

# Harvesting California's Renewable Energy Resources:

## A Green Jobs Business Plan



By Peter Asmus

Center for Energy Efficiency and Renewable Technologies

Sacramento, California

August 15, 2008

[www.cleanpower.org](http://www.cleanpower.org)



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RESOURCES:**  

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*A GREEN JOBS BUSINESS PLAN*



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## II. Executive Summary

### Introduction

The State of California is poised to harness the clean energy and economic development benefits that flow from massive new investments in its abundant renewable energy supplies. California is uniquely blessed with some of the best renewable resources (solar, geothermal, wind, biomass) on the planet. This gives California the opportunity to lead the nation in creation of new green jobs. Among the primary findings of this report are the following:

- If California obtained a third of its electricity from renewable energy by 2020, **state manufacturing employment could increase by almost 200,000 jobs.**
- Complying with this goal could pump as much as **\$60 billion into the state's stagnating economy.**
- With the price of natural gas and coal rising dramatically, and the state unemployment rate at its highest level in five years, it is incumbent upon policy makers to recognize renewable sources create more than six times the amount of jobs as development of these fossil fuels. **A large portion of the money we currently spend on imported and polluting fossil fuels can be spent instead on creating permanent stable employment for Californians.**
- To achieve these benefits California's leaders need to make commitments today that will open up investment in generation, transmission and human resources to build a sustainable energy system for the future.

**California would generate more jobs than any other state if the U.S. were to embark upon a large-scale program to stabilize carbon emissions that scientists have linked to global climate change.**

In order to capitalize on this green business opportunity facing California today, we need to fix the current broken electricity procurement process. This report details reforms urgently needed to free up investment in renewables. Tax reforms may be necessary to lure manufacturing jobs to California. And in order to lift up those at the bottom of the economic ladder, laws and regulations need to be carefully crafted, offering training and other targeted assistance to prepare all of California's citizens for the new energy economy of the future.

The first step in our *Green Jobs Business Plan* is to establish more aggressively meaningful goals. We must increase California's Renewable Portfolio Standard (RPS) from current levels of 20 percent renewable energy by 2010 to 33 percent renewable energy by 2020. CEERT developed a scenario based on analysis and scenarios developed by the California Independent System Operator, which manages most of the state's transmission system. Figure 1 depicts the mix of likely renewable resources CEERT researchers believe would come on-line to meet a 33 percent by 2020 RPS.

33% Renewable - Generation Mix in MW

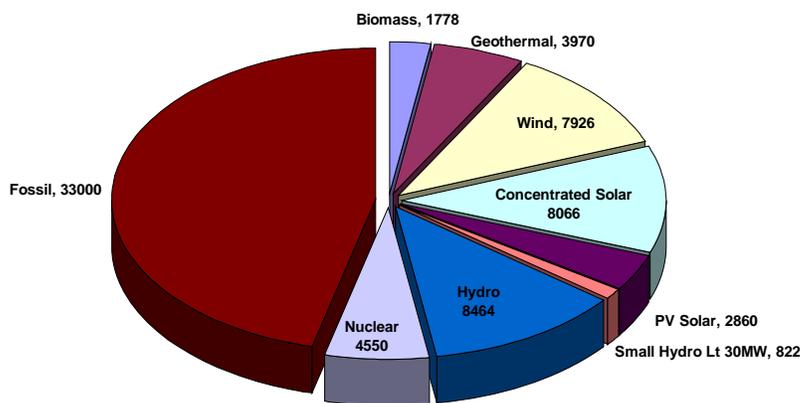


Figure 1 - 33% Renewables Resource Scenario, (Source : CEERT)

Because renewable energy development fosters greater economic benefits than traditional fossil fuel development, California will realize tremendous financial dividends – including major employment increases and much needed tax revenue – from a renewable energy renaissance that can touch virtually every part of California.

It is up to California's leaders to get the ball rolling, reasserting California's historic mission to be the global leader on renewable energy innovation and deployment.

### **The Business Case for Renewable Energy**

The “green jobs” that flow from new large-scale investments in the whole family of renewable energy resources – primarily solar, wind, geothermal and various forms of biomass – can be developed throughout all parts of California. A 2006 analysis performed by the Renewable Energy Policy Project looked at the employment gains throughout the U.S. to stabilize the greenhouse gas emissions that have been linked to global climate change. California ranked in No. 1 in the country, with over 5,000 firms capable of manufacturing the necessary components. Ongoing research by CEERT and state agencies will enable California to rank its renewable energy assets according to economic and environmental cost, and then identify and construct the best pathways by which to bring cost-effective and clean power into the state's electricity grid. This process is akin to building a superhighway or state water project, benefiting all Californians with least-cost access to clean electricity resources. Ultimately, jobs linked to each Competitive Renewable Energy Zone will be able to be projected, assisting local government planners and regional economic development agencies in capturing new high-quality jobs in green industries.

This report goes further by examining the degree to which California cities, counties, and the state as a whole would benefit from an aggressive build-out of the state's renewable energy assets. The report's findings are compiled from a number of well-regarded studies.

- A study conducted by researchers at the University of California-Berkeley's Energy and Resources Group in 2004 concluded, under every scenario examined, that the renewable energy sector generated more jobs than the fossil fuel sector per MW installed, per unit of delivered energy and per dollar of investment.
- If measured on the basis of jobs created per million dollars of annual investment over one decade, the wind industry generates 5.7 person-years of employment compared to just 3.96 person-years of employment for the dirty coal power we currently buy from other states.
- Furthermore, the renewable energy industry creates comparatively more manufacturing jobs in services and operation & maintenance, an attribute that, if properly addressed by state policy, could boost California's beleaguered manufacturing sector. Some of the biggest and most innovative energy and engineering companies in the world are willing to make massive investments in the development of California's renewable energy industry – if we only let them.
- The Union of Concerned Scientists (UCS) performed an analysis that matches closely with the goal of a 33 percent by 2020 RPS in California. UCS estimated jobs that would be created if a 20 percent RPS were applied to the electricity sector across the country. According to the UCS figures, state employment would grow by an average annual increase of 16,000 jobs if California obtained 30 percent of its electricity from renewable resources by 2020. ***This figure represents more than six times the employment that would be created if California would produce an equivalent amount of electricity from fossil fuels.***

***“The biggest benefit associated with new large-scale investments in renewable energy is not the direct jobs per dollar or jobs per MW benefit, but the fact that renewable energy (and energy efficiency) jobs are, almost by definition, investments in people and infrastructure, as opposed to simply buying a raw material...”***

***... Dan Kammen,  
Co-Director of the  
Berkeley Institute of  
the Environment***

## What Happened to the Miracle of California?

Following rolling blackouts, a bankrupt utility, and the quick rise and fall of Enron, California retreated as a leader in renewable energy technology at the turn of the last century, allowing the rest of the world to catch up or even surpass the state in securing future markets for most new renewable energy technologies. Today in California, progress too often stalls when making the transition from bright idea to full-scale commercialization of promising projects. Though the state may have progressive policies on renewable energy sources and global climate change, California is not held in high esteem by businesses trying to translate good intentions into practical reality. An example of this is solar photovoltaics, an area in which the majority of the technology leaders are California companies, but the majority of hardware being installed in California is manufactured overseas or in other states, thus diverting significant revenue streams that could flow into local government coffers and the pockets of California workers.

Texas also raced past California's national lead in total installed wind power capacity in 2006, and its Public Utility Commission approved a \$4.93 billion wind power transmission project this past July, ensuring that Texas will remain a world wind power leader. **California boasted 90 percent of the world's wind power market in 1988. Twenty years later, the state's market share on wind power has dipped to less than 4 percent of world market share.**

## How California's Communities Benefit from Renewable Energy Jobs

The California Economic Strategy Panel issued a report in March 2008 entitled *Clean Technology and the Green Economy*, revealing that green jobs related to renewable energy are scattered throughout the state. Prepared by Collaborative Economics, the report points out jobs in energy generation comprise the largest slice of the state's green technology businesses (43 percent), followed by the energy efficiency slice (31 percent). Within the energy generation segment of California's green technology sector, 64 percent of businesses and 53 percent of employment are directly related to solar energy. The report also examines the geographical distribution of green businesses and employment totals. Though concentrated in the San

### The Community Redevelopment Agency of Los Angeles

Alex Paxton, manager of policy analysis for the Community Redevelopment Agency of the City of Los Angeles (CRA/LA), has been working on a vision for the future of Los Angeles that "helps address the income disparity that exists in today's job market, and works towards developing more sustainable wages in the Los Angeles area." State statistics shows that, on average, industrial jobs pay 50 percent more than retail jobs, and this pay differential has shaped her approach to community development.

"The purpose of CRA/LA is to eliminate economic blight. We see a fundamental part of our mission as creating economic opportunity for the people who live and work near our project areas. Like other community redevelopment agencies, CRA/LA can offer incentives such as low-interest bonds and land write-downs to kick-start development," Paxton explained. "We didn't want to just build buildings and promote gentrification. We want to focus on better housing and better jobs through clean tech."

Green Technology Establishments by Green Sector

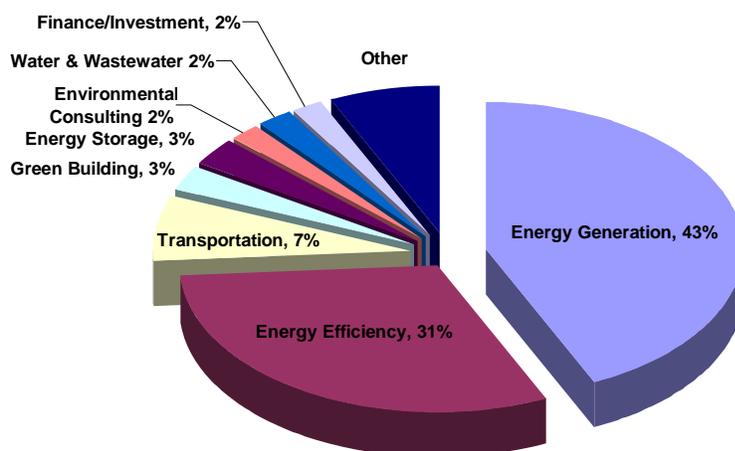


Figure 2 - Green Technology Establishments by Green Sector

Source: Collaborative Economics

Francisco Bay Area and in the Southern California region, energy generation jobs and businesses are located throughout the state.

Following this is a discussion of the employment and economic impacts of increased investment in new renewable energy generation in five regions of the state:

- Imperial County
- Kern County
- The Los Angeles region
- San Francisco and Silicon Valley
- The Central Valley

### **Conclusion**

Harvesting California's vast renewable energy resources will require long-term planning and the commitment of the Governor, state lawmakers and state government agencies to develop the infrastructure necessary to access these resources and then transport this clean power to where most Californians live and work. There is a lot of work to be done, and the state has begun to take appropriate steps that will help us achieve the 33 percent RPS requirement. This presents a huge opportunity for the creation of good, green jobs in the state. These are jobs that cannot be shipped overseas because the resource is native to California, and most of the work harvesting it must be done here within our state's borders.

Nevertheless, a series of other reforms need to take place in order for these almost 200,000 projected full-time jobs to be transformed into real people with real jobs:

- **Transmission Upgrades:** The only way for California to meet the goal of a 33 percent RPS by 2020 is to build the necessary superhighways to bring the lowest cost premier renewable resources developed in remote areas such as Imperial and Kern counties to urban centers of energy demand such as Los Angeles and San Diego.
- **Enforcement:** Because current statutes allow an investor-owned utility a three-year compliance window to meet its RPS goals and to allow "contracts," as opposed to actual energy deliveries, to count for compliance, the utilities have not had the incentives to sign contracts for procurement with new renewable projects that are sufficiently viable or likely to come on-line in a timely manner. CEERT believes that this disincentive to procure power from viable projects can be reversed by state agencies permitting reasonable transactional flexibility sufficient to overcome physical and market barriers to procurement, and committing to the imposition of an appropriately priced non-compliance payment adopted by the CPUC and CEC.
- **Renewable Energy Pricing:** California's current 20 percent by 2010 RPS is deeply flawed in that it links the pricing of new renewable energy supply to the cost of natural gas, the preferred resource choice of the state's investor-owned utilities. Known as a "Market Price Referent," this pricing policy limiting payments to renewable energy generators is not employed at any of the other 25 states that have enacted an RPS. One outcome of this approach is that many of the firms bidding into the California RPS market can no longer pencil out their projects because of recent raw material cost increases and a radically out-of-date payment structure.

*A Green Jobs Business Plan* is designed to show the way California can develop and prosper from exploiting its bountiful renewable energy resources. In doing so, by substituting labor for imported fuel, renewable energy can be the engine for generating massive new economic growth which will benefit millions of Californians. Despite the common misperception that renewable energy is an exotic but pricey side dish on our electrical power menu the time has come to choose it as our main course.

### III. Introduction

California is blessed with the most diverse renewable energy assets in the U.S., but has failed to aggressively maximize these assets over the past two decades. As a result, California squandered a golden opportunity to stabilize today's electricity rates at a time when fossil fuel prices have reached record highs. An even greater economic hit to the state is the jobs lost due to lack of progress in building and maintaining new renewable energy projects that tap the sun, the wind, geothermal steam below the earth's surface, and a diversity of biomass feedstock ranging from agricultural wastes in the Central Valley to the gas leaking from urban landfills.

With the U.S. economy sinking into a recession – and California facing a state budget shortfall of more than \$17 billion – fresh investments in renewable energy offer the best path forward to boost state and local government tax revenues and increase prosperity for all state citizens, including those at the bottom of the economic ladder.

Reports by a variety of credible organizations ranging from the University of California to the Union of Concerned Scientists disagree on the exact amount of new jobs that could be created with a massive build out of California's attractive renewable energy assets. Projections under different scenarios and assumptions show that a ramping up of electricity production from solar, wind, geothermal, biomass and other clean sources to meet the challenge of global climate change could add between 16,000 and 430,000 jobs to the state's economy by 2020. Despite this great disparity, these studies all agree that California would generate more jobs than any other state if the U.S. were to embark upon a large-scale program to stabilize the carbon emissions that scientists have linked to global climate change.

In order to maximize this green business opportunity, a comprehensive California reform agenda is needed to fix the current broken electricity procurement process. Tax reforms may be necessary to lure manufacturing jobs to California. In order to lift up those at the bottom of the economic ladder, laws and regulations need to be carefully crafted, offering training and other targeted assistance to prepare all of California's citizens for the new energy economy of the future.

The passage of AB 32 – the “Global Warming Solutions Act of 2006” – requires California to reduce its aggregate carbon emissions by 25 percent by 2020 from “business as usual” activities, adding further incentives to expand renewable energy capacity to meet California's environmental goals. The California Air Resources Board included the 33 percent by 2020 RPS policy in its AB 32 Scoping Plan released in the summer of 2008, recognizing that this increase in renewable energy supply is a key component in California's broad response to the global climate change threat. All told, complying with AB 32 – which impacts every sector of the state's economy – could, according to one estimate, boost state GDP by \$74 billion, generating 89,000 jobs in the process.<sup>1</sup>

***California would generate more jobs than any other state if the U.S. were to embark upon a large-scale program to stabilize the carbon emissions that scientists have linked to global climate change.***

Based on a scenario released by the California Independent System Operator on July 21<sup>st</sup> of this year, CEERT devised its own scenario of what California's mix of renewable energy resources might be with a 33 percent RPS by 2020. The result of this CEERT scenario is depicted in Figure 3.

Because renewable energy fosters greater economic development benefits than traditional fossil fuels, California has been missing out on an opportunity to bolster its economy through a renewable energy renaissance.

If measured in terms of jobs per megawatt, solar photovoltaics (PV) generates between 7 and 60 jobs for every one job associated with natural gas power plants,<sup>2</sup> California's current preferred electricity fuel. State regulators bet that the price of natural gas would be the cheapest fuel for generating electricity, only to discover that an overreliance upon natural gas is now responsible for double digit rate increases in northern and southern California, hurting both residential and business consumers.

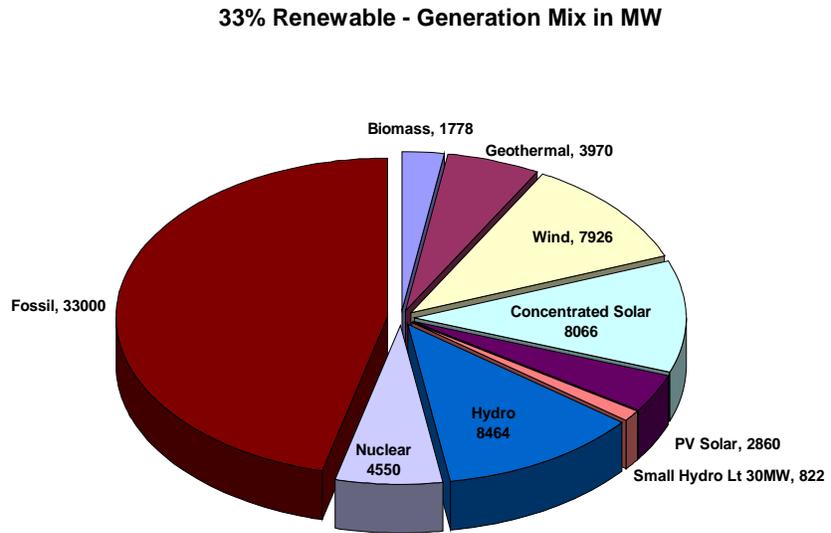


Figure 3 - 33% Renewables Resource Scenario (Source: CEERT)

Energy Source	Number of Jobs/MW
Wind	7.5
CSP	4.88
Solar PV	33.0
Geothermal	8.25
Biomass – Dedicated Steam	10.5
Natural Gas – For Comparison	>1.1

Table 1 - Jobs per MW

Source: REPP, UC-Berkeley, CEERT

According to this scenario, **approximately 191,174 manufacturing jobs could be created from new renewable energy supply under a 33 percent RPS by 2020:**

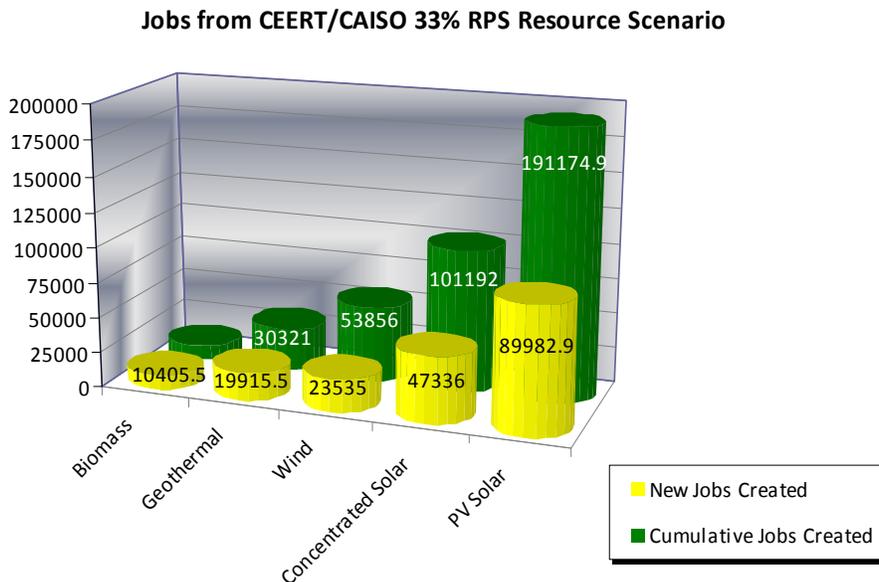


Figure 4 - Jobs from CEERT/CAISO 33% RPS Resource Scenario<sup>3</sup>

## IV. The Business Case for Renewable Energy

Reports from numerous widely respected sources document that renewable energy resources offer superior economic benefits to fossil fuels, with the added bonus of presenting both environmental and national security advantages. Why is this so? Generally speaking, a larger share of total investment in new power supply is spent on manufacturing equipment, installation and maintenance with renewable energy technologies than with their fossil fuel counterparts. On top of that, most renewable energy technologies have zero fuel costs, so there is no need to import fuels, keeping more dollars circulating within the local, state and national economies.

The “green jobs” that flow from new large-scale investments in the whole family of renewable energy resources – primarily solar, wind, geothermal and various forms of biomass – can be developed throughout all parts of California.

That said, California’s richest renewable resource basins are in the remote southeastern portions of the state, far from the majority of state consumers needing electricity. A collaborative process entitled the Renewable Energy Transmission Initiative (RETI) is identifying zones where renewable resources can be developed with the most economic benefit and the least environmental impact. Based on this analysis, it will be possible to rank California’s renewable energy assets according to economic and environmental cost, and then identify and construct the best pathways by which to bring such cheap and clean power into the state’s electricity grid. This process is akin to building a superhighway that can benefit all Californians with least-cost clean electricity. Ultimately, jobs linked to each of the Competitive Renewable Energy Zones will be able to be projected, assisting local government planners and regional economic development agencies in capturing new high-quality jobs in green industries.

*If measured in terms of jobs per MW, solar PV development generates more than 7 jobs for every 1 job associated with natural gas power plants, California’s current preferred electricity fuel.*

**According to this report, California has the greatest potential of all 50 states to generate new manufacturing activity to meet this level of demand for clean energy.**

A 2006 analysis performed by the Renewable Energy Policy Project (REPP) looked at the employment gains throughout the U.S. to stabilize the greenhouse gas emissions that have been linked to global climate change. REPP estimated that such a national effort would require 18,500 MW of annual renewable energy supply capacity additions throughout the country. According to this report, California has the greatest potential of all 50 states to generate new manufacturing activity to meet this level of demand for clean energy. More than 5,400 existing companies in the state are active in the industrial sectors capable of providing the component parts for new solar, wind, geothermal and biomass projects.

Table 2 from REPP shows California ranking No. 1 in the country with 95,616 full-time equivalent manufacturing jobs (i.e. 2,000 hours of annual work.) This figure represents the employment necessary to carry out a national climate response program equivalent to a 20 percent federal RPS.

<b>Manufacturing Jobs and Investment for 18,500 MW</b>						
<b>Location</b>	<b># of Firms</b>	<b>Jobs Wind</b>	<b>Jobs Solar</b>	<b>Jobs Geothermal</b>	<b>Jobs Biomass</b>	<b>Jobs Total</b>
<b>California</b>	5,409	32,046	48,896	8,465	6,209	95,616
<b>Texas</b>	3,358	25,044	23,221	4,660	7,175	60,100
<b>Illinois</b>	2,289	30,010	19,298	3,396	3,875	56,579
<b>Ohio</b>	2,465	29,820	11,833	5,079	4,537	51,269
<b>New York</b>	1,925	18,523	14,617	8,150	6,640	47,930
<b>Pennsylvania</b>	2,188	19,588	15,767	3,402	3,911	42,668
<b>Indiana</b>	1,321	25,180	7,485	3,191	3,365	39,221
<b>Michigan</b>	2,050	24,350	6,644	1,502	2,281	34,777
<b>North Carolina</b>	1,096	10,964	11,062	2,810	3,708	28,544
<b>Missouri</b>	785	10,260	7,532	2,907	2,097	22,796

**Table 2 - Manufacturing Jobs and Investment for 18,500 MW**

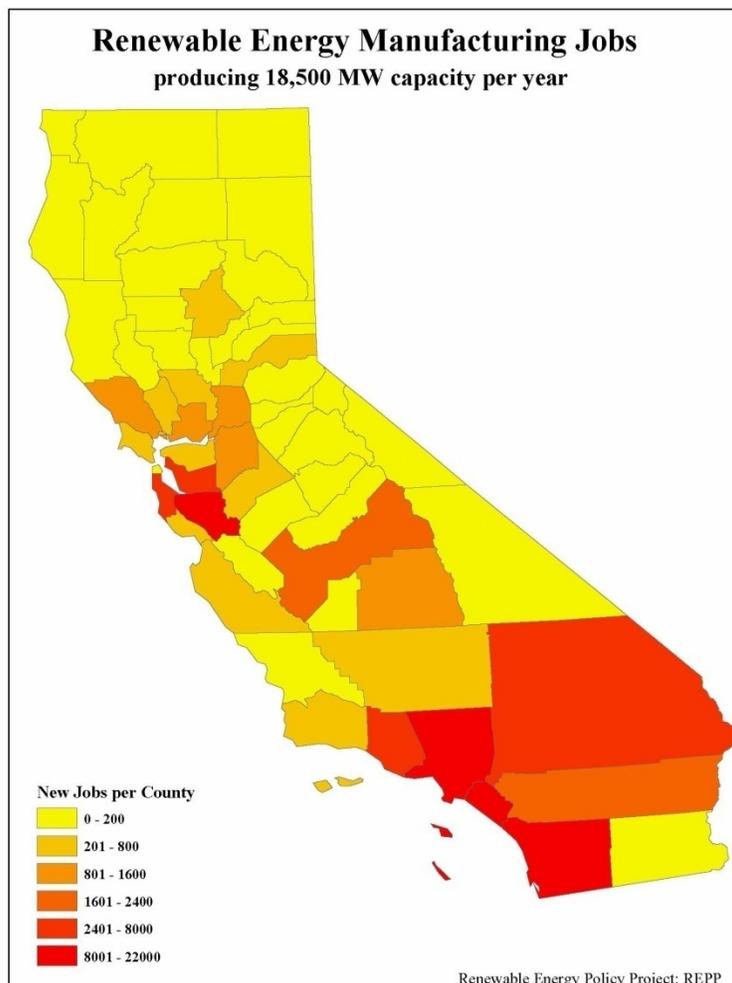
Source: REPP

Figure 5 is a map showing the degree to which counties would benefit from an aggressive build-out of the state's renewable energy assets. These numbers understate the potential employment and investment boon to California as they do not include concentrated solar power technologies. In addition, these figures, like many other studies looking at green jobs and renewable energy, are based on a national climate response program, and not specifically the *California Green Jobs Business Plan* proposed in this report.

“There are a series of studies looking at the link between renewable energy and economic development and each is based on a variety of assumptions, showing a range of potential employment levels,” observed George Sterzinger, executive director of REPP. “What our methodology at

***“The biggest benefit associated with new large-scale investments in renewable energy is not the direct jobs per dollar or jobs per MW benefit, but the fact that renewable energy (and energy efficiency) jobs are, almost by definition, investments in people and infrastructure, as opposed to simply buying a raw material...”***

***... Dan Kammen,  
Co-Director of the  
Berkeley Institute of  
the Environment***



**Figure 5 - Map of New Renewable Energy Manufacturing Jobs (by county) to achieve 20% RPS. Source: REPP**

REPP shows is that actual manufacturers in California could make components for wind, solar PV, geothermal and biomass power plants, so that these components are not just imported from overseas.” Sterzinger acknowledged the biggest question with all job projections from renewable energy is manufacturing, since other federal and state policies impact whether those jobs land in California, other states, or overseas.

Perhaps the most comprehensive California-specific analysis of employment gains with expanded use of renewable energy is a study conducted by researchers at the University of California-Berkeley’s Energy and Resources Group in 2004.<sup>4</sup> This analysis reviewed 13 independent reports and studies, examined the assumptions used in each, and then crafted a job creation model that projected employment under a variety of future energy scenarios. Unlike the REPP methodology, UC-Berkeley took into account the amount of energy generated by the installed capacity in calculating employment

benefits, but also included installation jobs. Yet under every scenario examined, the renewable energy sector generated more jobs than the fossil fuel sector per MW installed, per unit of delivered energy and per dollar of investment. (Please see Appendix A for these computations.)

“The biggest benefit associated with new large-scale investments in renewable energy is not the direct jobs per dollar or jobs per MW benefit, but the fact that renewable energy (and energy efficiency) jobs are, almost by definition, investments in people and infrastructure, as opposed to simply buying a raw material,” commented Dan Kammen, co-director of the Berkeley Institute of the Environment. “Far better to invest in human resources and development than to be perpetually buying fuel supplies,” he said. “With the forecast for perpetually rising and volatile fossil fuel prices, the time could not be better for a switch to renewable energy. Renewable energy resources are well distributed across the state, region and nation. The ideal time to make this shift to renewable energy was years ago. But like all good investments, the second best time to invest is today.”

*The wind industry generates 5.7 person-years of employment compared to just 3.96 person-years of employment for coal, if measured on the basis of employment created per million dollars of annual investment over one decade.*<sup>5</sup> Furthermore, the renewable energy industry creates comparatively more manufacturing jobs than in services and operation and maintenance, an attribute that, if properly addressed by state policy, could boost California’s beleaguered manufacturing sector. Massive investments in the production of renewable energy equipment and associated infrastructure could be targeted to strengthen sectors of the state economy suffering from high unemployment rates. If California decided to also focus on exporting renewable energy technologies, a report by the Research and Policy Center of Environment California claims the state could boost the total number of jobs in the renewable energy sector by a factor of 16.<sup>6</sup> See Table 3 below, which was based on a 20 percent RPS by 2017 scenario:

Technology	Construction Employment for International Markets	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	N/A	540	38,070	38,610
Solar PV	20,300	1,120	1,540	23,000
Fuel Cells	28,100	N/A	N/A	28,100
Solar Thermal*	N/A	390	550	940
<b>Total</b>	<b>78,100</b>	<b>4,770</b>	<b>118,120</b>	<b>201,040</b>

**Table 3 - Total California Employment Growth from Renewable Energy Maximize Exports Scenario**

Source: Environment California, 2003

\*These figures do not include recent development efforts linked to CSP

Since this report looked at a 20 percent RPS, simple extrapolations imply that a 33 percent RPS could create over 330,000 construction/manufacturing jobs in California developing renewable technologies to export overseas. These figures do not include CSP, so potential jobs under this maximize exports scenario could surpass 350,000 and even approach 400,000.

A long list of reports looking at a national market for clean power trumpet the economic development benefits of displacing fossil fuels with renewable energy, often coupled with wider deployment of energy efficiency programs and other ways to reduce overall consumption of energy. Typically, these reports focus on employment, though some also take into account other forms of economic benefits.

The Union of Concerned Scientists (UCS) performed an analysis that matches closely with the goal of a 33 percent by 2020 RPS in California. UCS estimated jobs that would be created if a 20 percent RPS were applied to the electricity sector across the country. UCS employed the same model employed by the federal Energy Information Administration (EIA) to make future projections on energy supply, demand, prices and expenditures. Results from this analysis were plugged into the Impact Analysis for Planning Model to determine the new jobs and income associated with the development of new power generation facilities. A modified version of EIA's Annual Energy Outlook served as the base case, with the 20 percent RPS as the comparison case. Interestingly enough, this national forecasting model projected that California would reach a 30 percent renewable energy portfolio by 2020. Unlike many other studies on this same subject, the UCS analysis looked beyond employment to also include other forms of economic development. But because the methodology looked at a national RPS, the employment benefits for California may be understated due to assumptions about the distribution of jobs on a national rather than statewide basis.

According to the UCS figures, state employment would grow by an average annual increase of 16,000 jobs if California obtained 30 percent of its electricity from renewable resources by 2020. ***This figure represents more than six times the employment that would be created if California would produce an equivalent amount of electricity from fossil fuels.***<sup>7</sup> Among the other economic gains to be realized by this scale of investment in renewable resources are the following:

- \$14.89 billion in new capital investments;
- \$1.85 billion in cumulative consumer electricity and natural gas savings by 2020 (growing to \$3.82 billion by 2030);
- \$1.41 billion in income to farmers, ranchers and rural landowners who lease their land to wind developers or generate electricity from biomass resources;
- \$631 million in new local property tax revenue to help pay for schools and other vital local government services.

“An RPS saves consumers money by reducing the demand for fossil fuels and introduces new competitors into the U.S. energy market,” said Alan Noguee, UCS Energy Program Director. “As a result, energy companies are limited in their ability to raise fossil fuel prices in the future. Compared with the ‘business as usual’ status quo, natural gas and coal therefore cost less for electricity generation and/or for other purposes such as heating. In this way the RPS can provide economic value to both electricity and natural gas consumers.”

Other projections of major economic benefits for California come from these two national studies:

### **Diverse Wind Smith Workforce in Solano County**

*One of the few regions in California to experience recent renewable energy development is the Montezuma Hills in Solano County, located near the Sacramento River Delta town of Rio Vista.*

*The work force at wind farms in this rural region of California is increasingly diverse. “Ten years ago, we were pretty much a white Caucasian group,” acknowledged John Opris, Operations Manager of enXco, an international company specializing in running and operating wind projects employing a wide array of different wind turbine technologies. At present, two-thirds of the 15 employees at the site are people of color.*

*“I would say that 90 percent of the people we employ have had no previous experience with wind technology,” said Opris. A 26-page test is given to all potential employees to determine their basic electrical and mechanical aptitude and to see where they best fit in with the wind farm operations. Wages start at around \$14/hour for those with no experience, but can quickly ramp up to over \$20/hour as employees prove themselves. EnXco has an internal quality control training program, but also reimburses employees for outside training up to \$1,000 per year. The company has been investigating establishing a nearby training program.*

*“Most of these guys, however, learn about the difference between a wind turbine and a tractor or car during on-the-job training,” said Opris. Experience with computers is also increasingly important in wind farm operations, he said. Fiber optics and microwave technologies for telecommunications are being incorporated into new wind turbine designs and management systems.*

*One employee – Adrian Grannum – came to the U.S. from Barbados, only to discover he had a grandfather living here, which persuaded other members of his family to immigrate to the U.S. too. He is one of the few current employees with previous experience in the wind industry. “One day, I saw a flier at school in Cleveland, Ohio, and I became curious. I wanted to learn what electronics had to do with wind turbines.”*

**...continued on next page**

- **438,922 permanent jobs to California’s employment totals over the course of a decade of investments in climate friendly technologies.**<sup>8</sup> The Apollo Alliance conducted a study in 2003-2004 that looked at what would happen to the U.S. economy if federal policy makers adopted a \$300 billion “crash program” for clean energy. This sum would be injected into the national economy over ten years with the goal of diversifying supply while reducing demand. The Waco, Texas-based Perryman Group then examined the economic impacts of such a sizable long-term investment into greening the nation’s power supply. This analysis showed that California’s overall economy would greatly benefit from this crash program on sustainable energy, **with overall state personal income rising by nearly \$18 billion.**
- **140,000 jobs to California payrolls from clean power investments by 2020:** The World Wildlife Fund’s *Clean Energy: Jobs for America’s Future* analyzed the employment, macroeconomic, energy and environmental impacts of implementing what it described as the “Climate Protection Scenario.” This package of programs included energy efficiency programs in the building and industrial sector, a series of policies – including an RPS – in the electricity sector, and a number of other demand reduction and greenhouse gas emissions reduction standards in the transportation sector. **California would capture almost 10 percent of the nation’s 1.3 million jobs created by this crash program in clean power.**<sup>9</sup>

**Diverse Wind Smith Workforce (Cont’d)**

He soon landed a job with a subsidiary of General Electric, and began traveling around the country, commissioning wind turbines, including some here in Solano County. He decided to plant his roots here. At the age of 33, he is now a Project Supervisor, using his electronics knowledge to work out the bugs in the larger, modern wind turbines being installed in the area. “I love finding the faults and working with electronics,” he said. “These wind turbines amuse me. I love to discover what makes them tick, and then fix them.”

Victor Chat, whose parents came to California from Cambodia, had been looking for a job for over two years when he saw a wind smith job advertised on-line. “I was an auto mechanic in Stockton, just trying to get by,” said Chat. Though he is afraid of heights (“I almost gave up a couple of times during my first few months here”), this 26 year old is happy with his job.

“I can’t sit in an office, and I like the challenge of working with wind turbines, especially the newer ones, because they have more electronics, and so they are tougher to fix,” he said. “Of course, they are also taller.” It is not uncommon for wind smiths to climb the equivalent of one mile per year if they work on first generation machines, which have towers ranging between 60 and 100 feet, and generate 100 kilowatts of electricity. In contrast, modern wind turbines feature towers as tall as 260 feet and can generate up to 3 MW – 30 times the power of first generation turbines. On the bigger machines, employees rely upon lifts that help reduce body weight by a third. Many projects now incorporate such systems resembling an elevator to transport technicians to the turbine top, ensuring safety and making it easier for aging wind smiths to keep their outdoor jobs.

Joaquin Villalobos, age 31, has been working with enXco for six years. He heard about job opportunities in the wind business from one of his Dad’s co-workers. “I was working at a grocery store, but they had too many employees, so I didn’t get a whole lot of hours,” he reminisced. He had learned some basic electrical skills in high school, but knew nothing about wind turbines. Today, he and a partner

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## V. What Happened to the Miracle of California?

In the early 1980s, California promoted solar, wind, geothermal, and biomass energy sources more than any other state in the country, offering its own set of tax credits and attractive, stable long-term power prices to complement federal incentive programs.

Approximately \$1 billion was diverted from federal and state taxes into the world’s first wind farms between 1981 and 1985 to jump-start the wind power industry in California, attracting companies and investors from all over the world. The end result was 1,700 MW of new capacity, representing over 90 percent of the total wind power capacity at that point in time. Today, California has fallen behind

**The California share of the global wind market has shrunk from 90 percent to less than 4 percent despite the fact that the US has led the world in new wind capacity additions for the last three years in a row.**

Texas as the national leader on wind power: California’s 2,688 MW compares to 5,317 MW for Texas. The California share of the global wind market has shrunk from 90 percent to less than 4 percent despite the fact that the US has led the world in new wind capacity additions for the last three years in a row.

More than two decades ago, California also offered attractive utility power purchase contracts and other public support for renewable energy technologies that yielded these significant world-class achievements under the watch of former Governor Jerry Brown:

- Concentrated solar power (CSP) systems known as “parabolic troughs” were brought into commercial operation in California during this time period. At present, these first generation CSP facilities represent 354 MW of peak power capacity and generate close to 1 billion kWh annually. Some 650,000 parabolic mirrors that stretch over one thousand acres of the desolate Mojave Desert. ***Rekindled interest in a host of CSP technologies is evidenced by 4,500 MW of approved power purchase agreements with California’s public and private utilities.***
- Geothermal steam technologies have also been pioneered in California, where, in 1960, the world’s largest geothermal facility was constructed in The Geysers region, straddling Lake and Sonoma counties. However, this type of geothermal fuel – flash steam – is rare, and other technologies were needed to access California’s other primary geothermal steam basins. One such basin is in Imperial County in southern California, the region that is the focal point for today’s proposed geothermal power expansion plans. Though California still leads the nation in total installed geothermal capacity, the amount of power generated from this renewable fuel has actually declined over time from 2,686 MW in 1989 to 1,556 MW today.
- California quickly became the nation’s top producer of electricity from biomass power plants. Of the 62 biomass power plants built in the ‘80s, less than 40 are still operable today, representing roughly 787 MW of electrical capacity. At the industry’s peak in the late ‘80s, state biomass plants diverted 9.7 million tons of solid urban wood waste from California’s crowded landfills.

In each major renewable energy category – wind, solar, geothermal and biomass – California quickly jumped into the category of global pioneer in the 1980s. In the 1990s, however, things started to unravel, and California – the shining light for many looking for alternatives to business-as-usual – began to lose quite a bit of its sheen. Leading renewable energy companies such as Livermore-based Kenetech – the world’s largest wind power company – went belly-up due, in large part, to California’s unstable power market conditions. A planning process for new power plants that was supposed to be “biennial” dragged out for eight years – and then was overturned by federal regulators in 1995, further frustrating efforts to install new wind and geothermal capacity in California.

### **Diverse Wind Smith Workforce (Cont’d)**

*take care of a territory populated with 120 first generation wind turbines.*

*“One of my main jobs is to prepare these machines for the wind season,” he said. In this part of California, the vast majority of power generated by wind farms occurs from April through September, times when California generally needs the most power on a seasonal basis. Maintenance work – such as oiling, greasing and big repairs – typically occurs during the winter. “I love learning about different machines. I would love to stay in the wind industry and make it a career,” Villalobos said.*

*Joaquin’s cousin Michael, age 30, actually helped write a paper about the wind farms of the Altamont Pass, which is located in Alameda and Contra Costa counties, when he was in high school. He never imagined that one day he would become a wind smith.*

*Having recently purchased a house in Stockton, Michael grew weary of the commute back and forth to San Jose, where he had been working as a car mechanic for 11 years. Though he was a bit apprehensive about a change in his career, he’s now a happy camper. Just the same, he admits his current job can be punishing. “The challenges are the rain, the wind and the cold,” he said. “But I like the outdoors, looking out at the hills. Sometimes I see a coyote or maybe a red-tailed fox. But I also like to be working in a green industry. You actually think about it sometimes, working to reduce pollution.” He acknowledged he had to take a small cut in pay, but with current gasoline prices, he “came out OK.”*



**Figure 6 – Wind Smith workers (L to R) – Victor Chat, Adrian Grannum, John Opris, Joaquin Villalobos, Mike Villalobos**

### **Renewable Energy a Global Engine for Economic Growth**

*In its most recent Vital Signs Update,<sup>1</sup> the Worldwatch Institute this past July pointed out that renewable energy sources represent major engines of economic growth while the coal, natural gas and oil industries are rapidly losing their appeal as anchors of economic development. In the U.S., for example, jobs linked to the coal industry have been cut in half over the last 20 years despite a one-third increase in production.*

*According to the Worldwatch Institute, the global renewable energy industry employs 2.3 million people today. This total employment of direct and indirect supplier employment breaks down as follows:*

- *Biomass and biofuels industry employs 1,000,000 workers;*
- *CSP and other solar thermal technologies employ 624,000 workers;*
- *Wind industry employs 300,000 workers;*
- *Solar PV industry employs 170,000 workers;*
- *Small-scale hydroelectric industry employs 39,000 workers;*
- *Geothermal industry employs 25,000 workers.*

*The report goes on to recognize Germany, Spain and Denmark as leaders in creating green jobs in the renewable energy sector. Germany, for example, reports that the country employed 259,000 people in direct and indirect green jobs in 2006, and that figure is expected to reach as high as 500,000 jobs by 2020 and 710,000 in 2030.*

*An analysis performed by CEERT shows power supplied by renewable energy sources more than doubled since the year 2000 and now accounts for 14.2 percent of the gross electricity generation in Germany. Between 2004 and 2007, employment in Germany's renewable energy sector increased by 55 percent. The same story is true in Denmark. Employment in the wind sector grew 118 percent from 1997 until 2007 and now totals 23,000 jobs. Wind power and other renewable sources provided 25.9 percent of Denmark's gross consumption in the year 2006. Spain also has seen its renewables industry expand rapidly in recent years. The industry now employs some 89,000 people directly and another 99,000 indirectly. (Interestingly enough, these*

*...continued on next page*

Heading the signs of the times, California began to investigate how to best “deregulate” electricity services. Economists boldly endorsed a “free market” to allow new ideas to flourish in a state that had become synonymous with cutting edge energy experimentation. However, the ballyhooed electrical restructuring unanimously passed by the California Legislature in 1996 further stalled development of renewable resources. It also set the stage for one of the darkest chapters in California’s energy history. Rolling blackouts, a bankrupt utility, and the quick rise and fall of Enron, all shattered California’s image as a savvy place to innovate.

California then retreated and went to sleep, allowing the rest of the world to catch up and then surpass the state in securing future markets for new renewable energy technologies. The one exception is the solar PV segment, where the California Solar Initiative has resulted in the state capturing more almost 60 percent of the nation’s solar PV market, a decline from 73 percent in 2006.<sup>10</sup> Yet the majority of solar PV products being installed in California are manufactured overseas in Japan and Germany, thus diverting significant revenue streams that could flow into local government coffers and the pockets of California workers.

Today, natural gas is still the dominant fuel for new electricity power generation in California. But fuel price volatility has made natural gas less and less attractive over time. Exacerbating the run-up in natural gas prices is the fact that the California Public Utilities Commission (CPUC) capped payments to new renewable energy facilities based on forecasts of natural gas prices. In the 1980s, state regulators pegged the cost of renewables to projections of fossil fuel prices that proved to be too high. Two decades later, state regulators made the opposite mistake, pegging the price of renewables to forecasts of natural gas that proved to be too low. The CPUC’s current pricing methodology minimizes the potential rate benefits these fixed-cost resources could bring to the electricity system.

### ***Has California really lost its reputation as a world leader on renewable energy?***

Though California has adopted an impressive list of policies and programs designed to boost production of electricity from various renewable energy resources, a lack of coordination and commitment to these well-meaning initiatives among feuding state agencies is now taking its toll on both economy and environment. California’s vaunted global leadership on renewable energy technologies is apparently nothing more than a nostalgic mirage.

When T. Boone Pickens, the Texas oil man, announces that he is sinking \$4 billion into a wind project in West Texas, it is clear that the rest of the world is onto the bright idea of renewable energy, technologies that California jumpstarted in the early 1980s. Texas

**Renewable Energy (Cont'd)**

European countries often rely upon a "feed-in tariff" approach to renewable energy development modeled after California's original Standard Offer contracts utilized in the 1980s.)

By way of contrast, the U.S. actually employed more people than each of these countries in 2006, with 446,000 direct and indirect jobs. But these jobs are the result of state policies, not a comprehensive federal approach, claims Worldwatch. The U.S. is also a far larger country and only derived 1 percent of its electricity from wind power. "Renewables are poised to tackle our energy crisis and create millions of jobs worldwide," commented Worldwatch senior researcher Michael Renner. "Government officials now have yet another reason to put the full weight of their support behind renewables. In addition to protecting our planet and phasing out an increasingly limited resource, policies that support renewable energy also support job creation."

not only surpassed California's national lead in total installed wind power capacity in 2006, but the Texas Public Utility Commission approved a \$4.93 billion wind power transmission project this past July, which is positioning Texas to become the world's wind power leader.

In California today, progress too often stalls during the transition from bright idea to on-the-ground achievement. The state has a reputation for progressive policies on renewable energy sources and global climate change, but gets low marks from businesses trying to translate good intentions into practical reality. In search of the perfect solution, California sometimes loses its way in the practical implementation of big-vision ideas. A report issued on August 1 by the California Public Utilities Commission (CPUC) underscores just how far short California's investor-owned utilities have fallen on meeting existing RPS targets of obtaining 20 percent of their total supply from renewable energy by 2010.

According to the quarterly CPUC report, only 400 of the necessary 5,900 MW of new renewable supply has come on-line since this RPS law went into effect. California's supply of renewable energy has actually declined from 14 to 12.7 percent between 2003 and 2007.<sup>11</sup>

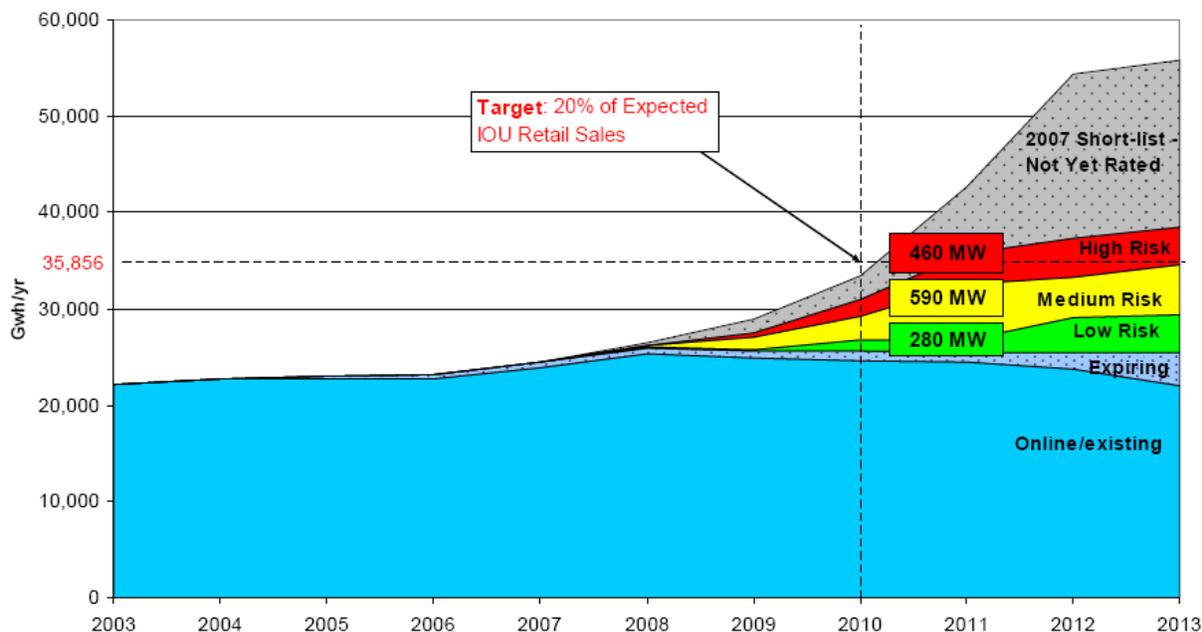


Figure 7 - Expected RPS Generation at Risk for California's Investor-Owned Utilities (Source: CPUC)

The state can no longer suffer the economic consequences of the gap between grand visions and actual success, particularly as it tries to employ new programs to lift up disadvantaged communities in these financially distressed times. "Those communities that were locked out of the last century's pollution-based economy must be locked into the new, clean and green economy," observed Van Jones, president

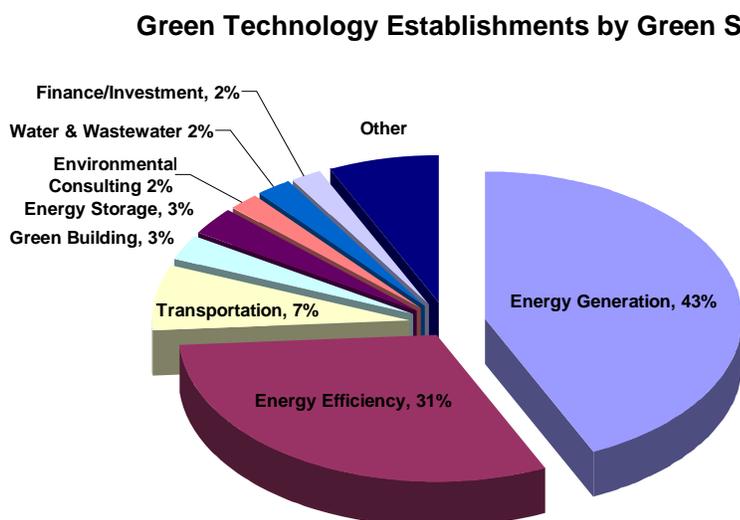
of the Oakland-based Ella Baker Center for Human Rights. “The national effort to curb global warming and oil dependence can simultaneously create good jobs, safer streets and healthier communities. To build a green economy strong enough to lift people out of poverty, that is the moral obligation of the 21st century.”

Carla Din, Western Regional Director for the Apollo Alliance, summed up the opportunity knocking at California’s front door: “The beauty of the clean energy economy is that it utilizes skills of all levels – from engineers to building and construction trades to manual labor. Through Career Technical Education, we can engage youth in areas like renewable energy – a far cry from flipping burgers at McDonald’s!” (The Apollo Alliance is a coalition consisting of labor, environmentalists, community groups and green businesses.)

## VI. Regional Examples of Potential Employment from Renewable Energy

California has the fortunate distinction of having a vast diversity of abundant renewable resources. Solar energy may be the most plentiful renewable resource available within the state’s borders, but California also features more high quality geothermal steam basins than any other state. While its wind resource is ranked 17th in the nation, the best build-out areas in Kern County near the Tehachapi Mountains have yet to be fully developed. California may add to its portfolio new biomass plants that combust urban wood waste, agricultural wastes or forestry trimmings. Significant opportunities still exist in both urban and rural settings to tap landfill methane and other gaseous waste sources for electricity.

The California Economic Strategy Panel issued a report in March 2008 entitled *Clean Technology and the Green Economy*. This report documents that green jobs related to renewable energy are scattered throughout the state. Prepared by Collaborative Economics, it points out that jobs in energy generation comprise the largest slice of the state’s green technology businesses (43 percent), followed by the energy efficiency slice (31 percent). Within this energy generation segment of California’s green technology sector, 64 percent of businesses and 53 percent of employment are directly related to solar energy.



**Figure 8 - Green Technology Establishments by Green Sector**

Source: Collaborative Economics

The report also examines the geographical distribution of green businesses and employment totals. Though concentrated in the San Francisco Bay Area (Alameda, Contra Costa, Marin, Napa, San Francisco, San Benito, San Mateo, Santa Clara, Santa Cruz, Solano and Sonoma counties) and in the Southern California region (Los Angeles, Orange, Riverside, San Bernardino and Ventura counties), energy generation jobs occur throughout the state, with more actual businesses located in the San Francisco Bay Area, but more employees in the Southern California region. Figures 5 through 10 come from this report.

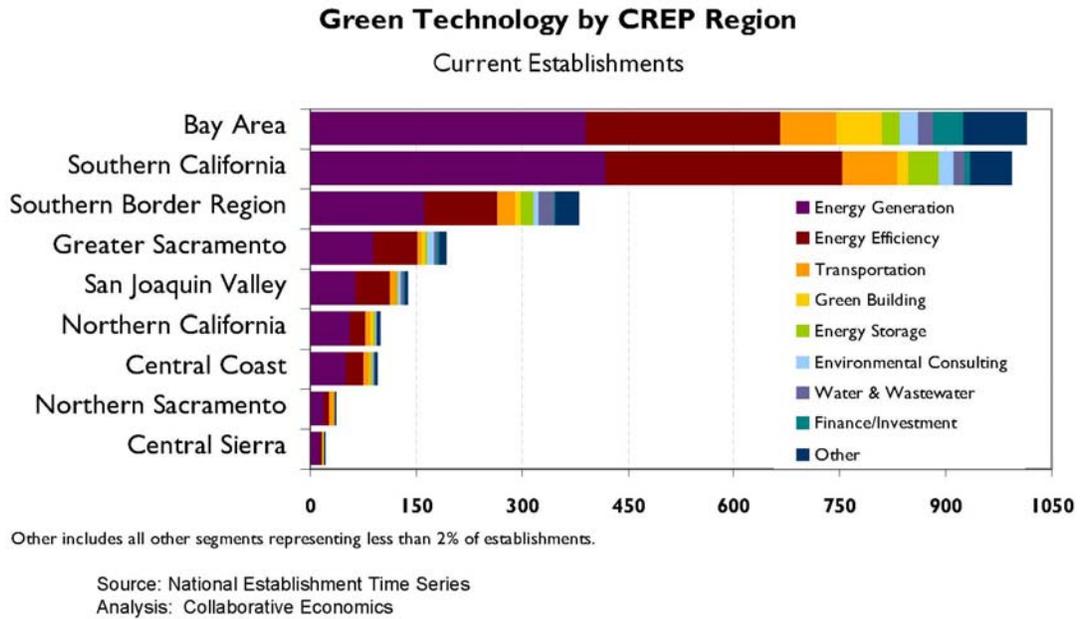


Figure 9 - Green technology by CREP Region

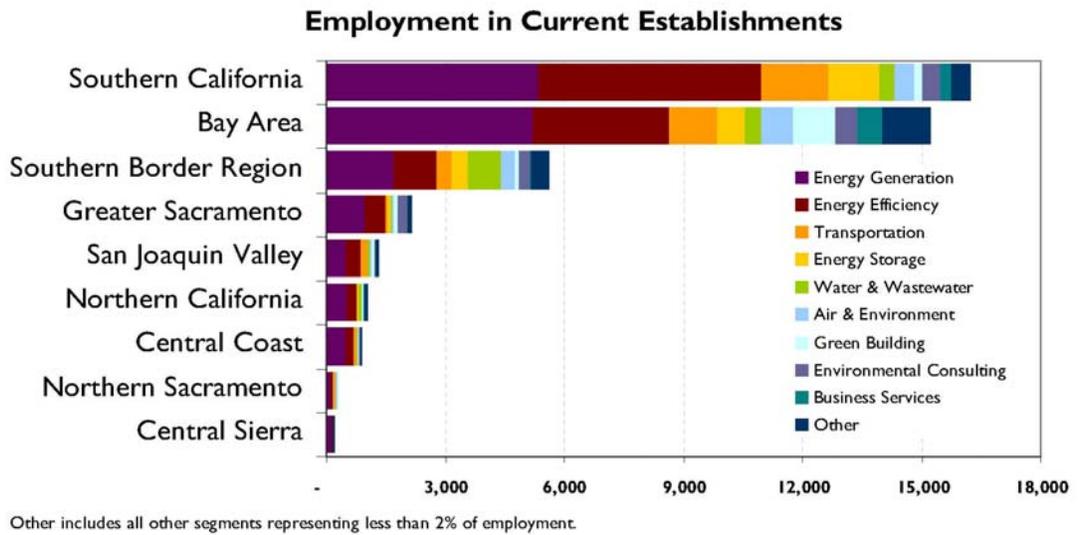


Figure 10 - Employment in Current Establishments

Another measure of green innovation occurring regionally is venture capital investments. A review of such infusions of capital over the three year period of 2005-2007 shows, unsurprisingly, that Silicon Valley ranks first in investment dollars flowing to green energy generation activities.

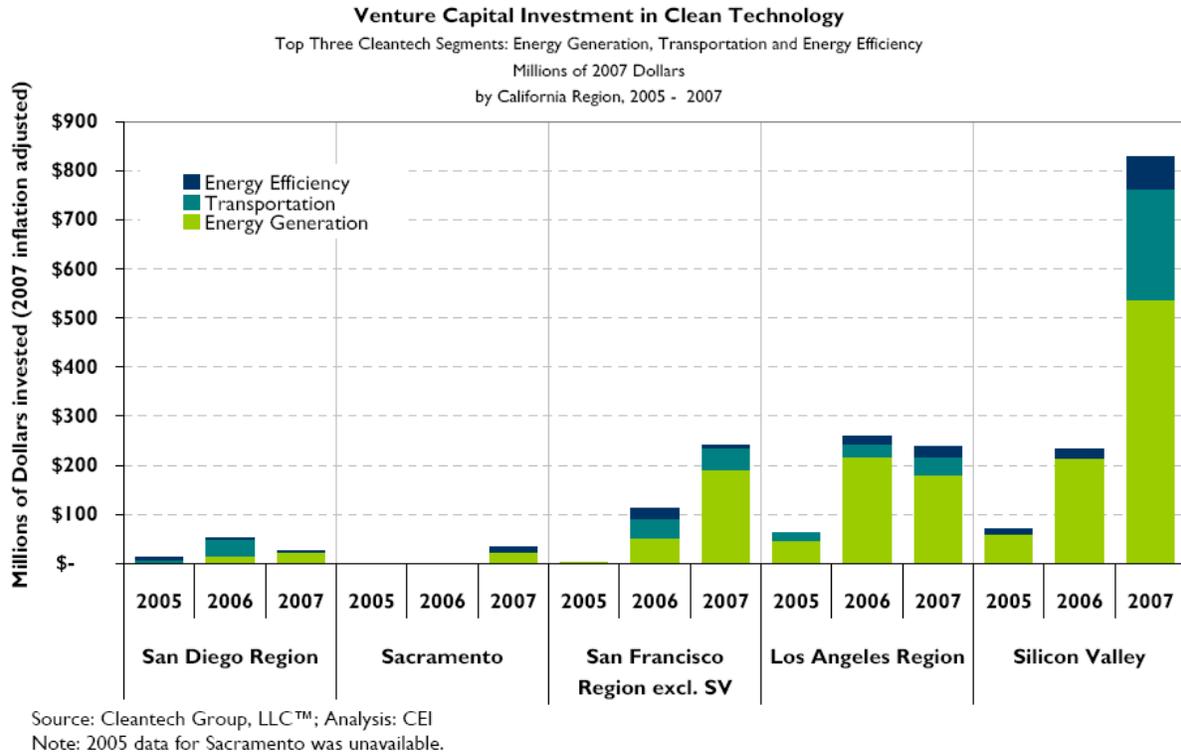


Figure 11 - Venture Capital Investment in Clean Technology

In the following sections of this report, the employment and economic impacts of increased investment in new renewable energy generation will be described for these regions of California:

- Imperial County
- Kern County
- San Francisco/Silicon Valley
- Greater Los Angeles Area
- The Central Valley

## Imperial County

When the Kent Imperial Company of Grand Rapids, Michigan showed up at the Sinclair Ranch in Imperial County in 1957, they had one thing in mind: oil. But the well they drilled found only an enormous basin of volcanically heated water now known as the Salton Sea geothermal field. The natural history of California with its storied earthquake faults created ideal conditions not only for fossil fuels such as petroleum and natural gas, but for geothermal steam as well.

Today, the geothermal industry is the largest source of local tax revenue for Imperial County. The ten geothermal power plants totaling 330 MW currently operating there generate approximately \$10 million annually in property tax revenue, nearly 20 percent of the total for Imperial County.

Often described as the “crown jewel” of renewable resource regions in California, Imperial County is notable not only for its prime geothermal sites, but also some of the world’s best solar resources, as well as significant wind capacity. According to the San Diego Regional Energy Office, Imperial County has the following technical renewable energy development potential: 31,900 MW of CSP; 3,400 MW of geothermal; and 1,830 MW of wind.<sup>12</sup>

The great advantage of all solar energy technologies is that they can provide power when California most needs it: on late sunny afternoons when air conditioning demand pushes electricity consumption up to its highest levels. Geothermal steam is a critically vital resource for California because unlike solar or wind generation, these power plants can generate power 24/7 and can therefore directly displace coal and natural gas power plants.

Using the same methodology employed in calculating the jobs estimates for Figure 1 of this report yields the following potential jobs given full build-out of these Imperial County renewable resources:

- 155,692 jobs in the CSP industry
- 28,050 jobs in the geothermal industry
- 13,725 jobs in the wind industry

These employment numbers – which total 197,467 jobs – highlight how renewable energy resources can deliver large numbers of jobs in poverty stricken regions of the state and country. Imperial County ranks among the poorest counties in California, having a June unemployment rate of 22.6 percent with approximately 16,500 people looking for work.<sup>13</sup> ***“With our payroll of several hundred high-paying jobs, we are the largest private employer in Imperial County, whose unemployment rate is the highest in California and one of the highest in the United States,” said Jonathan M. Weisgall, vice president for legislative and regulatory affairs for MidAmerican Energy Holdings Company, a subsidiary of Berkshire Hathaway and the parent company of CalEnergy.*** “As California moves to expand its renewable energy base, we are actively planning to develop our large untapped geothermal resources at the Salton Sea, which in turn will create more high-paying jobs for the clean tech sector.”

The primary challenge to developing and then delivering this clean power to San Diego, Los Angeles and the rest of the state is the need to build new transmission lines. If California wants to tap a sizeable portion of this potential employment – and wants to harness some of the lowest cost renewable energy supplies in the state – then new transmission lines will need to be built to deliver this clean power to consumers. The Sunrise Power Link proposed by San Diego Gas & Electric is under consideration, as are proposals for new transmission by the Los Angeles Department of Water and Power.

## Kern County

In 1909, the famed “Midway Gusher” blew out near the town of Fellows in Kern County, foreshadowing development of the billion-barrel Midway-Sunset oil field, the largest producing field in the entire continental US. Even today, roughly half of California’s total oil production comes from Kern County.

In addition to being California’s best oil production region, Kern County features California’s top wind farm development site. Local Native American tribes named this region “Tehachapi,” their word for “strong winds.” With elevations ranging from 2,500 to 8,000 feet, the unique geography of the Tehachapi Mountain Pass connects the lower San Joaquin Valley with the Mojave Desert. The differences in temperatures between these environments make it an ideal location to generate clean electricity from the prevailing northeasterly winds. The nearby Antelope Valley in northern Los Angeles County is also a prime wind area. Like Imperial County, however, a current lack of transmission has hindered efforts to fully take advantage of these premier renewable resource regions.

Though highly variable, wind power is the lowest cost renewable energy choice available. That is why bringing more Tehachapi wind power into the state’s electricity grid should be a top priority.

The Tehachapi Resource Area has approximately 730 MW of wind power capacity on-line today, more than any wind resource area in California. These existing clean electricity generators produce roughly 2 billion kilowatt hours annually. ***Yet the total technical potential for wind development in Kern County and surrounding areas is well in excess of 4,000 MW – about the same capacity as California’s current nuclear reactors.***<sup>14</sup> This level of wind farm development would represent a \$2 billion investment in the California economy and, according to the REPP job ratio methodology, would create 30,000 full-time manufacturing jobs. (The current unemployment rate in Kern County is 9.5 percent, with 34,700 people looking for work.) Efforts have been ongoing to create a master plan for new transmission lines linking up this prime wind resource. ***Kern County also featured the nation’s very best***

***This level of wind farm development represents a \$2 billion investment in the California economy and according to the REPP job ratio methodology, could create 30,000 full-time manufacturing jobs.***

***solar resource.*** The Renewable Energy Transmission Initiative (RETI) will soon issue recommendations for the best approach to build out these bulk-power renewable resources and then link this clean power to customers to the north and west.

The wind industry has already made a significant positive impact on the local economy. A study of regional economic impacts by the Kern County Wind Energy Association found that the local economy nets \$11 million from the purchase of goods and services from existing wind farm operations. Developers pay farmers and ranchers lease payments for their “wind rights,” offering revenue streams that

### SCOPE: Working Towards a Green Los Angeles

*Strategic Concepts in Organizing and Policy Education (SCOPE) has convened a multi-sector coalition called the Los Angeles Apollo Alliance that seeks to develop a green, clean and equitable economy for all communities in the Los Angeles area. This alliance is set to pass a city-wide ordinance to establish a green retrofit program for municipal building that will offer workforce training to create good-paying jobs for existing and entry-level workers in the community. A key feature of this proposed ordinance is a mandate that the City of Los Angeles install solar energy technologies on all large municipal buildings in order to reduce greenhouse gas emissions and generate energy savings.*

*“The City of Los Angeles alone – without including its proprietary departments – owns over 1,000 municipal buildings,” observed Elsa Barboza, a SCOPE activist. “This ordinance provides a huge opportunity to not only pursue renewable energy technologies and ameliorate environmental impacts, but also create a market for solar work and jobs in Los Angeles communities,” she said.*

*“The ripple effects of investing in renewable energy and green industries will address related problems in Los Angeles communities,” added Joanna Lee, research coordinator for SCOPE. Her research reveals that 3.7 million residents of Los Angeles County are living at or below 200 percent of the federal poverty level. “By creating jobs and improving air quality, such investments create healthier and cleaner communities,” she said. The infamous smog of LA – though reduced over the past few decades – still results in very high rates of asthma and respiratory disease among the local citizenry. “A Campaign for Green Jobs can provide a model to mitigate environmental hazards and health risks in environmental justice communities,” Lee said.*

often keep family agricultural enterprises in the black. While rates may vary, a modern 1.5 MW wind turbine typically pays off for landowners at rates of \$3,000 to \$4,000 per year.<sup>15</sup> Since agricultural operations may continue on the same land, this passive revenue stream is bolstering rural economies – and saving family farms and ranches – all across the country.

### The Los Angeles Region

The Southern California region employs more people in the renewable energy sector – over 5,000 workers – than any other part of the state. However, the Los Angeles Department of Water and Power – the nation’s largest municipal utility – is the dirtiest utility in California. Almost half of its electricity comes from out-of-state coal plants. Furthermore, four natural gas power plants located within the boundary of the City of Los Angeles provide another 26 percent of its supply. Renewable energy comprises only five percent of its supply mix.

In the eyes of Alex Paxton, manager of policy analysis for the Community Redevelopment Agency of the City of Los Angeles (CRA/LA), the city could emerge as a major manufacturing hub for the green technology jobs of tomorrow. “Los Angeles provides more manufacturing jobs than any other U.S. city,” said Paxton. Among the advantages Los Angeles has over other parts of California is the largest port in the U.S., and the Alameda Corridor, a 20-mile railroad express line that connects the ports of Long Beach and Los Angeles to the transcontinental rail network east of downtown LA. Used together, these routes can help import raw materials and export green technology products overseas and across the country. The region also boasts three of the top fifteen engineering schools in the country, and the most engineering graduates from these top schools in the U.S.

Paxton has been working with local governmental officials on a vision for the future of Los Angeles that “helps address the income disparity that exists in today’s job market, and that works toward developing more sustainable wages in the Los Angeles area.” State statistics show that, on average, industrial jobs pay 50 percent more than retail jobs, and this pay differential has shaped Paxton’s approach to community development. *(Continued on page 27)*



#### **Clean Tech Industrial Park (Crown Coach)**

- **Central Industrial Area Redevelopment**
- **Approximately 20.6 acres**
- **CRA/LA-owned Brownfield with approved, implemented remediation plan**
- **Zoned for heavy manufacturing**
- **Designated for model sustainable industrial development with anchor tenant, ancillary uses, and a clean tech incubator or jobs training facility**
- **Attract businesses that will create “career-ladder” local jobs**

Figure 12 – Clean Tech Industrial Park

Source: CRA/LA

### Concentrated Solar Power

The sun offers 50,000 times more radiation energy than the world actually needs as primary energy. While solar PV systems can be installed virtually anywhere and have become quite familiar to the general public, concentrated solar power (CSP) technologies can offer California far more clean electricity from giant solar farms at lower cost.

CSP technologies require higher concentrations of solar radiation than solar PV systems since they can only generate electricity from direct beam radiation. Although efficient direct solar electricity production from CSP is basically restricted to the so-called "sun belt of the world," i.e., that region situated between 15° to 35° latitude in both the Northern and Southern hemispheres, this is in fact the area with the largest increase in demand for energy. It also happens to include the desert Southwest and southeastern parts of California.

CSP technologies trace back to principles used by Archimedes of Syracuse in Italy in the 3<sup>rd</sup> century when he proposed to burn the Roman fleet with a parabolic dish device. Then, in the 16th century, Leonardo da Vinci conceived a parabolic mirror that concentrated solar energy for clothes dyeing. Later in the 18th century, Horace de Saussure invented the first flat plate solar collector, a little box with several glass tops that captured enough solar energy to boil liquids. Then, in the late 19th century, the Swedish American John Ericsson powered his hot-air engine with a parabolic trough. It was not until 1912 that such parabolic troughs were used for power generation when a 45 kilowatt steam-pumping plant using parabolic trough collectors developed by Scottish-American Frank Shuman was constructed in Egypt. Despite the plant's success, it was shut down in 1915 due to the onset of World War I and then falling fossil fuel prices.

The commercialization of solar thermal electric technology took a major step forward in the mid-1980s and early 1990s with the development of the SEGS plants in California by Luz International Ltd. Consisting of parabolic trough technology integrated with steam Rankine cycles, these facilities total 354 MW of installed capacity. These facilities have provided a wealth of operating experience and instilled confidence in a wide spectrum of observers about the viability of CSP technology as a future power source. Former members of LUZ have re-entered the market under a new name – BrightSource Energy – and in the summer of 2007 announced the development of an even larger solar farm project in the Mojave Desert that will feature a new "Power Tower" design. Another company whose members were involved with the SEGS projects is Berkeley-based Solar Millennium LLC, which is currently developing new projects utilizing the parabolic trough CSP technology in Spain and has proposed new CSP projects in California, too.

The key advantage of this next generation CSP technology developed by Solar Millennium LLC is that it can be developed in conjunction with thermal storage technologies – often molten salt – and therefore can offer reliable electricity to either meet peak demand or provide power 24/7. According to the company, 2,000 new MW of CSP capacity is expected to come on-line in California by 2010/2013 and another 8,000 MW by 2020, with development concentrated in the high Mojave Desert and Imperial Valley. If these projections hold true, California will benefit from 2,000 direct construction jobs that will span more than a decade. Direct manufacturing jobs would number roughly 1,000 and another 2,000 permanent operations and maintenance jobs would also be created in California. All told, these likely CSP projects would employ 5,000 workers.



Figure 13 - Construction of AndaSol 1 in Spain (Source: Solar Millennium, LLC)

**Los Angeles Region (Cont'd)**

CRA/LA is developing a Cleantech Industry Development Strategy that has identified three potential clusters in the Harbor, Downtown and San Fernando Valley “We want to find the highest and best use for these industrial lands. The purpose of CRA is to eliminate economic blight. We see a fundamental part of our mission as creating economic opportunity for the people who live in and near our project areas. Like other community redevelopment agencies, CRA/LA can offer incentives such as low-interest bonds and land write-downs to kick-start development,” Paxton explained. “We didn’t want to just build buildings and promote gentrification. We want to focus on better housing and better jobs through clean tech.”

**“We didn’t want to just build buildings and promote gentrification. We want to focus on better housing and better jobs through clean tech.”**

Paxton is hoping to use the proposed “Clean Tech Industrial Park” at the old Crown Coach site as a pilot and catalyst. “We want to find an anchor tenant that offers sustainable job opportunities, and produce something that falls within the category of green technology,” she said. In addition, CRA/LA is hoping to co-locating related industries or suppliers on the campus. A clean tech incubator for green collar jobs is also in the plans.

Though Paxton has yet to create any green collar jobs, REPP has provided CRA/LA with supply chain information for firms capable of producing component parts for the proposed new wind development in northern Los Angeles County and adjacent Kern County. “We are in the process of trying to better understand the supply side of the wind business, with the idea of repositioning some of the existing businesses within the Los Angeles area to offer components to the renewable energy industry,” she said. The REPP work has helped identify clusters of firms that show great potential in meeting demand for green technology components. “We also hope to identify bottlenecks in the supply chain, and then attract these firms to one of our clean-tech opportunity sites,” she concluded. Los Angeles County had an unemployment rate of 7.1 percent as of this past June, with 347,800 people looking for work.

**San Francisco and Silicon Valley**

When most people think about solar power, they don’t think about foggy San Francisco. Yet California’s Bay Area – and the surrounding region – is a hotbed for this technology, one of the few renewable energy options to generate clean electricity right at the point of electricity consumption. Known within the power industry as “distributed generation,” solar PV – small semiconductors that generate electricity directly from sunlight – is the bright spot in California’s renewable energy push in the 21<sup>st</sup> century.

The downside to solar PV is that it is still the most expensive renewable option, though many of its unique benefits are attracting significant attention from consumers and

Company	City	Products/Services	Employees
Sun Power Corp.	San Jose	Manufacturing, Design and Installation	350
Nanosolar	San Jose	Manufacturing (Thin Film PV)	250
Solar City	Foster City	Design/Engineering Installation, Financing	215
Akeena Solar	Los Gatos	Design/Engineering Installation, Financing	200
Miasole	Santa Clara	Manufacturing (Thin Film PV)	175
Borrego Solar Systems, Inc.	Berkeley	Design/Engineering Installation, Financing	130
Sun Light & Power	Berkeley	Design and Install Solar PV and Solar Thermal	60
Regrid Power, Inc.	Campbell	Design/Engineering Installation, Financing	50

Source: San Jose Business Journal, Oakland Tribune, New York Times and company web sites. Note: Employee numbers are best estimates based on available information.

**Table 4 - Major Bay Area Solar Firms**

investors alike. Because solar PV provides more jobs per MW than any other supply choice – and can be installed anywhere the sun shines – it has emerged as the favorite technology of most environmental justice (EJ) advocates.

Recent surveys suggest that California is home to 16,500 to 17,500 workers linked to the solar energy industry, with the vast majority involved with solar PV, the fastest growing power source in the world. On average, these solar energy firms expect 30 to 40 percent annual growth over the next decade.

A report entitled *Environmental Scan: Solar Industry – San Francisco Bay & Greater Silicon Valley* was based on interviews of 77 of the 257 solar related businesses located in the ten-county Bay Area to assess future employment trends in the solar energy market. Of the firms interviewed, 75 percent expected to increase employment over the next year.<sup>16</sup> This report projects that 5,000 new jobs could be created statewide in the solar PV industry over the next year, 1,900 of which would be in the Bay Area. Today, the Bay Area employs between 6,900 and 8,000 workers in solar-related business activity. Some of the major employers are listed on the previous page in Table 4: *Major Bay Area Solar Firms*.

The report notes that career pathways do exist in a rapidly expanding market for solar energy related products and services, offering both “green collar” and “white collar” job opportunities. The more mature job positions – and pay scales – are depicted on the following page in Figure 12 - *Career Pathways for Solar Industry Occupations*.

### Green Collar Jobs

*Some academics, such as San Francisco State Professor Raquel Pinderhughes, have developed the concept of “green collar jobs,” which she defines as blue collar manual labor jobs in businesses that generate green products and services that have relatively low barriers to entry. “There are potential green collar jobs at every sector level in renewable energy development, from manufacturing to distribution and the phases of installation, maintenance and repairs. The renewable energy industry is projected to grow exponentially, and there is an enormous opportunity to develop employment at every juncture of the renewable energy supply chain and within the ongoing service industries sector,” she said. Her surveys reveal low-income Bay Area residents like the idea of cleaning up the environment, “and they like the idea of doing it at the local level.”*

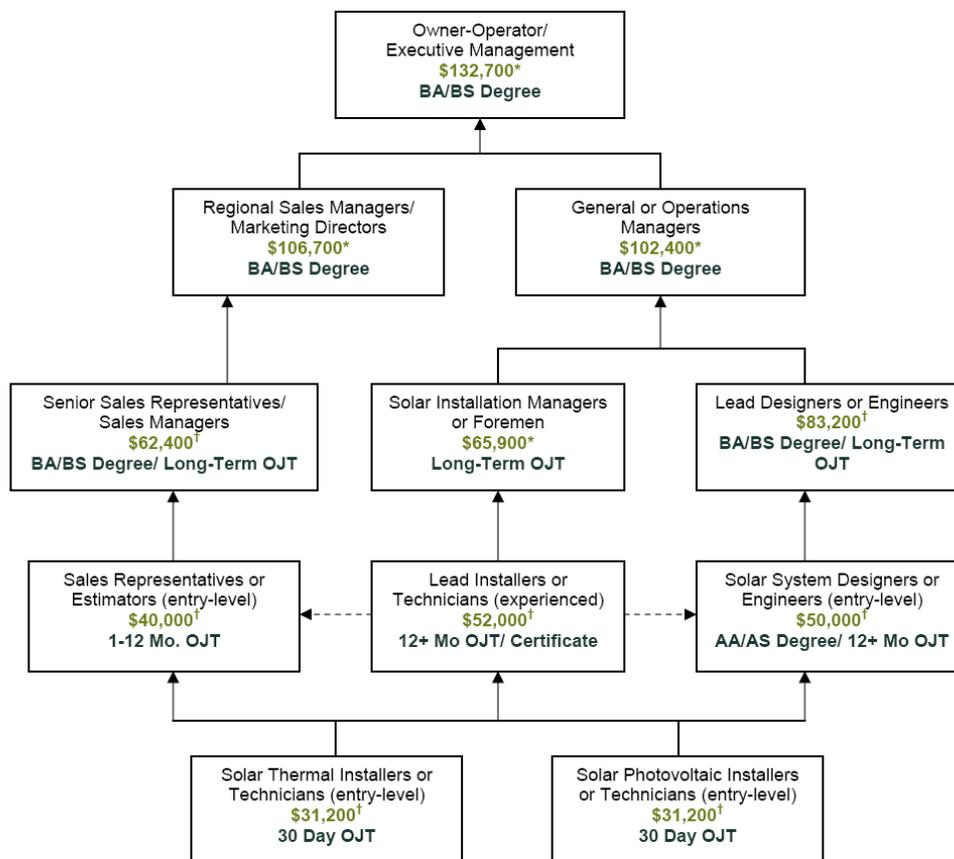
*The renewable energy market will no doubt grow over time, said Pinderhughes. From an EJ perspective, “what California needs to do is to mold and shape the green jobs program to integrate a new set of workers through green collar training programs.” She warned that a poorly crafted green jobs economic development program could actually erode worker wages. “Renewable energy has always been attractive to the EJ community, but our language has been reactionary and focused on shutting down traditional polluting power plants. Alliances with mainstream environmental organizations are getting better, and the EJ community is now more focused on looking at the issue of pollution and jobs with the frame of renewable energy opportunities,” said Pinderhughes.*

*Some early success stories with developing green collar jobs in the East Bay include Solar Richmond, which is part of the Richmond BUILD program that offers pre-apprentice construction skills and solar installation training to residents of a community that ranks as the most violent per capita in the state. The Hopland-based Solar Living Institute provides the technical training.*

*Richmond has suffered from the environmental impacts of chemical and oil refining operations. Richmond officials hope to boost local employment opportunities in their city, which has a high school dropout rate of more than 50 percent. So far, 11 people have graduated from the solar installation program, and landed jobs with starting wages averaging \$18.33 per hour. Future plans include an expansion of solar training to four weeks, which would lead to certification by the Northern California Board of Certified Energy Practitioners. The proposed career ladder would also include energy efficiency training for youth. Another potential success story is Rising Sun Energy Services, which is one of the Richmond BUILD partners. With funding from Pacific Gas & Electric and East Bay Municipal Utility District, high school students are earning a living wage this summer performing energy and water retrofits. A logical step in the evolution of this program is to add training programs so that solar PV and solar hot water installations could ultimately be part of the service delivery package.*



Figure 14 - Richmond Build



† Statewide solar industry workforce study entry and experienced level wages as estimated by the employers surveyed. Education and experience requirements are approximate and may vary among different employers.

\* Median statewide wages for these occupations were taken from the Labor Market Information Division's Occupational Employment Survey, 1<sup>st</sup> Quarter 2007 at [www.labormarket.edd.ca.gov](http://www.labormarket.edd.ca.gov).

**Figure 15 - Career Pathways for Solar Industry Occupations**

While the report on solar PV in the Bay Area is quite optimistic, it also highlights some remaining challenges for the solar PV industry:

- Lowering the cost of solar PV generation
- Establishing industry standards for installation and performance
- Streamlining the process for acquiring permits, interconnections, inspections and state rebates
- Securing future financing to support projected growth.

Venture capital is extremely important to the solar industry, as it seeks a foothold in the global market. State and federal subsidies for the solar industry have prompted a surge in private investment, led by venture capitalists. In 2007, these seed investors put \$654 million in 33 solar-related deals in California, up from \$253 million in 16 deals in 2006, according to the Cleantech Group. California received half of all solar power venture investments made in 2007 in the US.<sup>17</sup>

## The Central Valley

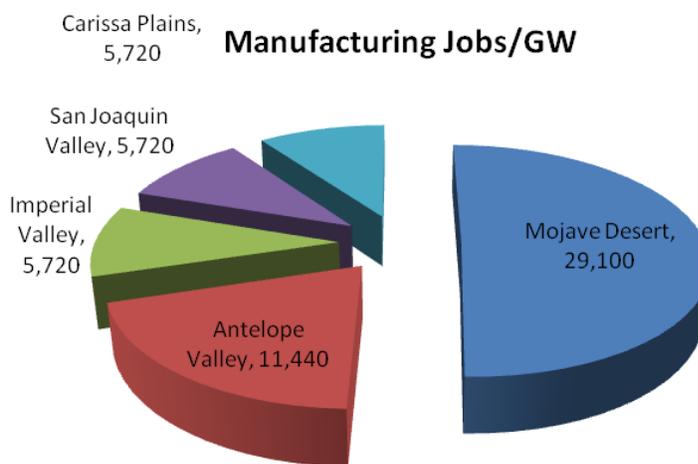
The San Joaquin Valley is the most contaminated air basin in the nation. Asthma is rampant among children, as well as other members of the community. Of the Center for Disease Control's top 50 cities for asthma, only Chicago and New York City rate higher than Fresno. One third of the city's population has been diagnosed with some form of chronic illness. The unemployment rate in Fresno County this past June was 9.7 percent, with 43,100 county residents seeking work.<sup>18</sup>

**Of the Center for Disease Control's top 50 cities for asthma, only Chicago and New York City rate higher than Fresno.**

Most local citizens suspect the blame lies with the agricultural and food processing industry that dominate life in the Central Valley. "All of these industries are being courted in the Valley by civic leaders seeking economic advantages, desperately seeking a tax base to support their municipality," observed Rey Leon, executive director of the Latino Environmental Advancement and Policy Institute. "The assumption always has been, if you bring in these mega-dairies, mega-dumps, mega-power-plants, incinerators and so on, jobs and economic development will follow." Instead, the region has been plagued with pollution and public health threats.

The Brookings Institution's *Katrina's Window: Confronting Concentrated Poverty Across America* report claims the City of Fresno has the highest concentration of poverty of any city in the nation.<sup>19</sup> It is safe to say that clusters of poverty can be found throughout the San Joaquin Valley. Tulare County, for example, continues to be the poorest of all counties in California, despite boasting the highest revenue from agriculture of any county in the US. Tulare County also happens to be the county with the state's highest percentage of Mexicans/Latinos, who make up 55.8 percent of the total population. Renewable energy offers a ray of hope to these Valley workers seeking a better life.

"With the Central Valley's strategic location on California's high-voltage network and abundant renewable energy resources – Tehachapi's wind, strong solar insolation on vast expanses of retired farmland and tremendous agricultural waste feed stocks – this region has enormous potential for being California's renewable energy powerhouse," claims Mark Stout, director of renewable technology planning for Fresno-based Cleantech America, Inc. His focus is on utility-scale solar PV, and according to his calculation (see Figure 16), the San Joaquin Valley would gain over 5,000 jobs if a 33 percent RPS by 2020 law was passed.<sup>20</sup> The Mojave Desert would gain the most employment – 29,100 jobs – followed by the Antelope Valley with 11,440 jobs.



**Figure 16 – Utility-Scale Solar PV Manufacturing and Install/O&M Jobs/GW**

Source: Cleantech America

Wind power jobs are being generated in both northern and southern portions of the Central Valley. Many of the workers in Montezuma Hills in Solano County, for example, commute from San Joaquin Valley cities such as Stockton and Tracy. Perhaps one of the most promising renewable resource opportunities for the Central Valley lies with biomass. With the abundance of agricultural activities up and down the Valley, converting orchard pruning and other waste streams into fuel for clean electricity generation is a top priority. Each new biomass power plant represents \$1.5 to \$2 million per MW. Depending upon the size of the facility, these power plants may create as many as 200 jobs during construction and 15 to 25 ongoing operations and maintenance jobs. Unlike other renewable power plants, biomass facilities require fuel collection, processing and transporting, which can generate between 100 and 200 more jobs in each community located near a biomass plant.

Though biomass facilities are a renewable resource, they do rely on combustion technologies. New biomass power plants must meet state-of-the-art air quality standards, or they will just be another contributor to the Central Valley's air quality woes.

## VII. The Reform Agenda Needed to Complete the Green Jobs Business Plan

California has an opportunity to take the first step in implementing the *Green Jobs Business Plan* by increasing the current state RPS to 33 percent renewable energy supply by 2020. But this new policy, supported by the Governor and analyzed by state agencies such as the California Air Resources Board (CARB), California Public Utilities Commission (CPUC), California Energy Commission (CEC) and California Independent System Operator, is only a first step. If California is to benefit from the more than 190,000 potential full-time manufacturing jobs projected to result from the adoption of this 33 percent target, a series of other reforms need to take place:

- **Transmission Upgrades:** The only way for California to meet the goal of a 33 percent RPS by 2020 is to build the necessary superhighways to bring the lowest-cost premier renewable resources developed in remote areas such as Imperial and Kern counties to urban centers of energy demand such as Los Angeles and San Diego.
- **Enforcement:** Because current statutes allow an investor-owned utility a three-year compliance window to meet its RPS goals and to allow “contracts,” as opposed to actual energy deliveries, to count for compliance, the utilities have not had the incentives to sign contracts for procurement with new renewable projects that are sufficiently viable or likely to come on-line in a timely manner. CEERT believes that this disincentive to procure power from viable projects can be reversed by state agencies permitting reasonable transactional flexibility sufficient to overcome physical and market barriers to procurement, and committing to the imposition of an appropriately priced non-compliance payment adopted by the CPUC and CEC.
- **Renewable Energy Pricing:** California's current 20 percent by 2010 RPS is deeply flawed in that it links the pricing of new renewable energy supply to the cost of natural gas, the preferred resource choice of the state's investor-owned utilities. Known as a “Market Price Referent,” this pricing policy limiting payments to renewable energy generators is not employed by any of the other 25 states that have enacted an RPS. One outcome of this approach is that many of the firms bidding into the California RPS market can no longer pencil out their projects because of recent raw material cost increases and a radically out-of-date payment structure.

According to the Economic and Technology Advancement Advisory Committee report prepared for CARB, nearly 340,000 California manufacturing jobs have been lost over the past five years. California's corporate income tax apportionment formula imposes a higher tax burden on those hiring and investing within the state's borders. Imposing a sales tax on manufacturing equipment installed for in-state use

makes the capital-intensive expansion process significantly more expensive in California, perhaps higher than any other U.S. state. As a result, companies moving products from laboratory to full-scale manufacturing are under strong economic pressures to locate out of state.

It is beyond the scope of this report to identify all of the barriers to generating the most possible employment from a 33 percent by 2020 RPS. National policies – such as the federal investment tax credit for solar PV and the production tax credit for wind power – also play a major role. An analysis by Navigant Consulting, for example, shows that California would take the biggest economic hit if Congress fails to renew these critical incentives for renewable energy projects. Their analysis shows \$19 billion and 116,000 jobs hang in the balance across the country. In California, 22,583 solar PV industry jobs are at risk, according to the Navigant analysis.<sup>21</sup>

Regardless of the actions of federal policymakers, the key to maximizing California's renewable energy assets is to capture a large share of jobs related to the manufacturing of components that make up wind turbines, solar PV panels, geothermal steam turbines and combustion technologies used in the biomass industry. The beauty of renewable energy is that these technologies substitute people's labor for imported fuel. That is why they generate so many more jobs than today's fossil fuel industry.

One of the key problems California has had with transforming its grand visions of a sustainable energy future into real power plants with steel in the ground and real jobs in urban and rural communities is that no one seems to be in charge. As the old saying goes, there seem to be too many cooks in the kitchen. Many renewable energy developers – who preferred to remain anonymous – complained of the large numbers of state regulatory agencies overseeing renewable energy development, and as a result, the processes for permits and other mundane details seem to take forever. ***Despite the threat of global climate change and economic hardships due to escalating fossil fuel prices, California has only added 400 MW of new renewable supply capacity over the last five years, while 5,900 MW is mandated by 2010 under state law.***

California currently imports about one-quarter of the energy it consumes, primarily from coal and large hydroelectric resources located in nearby states. These Western states also have significant additional renewable energy potential that could be tapped to help meet California's targets. With more than one million MWs of potential in-state renewable capacity, and significant renewable potential in neighboring states, it is simply ridiculous to continue to think of renewables as a side-dish option. Developing these vast resources will require long-term planning and the commitment of the government on behalf of its citizens to develop the infrastructure necessary to access them. There is a lot of work to be done, and the state has begun to take appropriate steps that will help us achieve the 33 percent RPS requirement. This presents a huge opportunity for the creation of good, green collar jobs in the state. These are jobs that cannot be moved overseas, because most of the work must be done here at home.

The *Green Jobs Business Plan* is designed to counter the common misperception that renewable energy is more expensive than fossil energy. By substituting people's labor for imported fuel, California can generate massive economic development benefits by regaining its leadership role on renewable energy. Despite the common misperception that renewable energy is an exotic but pricey side dish on our electrical power menu the time has come to choose it as our main course.

## VIII. Appendices

**Appendix A – Kammen, Kapadia & Fripp Table, “Energy and Jobs”**

Daniel M. Kammen, Kamal Kapadia and Matthias Fripp, *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* University of California-Berkeley, 2004.

Energy Technology	Source of Numbers	Capacity Factor	Equipment lifetime (years)	Employment Components			Average Employment Over Life of Facility					
				Construction, Manufacturing and Installation (person-yr/MWp)	Operation and Maintenance (jobs/MWp)	Fuel extraction and processing (person-yr/GWh)	Total jobs/MWp		Total jobs/MWa		Total person-yr/GWh	
							Construction, Manufacturing, Installation	O&M and fuel processing	Construction, Manufacturing, Installation	O&M and fuel processing	Construction, Manufacturing, Installation	O&M and fuel processing
PV 1	REPP, 2001	21%	25	32.33	0.25	0	1.29	0.25	6.21	1.20	0.71	0.14
PV 2	Greenpeace,2001	21%	25	30.00	1.00	0	1.20	1.00	5.76	4.80	0.66	0.55
Wind 1	REPP, 2001	35%	25	3.80	0.10	0	0.15	0.10	0.43	0.27	0.05	0.03
Wind 2	EWEA/Greenpeace, 2003	35%	25	22.00	0.10	0	0.88	0.10	2.51	0.27	0.29	0.78
Biomass – high estimate	REPP, 2001	85%	25	8.50	0.44	0.22	0.34	2.08	0.40	2.44	0.05	0.28
Biomass – low estimate	REPP, 2001	85%	25	8.50	0.04	0.04	0.34	0.32	0.40	0.38	0.05	0.04
Coal	REPP, 2001 Kammen, from REPP, 2001;	80%	40	8.50	0.18	0.06	0.21	0.59	0.27	0.74	0.03	0.08
Gas	CALPIRG, 2003; BLS, 2004	85%	40	8.50	0.10	0.07	0.21	0.60	0.25	0.70	0.03	0.08

Table 5: Kammen, Kapadia & Fripp: Comparison of jobs/MWp, jobs/MWa, and person-yr/GWh across technologies.

## **Appendix B – Notes on Methodology**

The methodologies used to calculate the employment and economic-development benefits of renewable energy resources are imperfect, each with their own strengths and weaknesses. This compilation report was designed to show the magnitude of the opportunity before California. Given timing and funding limitations, it was not designed to offer a definitive estimate of jobs, but rather to illuminate the potential economic benefits that would flow from California obtaining a third of its electric-generation portfolio from renewable resources.

The REPP methodology featured in the CEERT scenario for a 33 percent RPS by 2020 on p. 11 of this report for wind, geothermal and biomass is focused, on the most part, exclusively on potential manufacturing jobs that could be developed by existing companies located throughout California. These figures assume that all of the components used to make the new wind turbines or solar PV panels installed in California to meet the RPS target would be manufactured at existing businesses located in California counties. It does not factor in new companies locating here to make these products, nor does it account for the installation or ongoing operations and maintenance jobs that would be created by these investments. The concentrated solar power number and solar PV numbers employ different methodologies by CEERT and UC-Berkeley/Vote Solar.

The UC-Berkeley methodology figures featured in Appendix A do factor in construction, manufacturing and operations and maintenance employment, but does not include figures for geothermal or concentrated solar power technology, two renewable resource options expected to play a large role in meeting California's future demand for electricity. It also "de-rates" each renewable energy technology according to its particular capacity factor. For solar PV, for example, the UC-Berkeley study assumes the solar PV facility will only operate 21 percent of the time, so a 1 MW solar PV plant is assigned a value of .21 MW average. Some academics and industry experts claim this approach undervalues the economic benefits these renewable resources bring to the table, while others claim it recognizes the variability of some renewable resources.

The Environment California study featured on p. 15 does include employment estimates that factor in manufacturing, construction and operations and maintenance – *and technology export opportunities* – but was based on a 20 percent by 2017 RPS scenario, and therefore also understates the employment potential of a 33 percent by 2020 RPS.

The Union of Concerned Scientists (UCS) study relies upon an "input/output" model that poses other questions. While the UCS numbers featured on p. 16 included other non-job economic development benefits, the study was based on a national RPS, and due to assumptions about the location of manufacturing jobs going to lower-cost states than California, it likely undercounts potential employment benefits here.

The Apollo Alliance and World Wildlife Fund studies included in this report on p. 17 are also national in scope and include energy efficiency initiatives in the mix of policies to combat climate change, and therefore overstate the job potential of a strictly renewable energy-based program. Yet they also demonstrate the synergy between renewable energy and energy efficiency investments when implemented in a comprehensive and sustained way.

The intent of this report is not to offer firm predictions of actual jobs to be created in California from a 33 percent by 2020 RPS. Rather, it is designed to show that there is one consistent theme to all of the studies comparing renewable energy resources to fossil fuel resources: under every methodology and every

scenario, renewable energy technologies always create more jobs than fossil fuels, whether one focuses on the manufacturing jobs or ongoing operations and maintenance functions or installations or export opportunities. This makes inherent sense, as renewable energy sources substitute labor for imported fuel.

This is a “living document.” Follow-up research and analysis based on forthcoming studies by *Next 10* and Black & Veatch are expected to help in the development of more precise estimates of the expected jobs that would flow from the wind, geothermal, concentrated solar power, biomass and solar PV industries in specific regions of the state with a 33 percent by 2020 RPS. Look for these updates at the following website: [www.cleanpower.org](http://www.cleanpower.org).

## IX. Endnotes

- <sup>1</sup> D. Roland-Holst, *Economic Growth and Greenhouse Gas Mitigation in California*, University of California-Berkeley, August 2006.
- <sup>2</sup> George Sterzinger and Jerry Stevens, *Renewable Energy Demand: A Case Study of California*, Renewable Energy Policy Project, Washington, DC, October 6, 2006, p. 13.
- <sup>3</sup> This jobs calculation is based on a resource scenario that blends a July 21<sup>st</sup>, 2008 CAISO scenario on total MW needed to meet 33 percent of California's electricity demand with CEERT projections based on recent job estimates linked to concentrated solar power bids that now total over 24,000 MW in capacity. To calculate employment, the jobs per MW ratios featured in Table 1 were used. Because the REPP model for solar PV was based on 2 kW solar arrays – and the majority of solar PV contemplated under the CAISO projected resource mix is larger, utility-scale projects -- a jobs ratio of 33 jobs per MW was employed, the same jobs ratio for solar PV used to create Figure 16. This jobs ratio is based on job creation multipliers from a UC-Berkeley analysis done for Vote Solar ([www.votesolar.org/linked-docs/MSR\\_Job\\_Creation.pdf](http://www.votesolar.org/linked-docs/MSR_Job_Creation.pdf)).
- <sup>4</sup> Dan Kammen, Kamal Kapadia and Matthais Fripp: *Putting Renewables To Work: How Many Jobs Can the Clean Energy Industry Generate?* Energy and Resources Group, Goldman School of Public Policy, University of California-Berkeley, 2004, Table ES-1, p. 1.
- <sup>5</sup> Virender Singh and Jeffrey Fehrs, *The Work That Goes Into Renewable Energy*, Renewable Energy Policy Project/BBC Research and Consulting, Washington, DC, 2001.
- <sup>6</sup> Brad Haevner and Bernadette Del Chiaro, *Renewable Energy and Jobs*, Environment California, 2003: [http://www.environmentcalifornia.org/uploads/OW/aa/OWaa2RaedlfHwQOWbxKd5w/Renewable\\_Energy\\_and\\_Jobs.pdf](http://www.environmentcalifornia.org/uploads/OW/aa/OWaa2RaedlfHwQOWbxKd5w/Renewable_Energy_and_Jobs.pdf).
- <sup>7</sup> Union of Concerned Scientists, *Cashing in on Clean Energy*, Fact Sheet, 2007; *Renewable Electricity Standards at Work in the States*, Cambridge, Mass.: [http://ucsusa.org/clean\\_energy/clean\\_energy\\_policies/res-at-work-in-the-states.html](http://ucsusa.org/clean_energy/clean_energy_policies/res-at-work-in-the-states.html).
- <sup>8</sup> The Apollo Alliance, *New Energy for America*, 2004: [http://www.apolloalliance.org/state\\_and\\_local/california/cajobs.cfm](http://www.apolloalliance.org/state_and_local/california/cajobs.cfm)
- <sup>9</sup> This analysis was based on an input-output model known as IMPLAN which can analyze interactions between different sectors of the economy. WWF used the IMPLAN model to track changes in each sector's pattern of demand and spending linked to changes in fuel consumption and energy technology investments created by the proposed Climate Protection Scenario policies. In other words, the model looks at the necessary inputs required to shift the outputs of each economic sector.
- <sup>10</sup> Solar Energy Industry Association, *2007 Year in Review*, Washington, DC, p. 5.
- <sup>11</sup> California Public Utilities Commission, *Renewable Portfolio Standard, Quarterly Report*, July 2008: [http://docs.cpuc.ca.gov/word\\_pdf/REPORT/85936.pdf](http://docs.cpuc.ca.gov/word_pdf/REPORT/85936.pdf)
- <sup>12</sup> Barry Butler, Richard Caputo, Scott Debenham and Skip Tralick, *Promise of Renewable Energy in the San Diego Region*, San Diego Regional Energy Office, June 2006.
- <sup>13</sup> Cross-Border Economic Bulletin, "Why Have High Income Levels Bypassed Imperial County?" January 2001: [www.sandiegodiologue.org](http://www.sandiegodiologue.org); [www.labormarketinfo.edd.ca.gov/](http://www.labormarketinfo.edd.ca.gov/)
- <sup>14</sup> Tehachapi Collaborative Study Group, *Transmission in the Tehachapi Wind Resource Area*, CEERT for the California Public Utilities Commission, March 2005.
- <sup>15</sup> [www.awea.org/pubs/factsheets/WindyLandownersFS.pdf](http://www.awea.org/pubs/factsheets/WindyLandownersFS.pdf)
- <sup>16</sup> This optimism may be tempered if the federal investment tax credit for solar PV is not extended beyond 2008.
- <sup>17</sup> "A Green Industry Takes Root in California," *New York Times*, February 1, 2008.
- <sup>18</sup> [www.labormarketinfo.edd.ca.gov/](http://www.labormarketinfo.edd.ca.gov/)
- <sup>19</sup> Alan Berube and Bruce Katz, *Katrina's Window: Confronting Concentrated Poverty Across America*, Brookings Institution, October 2005.
- <sup>20</sup> These job calculations are based on a CAISO scenario released on July 21, 2008 of possible renewable resources to come on-line in response to a 33 percent RPS by 2020. Based on the projected 2.86 Gigwatts (GW) of expected solar PV, Cleantech America calculated that the projected 2,860 MW of expected utility-scale solar PV would generate 37,180 job-years of employment through installation and operations and maintenance activities and as many 57,200 jobs in the manufacturing sector (a large portion of which may be located overseas.)
- <sup>21</sup> Navigant Consulting, *Economic Impacts of the Tax Credit Expiration*, American Wind Energy Association/Solar Energy Research and Education Foundation, Burlington, MA, February 13, 2008.