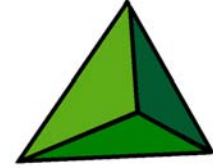




**ECONOMIC &
WORKFORCE
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through the
CALIFORNIA
COMMUNITY
COLLEGES

**BUSINESS AND WORKFORCE
PERFORMANCE IMPROVEMENT INITIATIVE**



Strategic Possibility Summary for Bay Region Community Colleges

SOLAR ENERGY

October 2006



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THE BUSINESS AND WORKFORCE PERFORMANCE IMPROVEMENT INITIATIVE IS A GRANT-FUNDED PROJECT THROUGH THE ECONOMIC & WORKFORCE DEVELOPMENT PROGRAM OF THE CALIFORNIA COMMUNITY COLLEGES. OUR MISSION IS TO STRENGTHEN CALIFORNIA'S WORKFORCE AND ADVANCE ECONOMIC GROWTH THROUGH EDUCATION, TRAINING AND JOB DEVELOPMENT.

The Solar Energy industry in California will create up to 41,600 new jobs by 2020 while producing a secure, renewable, domestic energy source for residential and commercial customers.

Source: Renewable Energy Policy Project

Executive Summary

California is emerging as the world's third largest solar market.¹ **Most industry and financial analysts forecast 20% annual growth in solar energy over both the near and long term**² Solar photovoltaics (PV) systems create more jobs per megawatt of capacity than any other energy technology. Instead of purchasing natural gas for power plants from out of state energy suppliers, California has an economic opportunity to produce abundant, clean electricity with PV technologies and create high-quality jobs and a more robust economy in the state. Solar PV technologies are easy to build, modularize, disperse, and deploy. Solar power can provide significant benefits to society, end-use customers, public utilities, solar energy manufacturers and solar energy service providers.³

The Renewable Energy Policy Project estimates that California's solar capacity will grow to between 700 and 1,300 megawatts (MW) by 2020.⁴ Based on this projected capacity and the Solar Energy Industries Association (SEIA) estimate that 32 jobs are created for every megawatt of installed solar power, it is reasonable to expect that **between 22,400 and 41,600 new jobs will be created in California's solar PV industry by 2020.** Jobs in this industry provide a living wage and include health benefits – generally because the industry relies heavily on manufacturing and construction. In addition, jobs in operations and maintenance, although fewer in number than manufacturing and construction would also pay well – approximately \$40,000 per year for entry-level workers.

The potential economic impact of this industry as it grows is significant. Job creation by 2020 as stated could be significant and with 70% of solar technology sales in exports, the jobs that are created stay in the U.S. and help reduce the trade deficit. The infusion of venture capital into the U.S. and California economy is growing to the extent that clean technology has risen to become the sixth largest venture investment category in the U.S. Global solar markets (including modules, system components, and installation) reached \$11.2 billion in 2005 – up 55% from a year earlier – and are expected to grow to \$51.1 billion by 2015.⁵

This report will show that the solar energy industry has the potential for high job growth and large economic impact if the economic investments described in this report are made. However, at this time, the industry does not warrant a strategic, regional response from the

¹ Sun Light & Power, <http://www.sunlightandpower.com/about/news.html>, home web page.

² Solar Power Solutions: A Business Case for Capturing Total Value, p.10)

³ The Clean Energy Trends 2006 report says that clean technology has already risen to become the 6th largest venture investment category in the U.S. and Canada, behind information technology, software, biotechnology, health care, and telecommunication, http://www.cleantech.com/reports-SF_cleantech.php.

⁴ *Renewable Energy for California: Benefits, Status and Potential*, Fred Beck et al, March 2002.

⁵ *Clean Energy Trends 2006*, Joel Makower, March 2006, Pg. 2,9.

community colleges. Community colleges will have the opportunity to partner with the solar energy industry as it grows to develop specific training programs that can be created or adapted to meet the industry's workforce development needs. Several of the California Community Colleges Economic and Workforce Development Centers – one focusing on Transportation and Energy, and another focusing on Advanced Competitive Technologies - are in an excellent position to provide technical expertise to this emerging industry as public and private investments are made. These Economic and Workforce Development Centers can also play a key role in assisting community colleges with developing the curriculum and capacity needed to serve the workforce development needs of the industry.

In sum, further research on the broader area of renewable energy and exploring opportunities for industry partnerships may be the best recommendations for moving forward. The renewable energy cluster of solar, wind, fuel cells and geothermal may be of greater relevance to our community colleges because the cumulative job growth projections and economic impact of this cluster presents a more viable strategic opportunity for our community college system than just the solar industry alone.

What is a Strategic Possibility?

A strategic possibility report identifies growing industries and occupations for which an effective college response would best serve our local communities. This report aims to identify the sector's relevance to the community colleges, its economic impact, the adaptability of colleges to respond, and the ability to build partnerships with state and industry leaders to create career paths and upward mobility. A full environmental scan may then be conducted to gather information at a level of detail that would suggest possible responses.

Strategic Possibility Description

California Senate Bill (SB) 1078, signed into law on September 12, 2002, established a renewable portfolio standard (RPS) for California's investor owned electric utilities and sets objectives for municipal power systems (see Appendix A.) By 2017, RPS retail electric sellers other than municipal utilities must have 20% of retail electric sales supplied by renewable resources and retail sellers must increase renewable supply by at least 1% per year until the 20% target is reached.⁶

The Clean Energy Trends 2006 report states that clean technology has already risen to become the sixth largest venture investment category in the U.S. and Canada, behind information technology, software, biotechnology, health care, and telecommunication, (http://www.cleantech.com/reports-SF_cleantech.php.)

As a result of both public initiatives and private investments, the Renewable Energy Policy Project estimates that California's solar capacity will grow to 700-1,300 MW by 2020.⁷ If these estimates are accurate, **between 22,400 and 41,600 new jobs will be created in**

⁶ Solar Electric Power Association, SMUD ReGenProgram, Project 1.2 Photovoltaic Markets and Technologies, Del. 1.2.2.1:SMUD's PV Program and Sacramento Markets Rept, Contract #4500015118, pg. 21.

⁷ *Renewable Energy for California: Benefits, Status and Potential*, Fred Beck et al, March 2002.

California's solar PV industry by 2020. Clean Edge predicts that **the global solar energy industry will grow from \$11.2 billion in 2005 to \$51.1 billion by 2015**⁸ and experts estimate that between 5 and 15 jobs are created for every million dollars invested in solar electricity.⁹

The solar energy industry offers the opportunity to build an industry of high-technology companies and jobs in science, engineering, manufacturing, construction and services. In addition, a renewable resource such as PV reduces dependence on all traditional sources of energy and creates a source of energy secure against any external supply interruption or price manipulations.¹⁰

Pre-Validation of Strategic Possibility

- **Our Solar Power Future**
Solar Energy Industries Association (SEIA)
- **Solar Task Force Report**
Western Governor's Association Clean and Diversified Energy Initiative
- **Quantifying the Benefits of Solar Power for California**
Ed Smeloff, December 2004, *The Vote Solar Initiative*
- **2005 Integrated Energy Policy Report: Committee Final Report Executive Summary**, California Energy Commission
- **Solar Power Solutions: A Business Case for Capturing Total Value**
Solar Electric Power Association

Qualifying the Strategic Possibility

The Business and Workforce Performance Improvement initiative has identified six criteria that determine if an industry qualifies for a strategic response from local community colleges. They are size, relevance, adaptive, economic impact, high growth, and leveraging. These criteria are discussed below.

⁸ *Clean Tech: Profits and Potential*, Clean Edge, Joel Makower et al, April 2001.

⁹ *Solar Energy 101*, Apollo Alliance, www.apolloalliance.org.

¹⁰ *Solar Power Solutions: A Business Case for Capturing Total Value*, 2002, p. 4

Employment Growth: Relative Size of the Strategic Possibility

The solar industry currently employs approximately 32 people for every megawatt (MW) of installed solar power. Twenty-four (24) of these jobs typically are in construction and manufacturing and eight (8) jobs are spread among diverse areas such as architecture and system design, distribution, installation, and service.¹¹ Solar thermal plants create 2.5 times as many skilled, high paying jobs for the communities in which they operate as do conventional power plants that use fossil fuels. (www.solardev.com – Solar Developments; a solar energy equipment supplier.)

Governor Schwarzenegger’s Million Solar Roofs Initiative, the California Energy Commission’s Emerging Renewable Program and the Public Utilities Commission’s Self-Generation Incentive Program¹² are providing monetary incentives to encourage solar installations into the construction of new and existing buildings. The following employment data are projections from the California Solar Initiative:

Employment Creation Benefits	Operations/Maintenance Job-Years	Manufacturing Job-Years
Jobs* generated by solar installed during California Solar Initiative (2006-2016)	3,995	6,146
Jobs* generated as a result of California Solar Initiative (2006-2026)	14,265	21,946

* Job numbers are estimates and based on each job lasting for ten years.

The following job functions are commonly identified with solar energy:

- Project Management
- Inverter (power conditioning unit)
- Engineering & Design
- Foundation (including tracking systems)
- Procurement
- Structure
- Permitting
- Electrical Wiring
- Installation
- Electrical Protection and Safety Equipment
- Site Facilities
- Construction Management
- Start-Up & Testing
- Electrical Interconnection & Metering
- Data Monitoring
- Communications and Control
- Operation & Maintenance
- Training

Jobs in this industry would provide a living wage and include health benefits – generally because they would draw so heavily from the manufacturing and construction sector which are highly unionized. In addition, jobs in operations and maintenance, although fewer in number than manufacturing and construction, would pay well – approximately \$40,000 per year for entry-level workers.

¹¹ Our Solar Power Future, 2005, Solar Energy Industries Association, p.9

¹² *Million Solar Roofs Initiative* – to facilitate the sale and installation of one million solar roofs by 2010, www.millionsolarroofs.org.
California Energy Commission Emerging Renewable Program – California Solar Initiative – aims to install 3,000 megawatts of solar energy on 1 million homes, businesses and public buildings over 11 years, www.energy.ca.gov/renewables/emerging_renewables.
Public Utilities Commission’s Self-Generation Incentive Program – home and business owners who install solar panels would be eligible for an initial \$2.80 rebate for each watt of capacity they install and in each consecutive year the rebate would be decrease by 10% until it becomes 25 cents in 2016, www.sdge.com/business/incentive_programs.shtml.

A few examples of how the solar industry is growing in the Bay Region:

- The City of Oakland is committing to obtain 100% of its electricity from renewable sources by 2030 and become a “zero-waste” city by 2020.¹³
- The Santa Rita Jail in Alameda County (500 kW) and the San Francisco Public Utilities Commission (255 kW) both recently installed PV systems.
- The City of Los Angeles is encouraging the installation of 100,000 solar rooftops.¹⁴
- The City of Berkeley is now home to a number of clean-energy businesses, including PowerLight Corp, the U.S. leader of PV integrated systems.¹⁵

Relevance

California Community Colleges can partner with solar energy providers, local municipalities, labor unions, and businesses to develop a comprehensive curriculum and develop certification programs to provide a skilled workforce to construct, install and maintain solar energy projects. Currently we are not aware of any California community colleges that have programs specifically preparing students in the solar energy industry. However, Seneca College in Toronto in partnership with the Canadian Solar Industries Association offers a PV Technician’s Certificate program. The program provides a comprehensive understanding of related electrical theory and the fundamentals of PV systems. Students learn the theory and practice required to use and install a solar electric system. Courses in the program include:

- Introduction to Electricity
- DC & AC Circuit Analysis
- Meter Principles and Operation
- Principles of Electrical Devices
- Solar Theory
- Electrical Code for PV Systems
- Batteries and Charge Controllers
- Practical Review of PV Equipment

Looking at the entire renewable energy industry may be of even greater relevance to our Community Colleges, because it would not only include solar energy, but wind, fuel cell and biomass technologies as well. Several California Community College Economic and Workforce Development Centers could serve the workforce development needs of the broader industry in the areas of Applied Competitive Technologies, Advanced Transportation and Energy and Environmental Technology. These Centers could bring their expertise in fuel cell technology, photovoltaic technology and wind technology to develop training and technical assistance programs for businesses.

Economic Impact

In 2006, the California Public Utilities Commission approved a ten year \$2.9 billion California Solar Initiative to increase the amount of installed solar capacity on rooftops in California by

¹³ *Harnessing San Francisco’s Clean-Tech Future, A Plan for Attracting and Businesses and Creating Jobs*, Ron Pernick et al, October 2004, Clean Edge, Inc., www.cleantech.com, pg. 12.

¹⁴ *Bright Spots on the Grid*, *Los Angeles Times*, Lynn O’Dell, June 17, 2001.

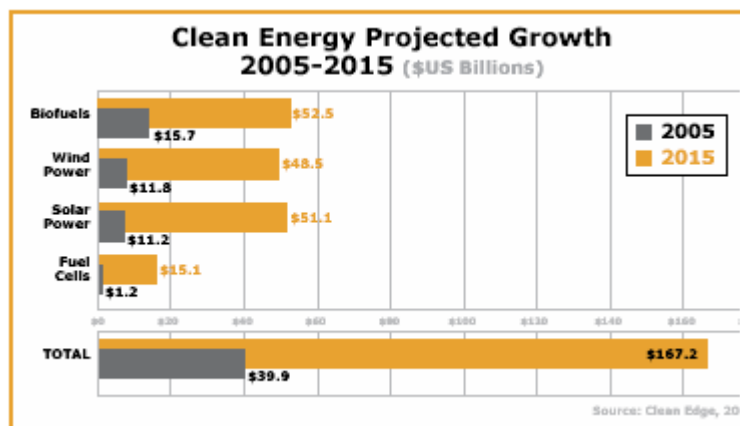
¹⁵ *Harnessing San Francisco’s Clean-Tech Future, A Plan for Attracting and Businesses and Creating Jobs*, Ron Pernick et al, October 2004, Clean Edge, Inc., www.cleantech.com, pg. 12.

3,000 megawatts by 2017.¹⁶ Additionally, Walgreen Drug Stores is currently installing solar electric systems in 112 of its stores and in its 2 distribution centers in California, thereby becoming the largest solar project ever completed in the United States. These new systems will generate more than 13.8 million kilowatt-hours per year.¹⁷

The Clean Energy Trends 2006 report states that clean technology has already risen to become the sixth largest venture investment category in the U.S. and Canada, behind information technology, software, biotechnology, health care, and telecommunication. http://www.cleantech.com/reports-SF_cleantech.php.

In 2005, Venture Capital firms invested more than \$150 million in U.S. companies such as Advent Solar, Energy Innovations, Nanosolar and PowerLight – double the investments from 2004. (Clean Energy Trends, 2006) This translates into approximately 1,500 new solar industry jobs created in the U.S. last year with this investment. The trend is similar in the public marketplace, with the three largest technology Initial Public Offerings (IPOs) of 2005 coming from solar companies: Q-Cells, SunPower and Suntech Power. By the end of their first day of trading, each had market capitalization exceeding \$1.5 billion (Clean Energy Trends, 2006)

The following chart shows the projected growth (in billions of dollars) of the global solar energy industry along with other clean energy sources:



Source: *Harnessing San Francisco’s Clean-Tech Future, A Plan for Attracting and Businesses and Creating Jobs*, Ron Pernick, etc., October 2004, Clean Edge, Inc., www.cleantech.com, pg. 9

Solar Energy projects have both direct and indirect positive economic impacts. Direct economic impacts from projects are the dollars directly spent on materials, equipment and wages. Also, the ability of California businesses to produce electricity for use in the state as opposed to purchasing power from other states is a direct economic impact. Indirect economic impacts - also referred to as the “multiplier” effect of each dollar spent in the region – come from industry workers’ earnings being spent in the region on goods and services. In addition, solar generation projects include increased tax revenues to state and local

¹⁶ California Approves \$2.9 Billion Solar Energy Initiative, January 18, 2006, http://www.eere.energy.gov/news/news_detail.cfm?news_id=9663.

¹⁷ Walgreens to Harness Power of Sun, January 11, 2006, <http://www.walgreens.com/about/press/othernews>.

governments, such as increased personal and corporate income taxes, increased gross receipts taxes, increased compensating taxes on imported equipment, increased property taxes and other taxes specific to electric utilities.¹⁸ Finally, California businesses that can reduce their energy costs and the environmental impacts of the energy they use will produce an economic benefit.

The growing demand for reliable electricity internationally has contributed to the growth of the U.S. solar energy industry. Close to 70% of solar technology systems manufactured in the U.S. are sold to other countries, thus helping to reduce the trade deficit while keeping the manufacturing jobs that are created here in the U.S.¹⁹ The application of solar PV systems is quite diverse. Solar energy systems are currently providing electricity services to a wide range of consumers including those in communications, health care, crop irrigation, water purification, environmental monitoring, marine and air navigation, utility power, lighting and many other residential and commercial applications.

Economic Benefits of Concentrating Solar Power in California

Source: Western Governor’s Association, 2006

Deployment level	2 GW	4 GW
Increase in Gross State Output*	\$11.7 billion	\$22.2 billion
Creation of construction jobs	6,800	12,800
Creation of permanent operation jobs	500	1,100
Increase in State Tax Revenues*	\$1 billion	\$2 billion

* Compared to an alternative gas-fired power plant

The generation of solar electricity coincides with the normal peak demand during daylight hours in most communities. It therefore reduces peak energy costs, brings total energy bills down, and reduces the need to build additional generation and transmission capacity as would be the case with traditional energy sources.²⁰

Industry Training Needs, Challenges, Limitations

If solar energy is to become a viable industry that will create employment and economic opportunities on a large scale, the following must occur:

- Creating more public and private partnerships
- Identifying the right public and private stakeholders
- Engaging these stakeholders in investment and cost sharing
- Defining the scope of projects
- Identifying which stakeholder is the most appropriate lead for particular actions
- Creating industry education and certification requirements
- Emphasizing more public education

¹⁸ Solar Task Force Report, Western Governor’s Association Clean and Diversified Energy Initiative, January 2006, p.18.

¹⁹ Careers in Renewable Energy, U.S. Department of Energy, January 2001, p. 3

²⁰ Solar Power Solutions: A Business Case for Capturing Total Value, 2002, p. 4

Limitations and Data Gaps

Employment projections are not available through the California Employment Development Department's Labor Market Information Division (LMID) on the occupations specific to the solar energy industry. There is also no current data available on the number of workers in California or the Bay Region who currently work in the solar energy industry.

Another gap that exists is a clearer understanding of how likely it is that major and consistent investment in solar energy production in California and the Bay Region will occur. The economic models are in place to show that the jobs and economic development will follow if the investments are made.

One scenario is that the industry will grow slowly over the next ten years, because the investments are not made to start new projects. Another scenario is that the solar industry and other renewable energy sources (i.e. wind, fuel cells, geothermal, tidal power, and biomass) grow simultaneously to create a clean energy industry cluster that grows rapidly because of rising oil and gas prices, the removal of regulatory barriers, economic incentives from the State and Federal Government and new concerns about global warming and the environment. In addition, as costs become more competitive, there will be a greater demand for renewable energy projects.

More primary research with regional and statewide solar and clean energy industry associations is needed to better understand the market forces and the prospects for the near future of the newly emerging clean energy industry cluster.

Industry Related Associations

American Solar Energy Society - www.ases.org

California Solar Energy Industries Association - www.calseia.org

Solar Electric Power Association – <http://www.solarelectricpower.org>

Solar Energy Industries Association - <http://www.seia.org/>

Northern American Board of Energy Practitioners - www.sunlightandpower.com/links/index.html

The Northern California Solar Energy Association - www.ases.org/about_ases/chapters.htm

Clean Energy States Alliance – <http://www.cleanenergystates.org>

California Energy Commission - <http://www.energy.ca.gov/>

Summary

Solar energy, which is one facet of the broader renewable energy industry, is not only good for our country's energy self-sufficiency but also for preserving our environment. A critical element of the future potential of this energy production strategy is the significant positive impact it has on job creation and economic development.

However, it appears that at this time, the solar energy industry does not warrant a strategic, regional response from the community colleges. What we do know is that the industry has the potential for high job growth and large economic impact if the economic investments described in this report are made. Jobs in this industry provide a living wage and include health benefits – generally because they would draw so heavily from manufacturing and construction. In addition, jobs in operations and maintenance, although fewer in number than manufacturing and construction would pay well – approximately \$40,000 per year for entry-level workers.

Community colleges have the opportunity to partner with the renewable energy industry to develop specific training programs that can be created or adapted to meet the workforce needs of the renewable energy industry. Community College Economic and Workforce Development Centers in the areas of Applied Competitive Technologies and Advanced Transportation and Energy are well suited for the skill sets needed in this industry and may be in an excellent position to monitor this emerging opportunity. In addition, there may be opportunities for Contract Education departments within colleges to design specific customized short-term training programs to meet regional employer needs.

In sum, further research on the broader area of renewable energy and exploring opportunities for industry partnerships may be the best recommendations for moving forward. The renewable energy cluster of solar, wind, fuel cells and geothermal may be of greater relevance to our community colleges as a viable strategic opportunity as opposed to solar energy alone, because of the cumulative job growth and economic impact that this industry cluster represents.

References

2005 Integrated Energy Policy Report, California Energy Commission, November 2005.

Annual Energy Outlook 2006 with Projections to 2030, Energy Information Administration, Official Energy Statistics from the U.S. Government, Report #:DOE/EIA-0383(2006), February 2006.

Bringing Solar to Scale, California's Opportunity to Create a Thriving, Self-Sustaining Residential Solar Market, Environment California Research & Policy Center, Dave Algosio et al, 2006.

California Approves \$2.9 Billion Solar Energy Initiative, January 18, 2006,
http://www.eere.energy.gov/news/news_detail.cfm?news_id=9663

California Solar Initiative – www.votesolar.org.

Clean Energy Trends 2006, Joel Makower et al, Clean Edge, March 2006, www.cleandedge.com.

Harnessing San Francisco's Clean-Tech Future, A Plan for Attracting Businesses and Creating Jobs, Ron Pernick et al, October 2004, www.cleandedge.com.

Jobs in L. A.'s Green Technology Sector, Economic Roundtable, 2006, www.economicrt.org.

New Energy for America, The Apollo Jobs Report: Good Jobs & Energy Independence, January 2004, www.apolloalliance.org.

Photovoltaics and Distributed Generation - <http://www.fsec.ucf.edu/PVT/aboutus/index.htm>.

Putting Renewable to Work: How Many Jobs Can the Clean Energy Industry Generate?, RAEI Report, University of California, Berkeley, Daniel Kammen et al, April 13, 2004,
<http://socrates.berkeley.edu/~rael/papers.html>.

Quantifying the Benefits of Solar Power for California, Ed Smeloff, December 2004, The Vote Solar Initiative, <http://www.solarelectricpower.org/ewebeditpro/items/O63F5152.pdf>.

The Work That Goes Into Renewable Energy, Renewable Energy Policy Project Research Report, November 2001, No. 13, Marshall Goldberg et al, <http://www.repp.org>.

Renewable Energy and Jobs, Employment Impacts of Developing Markets for Renewables in California, Environmental California Research and Policy Center, Brad Heavner et al, July 2003.

Solar Power Association, SMUD ReGen Program, Project 1.2 Photovoltaic Markets and Technologies, Del 1.2.2.2: SMUD's PV Program and Sacramento Markets Report, Contract # 4500015118, www.solarelectricpower.org/ewebeditpro/items/O63F3974.pdf.

Solar Power Solutions: A Business Case for Capturing Total Value, April 2002, Solar Electric Power Association.

Western Governor's Association Clean and Diversified Energy Initiative Solar Task Force, January 2006

Wikipedia, the free encyclopedia, http://en.wikipedia.org/wiki/Solar_energy,

APPENDIX A

Projected Annual Growth Rates of Renewable Energy Resources²¹

Source	2000- 2010	2010- 2020	2000- 2020
Hydropower	0.1%	0.0%	0.0%
Geothermal	2.3%	4.1%	3.2%
Municipal Solid Waste	3.2%	1.0%	2.1%
Biomass	2.2%	1.3%	1.8%
Solar Thermal	0.9%	1.3%	1.0%
Solar PV	27.1%	9.4%	19.8%
Wind	12.2%	1.7%	6.8%
Total	0.9%	0.4%	0.6%

Total California Employment Growth from 2003 - 2017 Renewable Energy Development (person-years)²²

Technology	Construction Employment for International Market	Construction Employment for In-State Market	Operating Employment for In-State Market	Total
Wind	28,900	1,490	18,930	49,320
Geothermal	800	1,230	59,030	61,070
Biomass	na	540	38,070	38,610
Solar PV	20,300	1,120	1,540	23,000
Fuel Cells	28,100	na	na	28,100
Solar Thermal	na	390	550	940
Total	78,100	4,770	118,120	201,040

²¹ *Solar Power Solutions: A Business Case for Capturing Total Value*, Solar Electric Power Association, April 22, 2002, pg. 5.

²² *Renewable Energy and Jobs*, Employment Impacts of Developing Markets for Renewables in California, Environment California Research and Policy Center, Brad Heavner et al, July 2003, pg. 25.

Bay Area Counties Offering Solar Rebates

County	Program Name	
Marin	Solar Rebate	Marin's BEST!
Palo Alto	Utilities PV Partnership	
Oakland	Self Certification for Renewable Energy Production Facilities	
San Jose	Green Building	
San Francisco	Renewable Energy Purchasing Program	
*** Santa Clara	Nation's first municipal solar utility ²³	

California Solar PV Manufacturing Companies

Name of Company	Location
PowerLight	Berkeley and Oakland
Shell Solar	Camarillo
AstroPower	Concord
Xantrex	Livermore
Schott Applied Power	Rocklin
Sharp Electronics	Huntington Beach
Amonix	Torrance

²³ <http://www.solarrebates.com/main.htm>, *Solar Rebates*.

APPENDIX B

U.S. based venture in energy technologies capital investments increased from \$716 million in 2004 to \$917 million in 2005. As a percent of total venture capital investments, energy technologies increased from 3.3% in 2004 to 4.2% in 2005. Over the last six years, venture capital investments quadrupled as a percent of total venture capital investments, increasing from less than 1% in 1999 to total venture capital investments of 4.2% in 2005.

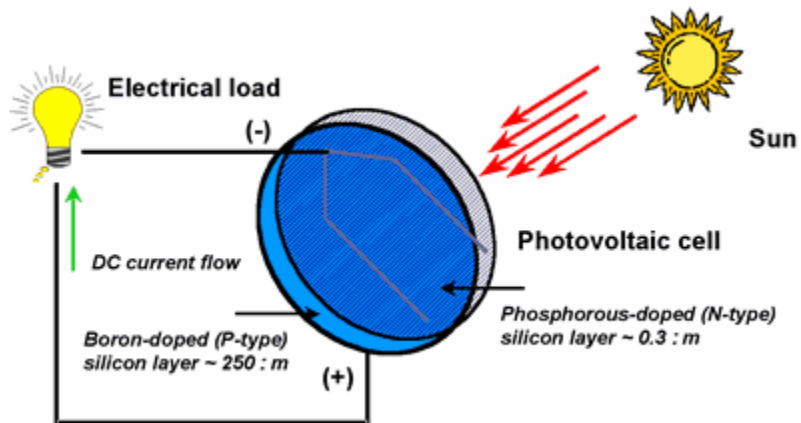
Clean Energy Venture Capital Investments in U.S.-Based Companies as Percent of Total

Year	Total Venture Investments (US\$ Billions)	Energy Technology Investments (US\$ Millions)	Energy Technology Percentage of Venture Total
1999	\$59	\$468	0.8%
2000	\$103	\$1,329	1.3%
2001	\$41	\$932	2.3%
2002	\$21	\$566	2.7%
2003	\$18	\$547	3.0%
2004	\$20	\$716	3.3%
2005	\$22	\$917	4.2%

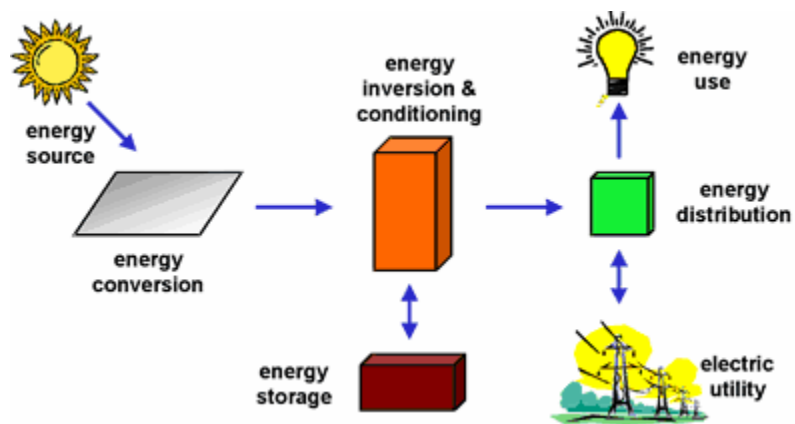
Source: Nth Power LLC and Clean Edge, Inc.

APPENDIX C

Diagram of photovoltaic cell



Major photovoltaic system components



APPENDIX D

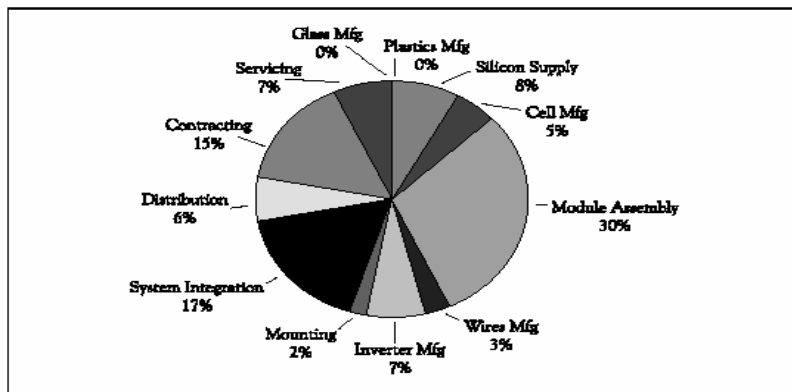
The following shows the different activities to construct, transport, install and service 1 MW of PV.

Labor Requirements Per Megawatt of PV (in hours)²⁴

Project Activity	Occupational Category									TOTAL by Project Activity
	Prof, Tech & Manage (0/1)	Clerical & Sales (2)	Service (3)	Agri, Fishery, Forestry (4)	Process-ing (5)	Mach. Trades (6)	Bench-work (7)	Structural Work (8)	Misc. (9)	
Glass	50				50	50			50	200
Plastics	50					250				300
Silicon	1,550	200	200		3,300	200	200			5,650
Cell Manufacturer	800				1,600		600	50	150	3,200
Module Assembler	3,500				1,600		8,250	750	6,850	20,950
Wires	150					1,700				1,850
Inverters	750				1,000	1,000	1,000	1,000		4,750
Mounting Frame	500	500				150	100	150	100	1,500
Systems Integration	8,900	2,850								11,750
Distributor Contractor/ Installer	1,500	1,500							1,000	4,000
Installer	2,500							8,000		10,500
Servicing ^b	5,000									5,000
TOTAL by Occupation	25,250	5,050	200	0	7,550	3,350	10,150	9,950	8,150	69,650
TOTAL Person-Years	12.9	2.6	0.1	0	3.9	1.7	5.2	5.1	4.2	35.5^c

- a. Figures derived from a survey to determine labor requirements for a 2-kW residential PV installation.
 b. Includes servicing for ten years of operation.
 c. Totals for person-years do not add up due to rounding.

Labor Requirement for PV According to Activity²⁵



²⁴ *The Work That Goes Into Renewable Energy*, Virinder Singh with BBC Research and Consulting and Jeffrey Fehrs, Renewable Energy Policy Project, Research Report No. 13, November 2001, pg. 12, <http://www.repp.org>.

²⁵ *The Work That Goes Into Renewable Energy*, Virinder Singh with BBC Research and Consulting and Jeffrey Fehrs, Renewable Energy Policy Project, Research Report No. 13, November 2001, <http://www.repp.org>, pg. 13.

How to Utilize this Report

About Us - Description of BWPI

The Business and Workforce Performance Improvement (BWPI) initiative is focused on building the capacity of the colleges in the area of economic and workforce development to enhance their ability to deliver education and training services to businesses and workers in high growth industries, new technologies, and other clusters of opportunities.

The Centers of Excellence (COE) within BWPI provide information regarding workforce trends, increasing awareness and visibility about the colleges economic and workforce development programs and services, and building partnerships with business and industry.

The difference this will make to the colleges is that it will position them as THE workforce partners of choice to business and industry and ensure that college programs are current and responsive. This will contribute to the overall economic vitality of the communities in which they serve.

How to Use This Strategic Possibility Report

The Centers of Excellence within the Business and Workforce Performance Improvement Initiative of the California Community College Economic and Workforce Development Program have undertaken Industry Scanning to provide targeted and valuable information to community colleges on high growth industries and occupations.

This report, while not a full industry scan, is intended to assist the decision-making process of California community college administrators and planners in addressing local and regional workforce needs and emerging job opportunities in the workplace as they relate to college programs. The information contained in this report can be used to guide program offerings, strengthen grant applications, and support other economic and workforce development efforts.

This report is designed to provide current industry data that will:

- Define potential strategic opportunities relative to an industry's emerging trends and workforce needs;
- Influence and inform local college program planning and resource development; and
- Promote a future-oriented and market responsive way of thinking among stakeholders.

This Industry Scan included a review of the California Regional Economies Project reports and Employment Development Department (EDD) Labor Market Information (LMID) projections that cover the communities in this region, as well as many other sources as listed.

Important Disclaimer:

All representations included in this Environmental Scan product/study have been produced from a secondary review of publicly and/or privately available data and/or research reports. Efforts have been made to qualify and validate the accuracy of the data and the reported findings. The purpose of the Environmental Scan is to assist the California Community Colleges to respond to emerging market needs for workforce performance improvement. However, neither the Business and Workforce Performance Improvement Centers of Excellence, COE host college or California Community Colleges Chancellor's Office are responsible for applications or decisions made by recipient community colleges or their representatives based upon this study including components or recommendations.