addition of over 230 jobs.

- Distributed Generation represents 59 percent of employment in smart grid.
- Although one of the smaller sectors, Transmission reports the highest employment concentration in the region.

THE BAY AREA'S SMART GRID-RELATED INDUSTRIES ARE DIVERSE AND DISTRIBUTED ACROSS THE VALUE CHAIN

- Across these sectors, Manufacturing represents 50 percent of total smart grid employment.
- Service jobs are well distributed across smart grid sectors and have increased proportionally over the years.
- Sixty-six percent of Research & Development jobs related to smart grid in the Bay Area are in Energy Storage, and 33 percent are in Distributed Generation.

SILICON VALLEY'S IT INDUSTRY PLAYS A SIGNIFICANT ROLE IN THE DEVELOPMENT OF THE REGION'S SMART GRID INDUSTRY

In addition to numerous start-ups and small companies, some of the region's biggest players in smart grid are large IT companies with a diverse portfolio of products and services. Additionally, the vast new volumes of data generated by the smart grid will call for faster data processing infrastructure, data storage, analytical tools and data management systems – core competencies of Silicon Valley. The dynamism and high employment concentration in IT industries in San Mateo and Santa Clara Counties and a culture of early adoption of new technology positions Silicon Valley well to establish itself as a leader in the development and deployment of smart grid technology.

- While Silicon Valley's total employment remained relatively stagnant in recent years, specific IT sectors have grown. From 2008 to 2009, employment in Computer Hardware expanded seventeen percent, Instrument Manufacturing rose eleven percent, and Software grew three percent.
- With employment of 126,980, Software accounts for Silicon Valley's largest IT sector.
- Large, diverse IT companies in the region have entered the smart grid space with expanding employment shares focused on new products and services.

SMART GRID IMPLEMENTATION PROJECTS AND PILOTS DEVELOPING IN THE BAY AREA, ACROSS THE COUNTRY, AND AROUND THE GLOBE VARY IN SCOPE OF DEPLOYMENT AND COMPLETION STATUS

- The Moffett Park Community Smart Grid Project in the Bay Area is a public-private partnership developing a fully-integrated smart grid in and around Moffett Field, home to NASA Ames Research Center. Lawrence Berkeley National Laboratory is joined by the City of Sunnyvale as well as Google, Juniper Networks and others in this effort.
- American Electric Power (AEP) launched an initiative called gridSMART in South Bend, Indiana in 2007 and achieved the targeted efficiency and cost savings with the installation of new meters, power management, and customer applications.
- The Pecan Street Project is a collaboration of energy providers, academic institutions, city departments and businesses in Austin, Texas. Bringing together local smart grid technology providers, this effort recognizes the economic development potential of local deployment.
- The PowerCentsDC program used smart grid technology to enable tests of three alternative pricing structures for Pepco customers. New pricing structures were successful in reducing peak demand and monthly electricity bills and were preferential to the default standard offer pricing system.

HOW DOES THE BAY AREA BEST LEVERAGE ITS ASSETS OF TALENT, COMPANIES AND RESEARCH FACILITIES ACTIVE IN SMART GRID IN ORDER THE MAXIMIZE THE ECONOMIC BENEFITS IN THE REGION?

The Bay Area needs to align efforts behind the broad-based deployment of smart grid-related technologies in the region. Office parks, neighborhoods and public facilities can become the next round of implementation projects. Implementing the smart grid regionally will accelerate innovation in the technology and in its useful adoption by consumers and utilities. Establishing the Bay Area as an early adopter of smart grid will help retain and attract smart grid companies, improve the region's competitive advantage afforded by a reliable and efficient electrical grid, and maintain the Bay Area's role as the nation's smart grid hub.

1 Introduction: Silicon Valley & the Smart Grid

The regional deployment of the smart grid will improve the Bay Area's energy productivity and grow economic opportunity. Any region can benefit significantly from improvements in energy efficiency; however, deployment of the smart grid in the Bay Area yields additional positive impacts because of the region's unique industry mix. Not only does the Bay Area host a high concentration of companies producing vital components to the smart grid, Silicon Valley's information technology (IT) industry will be impacted by the vast new volumes of data generated by growing numbers of "smart" devices along our electricity networks. The Bay Area's community of early adopters of technology has long played an important part in spurring the innovation process in the region and maintaining its role as a global leader in new technology.

In addition to its world-class companies, the Bay Area is also home to world-class research and academic institutions that are contributing to the development and deployment of smart grid-related technologies and the adoption of comprehensive energy policy. Research contributions by the region's labs and universities are not only addressing technological advance, but also behavioral science related to the adoption of new technology and public policy options related to smart grid enabled applications.

The Center for Information Technology Research in the Interest of Society (CITRIS) is located at the University of California (UC) at Berkeley and partners with UC Davis, UC Merced, UC Santa Cruz and private sector partners. Their research focuses on "highly-distributed, reliable, and secure information systems that can evolve and adapt to radical changes in the environment."[2] CITRUS is researching home demand response methods in collaboration with the Berkeley Lab, the Center for the Built Environment, the Berkeley Wireless Research Center, the Berkeley Sensor and Actuator Center. Working with the private sector, their work is accelerating the deployment of technology, and recent efforts have proven that smart sensors and control systems for building lighting can significantly increase energy efficiency.[3]

The Lawrence Berkeley National Lab's Demand Response Research Center (DRRC) was established in 2004 to perform research that will support the adoption of demand response technologies, policies, programs, strategies and practices.

The Electrical Power Research Institute (EPRI) is investigating demand response working with the Consortium for Electric Reliability Technology Solutions (CERTS), whose members include four national labs, a National Science Foundation (NSF) industry-university research center, and members of the private sector. CERTS is also performing research on microgrids in an effort to decentralize the grid and incorporate distributed energy resources, software tools for grid reliability, and low-cost power quality monitoring systems.

The University of California Energy Institute, located at UC Berkeley, involves multiple UC campuses in the research and education of energy policy and has produced valuable research on how pricing in electricity markets can improve use efficiency.

Stanford University's Human Sciences and Technologies Advanced Research Institute (H-STAR) and Precourt Energy Efficiency Center (PEEC) are collaborating on the design of "smart technologies" that will provide consumers useful information about household energy consumption. The effort researches policy, building energy management systems, media and marketing, community-based programs for reducing energy consumption and will include pilot projects. Funding for the effort came from a two-year $4.9 million grant from the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) program in October of 2007 and matching funds of $1.28 million from the California Energy Commission and Stanford.[4]

Substantial investment in the modernization of the electrical infrastructure is taking place nationwide, and much of this is directed toward the roll out of the smart grid. Especially in California, private investment is driving much of this effort. In terms of investments in demand side management of electrical infrastructure, three of the top four U.S. utilities are located in California in 2010. Pacific Gas and Electric (PG&E), Southern California Edison, Florida Power and Light (the principal subsidiary of NextEra Energy) and San Diego Gas and Electric have garnered the largest sums of private investment.[5] Investments by PG&E include 27 smart grid projects, including improving metering infrastructure, advancing transmission and distribution system automation, and enhancing their website to provide energy information to customers.

Public funding is playing a vital role as well. In October 2009, President Obama announced that $3.4 billion in grants would be awarded through the American Reinvestment and Recovery Act (ARRA), and $203 million would go to California for deploying smart grid technologies.[6] Complementing private investments, Sacramento Municipal Utility District will receive upwards of $127 million in ARRA funding, bringing its total project grant to over $307 million. Similarly, Burbank Water and Power will receive $20 million in ARRA grants, totaling $62 million in public-private grants. Other California utilities receiving grant funding include San Diego Gas and Electric Company, City of Glendale Water and Power, City of Anaheim, and Modesto Irrigation District. Grant funds are supporting the installation of demand response controls, programmable smart thermostats, home energy management systems, electric vehicle charging stations, dynamic pricing capabilities, and education and outreach.

As the deployment of smart grid spreads nationally, the Bay Area's companies offering products and services related to the smart grid will experience increasing market demand. Because the smart grid is essentially about the generation, communication and management of data related to every aspect of our electricity grid, the deployment of the smart grid will create vast new volumes of data. These new flows of information will require high-speed data processing to enable real-time operations, greater data storage capacity, greater cyber security, and new data management systems, analytical tools and user interfaces. The enormous scope of data management related to smart grid points to Silicon Valley's core IT industries.

As a result, the broad deployment of the smart grid will not only spur demand the Bay Area's companies active in specific smart grid technologies. It will also spur demand for all aspects of data processing, storage, and management technology across Silicon Valley's hardware and software industries. The region provides the perfect breeding ground for developing the diversity of products and services needed to enable smart grid operations including distributed energy generation systems, advanced metering, sensors, communications and all technology related to data management. Growing demand will help drive innovation in the region, improving products and reducing costs.

The sections that follow provide a brief introduction to the smart grid and outline the relationship between energy productivity and economic competitiveness. Then, an analysis of employment growth and concentration in the Bay Area's smart grid-related industries as well as Silicon Valley's IT industries is presented. Finally, examples of different smart grid deployment projects are discussed.

2 What is the Smart Grid?

The deployment of the smart grid will transform the electrical power system, create demand for smart grid components, drive new demand for information technology, and raise the region's competitive advantage through improved grid reliability and productivity. The electrical grid is a network of systems that delivers electricity from power plants to consumers. The current grid system has not evolved to meet the electricity and power quality needs of the changing consumer base. In addition, there is the urgent need for greater efficiency across all aspects of the grid from generation, transmission, consumption, and operation and maintenance – where improvements reduce negative environmental impacts and yield costs savings.

According to the Federal Smart Grid Taskforce, "A smarter grid will enable many benefits, including improved response to power demand, more intelligent management of outages, better integration of renewable forms of energy, and the storage of electricity."[7] The Taskforce differentiates a "smarter grid" from the conventional grid on three essential points: it uses information technologies to improve how electricity travels from power plants to consumers, it allows consumers to interact with the grid, and it integrates new and improved technologies into the operation of the grid.

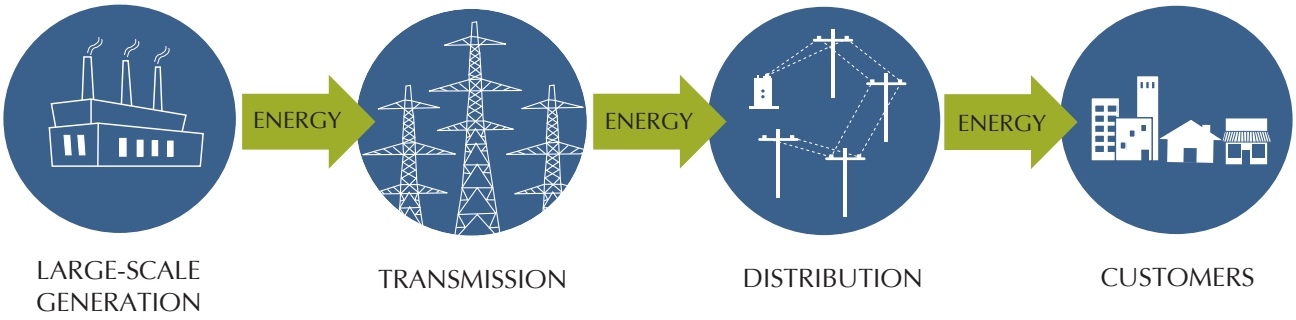
The conventional grid consists of large-scale electricity generation, distribution, and transmission. Electricity generation is the process of producing electricity from other forms of energy like chemical combustion from burning fossil fuels, kinetics such as in the turning of turbines powered by water, steam or wind, or solar energy. Electricity transmission is the conveyance of bulk electricity loads from generators to substations through overhead power lines or underground cables. Electricity distribution is the transportation of electricity from a substation to the point where electricity use by the customer is metered and includes components like feeders, power lines, and transformers.

Building on the conventional grid, the smart grid introduces layers of communications technology and information technology which measure, communicate and direct the flow of power across a distributed network. These technological components increase efficiency, resiliency, manageability and customer interaction with the electrical grid. Additionally, the new grid structure better integrates distributed generation from renewable energy sources and smooths the integration of variable generation from sources such as wind and solar.

A component of the smart grid is Advanced Metering Infrastructure (AMI). More than just electricity metering equipment, AMI consists of measurement and collection systems for data tracked by meters, as well as communication networks and Meter Data Management Applications (MDMA).[8] MDMA is composed of computer hardware and software, which process and organize the large quantity of data collected by metering devices. An advanced metering system differs from Automatic Meter Reading (AMR), the traditional metering system, in that it allows for two-way communication between the smart meter and electrical utility. AMI enables tracking, storage and communications of hourly-use data.[9]

The smart grid system is distinct from the traditional electrical grid in that it significantly improves energy efficiency, environmental quality and grid security and safety. Additionally, the deployment of the smart grid will spur the development of emerging technologies and new energy markets. The following examples are key characteristics highlighting improvements afforded by the smart grid.

THE CONVENTIONAL ELECTRICAL GRID



ENABLES SELF HEALING

Real-time data and analytical capabilities provided by smart grid systems allows for the early detection of transmission and distribution errors and the prevention of power outages and negative effects on the consumer. The conventional grid lacks the system-wide feedback capacity which means problems can only be addressed once they occur.

EMPOWERS ELECTRICITY CUSTOMERS

Presently, electricity consumers are uninformed about real-time electricity demand and rate structures. Smart grid provides the ability to access real-time information regarding electricity rates, enabling consumers to make informed decisions about performing energy-intensive activities when rates and demand are lowest and to save money on their electricity bills. Consumers with AMI can also opt for dynamic pricing plans to take advantage of low off-peak prices by shifting usage from peak times. Deferred use during peak hours removes stress on the grid system, decreasing the risk of shortages, blackouts and bottlenecks. Real-time information streaming from the smart grid system also enables the use of smart appliances. Smart appliances automate the decision to operate during lower rate and lower demand periods after receiving signals from the grid. Examples of smart appliances include traditional energy-intensive appliances such as water heaters and air conditioners. "Set-and-forget" smart appliances technology can be extended to refrigerators, dishwashers, and clothes washers and dryers.

IMPROVES GRID RESISTANCE TO ATTACK

The existing grid system is susceptible to damage by natural disasters as well as physical and cyber attacks. Key technologies for security improvements in the smart grid include integrated communications, sensing and measurement, advanced control methods, improved interfaces and decision support. Adoption of these key technologies will provide the necessary security and protection, create a more robust grid, and allow for quick and well-informed response to attacks.

IMPROVES POWER QUALITY

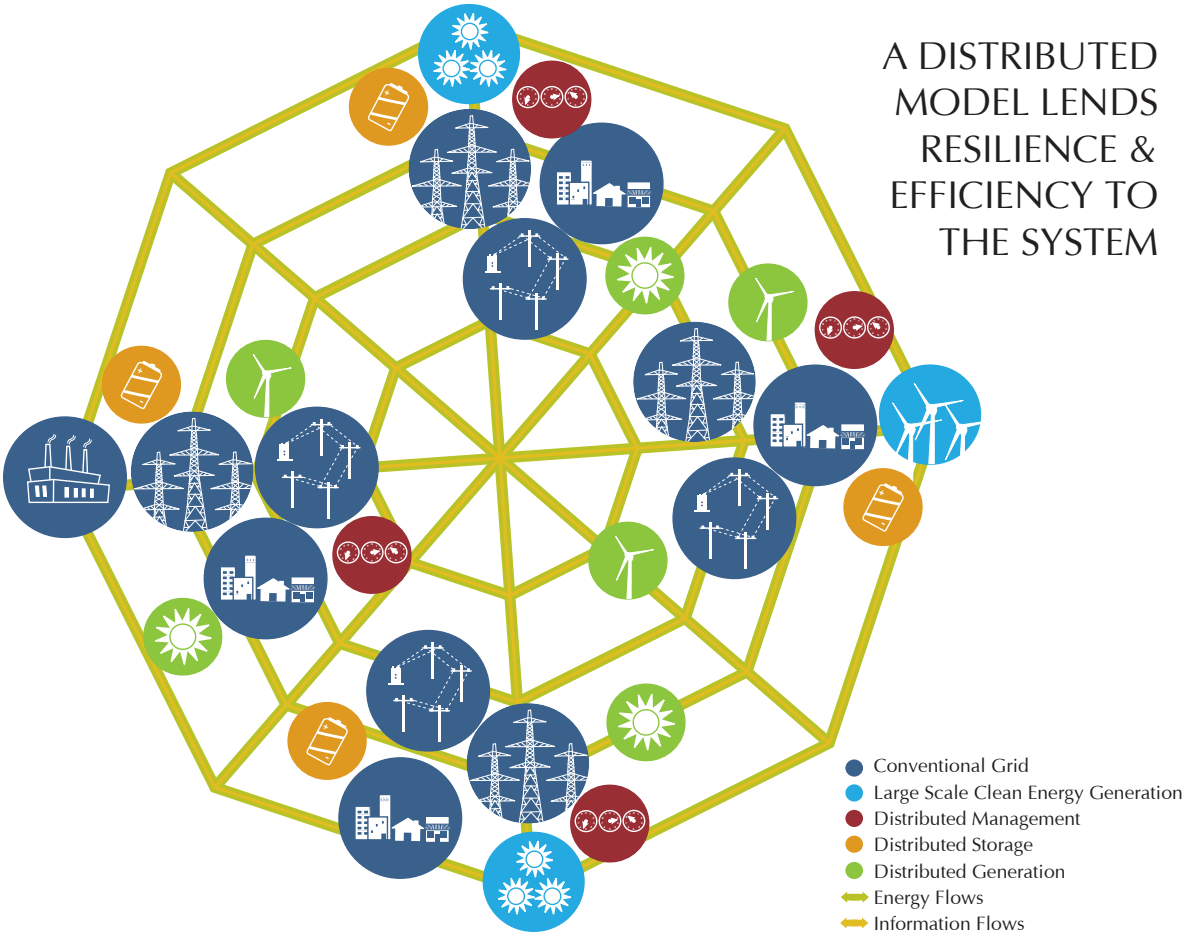
The deployment of the smart grid will improve the quality of power delivery and better address specific power needs of sensitive electric load users. "Clean" power is power free of disturbances such as lightening strikes, harmonic voltages, phase imbalances, and switching surges. It is estimated that power disturbances cost about $20 billion each year.[10] Companies in information, industrial, and manufacturing industries rely heavily on "ultraclean" power, as even small disturbances can cause costly process disruptions and delays. The concentration of companies in these industries has grown in the past decade and is expected to increase steadily in the near future. The demand will grow for technologies including power quality metering, superconducting magnetic energy storage (SMES) and advanced batteries to create stable supplies for sensitive consumers, and electronic devices to instantly correct for certain disturbances.

FACILITATES INTEGRATION OF DISTRIBUTED RENEWABLE RESOURCES AND ENERGY STORAGE

The current grid system presents obstacles for incorporating smaller onsite electricity generation, which include many renewable energy systems. Because of the network characteristic and the multi-directional flows of electricity and communications across the network, the smart grid facilitates the integration of distributed energy generation, such as wind and solar which produce variable levels of power. Smart grid can smooth the variability of generation and leverage these sources to support mainstream generators during peak hours thereby preventing possible outages and limiting the need for investment in new "peaker plants." Therefore, the smart grid plays a significant role in reducing the carbon dependency and greenhouse gas emissions of electricity generation. Smart grid will improve the infrastructure requirements for charging electric vehicles and also provide the ability to integrate the vehicle batteries into the smart grid in the form of distributed energy storage.

OPTIMIZES ELECTRICITY ASSETS AND OPERATIONAL EFFICIENCY

The current grid lacks the sensors, information systems and advanced operating tools to monitor the grid in real time and manage power flows. Smart grid systems provide proper data and tools required by system operators to efficiently prevent outages, expedite outage response, and make proper risk assessments. Engineers can accurately plan for additional capacity infrastructure or maintenance activities with new information regarding equipment health. Additional information about real-time demand and utility asset health coupled with forecasting, modeling, and simulation tools help to alleviate deficiencies, and therefore increase the lifespan of electrical assets, and produce an overall lower cost of electricity. A report by Pacific Northwest National Laboratory (PNNL) cites that eliminating or deferring investments in large centralized generating plants, transmission and distribution lines, and substations can save tens of billions of dollars over a 20-year period.[11]



ENABLES NEW MARKETS, PRODUCTS, AND SERVICES

The deployment of the smart grid will generate real-time information on demand fluctuation and create new energy markets. Currently, prices for electricity delivery are fixed, and generation costs vary by on-peak or off-peak usage. New retail and wholesale electricity service models allow for greater consumer demand-response markets and time-of-use rates, which will result in cost structures that are more reflective of market demand and in better communication of prices to consumers. As a result, peak electricity use will decrease, translating into cost savings and reduced strain on electrical infrastructure. Future demand will grow for distributed generation, community organized virtual power plants, and products and services that help connect consumers to smart grid information.

AFFORDS ENVIRONMENTAL BENEFITS

The smart grid reduces multiple negative environmental impacts and facilitates the broader application of clean energy technology. Through the communication flows and responsiveness, Smart grid can yield system-wide efficiency gains in the management, transmission, distribution and consumption of electricity. These improvements will slow the growth in electricity demand and the need for additional generation capacity, and thereby reducing harmful greenhouse gas emissions from electricity production. Smart grid infrastructure facilitates the integration of distributed energy resources, both large and small in scale, which reduces greenhouse gas emissions by replacing dirty energy generation with clean alternatives. Electric vehicles and charging stations are better accommodated with the implementation of a smart grid, enabling the transition from petroleum fueled vehicles with those powered by cleaner electric energy.

3 Energy Productivity & Economic Competitiveness

Improving energy productivity raises economic resilience and competitiveness. Improving efficiencies in the consumption of energy will boost the competitive edge of a company as well as an economy as a whole. Just as the proliferation of IT products across the economy radically increased labor productivity decades ago, the wide-spread adoption of smart grid-related technologies has the potential for vastly increasing energy productivity and improving economic resilience.[12] Further, the deployment of the smart grid will result in the growth in jobs associated with smart grid operations.

As the application of IT spread over the last several decades, labor productivity has achieved huge gains across the economy, transforming the economy, and spurring the growth of new markets.[13] According to Robert Atkinson and Andrew McKay, authors of Digital Prosperity: Understanding the Economic Benefits of the Information Technology Revolution (2007), "The integration of IT into virtually all aspects of the economy and society is creating a digitally-enabled economy that is responsible for generating the lion's share of economic growth and prosperity."[14]

Over the last thirty years, new opportunities for cost savings and new product development emerged across industries, and the IT industry continued to grow and diversify offering wider ranges of products, services and employment opportunities. Similarly, digitally enabling our electricity networks will boost efficiency, resource productivity, and economic innovation.

By finding new ways of doing things, reconsidering inputs and redesigning processes, a company can boost its energy efficiency and thereby create more value with less energy. In addition to capturing new savings from energy not consumed, a company can better buffer itself from external shocks (such as volatile fuel costs). As a result of improving its energy productivity and its overall resilience, a company can improve its competitive edge over other companies.[15] This logic extends also to a regional economy and a country.

The deployment of smart grid improves the efficiency and reliability of the electrical grid system which results in positive, system- wide economic impacts

for utilities and consumers. According to the National Institute of Standards and Technology: "By linking information technologies with the electric power grid to provide 'electricity with a brain,' the Smart Grid promises many benefits, including increased energy efficiency, reduced carbon emissions, and improved power reliability."[16]

Power disturbances undermine a company's and an economy's competitiveness. It is estimated that power disturbances create annual losses of approximately $100 billion for electricity consumers.[17] Each blackout costs around $10 billion and effects large areas of consumers for often long periods of time.[18] Advanced metering infrastructure and demand response abilities enabled by smart grid reduce the occurrence of power disturbances and blackouts through preemptive measures. In the event of a blackout or other disturbance, the new system allows utilities to detect the location of problems so they can be addressed promptly.

Smart grid infrastructure improvements cut costs for energy providers by reducing call center requirements, the need for outage response resources, and repair costs for capital damaged by poor distribution management. Additionally, revenues increase with uninterrupted power delivery and improved billing systems. Consumers benefit from reliable electricity and avert costs and inconveniences from power outages such as productivity losses and damage to physical property (e.g. flooding basements from pump failure or perished foods from lack of refrigeration).

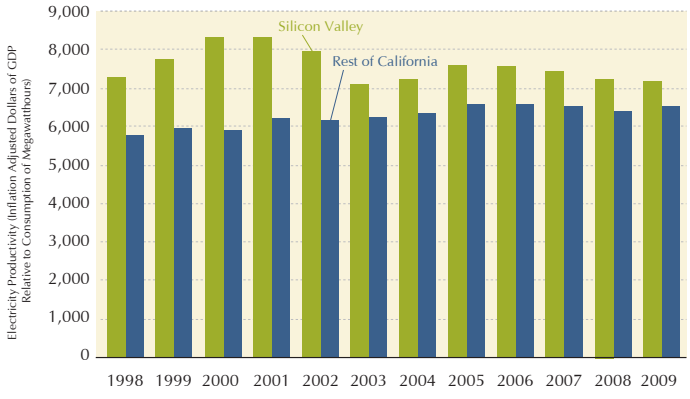
Improving environmental resilience, the smart grid facilitates the integration of distributed renewable energy generation and therefore the reduction of carbon emissions and the associated costs of climate change. Renewable energy integration to the grid will contribute greatly to achieving Renewable Portfolio Standard goals implemented by the state of California for 33 percent renewable energy production by the year 2020.

HOW DO YOU MEASURE ELECTRICITY PRODUCTIVITY?

The economic value produced per megawatt hour consumed is a measure of the region's electricity productivity and illustrates the degree to which the region's production of economic value is linked with its electricity consumption. In 2009, Silicon Valley's electricity productivity was eleven percent higher than that of California. Since 1998, electricity productivity has diminished slightly in Silicon Valley (-2%) and improved twelve percent in the state as a whole.

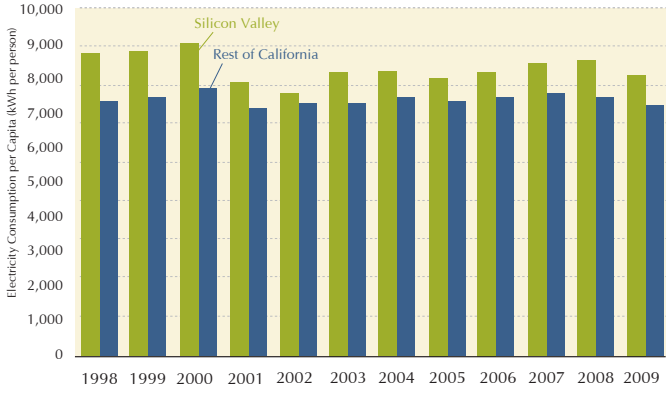
Per capita, electricity consumption in Silicon Valley is higher than the statewide average. This suggests that the region has a good deal to gain by improving efficiency. From 1998 to 2009, per capita consumption decreased seven percent in Silicon Valley and two percent statewide.

ELECTRICITY PRODUCTIVITY
Santa Clara & San Mateo Counties, Rest of California



Data Source: Moody's Economy.com, California Energy Commission
Analysis: Collaborative Economics

ELECTRICITY CONSUMPTION PER CAPITA
Santa Clara & San Mateo Counties, Rest of California



Data Source: Moody's Economy.com, California Energy Commission
Analysis: Collaborative Economics

4 Business Growth Related to the Smart Grid

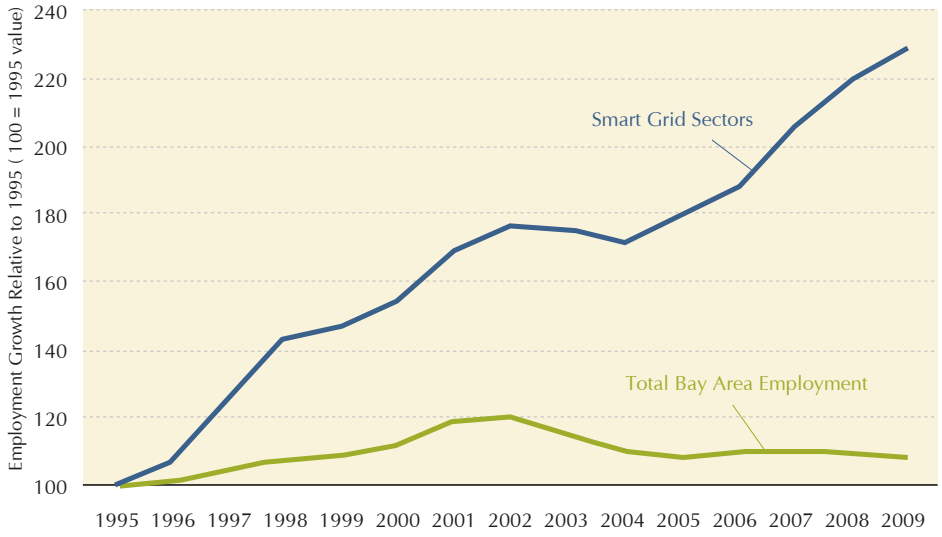
The San Francisco Bay Area is home to many companies producing products and providing services related to the smart grid. Smart grid operations require products and services that are specific to smart grid as well as technology with wider applications. As smart grid technologies are implemented across broader sections of the existing electrical grid, Bay Area companies will benefit from the increased demand for their products. In addition, as these sensors, metering devices and communications technology are deployed, the volumes of data produced by these technologies will quickly grow. This means that the deployment of the smart grid will drive new demand for information technology in order to manage the vast new flows of real-time information. This also means that with the roll out of the smart grid, the Bay Area's high concentration of IT companies located primarily in Silicon Valley will benefit also from new demand for information management, processing and storage technology.

Investment activity across the diverse technology areas associated with smart grid has been robust since 2005 (see Appendix A for supplemental analysis). While global venture capital (VC) investment was hit hard in 2009, investment has continued in smart grid. California accounts for 69 percent of total US VC investment in smart grid in 2010. Increasing 66 percent from 2009, total investment reached 2.8 billion dollars in 2010. Since 2005, nationally, investment has grown 309 percent and in California, by 183 percent, and continued growth is anticipated.

In the analysis that follows, employment concentrations and trends are tracked in the region for business establishments with primary activities related to smart grid products and services. Since these businesses are widely distributed around the Bay Area, the analysis is based on the four-county core Bay Area (Santa Clara, San Mateo, Alameda and San Francisco Counties). Because of the impact on IT products, IT employment concentrations and trends are tracked for Silicon Valley (Santa Clara and San Mateo Counties).

There are numerous large, diverse companies that include smart grid among their portfolio of products and services. Without the accurate estimates for employment shares focused on smart grid, including the full employment of these companies would distort the results focused on smart grid. Therefore, the activities of these companies are described separately.

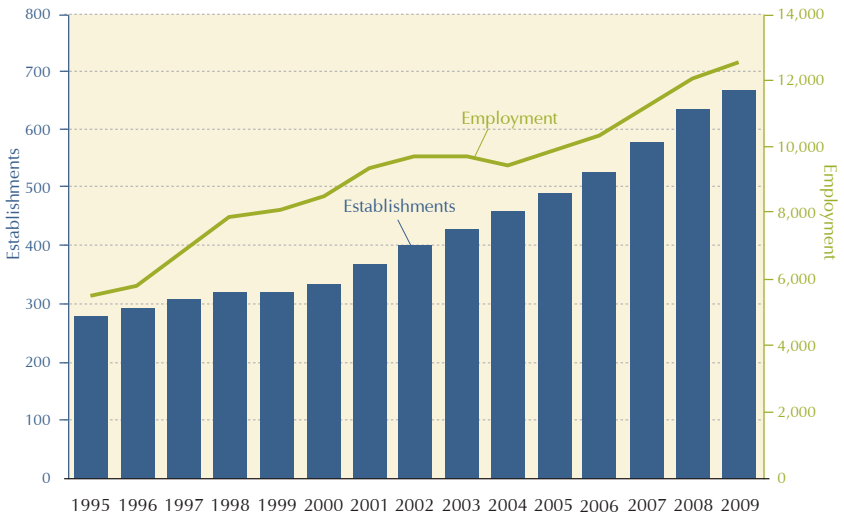
EMPLOYMENT GROWTH RELATIVE TO 1995
Bay Area



Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

SMART GRID SECTORS

SMART GRID ESTABLISHMENTS & EMPLOYMENT
Santa Clara, San Mateo, Alameda and San Francisco Counties



Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

Since 1995, employment in smart grid-related sectors increased 129 percent in the Bay Area while total employment rose only eight percent in the region. For the purposes of this report, the smart grid-related industries are categorized into four sectors of products and services: Power Management & Energy Efficiency Products, Energy Storage, Distributed Energy Generation, and Electricity Transmission & Distribution. Power Management & Energy Efficiency Products includes companies providing products that improve the way electricity is directed throughout the grid as well as high-efficiency appliances that conserve energy and can be integrated into the demand response system of the smart grid. Energy Storage includes grid-scale advanced batteries and fuel cells as well as distributed storage including the capacity of electric vehicles. Distributed Energy Generation includes all businesses that research, develop or produce clean energy systems, accessory equipment and controls. Electricity Transmission & Distribution includes companies that provide products and services for the electricity distribution and transmission and associated infrastructure. Specific fields are power monitoring, power quality and testing, and cables and equipment.

SMART GRID SECTOR		EXAMPLE COMPANY
TRANSMISSION & DISTRIBUTION	Energy Infrastructure Cable & Equipment Power Monitoring Power Quality & Testing Sensors & Controls	Silver Spring Network provides utilities with a Smart Energy Platform to aid them in successfully deploying smart grid projects. Other companies: Trilliant Networks Inc., Power Integrations Inc., Echelon Corporation
POWER MANAGEMENT & ENERGY EFFICIENCY PRODUCTS	Meters & Measuring Devices Energy Management Software, Services & Devices Energy Conservation Products & Software Smart Lighting Systems Solar Appliances & Devices Home Area Networks & Home Automation	Teridian Semiconductor Corp. develops metering integrated circuits enable accurate and efficient measurement and communication of recorded energy data. Other companies: Sentilla Corporation, EcoFactor Inc., Exar, eMeter Corporation
ENERGY STORAGE	Advanced Batteries Fuel Cells Hybrid Systems Uninterruptible Power Supply Battery Components & Accessories	Deejya Energy Inc. manufactures electrical energy storage systems. The company's energy storage platform uses NASA technology and can be used for scalable electrical grid storage applications like distributed energy resources. Other companies: Bloom Energy, Oorja
DISTRIBUTED ENERGY	Clean Energy Generation Accessory Equipment & Controls Research & Testing Energy Research	SunPower Corporation produces the most efficient solar cells on the market as well as monitoring systems to track solar energy production. Other companies: Modular Energy Solutions, Tumbler Technologies

In 2009, smart grid sectors accounted for 12,560 jobs in the Bay Area and expanded 129 percent over the period from 1995 to 2009. Despite the generally dampening effects of the recession, which kept total employment growth in the region static in recent years, smart grid employment grew by four percent from January 2008 to 2009.

Business establishments in the Bay Area providing smart grid-related products and services grew 138 percent between 1995 and 2009, expanding from 280 to 670 establishments. Most recently, from January 2008 to 2009, the number of establishments increased five percent with the addition of over 30 businesses.

A large proportion of these business establishments are small (See Appendix A for supplemental analysis). In 2009, 69 percent of smart grid establishments had ten or fewer employees. Small businesses have doubled in share, representing only 34 percent in 1995. This suggests that entrepreneurial activity in this diverse field is growing.

Distributed Generation accounts for 59 percent of smart grid sector employment. This sector includes all forms of renewable energy generation that can be connected to the grid. In 2009, there were about 7,430 jobs in Distributed Generation in the four-county region, a six percent increase over the previous year, and an 86 percent increase since 1995.

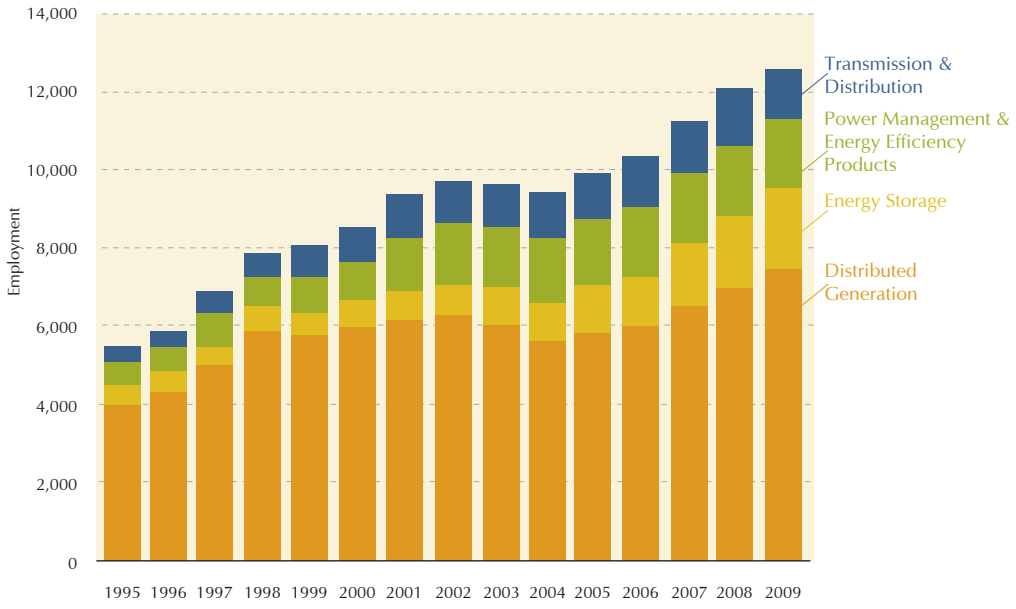
Energy Storage accounts for 17 percent of employment and includes battery and fuel cell technology for grid-scale storage as well as small, distributed storage including the capacity in the form of electric vehicles. Growth in Energy Storage outpaced the other three sectors, expanding by 13 percent from 2008 to 2009, with the addition of over 230 jobs. Over the long term, employment nearly quadrupled from roughly 530 employees in 1995 to approximately 1,850 in 2009.

Power Management & Energy Efficiency Products represents 15 percent of smart grid employment and includes energy conservation products, smart lighting systems, solar appliances and devices, computer software, systems and consulting engineers, and semiconductor and circuit production.

Power Management & Energy Efficiency Products employment more than tripled over the 15-year period and represents the third largest smart grid sector. Growing three percent from 2008 to 2009, this sector employed around 1,800 individuals in the four-county region in 2009.

Transmission & Distribution accounts for 10 percent of smart grid jobs with close to 1,230 jobs. Although dropping 17 percent since 2008, employment in this sector more than tripled over the 15-year period.

SMART GRID EMPLOYMENT BY SECTOR
Santa Clara, San Mateo, Alameda and San Francisco Counties



Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

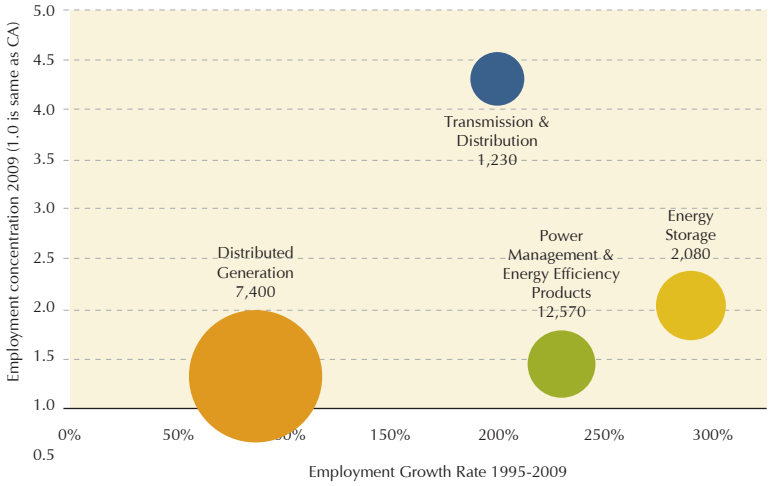
EACH OF THE FOUR SMART GRID SECTORS HAS GROWN OVER THE 15-YEAR PERIOD AND REFLECTS AN EMPLOYMENT CONCENTRATION ABOVE THE STATE AVERAGE

The size of the bubbles in the chart represents the relative employment sizes of each sector in 2009. The vertical position of the bubble along the y-axis represents the concentration of employment in a particular sector relative to the state as a whole. A value of one on the vertical axis (y-axis) reflects an employment concentration equal to California. A value above one suggests that the region hosts a higher degree of specialization and possibly value added in that particular industry. The position of the bubble along the horizontal azis (x-axis) represents the employment growth posted from 1995 to 2009.

Over the long term, employment growth has been strongest in Energy Storage and Power Management & Energy Efficiency Products. Although the smallest sector, employment in Trasmission & Distribution is 4.3 times more concentrated in the region relative to the state. Energy Storage jobs are two times more concentrated in the four-county region. Power Management & Energy Efficiency Products and Distributed Generation are both 40 percent more concentrated in the region when compared to California.

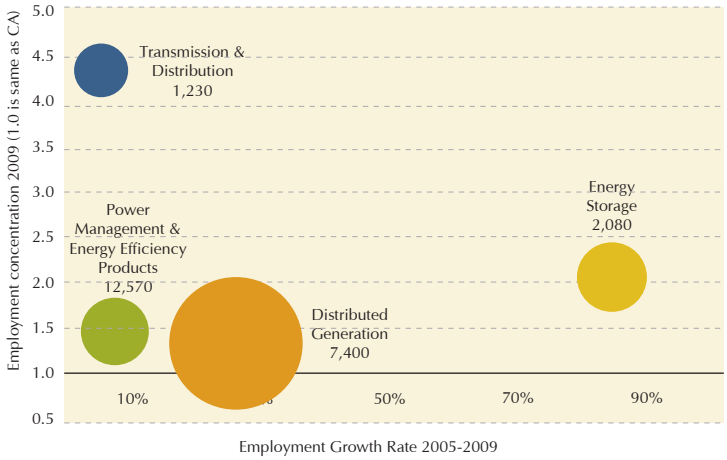
The second bubble chart for smart grid sectors displays employment growth over the recent period, from 2005 to 2009. Although employment expanded across all four sectors, growth was most pronounced in Energy Storage.

LONG-TERM GROWTH IN SMART GRID SECTORS
Santa Clara, San Mateo, Alameda and San Francisco Counties



Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

RECENT GROWTH IN SMART GRID SECTORS
Santa Clara, San Mateo, Alameda and San Francisco Counties



Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

SMART GRID EMPLOYMENT IS DIVERSE ACROSS THE VALUE CHAIN

Over the 15-year period, Manufacturing jobs have represented at least 50 percent of total smart grid employment in the Bay Area. Other segments of the value chain have grown in proportion since 1995. The diversity of activities across the value chain suggests there is a great variety of occupational opportunity in the Bay Area's smart grid related industries. Compared with California's value chain composition, smart grid employment in the Bay Area has nearly double the proportion for Manufacturing (50%), and half the proportion for the Services (6%) and Supplier (20%) categories.

Smart grid employment in Services increased in share over the period and represented the second largest value chain segment in 2009. Total smart grid employment in Services more than tripled from 1997 to 2009 to roughly 2,560 jobs.

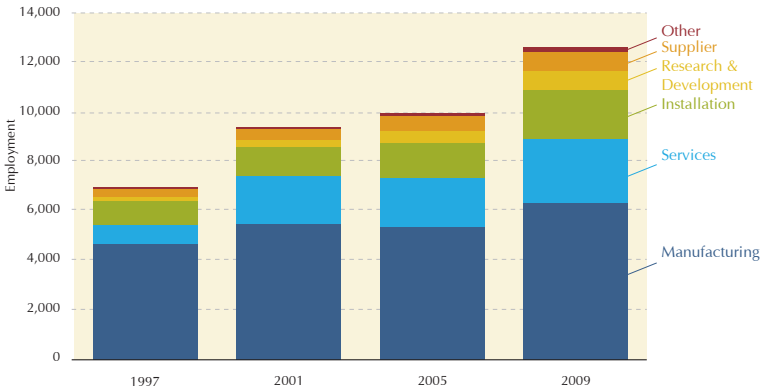
Installation represented 15 percent of smart grid employment in 2009 with over 1,940 jobs in the four-county region.

Research & Development jobs represented roughly six percent of smart grid employment in 2009, and the number of jobs increased by more than a factor of five since 1997.

Supplier employment accounted for six percent of total smart grid employment in 2009, an increase of 1.5 percent since 1997.

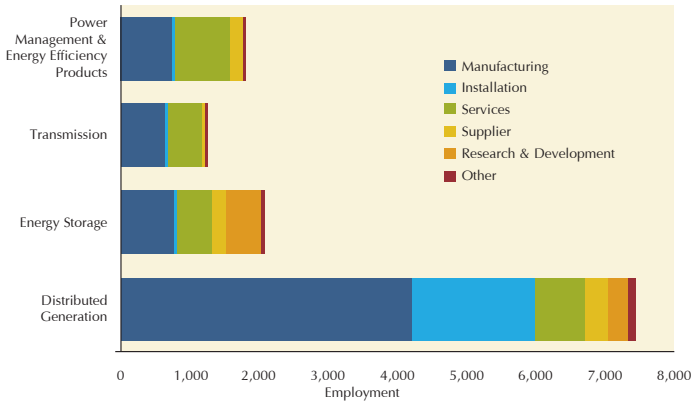
In nearly all smart grid sectors, Manufacturing represents the largest percentage of employment. Fifty-seven percent of employment in Distributed Generation is in Manufacturing, followed by 24 percent in Installation and ten percent in Services. Energy Storage employment is well distributed across the value chain with 37 percent in Manufacturing and 25 percent in each Services and Research & Development. Employment in Power Management & Energy Efficiency Products is primarily in Services (44%) and Manufacturing (41%). Half of Transmission & Distribution employment is in Manufacturing and 40 percent is in Services.

SMART GRID EMPLOYMENT ALONG THE VALUE CHAIN
Santa Clara, San Mateo, Alameda and San Francisco Counties



Note: Other includes Sales and Public Administration
Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

EMPLOYMENT ALONG THE VALUE CHAIN IN 2009
Santa Clara, San Mateo, Alameda and San Francisco Counties



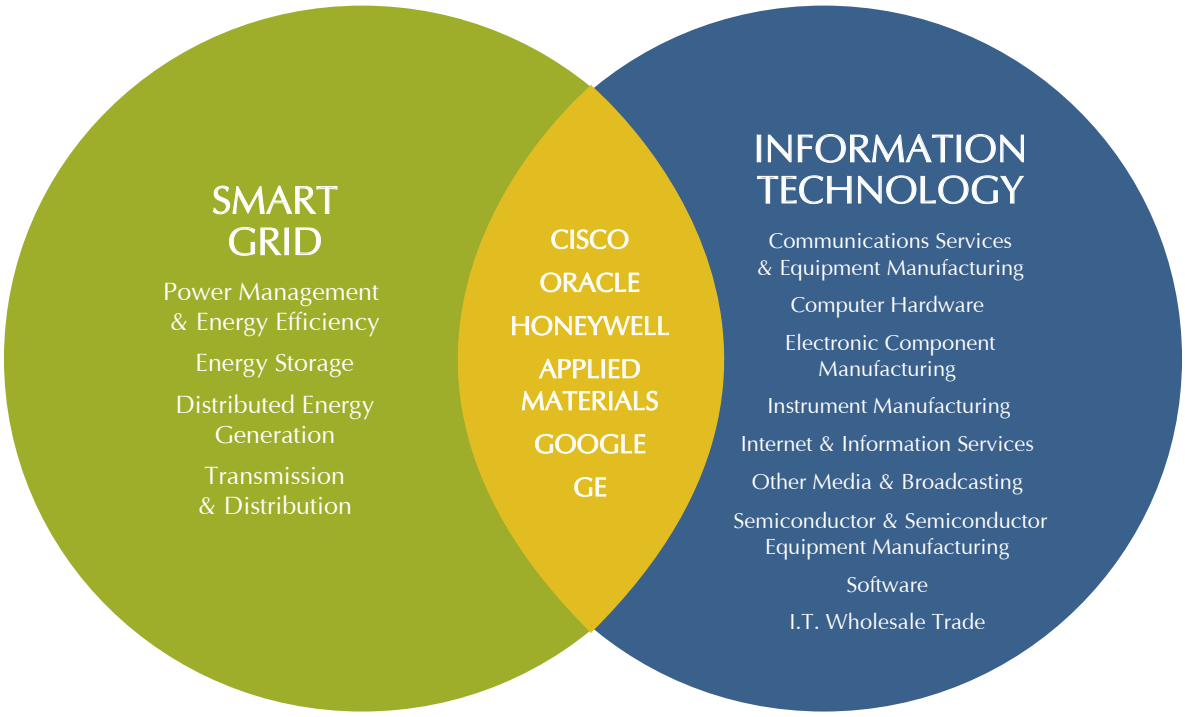
Note: Other includes Sales and Public Administration
Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

INFORMATION TECHNOLOGY IN SILICON VALLEY

The deployment of the smart grid will generate vast new volumes of data that will need to be processed, stored, secured from cyber attack, managed, analyzed and accessed by diverse users. The enormous scope of data management related to smart grid points to Silicon Valley's core IT industries.

Among the region's core IT companies, there are large, diverse companies that are expanding their scope of activities to include products and services related to smart grid operations. Examples of these companies include Cisco, GE, Applied Materials, Google, Honeywell and Oracle. Because these companies all do many things not directly related to smart grid, their large employment would distort the examination smart grid employment trends. Therefore, most of these companies are included in the IT analysis.

For the purposes of this report, information technology is composed of the following categories: Software, Computer Hardware, Semiconductor & Semiconductor Equipment Manufacturing, Internet & Information Services, Electronic Component Manufacturing, IT Wholesale Trade, Communication Services & Equipment Manufacturing, Instrumental Manufacturing, and Other Media & Broadcasting.[19] The geographical scope of the IT analysis focuses on Silicon Valley (Santa Clara and San Mateo Counties).



LARGE, DIVERSE COMPANIES OFFERING SMART GRID-RELATED PRODUCTS & SERVICES	
Company	Scope of Smart Grid Activities
Cisco Systems	Cisco provides solutions in multiple utility and consumer oriented sectors of smart grid, including; substation automation, home and business energy management, grid security, and data center operations. Cisco also works in smart grid networking communications and smart grid technology standards.
General Electric	The Intelligent Platforms division of General Electric provides smart grid software technologies for real-time data delivery and analytics for utilities. They also offer roadmap consulting services to assist in customizing a more efficient grid system that manages operations, load, and capital lifecycle. GE Nucleus provides a wireless home energy monitor that collects information from smart meters to show real-time consumption and pricing data. GE appliances with Brillion Technology can respond to signals to delay performance until rates and demand are lower.
Google Inc.	PowerMeter is a free application provided by Google to monitor household energy use to save both electricity and money. RechargeIT is an effort to accelerate the adoption of plug-in electric vehicles. Google's fleet of electric vehicles was made available through a company car-sharing program and was used to collect data on their performance. A controlled experiment using the fleet found plug-in electric vehicles to be much more fuel and cost efficient than other hybrid and non-hybrid vehicles.
Honeywell International	Honeywell is developing smart grid enabled products, implementing smart grid programs with utilities, and developing smart grid standards. The company's product lines range from electric meters to programmable thermostats and demand response automation technology.
IBM	IBM is involved in system integration, hardware and appliances, cloud services, research and solutions for electricity and utilities, software applications for generation, transmission and distribution, analytics and optimization for generators, security and compliance.
Intel	Intel Active Management Technology tracks failures, protects against infected devices, and restores systems remotely. Intel Virtualization Technology isolates smart grid applications in secure partitions to avoid the need for rebooting other applications when only one is failing. Intel Trusted Execution Technology protects against software-based attacks, guarding critical software from malware and stopping unauthorized use of data. Intel also sponsors the Open Energy Initiative with the goals of influencing smart grid policy, leading in government programs, standards bodies, and partnering with utilities, and investing strategic venture capital.
Johnson Controls	Johnson Controls is partnering with IBM for the Smart Building Solution. This effort unites the software, hardware, and services expertise of IBM with their energy efficiency and sustainability technologies to improve energy and asset management in their businesses. The program will utilize Johnson Controls' Energy and Emissions Management System, Metasys Sustainability Manager, and Visible Living Lab tools along with IBM products and services to manage energy, report savings, and integrate business, building and smart grid systems.
Juniper Networks	Juniper Networks developed a network-based security infrastructure for smart grid that identifies, mitigates and reports attacks, improves performance, and provides network-wide visibility. These features are accomplished through firewalls, intrusion prevention applications, local and remote user access control, data acceleration and encryption, and central management.
Lockheed Martin	Lockheed Martin's Smart Energy Enterprise Suite (SEE) includes applications allowing utilities to operate smart grids efficiently. SEEload helps utilities manage energy with analytics that integrate demand response programs and manage loads with adaptive algorithms. SEEview provides real-time integrated views of operational systems to help manage smart grid systems. SEEgrid allows utilities to manage multiple microgrids and offers customers information on real-time market demand. Security is at the core of every application.
Microsoft	Microsoft collaborates with multiple partners to offer solutions in the following areas: business intelligence and analytics, electric distribution management systems, energy and information management, GIS and asset management, mobile workforce management, project intelligence, and smart metering.
Oracle Systems Corp	Oracle provides software applications, servers and storage for smart grid operations. Products assist utilities with billing and customer service, meter data management, asset management, and energy storage.
Siemens Communications	Siemens provides solutions across the smart grid spectrum including utility-scale technology, electric distribution networks, and the industrial, commercial, or residential end-users. Siemens is developing new innovations in advanced metering and control devices and demand response technologies as well as intelligent building and industrial process controls that augment the smart grid work being developed at utility scale.
Verizon Wireless	Verizon Wireless partners with companies like Itron, Ambient Corp. and Qualcomm, providing use of their wireless network for machine-to-machine services that communicate smart grid device data over the network. Verizon Wireless also offers utilities security consulting services, building off their cybersecurity expertise gained in the context of mobile devices.

SILICON VALLEY'S IT INDUSTRY IS LARGE, DIVERSE, HIGHLY CONCENTRATED AND GROWING

As large, diverse IT companies in the region have entered the smart grid space with expanding employment shares focused on new products and services, the region's core IT sector will provide the vital IT infrastructure required by the smart grid. While Silicon Valley's total employment remained relatively stagnant in recent years, specific IT sectors have grown. From 2008 to 2009, employment in Software grew three percent, Instrument Manufacturing grew 11 percent, and Computer Hardware grew 17 percent.

With 126,980 employees in 2009, Software accounts for the largest IT sector in Silicon Valley. In addition, Software jobs are 4.5 times more concentrated than the state as a whole, and employment expanded by 125 percent since 1995. The sectors Semiconductor & Semiconductor Equipment Manufacturing and Computer Hardware are also highly concentrated in the region and boast the second and third highest IT employment numbers in 2009. Every IT sector except Other Media & Broadcasting is more highly concentrated in Silicon Valley than in the state as a whole.

Over the long term, the three IT sectors with the strongest growth are Software (+125%), Other Media & Broadcasting (+28%), and Internet & Information Services (+18%).

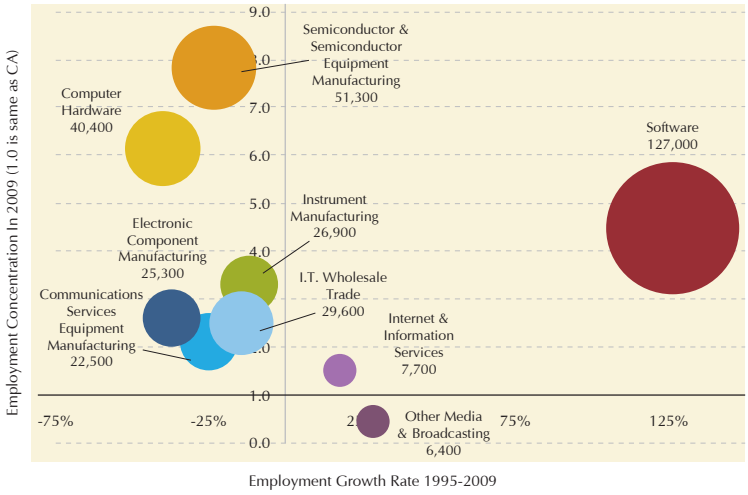
Over the more recent period, 2005 to 2009, Software (+25%), Instrument Manufacturing (+17%), I.T. Wholesale Trade (+7%), and Computer Hardware (+6%) reported the strongest employment growth in Silicon Valley. Except for Software, this recent growth stands in contrast to the long term trends. Conversely, Internet & Information Services employment grew from 1995 to 2009, but contracted 13 percent in the more recent five-year period.

Although contracting over the long term, employment in the sectors of Computer Hardware and Instrument Manufacturing expanded by 17 percent and eleven percent respectively from 2008 to 2009.

Business with ten or fewer employees make up a significant share of Silicon Valley's IT industry and this share has increased from 71 percent to 75 percent since 1995. In 2009 small businesses were most highly concentrated in Other Media & Broadcasting (92%), Internet & Information Services (85%) and I.T. Wholesale Trade (80%). Semiconductor (47%) and Computer Hardware (56%) report smaller shares of small businesses.

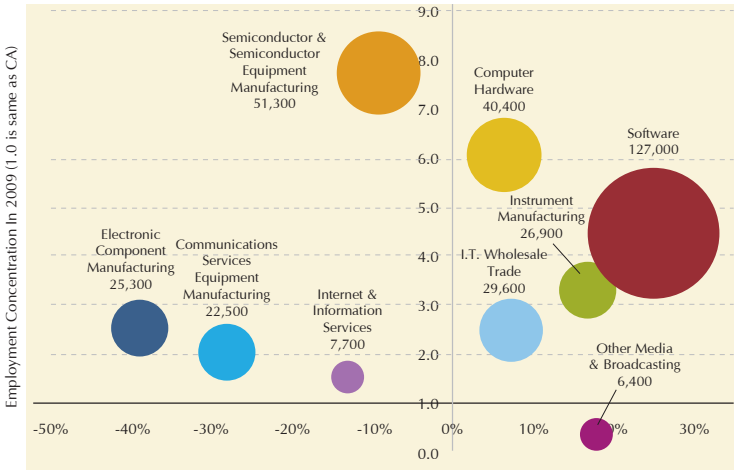
Recent trends in overall employment suggest that even in the context of the recent economic downturn, Silicon Valley and the broader Bay Area are well positioned to continue to grow and lead in the development and application of smart grid related technologies. This analysis requires the use of highly

LONG-TERM GROWTH INFORMATION TECHNOLOGY
Santa Clara and San Mateo Counties



Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

RECENT GROWTH IN INFORMATION TECHNOLOGY
Santa Clara and San Mateo Counties



Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

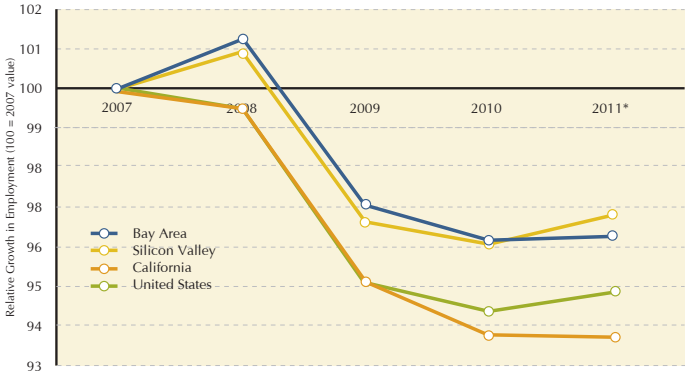
detailed business establishment data, for which there is a greater time lag than is the case with more general public data. While the employment estimates reported in this analysis are current as of January 2009, recent overall job trends indicate that Silicon Valley and rest of the Bay Area should be able to continue the job growth related to smart grid beyond what was reported as of January 2009.

Heading into the recent downturn, Silicon Valley and rest of the Bay Area felt the blow of job losses a year later than the state and nation, and losses were not as deep. Bottoming out in 2010, employment in Silicon Valley and the Bay Area had dropped four percent from 2007 levels. Relative to 2007, employment fell by 5.6 percent nationally and 6.3 percent statewide. The rebound in the region is outpacing that of the state.

PERCENT CHANGE IN EMPLOYMENT	
August 2010 - August 2011	
Silicon Valley	+ 2.0%
Bay Area	+1.0%
California	-0.4%
U.S.	+1.1%

Comparing employment growth over the most recent 12-month period, Silicon Valley employment has expanded at twice the rate of the nation. From August 2010 to August 2011, employment in Silicon Valley expanded by two percent and the Bay Area by one percent compared to United States employment which grew by 1.1 percent. These recent trends suggest that growth related to the smart grid should continue as well.

GROWTH IN AVERAGE ANNUAL EMPLOYMENT RELATIVE TO 2007
Silicon Valley, Bay Area, California and the United States



*Data for 2011 is through August
Note: Silicon Valley is Santa Clara and San Mateo Counties. Bay Area is Santa Clara, San Mateo, San Francisco, and Alameda Counties.
Data Source: California Employment Development Department, Labor Market Information Division, Current Employment Statistics Survey (CES); U.S. Department of Labor, Bureau of Labor Statistics, Current Employment Statistics (CES)
Analysis: Collaborative Economics

5 Smart Grid Implementation Projects

Smart grid implementation projects and pilots are materializing across the country and around the globe. The scope of deployment and the status of completion vary from one project to the next. For example, the Sacramento Municipal Utility District (SMUD) has installed a wireless network with access points and relays to transmit energy information from smart meters. Oklahoma Gas & Electric implemented a demand response pilot in the City of Norman, featuring smart meters, wireless connections, distribution automation, data management, and customer studies. Other projects are underway in South Carolina by Duke Energy and in Texas by Center Point Energy. Globally, Castellon, Spain is home to one of the country's first smart grid projects initiated by the world's fourth largest utility, Iberdrola.[20]

The following examples illustrate four different types of smart grid deployment efforts in the United States. The first project, located in the heart of Silicon Valley, is a public-private collaboration that brings together some of the region's strongest research assets and businesses in the development of a micro grid, networking buildings and facilities in and around NASA's Moffett Field. The second implementation project, located in South Bend, Indiana is currently testing participant incentive schemes for remote access to thermostats. The Pecan Street project in Austin, Texas is a public-private deployment effort that focuses on a broad set of issues related to smart grid including technical components such as demand response, network storage and distributed generation, as well as workforce training, utility business models, and consumer impacts and behavioral economics. Lastly, the PowerCentsDC program launched in the nation's capital tested three pricing structures to examine whether or not customers would respond to price changes and produce electricity and cost savings.

MOFFETT PARK COMMUNITY SMART GRID PROJECT

Silicon Valley

The Moffett Park Community Smart Grid Project is a public-private partnership with the goal to develop a fully-integrated smart grid in the area in and around Moffett Field. Launched as an initiative of Joint Venture: Silicon Valley Network's Climate Prosperity Initiative, local companies such as Juniper Networks, NetApp, University Associates – Silicon Valley, and Google, along with the City of Sunnyvale, are working in a collaborative to make building controls smarter, buildings more grid responsive, and the system of renewables and grid devices an exemplary technology platform for next generation Smart Grid Systems. The U.S. Department of Energy's Lawrence Berkeley National Laboratory is the co-lead on the project and brings its expertise from the research and development perspective.

A vertically-integrated approach to the implementation of the smart grid will lead to demand shed and increased reliability to end-users while proving the interoperability of smart grid technologies. And the Moffett Park area is uniquely suited to be an ideal host for the implementation of these technologies, including:

- Billions of dollars planned for new development of over 200 acres of land
- Unique, contiguous location of government and private sector organizations
- Home to many large and well known green focused companies
- Need for upgrades to current substation and distribution system
- Close proximity to utility owned transmission infrastructure
- Research facilities, data centers and waste water treatment facility smooth 24 hour power demand
- Vacant landfills and large parking areas available for distributed renewable generation sites

Participating organizations signed a memorandum of understanding to participate in the project on March 11, 2011, and the installation of the first phase of technologies will take place over the following twelve months.

The project's steering committee includes the Joint Venture: Silicon Valley Network, U.S. Department of Energy's Lawrence Berkeley National Laboratory, the City of Sunnyvale, Juniper Networks, NetApp Inc., Google Inc. and the Moffett Park Business Group, whose membership includes many of the previously mentioned organizations in addition to Lockheed Martin Corp., Yahoo Inc., Infinera Corp., Jay Paul Company, Detati Communications, and Labcyte. Other participants may include NASA's Ames Research Center, the City of Mountain View, and Pacific Gas & Electric Co.[21]

AMERICAN ELECTRIC POWER, gridSMART

South Bend, IN

American Electric Power (AEP) is headquartered in Ohio and serves as a utility provider for roughly 5.3 million people in the states of Ohio, Texas, Virginia, West Virginia, Tennessee, Michigan, Kentucky, Oklahoma, Arkansas, Indiana, and Louisiana. In 2007, AEP commenced an initiative called gridSMART in South Bend, Indiana. The objectives of this project are to engage customers to reduce energy use, improve customer service, and increase the efficiency of grid operations. The pilot began in 2009 and continued through the 2010 cooling season.[22] Infrastructure improvements included nearly 10,000 installed smart meters and customer components through which users view their energy usage from the prior day and participate in programs aimed to reduce electricity use. The improved smart grid infrastructure enabled remote connect and disconnect abilities, automated outage detection and restoration, and distributed automation.

Most of AEP's expectations were in line with the realized cost savings and improvements in internal efficiency observed throughout the pilot. The pilot revealed valuable insights regarding customer

participation in voluntary programs and how to better promote the programs in the future. For example, gridSMART provided customers with the option to subscribe to time-of-day rates that charged less for off-peak energy use, but significantly more for use during peak hours. Voluntary subscription to the program was roughly one fifth of the program capacity, and AEP found that customers who did not enroll felt the program did not fit their lifestyle or were unaware the program was available. Improved marketing and customer awareness can help to boost future enrollment in time-of-day rate programs.

An additional voluntary customer engagement program allowed customers to permit the utility to control their thermostat settings with a company-installed, programmable communicating thermostat during periods of high risk for electricity outages. By allowing remote control of their thermostats in two-degree increments, with a change of up to four degrees, customers received a $5 reduction in their monthly bills and reserved the right to override utility settings. AEP reported they achieved the savings anticipated for each of the eight instances when remote control of thermostats was implemented. However, technical glitches did arise, so AEP collaborated with their technology partners to ameliorate the problems and plan a marketing strategy for the next cooling season. Program modifications for the next round of implementation include increased incentives of $8 monthly rebates for participation that decrease to $4 after one override and program disenrollment after a second override.

Riding on the success of the South Bend pilot, a larger version of gridSMART involving 110,000 customers in central Ohio will be partially funded by a $75 million grant from the Department of Energy. The project cost is projected at $150 million and will include smart meters, distributed automation equipment, community energy storage devices, smart appliances and home energy management systems, cyber security, plug-in hybrid electric vehicles (PHEVs), and utility-activated remote control technologies. AEP is partnering with appliance manufacturers to develop smart appliances that can receive price and demand signals from the grid.

Initiatives are in play in Oklahoma and Texas to advance smart grid components, and AEP hopes to install 5 million smart meters in the boundaries of their service area by the year 2015 through gridSMART initiatives. AEP recognizes the need for regulatory support to achieve their goal.

PECAN STREET PROJECT

Mueller Community, Austin, TX

The Pecan Street Project in Austin, Texas was initiated by the City of Austin, Austin Energy, the University of Texas, and the Greater Austin Chamber of Commerce. The founding partners enlisted the help of the Environmental Defense Fund which recruited corporate partners including Dell, Freescale Semiconductor, Gridpoint, Sematech and several companies present in Silicon Valley including IBM, Intel, Oracle, Cisco, Microsoft, Applied Materials, and GE. This group of organizations and businesses met in January 2009 and formed 12 workgroups to focus on different aspects of the project including technical components of smart grid such as demand response, network storage and distributed generation, as well as workforce training, utility business models, and consumer impacts and behavioral economics. In August of 2009, the Pecan Street Project, Inc. was formed, and the non-profit won a $10.4 million grant from the Department of Energy for a smart grid demonstration project in the Mueller community of Austin.

Even before receiving the grant, planning and research for the Pecan Street Project was governed by seven guiding principles as described in a document of working group recommendations[23]; environmental protection, ability to replicate, economic development, city-owned City of Austin Energy, interdependency of renewable energy & efficiency, scope of community integration, and a collaborative process. What makes this project unique from other smart grid pilots is that it started out as an economic development idea and a major project goal is to evaluate what economic opportunities smart grid deployment has for Central Texas. There is a strong base of semiconductor design, technology commercialization, energy research and job-training

methods that can grow a smart grid cluster in the region.

The first pilot included 100 volunteer homes which participated in energy audits for baseline data collection. The installation of energy monitoring systems was completed in late January 2011. The monitoring system can collect energy data every minute and track energy use of up to six home appliances. Collected information is transmitted securely via each homes internet modem. The second pilot of the program will commence in the spring of 2011 and the focus will be on evaluating customers' motivations for electricity conservation improvements.

PowerCentsDC
Washington, DC

PowerCentsDC is sponsored by the Smart Meter Pilot Program Inc., which is a non-profit organization bringing together the expertise of the Consumer Utility Board, District of Columbia Office of the People's Counsel, District of Columbia Public Service Commission, International Brotherhood of Electrical Workers, and the local utility, Pepco. This project sheds light on how effective dynamic pricing can be at reducing electricity consumption and saving consumers money on their monthly electricity bills.

Commencing in July 2008, roughly 900 randomly selected Pepco customers in the District of Columbia were equipped with smart meters, a smart thermostat and agreed to one of three pricing structures. Each participant received an informational package to explain the pricing structures and critical peak hours. A large portion of program participants were those with limited incomes. The program concluded in October 2009, producing data that includes two summers and one winter.

The three pricing structures that determined customer's electricity bills were Critical Peak Pricing (CPP), Critical Peak Rebate (CPR), and Hourly Pricing (HP). CPP features slightly lower prices throughout the year, except for 60 critical peak hours when prices are significantly higher. CPR provides rebates to customers who reduce usage below the baseline during critical peaks. HR customers pay wholesale prices for electricity that change hourly. Both CPP and CPR customers received alerts to critical peak pricing events through telephone, email or text messages. All program customers had access to eMeter's consumer engagement web portal, which provided real-time pricing, month-to-date costs and usage information.

Statistical findings from this pilot were conducted by Stanford Economics Professor Frank Wolak and only results with a 90 percent level of confidence were reported. Overall, CPP produced the greatest peak reductions in electricity use by pilot participants. During the summer, peak hour usage decreased by 34 percent and during the winter by 13 percent. CPR customers reduced summer usage during peak hours by 13 percent and by five percent in the winter. HR customers made the smallest changes in peak hour consumption, which declined by four percent in the summer and two percent in the winter. In general, higher summer temperatures resulted in greater reductions in use, and automatic responses via smart thermostats during critical peak hours significantly reduced summer electricity use for CPP and CPR customers.

Reductions in peak hour use translated into monthly bill reductions for over 91 percent of CPP and CPR participants who saved an average of 3.4 percent on their electric bills. Program participants were surveyed at the conclusion of the program. Over 93 percent preferred the pricing options provided by PowerCentsDC over Pepco's standard offer service pricing, and participants' main motivation was saving money. The success of the program is recognized by the White House National Science and Technology Council Smart Grid Committee and demonstrates many best practices for smart grid implementation.

In Conclusion

The deployment of the smart grid nationally will transform the electrical power system, create demand for smart grid technology, drive new demand for a broad set of information technology, and raise economic competitiveness. Silicon Valley, and the broader Bay Area, is well positioned to be a leader in the development and deployment of smart grid-related technology and to reap the economic benefits of both. The Bay Area is host to a high concentration of talent, companies, and research centers active in the growing space of smart grid-related products and services. Additionally, the region's culture of early adoption of new technology can help drive innovation in these industries in the region.

The regional deployment of the smart grid will improve the Bay Area's energy productivity and grow economic opportunity. Any region can benefit significantly from improvements in energy efficiency; however, deployment of the smart grid in the Bay Area yields additional positive impacts because of the region's unique industry mix. Not only does the Bay Area host a high concentration of companies producing vital components to the smart grid, Silicon Valley's information technology industry will be impacted by the vast new volumes of data generated by growing numbers of "smart" devices along our electricity networks. The Bay Area's community of early adopters of technology has long played an important part in spurring the innovation process in the region and maintaining its role as a global leader in new technology.

The implementation of smart grid confers multiple benefits in the economy by reducing costs associated with the dysfunctional grid, opening up new economic opportunities, and enabling the wider adoption of renewable energy systems. It is estimated that power disturbances create annual losses of approximately $100 billion for electricity consumers and each blackout costs around $10 billion and effects large areas of consumers for often long periods of time.[25] Advanced metering infrastructure and demand response abilities enabled by smart grid reduce the occurrence of power disturbances and blackouts through preemptive measures. In the event of a blackout or other disturbance, the new system allows utilities to detect the location of problems so they can be addressed promptly.

In addition to avoiding the costs associated with a dysfunctional grid, smart grid enables new markets for demand response, distributed renewable energy resources, plug-in hybrid vehicles, and more. The ability to seamlessly integrate distributed renewable energy resources increases the viability of energy generation. Renewable energy integration to the grid will contribute greatly to achieving Renewable Portfolio Standard goals implemented by the State of California for 33 percent renewable energy production by the year 2020.

Deploying smart grid locally will fuel the demand for smart grid-related products and services as well as for IT products in general while also improving the region's competitiveness through the establishment of a more reliable and efficient electrical grid. This growth will not only drive employment growth in these industries, employment associated with smart grid operations will also grow. The Bay Area can maximize the economic benefits from both the development of smart grid companies and the deployment of the smart grid by leveraging its rich assets of technology companies, talent, and research and development facilities. By supporting the broad-based deployment of the smart grid in the region, the Bay Area will be well positioned to grow its leadership in smart grid technologies.

Endnotes

1 All employment and establishment figures are rounded.

2 "Innovative Energy Solutions from the San Francisco Bay Area: Fueling A Clean Energy Future." *Bay Area Council Economic Institute*. July 2007.

3 CITRUS researchers partnered with a Los Angeles lighting company and Bay Area startup to prove smart sensors and control systems for building lighting can drastically increase energy efficiency, saving $8 billion in energy costs nationally and reducing five million metric tons of carbon emissions a year by automatically changing light settings based on daylight levels. Ibid. 58-59.

4 "Stanford researchers awarded $6.27 million to study energy efficiency and human behavior ." *Stanford University News*. 27 Oct. 2009. <http://news.stanford.edu/news/2009/october26/energy-efficiency-funds-102709.html>.
Moresco, Justin. "How 3 ARPA Grants Could Reinvent Building Efficiency." *GigaOM*. 30 Oct. 2009 <http://gigaom.com/cleantech/how-3-arpa-e-grants-could-reinvent-building-efficiency/>.

5 "Top 10 U.S. Utilities by Demand-Side Investment." *Zpryme Research and Consulting*. Mar. 2011. <http://smartgridresearch.org/smart-grid/top-10-u-s-utilities-by-dsm-investment/>

6 Chong, Rachelle. "California Utilities Receive $203 Million in Smart Grid Investment Grant Awards from Dept of Energy." *California Public Utilities Commission*. 27 Oct. 2009. <https://ia.cpuc.ca.gov/CommChong/post/California-Utilities-Receive-24203-Million-in-Smart-Grid-Investment-Grant-Awards-from-Dept-of-Energy.aspx>

7 "Smart Grid Basics" *Federal Smart Grid Task Force*. 14 July 2010. <http://www.smartgrid.gov/basics>

8 "Smart Grid Realities: Technology Leaders, Investments and Projects" *Energy Business Reports*. 66-80.

9 For more detailed information on the smart grid and related components, please see: National Energy Technology Laboratory (NETL) white papers: <http://www.netl.doe.gov/smartgrid/refshelf.html#White Papers>; Smart Grid Realities: Technology Leaders, Investments and Projects: Energybusinessreports.com

10 "Smart Grid Principle Characteristics: Provides Power Quality for the Digital Economy." *National Energy Technology Laboratory*. Oct. 2009

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12 The use of the term "economic resilience" is meant as the ability of an economy to withstand or recover from the effects of adverse exogenous shocks (e.g. volatile fuel prices, global financial crisis or natural disaster). See L. Briguglio, G. Cordina, N. Farrugia, S Vella. 2009. "Economic Vulnerability and Resilience: Concepts and Measurements." *Oxford Development Studies*. Vol. 37, no. 3, pp. 229-247. Sept. 2009.

13 For more on how the deployment of IT changed all industries and promoted economic innovation and productivity, see Atkinson, Robert and Andrew McKay. "Digital Prosperity: Understanding the Economic Benefits of the Information Technology Revolution." *The Information Technology & Innovation Foundation*. Mar. 2007.

14 Ibid, 3.

15 Porter, Michael and Claas van der Linde. "Green and Competitive," *On Competition*. Boston: Harvard Business Review Book.
"Enhancing our Commitment to a Sustainable Future." *Business Roundtable's S.E.E Change and Climate Resolve initiatives*. 2010.

16 "Smart Grid" *National Institute of Standards and Technology*. 7 Apr. 2011 <http://www.nist.gov/smartgrid/index.cfm>

17 "Understanding the benefits of Smart Grid v1.0." National Energy Technology Laboratory. 18 June 2010. 6.

18 Ibid.

19 These categories are consistent with the definition used by Joint Venture: Silicon Valley Network in the *Index of Silicon Valley*.

20 "The World's Fourth Largest Utility Iberdrola Selects Distribution Smart Grid Provider CURRENT Group for Industry's First Open and Interoperable Smart Grid Deployment." *CURRENT*. 27 Apr. 2010. <http://www.currentgroup.com/press_releases.php?id=98>

21 Sibley, Lisa. "Smart grid may come to Moffett Park," *Silicon Valley / San Jose Business Journal*. 11 Mar. 2011. <http://www.bizjournals.com/sanjose/news/2011/03/11/smart-grid-may-come-to-moffett-park.html>

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25 "Understanding the benefits of Smart Grid v1.0." *National Energy Technology Laboratory*. 6. <http://www.netl.doe.gov/smartgrid/referenceshelf/whitepapers/06.18.2010_Understanding%20Smart%20Grid%20Benefits.pdf>

Appendix A: Supplementary Analysis

Summary of IT and Smart Grid Employment and Growth

SILICON VALLEY* IT EMPLOYMENT	1995	2005	2009	PERCENT CHANGE 1995-2009	PERCENT CHANGE 2005-2009
TOTAL IT	336,400	333,940	337,110	0%	1%
SILICON VALLEY	1,396,750	1,513,060	1,531,410	10%	1%
TOTAL CA IT	15,396,750	18,092,930	18,760,480	18%	4%

BAY AREA** SMART GRID EMPLOYMENT	1995	2005	2009	PERCENT CHANGE 1995-2009	PERCENT CHANGE 2005-2009
SMART GRID	5,480	9,990	12,560	129%	27%
BAY AREA	2,810,850	3,037,210	3,040,170	8%	0%
TOTAL CA SMART GRID	15,396,750	18,092,930	18,760,480	18%	4%

* Silicon Valley refers to Santa Clara and San Mateo Counties

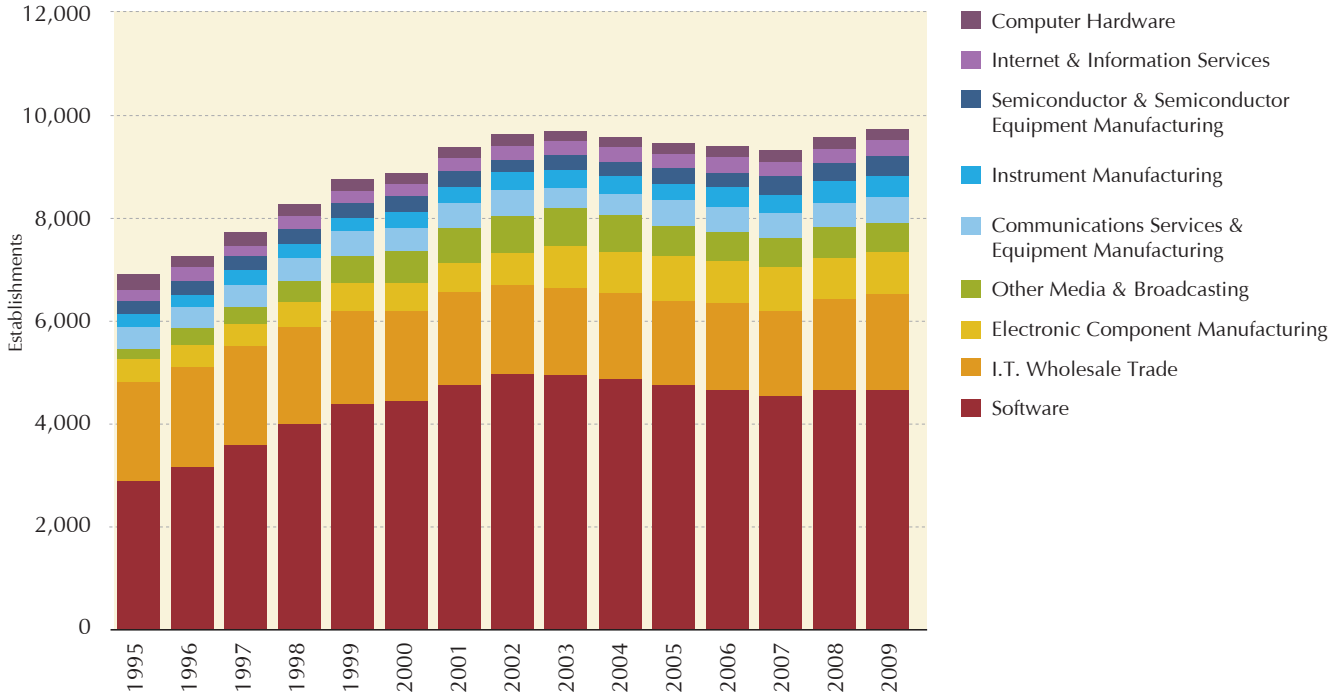
** Bay Area refers to Santa Clara, San Mateo, San Francisco and Alameda Counties

Small Businesses in IT and Smart Grid Sectors

In addition to the cohort of large and diverse companies working in the space of smart grid, there is a large proportion of small businesses innovating smart grid technologies. The long-term increase in proportion of small companies working in smart grid fields indicates suggest an increase in entrepreneurial activity.

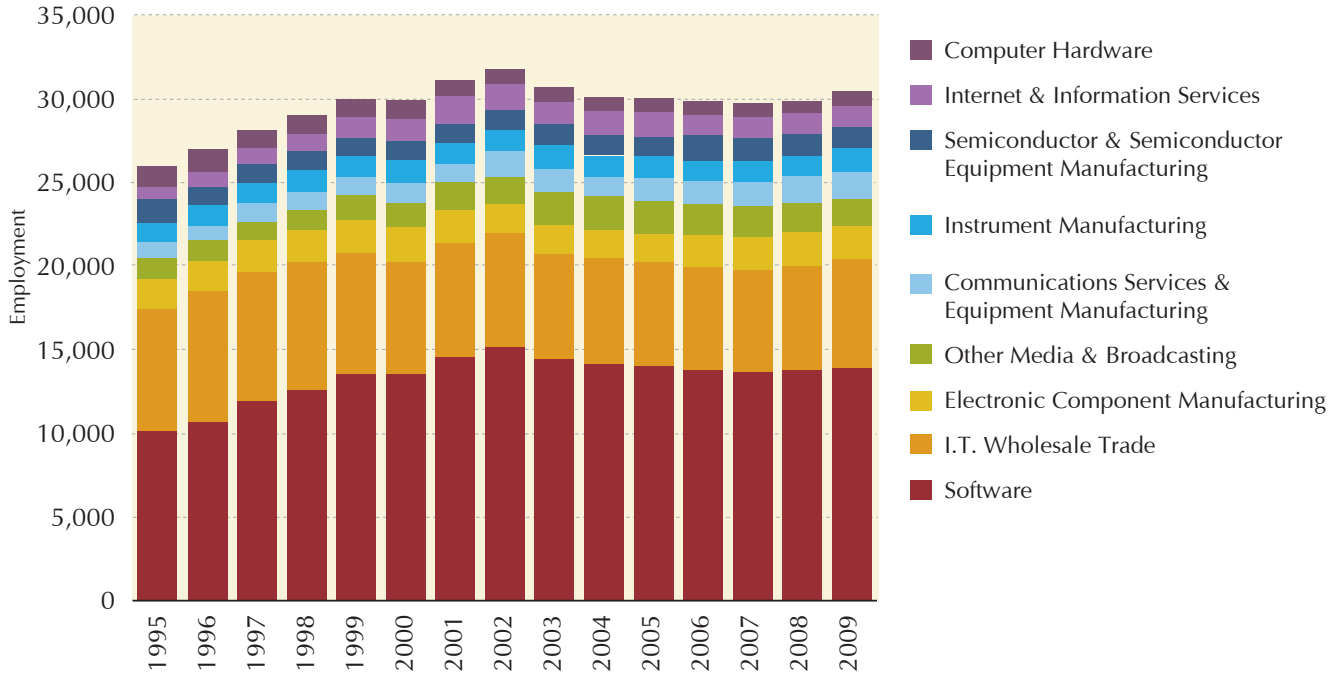
PERCENTAGE OF ESTABLISHMENTS WITH 10 OR FEWER EMPLOYEES			
		1995	2009
BAY AREA	SMART GRID	34%	69%
	TOTAL	71%	75%
SILICON VALLEY	IT	84%	90%
	TOTAL	84%	91%

IT SECTOR ESTABLISHMENTS WITH 10 OR FEWER EMPLOYEES
Santa Clara and San Mateo Counties



Data Source: Green Establishment Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

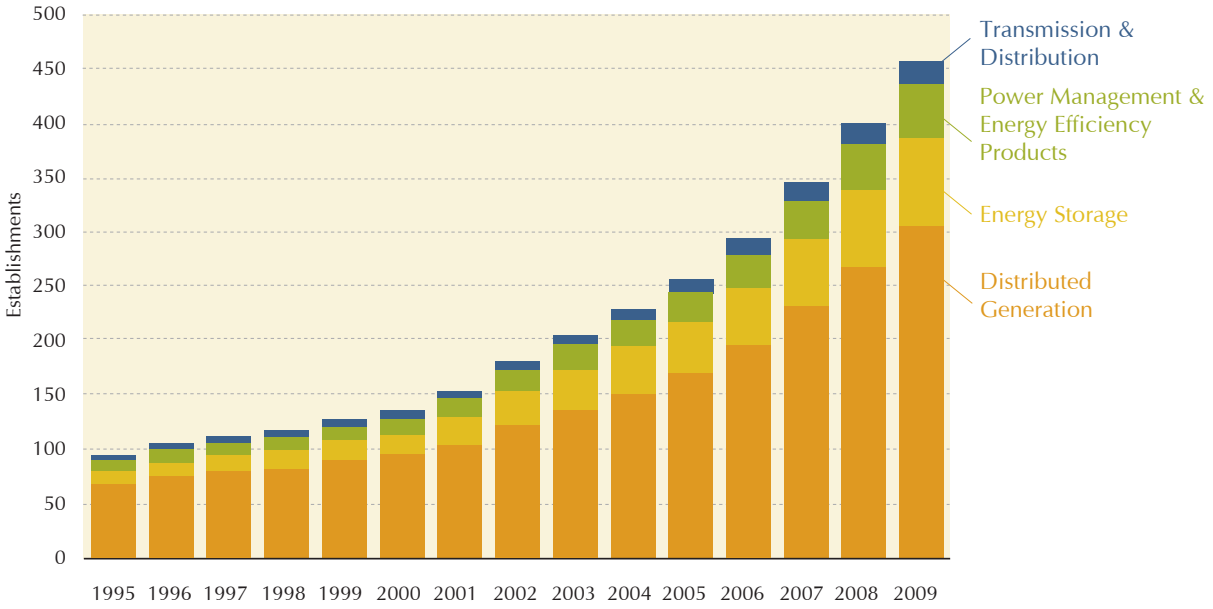
IT SECTOR EMPLOYMENT IN ESTABLISHMENTS WITH 10 OR FEWER EMPLOYEES
Santa Clara and San Mateo Counties



Data Source: Green Establishment Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

SMART GRID ESTABLISHMENTS WITH 10 OR FEWER EMPLOYEES

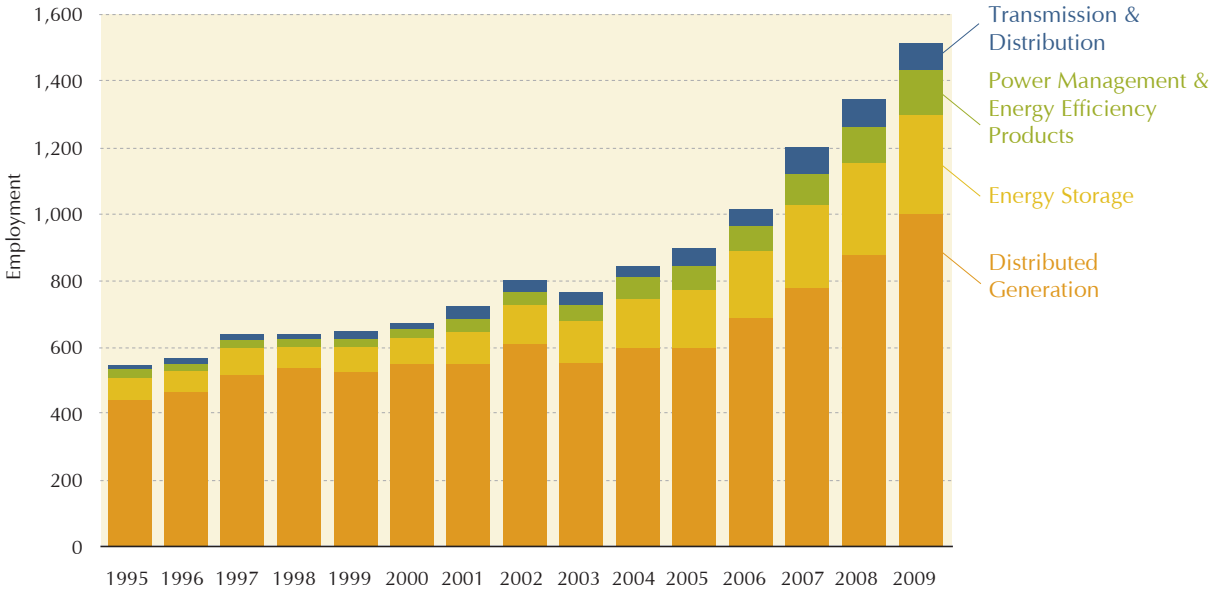
Santa Clara, San Mateo, Alameda and San Francisco Counties



Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

SMART GRID EMPLOYMENT IN ESTABLISHMENTS WITH 10 OR FEWER EMPLOYEES

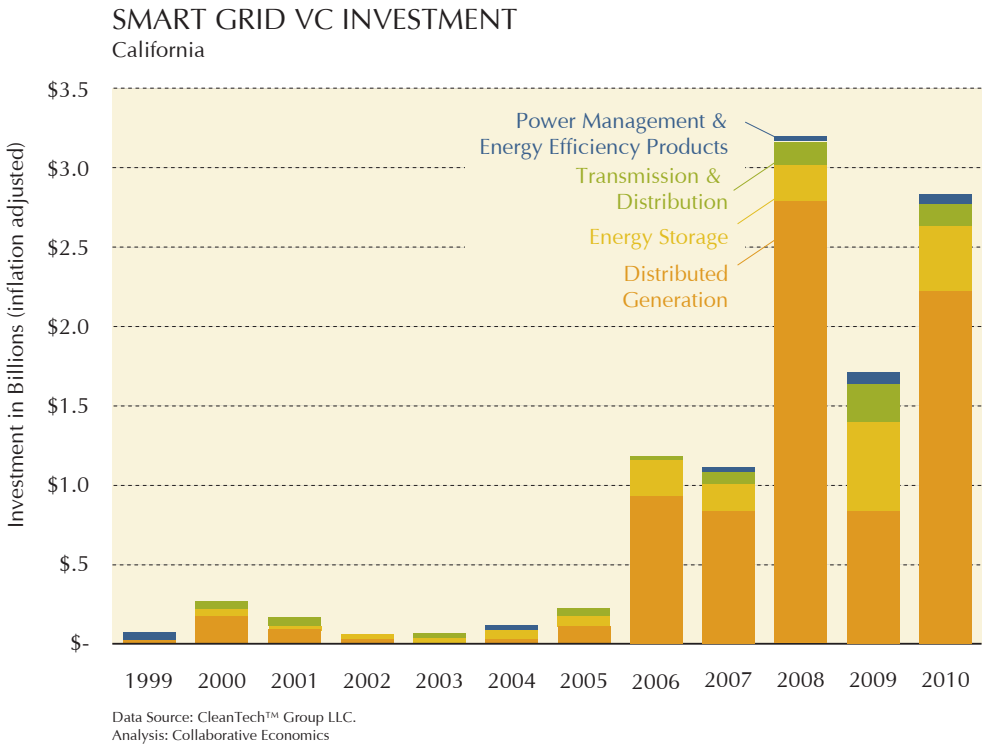
Santa Clara, San Mateo, Alameda and San Francisco Counties

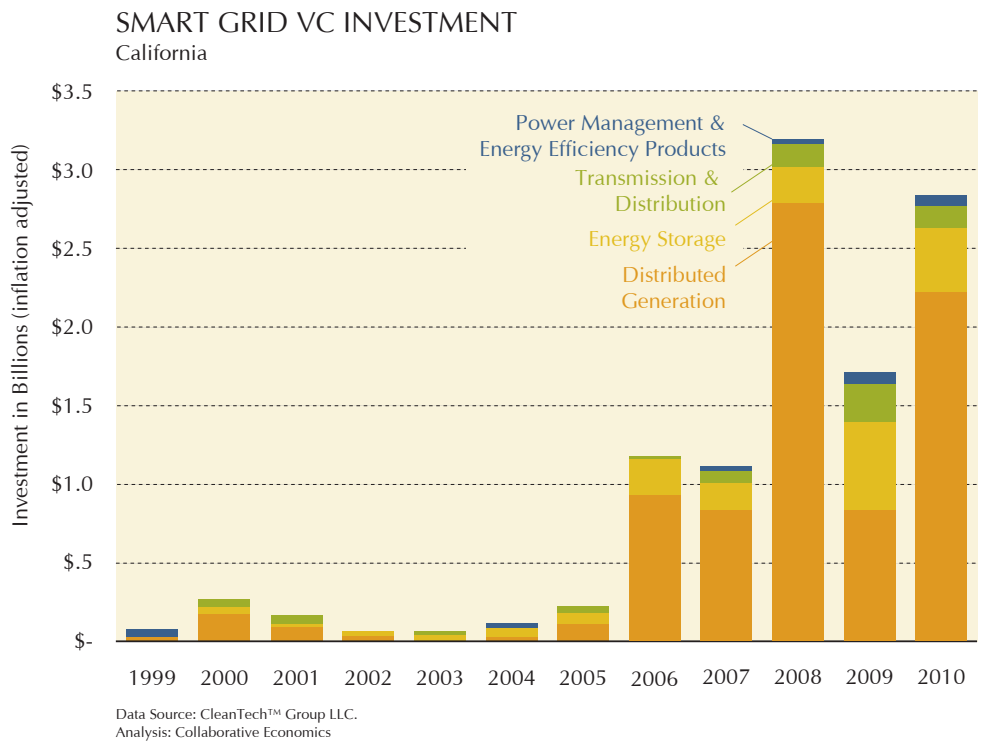


Data Source: Green Establishments Database, National Establishment Time-Series (NETS) Database
Analysis: Collaborative Economics

SMART GRID VC INVESTMENT

Increasing 66 percent from 2009, total California venture capital investment in smart grid related sectors reached 2.8 billion dollars in 2010. Since 2005, nationally, investment has grown 309 percent and in California, by 183 percent, and continued growth is anticipated.





Appendix B: Methodology & Data Notes

ELECTRICITY PRODUCTIVITY AND CONSUMPTION

Electricity Consumption data is from the California Energy Commission. Gross Domestic Product (GDP) data is from Moody's Economy.com. GDP values are inflation-adjusted and reported in 2010 dollars, using the CPI for the U.S. City Average from the Bureau of Labor Statistics. Silicon Valley data includes Santa Clara and San Mateo Counties.

GROWTH IN AVERAGE ANNUAL EMPLOYMENT, RELATIVE TO 2007

Monthly and annual employment data for the Santa Clara, San Mateo, San Francisco and Alameda Counties, and California is from California Employment Development Department, Labor Market Information Division, Current Employment Statistics Survey (CES) and is non-seasonally adjusted. Monthly and annual employment data for the United States is from the Bureau of Labor Statistics, Current Employment Statistics (CES) survey and is non-seasonally adjusted.

SMART GRID VENTURE CAPITAL INVESTMENT

Venture capital investment data for smart grid is based on Cleantech™ Group LLC Venture Investment data. The definition for Smart Grid and its four segments is based on the Primary, Secondary and Tertiary Industries created by Cleantech™ Group LLC. The three levels of Industries included in the Smart Grid VC Investment definition are as followed: Energy Efficiency with secondary industries of Lighting and Other, with the tertiary industries of Smart Lighting Systems, Monitoring, Metering & Controls, Sensors & Controls. Within the Energy Generation primary industry, all secondary and tertiary industries have been included. For the Energy Infrastructure industry, all of Transmission and Management secondary segments have been included. All secondary and tertiary segments in Energy Storage have been included. Within Transportation, only the tertiary segments of Electric & Hybrids and Bicycles & Scooters have been included.

CALIFORNIA'S CORE GREEN ECONOMY: GREEN BUSINESS ESTABLISHMENTS DATABASE

Collaborative Economics has developed an approach for identifying and tracking the growth of businesses with primary activities in the Core Green Economy. This methodology was originally developed for work carried out on behalf of Next 10, a California-based nonprofit, and published in the California Green Innovation Index (2008, 2009, and 2010). Building on this work, CEI designed and conducted the nationwide analysis of green business activity on behalf of the Pew Charitable Trusts. The Pew Center on the States reformatted the results of the analysis and developed the report, The Clean Energy Economy (June 2009).

The accounting of green business establishments and jobs is based on multiple data sources (including New Energy Finance and the Cleantech GroupTM, LLC) for the identification and classification of green businesses and also leveraged a sophisticated internet search process. Collaborative Economics designed the parameters of the internet search platform which was engineered by PlanetMagpie, a Bay Area-based IT service company. The National Establishments Time-Series (NETS) database based on Dun & Bradstreet business-unit data was sourced to extract business information such as jobs. The operational definition of green is based primarily on the definition of cleantech defined by the Cleantech Network.

The jobs numbers reported in the database reflect all jobs at each business location. In the case of multi-establishment companies, only the green establishments are included. While this approach does not examine specifically green occupations that are appearing across the entire economy (such as Chief Sustainability Officer), it does account for the businesses behind the products and services that these new professionals need to use in their jobs (such as advanced metering devices, co-generation equipment, and various high-efficiency materials).

The multilayered process involves both automated and manual verification steps of business establishments and their activities. In cases where the results were uncertain and the activities of a business establishment could not be verified (e.g. on a company's website), the establishment was dropped from the database. Therefore, the database offers a conservative estimate for the numbers of establishments and jobs in the Core Green Economy.

SMART GRID SECTORS

The smart grid sectors were created using establishment information from the Green Establishment Database and the 15 Green Segments as defined in Next 10's Many Shades of Green Report. A large portion of smart grid sector data originates from four of the 15 Green Segments: Energy Generation, Energy Infrastructure, Energy Efficiency and Energy Storage. All establishments from the Green Establishment Database with products or services applicable to a sector of smart grid are included. Additional outside research identified smart grid related companies that were not previously identified with one of the 15 Green Segments. These companies where analyzed for relevance and included in the appropriate smart grid sector.

NATIONAL ESTABLISHMENT TIME-SERIES (NETS) DATABASE

The NETS database is constructed from 20 "snapshots" taken every January since 1990 of all active Dun and Bradstreet establishments (currently 41.7 million unique establishments with over 24 million still active). That data is then put through rigorous quality control, statistical analysis, and additional estimation procedures to create the resulting time-series in the NETS Database. These snapshots use the Duns Marketing Information (DMI) file to determine which establishments were active. Other archival files (e.g., the Credit Rating file) were utilized to provide annual raw establishment data that allowed us to create time-series information. Each summer the NETS Database is updated with another year of establishment information. No establishments are ever deleted from the Database; but their "LastYear" is indicated, so one can explore the dynamics of "births" and "deaths" of establishments. Walls & Associates maintains the NETS Database and continues to update and improve estimates before the next annual update. The calendar year for NETS data is from January to January.

I.T. NAICS Definition

Sub Category	NAICS Code	2007 NAICS Title
Communications Services & Equipment Manufacturing	334210	Telephone Apparatus Manufacturing
Communications Services & Equipment Manufacturing	334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing
Communications Services & Equipment Manufacturing	334290	Other Communications Equipment Manufacturing
Communications Services & Equipment Manufacturing	334310	Audio and Video Equipment Manufacturing
Communications Services & Equipment Manufacturing	517110	Wired Telecommunications Carriers
Communications Services & Equipment Manufacturing	517210	Wireless Telecommunications Carriers (except Satellite)
Communications Services & Equipment Manufacturing	517410	Satellite Telecommunications
Communications Services & Equipment Manufacturing	517911	Telecommunications Resellers
Communications Services & Equipment Manufacturing	517919	All Other Telecommunications
Computer Hardware	334111	Electronic Computer Manufacturing
Computer Hardware	334112	Computer Storage Device Manufacturing
Computer Hardware	334113	Computer Terminal Manufacturing
Computer Hardware	334119	Other Computer Peripheral Equipment Manufacturing
Electronic Component Manufacturing	327113	Porcelain Electrical Supply Manufacturing
Electronic Component Manufacturing	327212	Other Pressed and Blown Glass and Glassware Manufacturing
Electronic Component Manufacturing	334411	Electron Tube Manufacturing
Electronic Component Manufacturing	334412	Bare Printed Circuit Board Manufacturing
Electronic Component Manufacturing	334414	Electronic Capacitor Manufacturing
Electronic Component Manufacturing	334415	Electronic Resistor Manufacturing
Electronic Component Manufacturing	334416	Electronic Coil, Transformer, and Other Inductor Manufacturing
Electronic Component Manufacturing	334417	Electronic Connector Manufacturing
Electronic Component Manufacturing	334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing
Electronic Component Manufacturing	334419	Other Electronic Component Manufacturing
Electronic Component Manufacturing	334612	Prerecorded Compact Disc (except Software), Tape, and Record Reproducing
Electronic Component Manufacturing	334613	Magnetic and Optical Recording Media Manufacturing
Electronic Component Manufacturing	335110	Electric Lamp Bulb and Part Manufacturing
Electronic Component Manufacturing	335121	Residential Electric Lighting Fixture Manufacturing
Electronic Component Manufacturing	335311	Power, Distribution, and Specialty Transformer Manufacturing
Electronic Component Manufacturing	335312	Motor and Generator Manufacturing
Electronic Component Manufacturing	335313	Switchgear and Switchboard Apparatus Manufacturing
Electronic Component Manufacturing	335314	Relay and Industrial Control Manufacturing
Electronic Component Manufacturing	335912	Primary Battery Manufacturing
Electronic Component Manufacturing	335921	Fiber Optic Cable Manufacturing
Electronic Component Manufacturing	335929	Other Communication and Energy Wire Manufacturing
Instrument Manufacturing	333314	Optical Instrument and Lens Manufacturing
Instrument Manufacturing	333315	Photographic and Photocopying Equipment Manufacturing
Instrument Manufacturing	334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
Instrument Manufacturing	334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use
Instrument Manufacturing	334513	Instruments & Related Products Manufact. for Measuring, Displaying, & Controlling Industrial Process Variables
Instrument Manufacturing	334514	Totalizing Fluid Meter and Counting Device Manufacturing
Instrument Manufacturing	334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
Instrument Manufacturing	334516	Analytical Laboratory Instrument Manufacturing
Instrument Manufacturing	334517	Irradiation Apparatus Manufacturing
Instrument Manufacturing	334518	Watch, Clock, and Part Manufacturing
Instrument Manufacturing	334519	Other Measuring and Controlling Device Manufacturing
Internet & Information Services	515210	Cable and Other Subscription Programming
Internet & Information Services	518210	Data Processing, Hosting, and Related Services
Internet & Information Services	519130	Internet Publishing and Broadcasting and Web Search Portals
Internet & Information Services	519190	All Other Information Services
Other Media & Broadcasting	512110	Motion Picture and Video Production
Other Media & Broadcasting	512191	Teleproduction and Other Postproduction Services
Other Media & Broadcasting	512199	Other Motion Picture and Video Industries
Other Media & Broadcasting	512210	Record Production
Other Media & Broadcasting	512220	Integrated Record Production/Distribution
Other Media & Broadcasting	512230	Music Publishers
Other Media & Broadcasting	512240	Sound Recording Studios
Other Media & Broadcasting	512290	Other Sound Recording Industries
Other Media & Broadcasting	515111	Radio Networks
Other Media & Broadcasting	515112	Radio Stations
Other Media & Broadcasting	515120	Television Broadcasting
Other Media & Broadcasting	519110	News Syndicates
Other Media & Broadcasting	519120	Libraries and Archives
Semiconductor & Semiconductor Equipment Manufacturing	333295	Semiconductor Machinery Manufacturing
Semiconductor & Semiconductor Equipment Manufacturing	334413	Semiconductor and Related Device Manufacturing
Software	334611	Software Reproducing
Software	511210	Software Publishers
Software	541511	Custom Computer Programming Services
Software	541512	Computer Systems Design Services
I.T. Wholesale Trade	423430	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers
I.T. Wholesale Trade	423610	Electrical Apparatus and Equipment, Wiring Supplies, and Related Equipment Merchant Wholesalers
I.T. Wholesale Trade	423690	Other Electronic Parts and Equipment Merchant Wholesalers