

# Harvesting California's Renewable Energy Resources:

## A Green Jobs Business Plan



By Peter Asmus

Center for Energy Efficiency and Renewable Technologies  
Sacramento, California

Revised  
February 7, 2009

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



# HARVESTING CALIFORNIA'S RENEWABLE ENERGY RESOURCES:

## *A GREEN JOBS BUSINESS PLAN*



**By Peter Asmus**  
**Center for Energy Efficiency and Renewable Technologies**  
**Sacramento, California**  
**Revised**  
**February 7, 2009**

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



## Table of Contents

|  |    |
|--|----|
| Table of Contents.....   | 3  |
| I. Executive Summary .....   | 5  |
| Introduction .....   | 5  |
| The Business Case for Renewable Energy .....                               | 7  |
| The Need for Green Energy Infrastructure.....                              | 9  |
| How California's Communities Benefit from Renewable Energy Jobs .....      | 10 |
| Conclusion .....   | 11 |
| II. Introduction .....   | 13 |
| What Role Now For California?.....   | 14 |
| III. The Business Case for Renewable Energy .....                          | 18 |
| IV. The Need for Green Energy Infrastructure.....                          | 24 |
| V. Regional Examples of Potential Employment from Renewable Energy.....    | 27 |
| Imperial County .....  | 30 |
| Kern County .....  | 31 |
| The Los Angeles Region.....  | 33 |
| San Francisco and Silicon Valley .....                                     | 36 |
| The Central Valley .....   | 38 |
| VI. The Reform Agenda Needed to Complete the Green Jobs Business Plan..... | 39 |
| Appendices .....   | 41 |
| Appendix A – Kammen, Kapadia & Fripp Table, “Energy and Jobs” .....        | 42 |
| Appendix B – Notes on Methodology .....                                    | 44 |
| Endnotes .....   | 46 |



## I. Executive Summary

### ***Introduction***

As one of his first acts, President Barack Obama endorsed the American Recovery and Reinvestment Act of 2009, which would pump more than \$825 billion into the U.S. economy via tax cuts and publicly funded investments in infrastructure and work force development. Roughly \$88 billion of this total falls under the category of “energy.” The largest single share of federal government clean energy investments is \$32 billion earmarked for transmission lines, smart distribution grid upgrades and renewable energy technologies. Another \$4 billion is set aside for green collar job training.

The American Recovery and Reinvestment Act of 2009 aims to double the nation’s renewable energy capacity over the next three years, creating 460,000 jobs. This stimulus program would help fund the construction of 3,000 miles of transmission lines to help deliver abundant renewable energy from remote regions to urban centers of high electricity demand. According to administration and Congressional sources, the funds earmarked for renewable energy and grid upgrades in this stimulus package are just the beginning and a separate bill devoted exclusively to clean energy solutions is forthcoming.

***The American Recovery and Reinvestment Act of 2009 aims to double the nation’s renewable energy capacity over the next three years, creating 460,000 jobs.***

At the state level, there is also unprecedented support for rebuilding the state’s troubled economy through larger investments in renewable energy.

- Governor Schwarzenegger issued an Executive Order on November 17, 2008, endorsing a 33 percent Renewable Portfolio Standard (RPS) by 2020. This Order was designed to get state and federal agencies to cooperate in streamlining approvals on a portfolio of new renewable energy projects representing an investment of \$60 billion into California’s economy.
- The California Air Resources Board (CARB), the lead state agency implementing the "Global Warming Solutions Act of 2006" (AB 32), also incorporated the 33 percent RPS in its Scoping Plan approved on December 11, 2008. This RPS target is necessary in order for California to cut aggregate carbon emissions by 25 percent by 2020.
- Assembly Bill (AB) 64 (Kerkorian, Bass and Blakeslee) has been introduced in the current legislative session to statutorily boost the current RPS to 25 percent renewable content by 2015, 35 percent by 2020, and 50 percent by 2035. Perhaps the most notable feature of this legislation is the proposed creation of a Renewable Infrastructure Authority (RIA), which would govern the siting of both renewable energy power plants and new transmission lines. This RIA would work to enact recommendations of the Renewable Energy Transmission Initiative (RETI), which is described below.

***But tax credits and even an RPS – whether instituted at the federal or state levels -- are not enough to guarantee that the needed investments will be made.***

A comprehensive framework on energy policy reforms will be necessary if the promise of renewable energy so eloquently described by Obama is to become a practical reality in California and the nation. Congress already took an important step forward this past autumn by extending the investment tax credits for solar technologies (solar photovoltaics (PV), concentrated solar power (CSP) and solar thermal) through 2016, a long-term policy signal that could attract \$230 billion in investments and spur 440,000 green jobs.

But tax credits and even an RPS – whether instituted at the federal or state levels -- are not enough to guarantee that the needed investments will be made. Policymakers, environmentalists and regulators at

federal, state and local levels also need to work together to enable building the “green infrastructure” necessary to bring large-scale renewable energy to market.

California and the rest of the West are blessed with rich and diverse renewable energy resources. With some of the world’s best sites for solar, geothermal, wind and biomass resources, California can serve as the testing ground for large-scale deployment of diverse renewable energy sources, and show how best to balance economic and environmental considerations. California has also attracted many of the most innovative new energy technology companies and most experienced project developers. This all sets the stage for California to lead the nation in creation of new green jobs. Among the primary findings of this report are the following:

- Building the power plants and green infrastructure needed to meet a 33 percent RPS by 2020 **could pump as much as \$60 billion into the state’s stagnating economy.**
- **Between 100,000 and 235,000 new manufacturing and operations and maintenance jobs could be created** under current business conditions to meet those goals.
- If California obtained a third of its electricity from renewable energy by 2020, **state manufacturing employment alone could increase by almost 200,000 jobs if tax reforms and other public policy enhancements are also implemented at the state level.**

With the price of natural gas and coal fluctuating dramatically -- and the state unemployment rate now at 9.3 percent -- it is incumbent upon policy makers to recognize renewable resources create more than six times the amount of jobs as development of these fossil fuels. Instead of spending billions on imported and polluting fossil fuels, we can use those funds in the near future to create permanent stable employment for Californians in the burgeoning renewable energy sector.

In order to achieve these benefits, California's leaders need to make commitments in 2009 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.**

The first step is to establish more aggressive, 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 created 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.

Because renewable energy development fosters greater economic benefits than traditional fossil fuel development, California will realize tremendous

33% Renewable - Generation Mix in MW

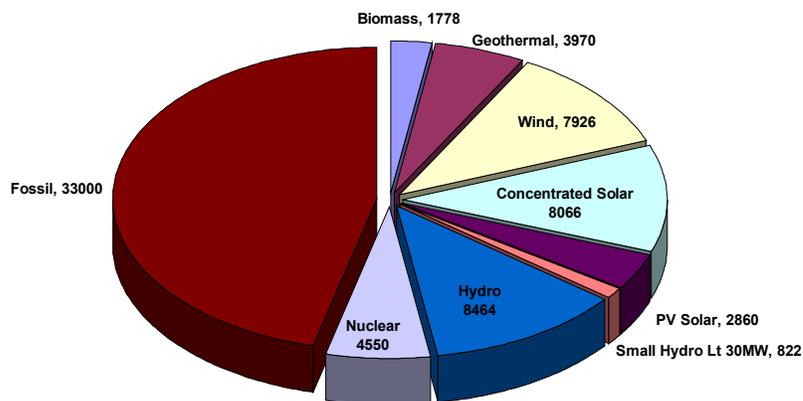


Figure 1 - CEERT/CAISO 33% RPS scenario

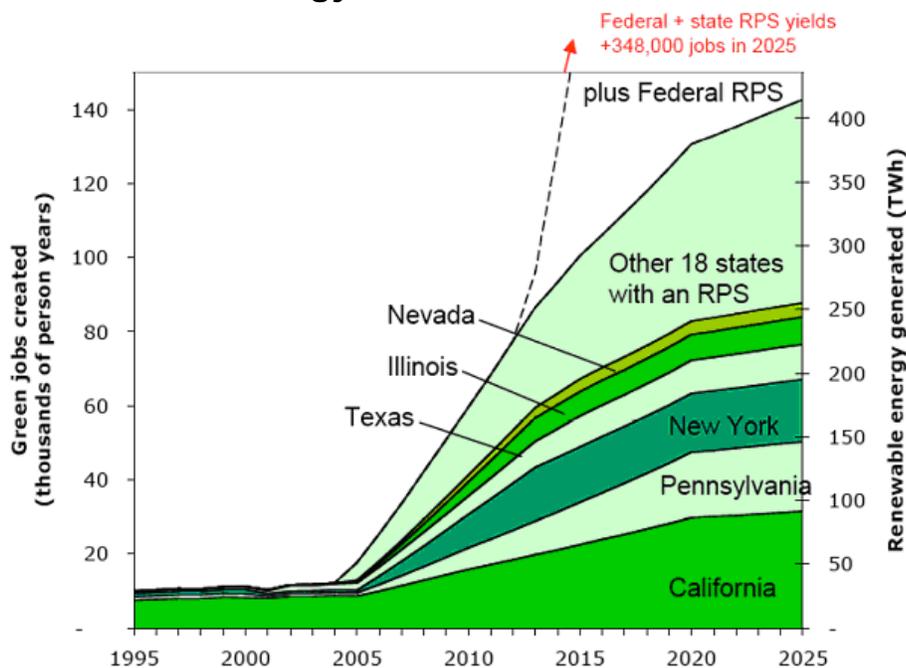
financial dividends – including major employment increases and much-needed tax revenue – from a renewable energy renaissance that can touch virtually every part of California.

### The Business Case for Renewable Energy

This report is a compilation of studies conducted in recent years looking at the amounts of jobs created by different segments of the renewable energy development and transmission and distribution grid upgrades necessary to bring our energy supply infrastructure into the 21<sup>st</sup> century. To date, the only study to look at the complete array of renewable resources available in California with a common methodology that incorporates employment figures from installation, operations and maintenance, and manufacturing was published in 2003, and was focused on the goal of a 20 percent RPS by 2010. While no single study predicts employment under the higher 33 percent RPS, together they provide compelling evidence of the major economic benefits

*“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 2 – Green job creation totals for selected states and for the nation as a whole if a 20% federal RPS were adopted for 2020.** Source: UC-Berkeley

flowing from such investments.

Despite the lack of forecast precision, the indisputable facts include: (1) All renewable energy sources generate more jobs than equivalent investments in fossil fuels – recent studies suggest from four to six times as many jobs per megawatt of installed capacity; (2) The key factors in maximizing jobs in California are policies impacting the manufacturing sector, since at present, the majority of equipment installed in renewable energy projects is imported from overseas; and (3) Under all scenarios created by academics, non-profits and industry groups, California stands to benefit the most of any state from an aggressive federal push on renewable energy and/or climate change.

This *Green Jobs Business Plan* compiles the results of a series of studies that shows California could add hundreds of thousands of jobs to employer payrolls throughout the state. 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. The report also discusses the critical role of new transmission. And it highlights five key regions throughout California that would benefit dramatically from a 33 percent RPS by 2020.

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. from reducing the greenhouse gas emissions that have been linked to global climate change. California ranked No. 1 in the country.

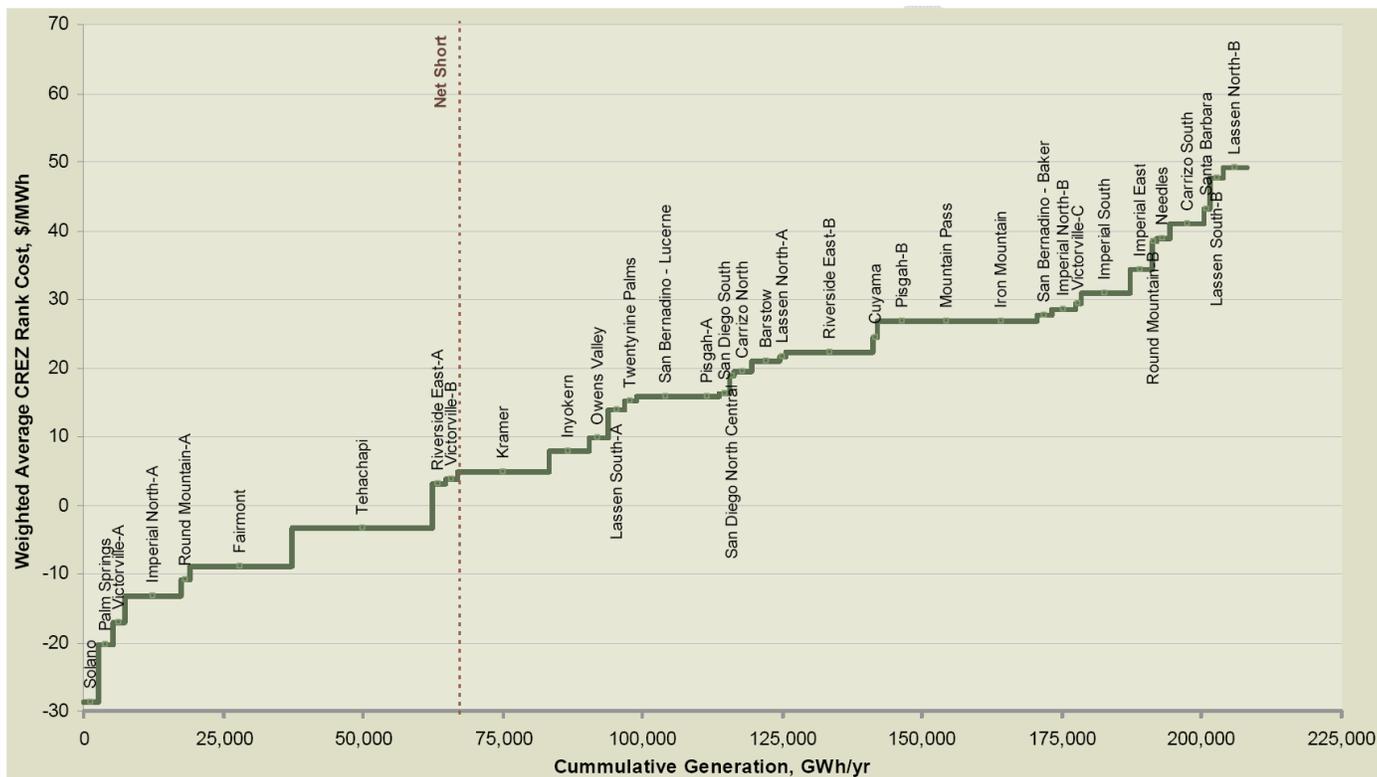
This CEERT analysis goes further by examining the degree to which California cities, counties, and the state as a whole would benefit from an aggressive build-out of the state’s renewable energy assets. The report’s findings are compiled from a number of well-regarded studies.

- A study conducted by researchers at the University of California-Berkeley’s Energy and Resources Group in 2004 concluded, under every scenario examined, ***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 and 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.***
- An October 2008 analysis and forecast by the Global Insight Energy Group for the United States Conference of Mayors shows that three California urban regions – Los Angeles, San Francisco and San Diego – currently rank in the top ten metropolitan areas in the country in terms of green jobs. ***In addition, this study projected that a total of 26 California cities are slated to generate over a half million green jobs by 2038, with Los Angeles leading the pack with 159,321 green jobs.***
- A January 2009 report by Kema, Inc. projected that 280,000 jobs can be tied directly to the development of the smart grid across the U.S., through upgrades that are also necessary to fully integrate renewable energy into our energy supply infrastructure. ***It is estimated that 150,000 jobs could be created within one year with a federal investment of \$16 billion into modernizing the electricity grid.*** To put that figure in context, the American Recovery and Reinvestment Act of 2009 includes \$11 billion for smart grid upgrades and a Senate version of the federal stimulus legislation includes \$16 billion for the same purpose. In addition, \$8 billion in energy loan guarantees for renewable energy power generation and transmission projects is included in the House bill, which already passed the House of Representatives on January 28, 2009.

### The Need for Green Energy Infrastructure

A collaborative process entitled the Renewable Energy Transmission Initiative (RETI) has identified zones where renewable resources with quantified economic and environmental value can be developed in California. Based on this analysis, it is now possible to identify the most promising renewable energy areas in the state. The prime purpose of RETI, however, is to identify the best transmission pathways to bring renewable energy typically generated at remote sites to urban areas with high demand for electricity. Without construction of this green infrastructure, California will never meet a 33 percent RPS by 2020. These transmission systems are akin to building superhighways that can benefit all Californians with high-value, carbon-free electricity.

The RETI analysis is based on Competitive Renewable Energy Zones (CREZs), a concept developed in Texas that is also now being used in Colorado, Nevada and Utah. The RETI Stakeholder Steering Committee released its draft Phase 1B study last November. Written by the firm of Black & Veatch and the RETI Environmental Working Group, this report identified 29 CREZs within California that represent 80,000 MW of potential renewable energy development. Another 40,000 MW of potential renewable resources were identified outside of state borders: geothermal resources in British Columbia, Oregon and Nevada, as well as promising wind sites in Baja, Mexico. Finally, another 25,000 MW of in-state renewables not located in a CREZ were also evaluated – primarily utility-scale solar PV projects. All told, RETI identified 2,100 potential renewable resource projects with a combined generating capacity of over 153,000 MW that could be used to meet the 33 percent RPS 2020 target.



**Figure 3 - Weighted Average Rank Cost (\$/MWh) for CREZ and Resource Areas.**

Source: RETI/B&V

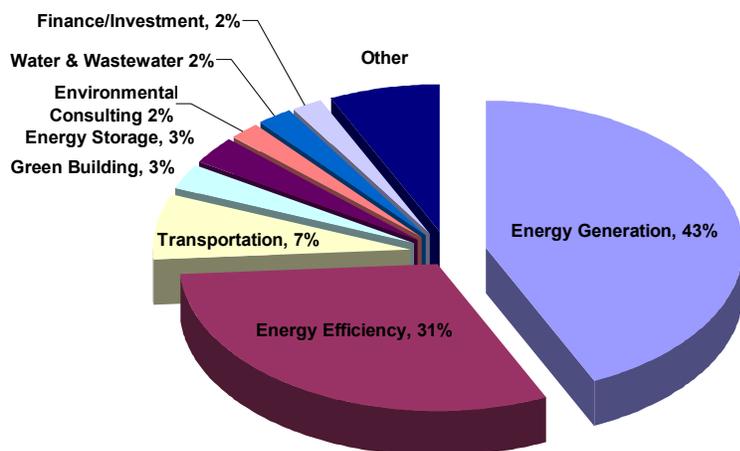
California currently produces approximately 12 percent of its energy supply from renewable sources. The RETI analysis assumed committed renewable projects would be completed – such as the 3,000 MW of solar PV projected to come on-line by 2016 under the California Solar Initiative. The remaining gap in

energy generation beyond these committed resources needed to meet the 33 percent by 2020 RPS target was deemed the “net short” figure: 68,000 GWh/year. Since the operating profile or “capacity factor” of each renewable resource site and technology varies widely, ranging from over 90 percent for a biomass or geothermal steam facility to as low as 20 percent for some solar resources, it is impossible to come up with a precise total MW figure. That said, the RETI report estimates that 19,300 MW of new renewable energy resource development operating at a 40 percent capacity factor (and not currently planned or under construction) will be necessary to meet the 33 percent RPS.

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

**Green Technology Establishments by Green Sector**



**Figure 4 - Green Technology Establishments by Green Sector**  
Source: Collaborative Economics

#### 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 show 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.”*

Later in this report 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 resources are native to California, and most of the work harvesting them must be done here within our state's borders.

The current RPS law creates constraints that work at cross purposes with a mandate ostensibly aimed at increasing California's reliance on renewable generation. These constraints include:

- **Pricing:** California's current RPS measures the pricing of new renewable energy against a benchmark based on the cost of natural gas, known as the Market Price Referent (MPR).
- **Flexibility:** Flexible compliance rules allow utilities to meet their RPS goals as much as three years beyond the deadline. Additionally, utilities can meet targets with contracts rather than actual energy deliveries.
- **Contract Evaluation:** Contracts are not subject to robust standards for project viability or reasonableness, so little incentive exists for utilities to work to move from contracts to steel in the ground.
- **Transmission, Permitting, and Siting:** Transmission, permitting, and siting constraints remain a constant barrier to the timely and cost-effective delivery of remote renewable energy resources.

Nevertheless, a series of reforms can transform the projected 100,000 to 200,000 full-time jobs into real people with real jobs here in California.

- Remove the cost limitation imposed by the MPR and avoid "caps" on renewable procurement pricing since none exists for fossil fuel resources.
- Allow reasonable, transactional flexibility to overcome physical and market barriers to procurement.
- Encourage and rely on the collaborative work among stakeholders involved in RETI.
- Review projects for developer experience, technology type, commercial viability and project financeability.
- Require reasonableness reviews for project viability and pricing.
- Ensure that transparent and meaningful milestones for siting, permitting, and transmission are applied and enforced
- Enforce penalties for RPS non-compliance
- Build transmission lines to bring the lowest cost resources from remote areas into urban centers with high energy demand.

*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, and 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.

## II. Introduction

President Barack Obama is offering a major shift in public policy designed to revitalize the economy. Instead of the supply-side economics in vogue since Ronald Reagan was elected in 1980, Obama is looking to enact a green “New Deal” to lift up the country much as the first New Deal led to sustained economic growth for several decades after the Great Depression of 1929. A major source of economic development funded by President Franklin D. Roosevelt in the first New Deal was large federally owned hydroelectric projects that helped expand the electricity grid with low-cost power reserved for rural America.

A major component of Obama’s economic stimulus package is tapping the vast renewable resources of the U.S. for our future energy supplies. This is how our new president summed up the energy challenges facing the U.S. today in a speech on January 26, 2009:

*America’s dependence on oil is one of the most serious threats that our nation has faced. It bankrolls dictators, pays for nuclear proliferation and funds both sides of our struggle against terrorism. It puts the American people at the mercy of shifting gas prices, stifles innovation, and sets back our ability to compete...President Nixon promised to make our nation energy independent by the end of the 1970s. When he spoke, we imported about a third of our oil, and we now import more than half.*

President Obama also wholeheartedly endorsed the American Recovery and Reinvestment Act of 2009, which would pump more than \$825 billion into the U.S. economy via tax cuts and publicly funded investments in infrastructure and work force development. Roughly \$88 billion of this total falls under the category of “energy.” The largest single share of these new federal government clean energy investments is \$32 billion earmarked for transmission lines, smart distribution grid upgrades and renewable energy technologies. Another \$4 billion is set aside for green collar job training.

**The American Recovery and Reinvestment Act of 2009 aims to double the nation’s renewable energy capacity over the next three years, creating 460,000 jobs.**

The American Recovery and Reinvestment Act of 2009 aims to double the nation’s renewable energy capacity over the next three years, creating 460,000 jobs. This stimulus program would help fund the construction of 3,000 miles of transmission lines to help deliver the cheapest renewable energy from remote regions to urban centers of high electricity demand.

**But tax credits and even an RPS – whether instituted at the federal or state levels -- are not enough to guarantee that the needed investments will be**

A comprehensive framework on energy policy reforms will be necessary if the promise of renewable energy so eloquently described by Obama and his fellow Democrats is to become a practical reality. Congress already took an important step forward this past autumn by extending the investment tax credits for solar technologies (solar photovoltaics (PV), concentrated solar power and solar thermal) through 2016, a long-term policy signal that could attract \$230 billion in investments and spur 440,000 green jobs.

But tax credits and even an RPS – whether instituted at the federal or state levels -- are not enough to guarantee that the needed investments will be made. Policymakers, environmentalists and regulators at federal, state and local levels also need to work together to build the “green infrastructure” necessary to bring large-scale renewable energy to market.

## What Role Now For California?

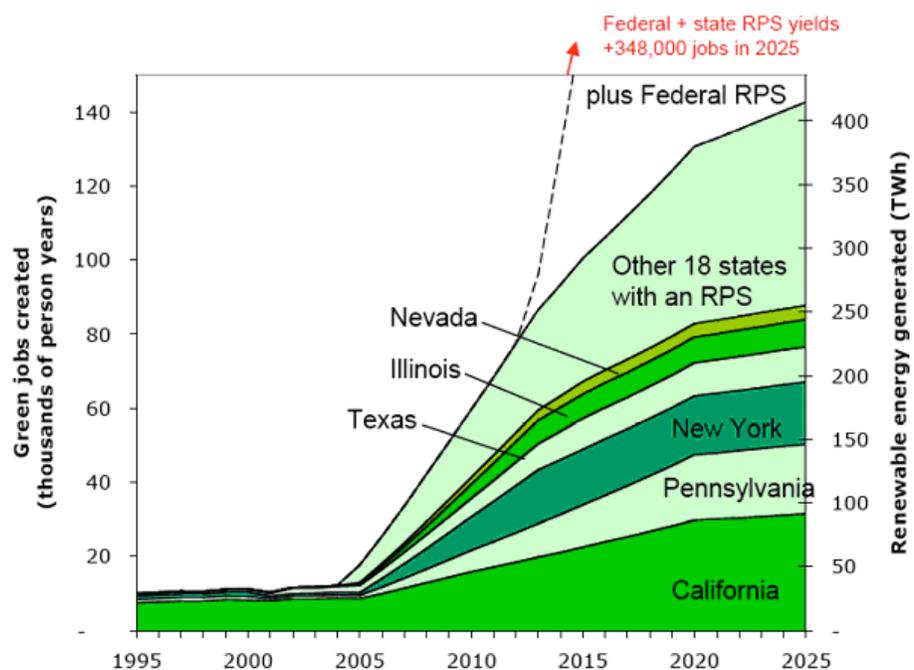
California and the rest of the West are blessed with diverse renewable energy resources. With some of the world's best sites for solar, geothermal, wind and biomass resources, California can serve as the testing ground for large-scale deployment of diverse renewable energy sources, showing other parts of the country how best to balance economic and environmental considerations.

At the state level, there is also unprecedented support for rebuilding the state's troubled economy through larger investments in renewable energy.

- Governor Schwarzenegger issued an Executive Order on November 17, 2008 endorsing a 33 percent by 2020 RPS. This Order was designed to get state and federal regulators to work better together to put steel in the ground on a portfolio of new renewable energy projects representing an investment of \$60 billion into California's economy.
- The California Air Resources Board (CARB), the lead state agency implementing AB 32, also included the 33 percent RPS in its Scoping Plan approved on December 11, 2008. CARB argues this RPS target is necessary in order for California to cut aggregate carbon emissions by 25 percent by 2020.
- Assembly Bill (AB) 64 (Kerkorian, Bass and Blakeslee) has been introduced in the current legislative session to boost the current RPS to 25 percent renewable content by 2015, 35 percent by 2020, and 50 percent by 2035. Perhaps the most notable feature of this legislation is the proposed creation of a Renewable Infrastructure Authority (RIA), which would govern the siting of both renewable energy power plants and new transmission lines. This RIA would work to enact recommendations of the Renewable Energy Transmission Initiative (RETI), which is described below.

With the U.S. economy mired in a recession – and California facing yet another budget deficit that could reach \$40 billion by 2010 – fresh investments in renewable energy may 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.

Since a renewable energy economy circulates dollars regionally and substitutes people's labor for imported fossil fuels, it offers superior jobs benefits



**Figure 5 – Green job creation totals for selected states, and for the nation as a whole, if a 20% federal RPS were adopted for 2020.**  
Source: UC-Berkeley

when compared to investments in fossil fuels. Instead of ratepayer dollars going to other states or countries to purchase fuel such as coal or natural gas, these funds would pay the salaries of wind smiths climbing wind turbines or installers of solar panels on your rooftop. At present, more than 5,000 existing California companies are capable of becoming part of the clean energy economy by providing the component parts that comprise a wind turbine, solar panel or generator used for geothermal steam or biomass power plants.

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 has squandered a golden opportunity to stabilize today's electricity rates during times of great fossil fuel price volatility. 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.

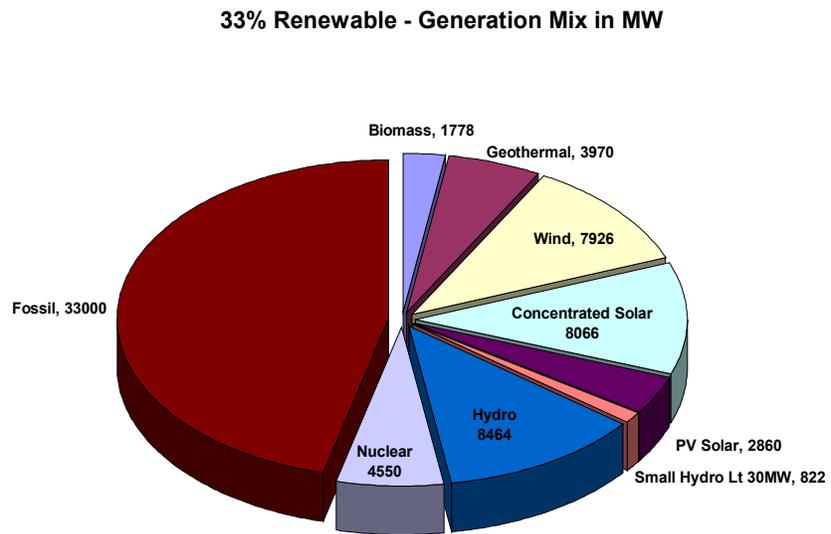


Figure 6 - CEERT/CAISO 33% RPS scenario

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 and the current economic recession 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 reduce 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

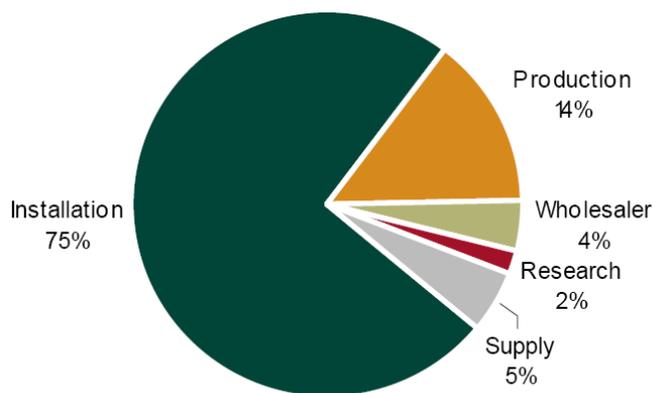
impacts every sector of the state's economy – could, according to one estimate, boost state GDP by \$74 billion, generating 89,000 jobs in the process.<sup>1</sup>

Based on a scenario released by the California Independent System Operator on July 21, 2008, 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 6.

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 the most jobs according to most studies, though there is considerable disagreement about exactly how many more jobs solar PV creates compared to other renewable energy technologies. A recent assessment by Barclays Capital Research, for example, estimated that 10 jobs per MW are created during the production of solar PV panels, but that 33 jobs per MW were created during installation. All told, Barclays estimated that 3.7 million people are already employed in the global solar PV industry.<sup>2</sup>

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

**Worldwide Employment in PV-Related Jobs 2030 (3.7M Jobs)**



**Figure 7 - Worldwide Employment in PV-Related Jobs 2030 (3.7M Jobs)**

Source: EPIA, Barclays Capital Research

Since solar PV is largely deployed as a distributed generation resource and is currently the most expensive commercial renewable energy technology, any viable strategy to create employment in California or elsewhere will also have to tap into the larger family of renewable energy resources.

A June 2002 report entitled *Renewables Work: Job Growth from Renewable Energy Development in California* features job estimates from the Electric Power Research Institute in a study funded by the California Energy Commission. According to the report published by the CALPIRG Charitable Trust, landfill/digester-gas projects generate the most jobs under a 20 percent by 2010 RPS if judged on the basis of total employment per 500 MW of development, expressed in person-years.

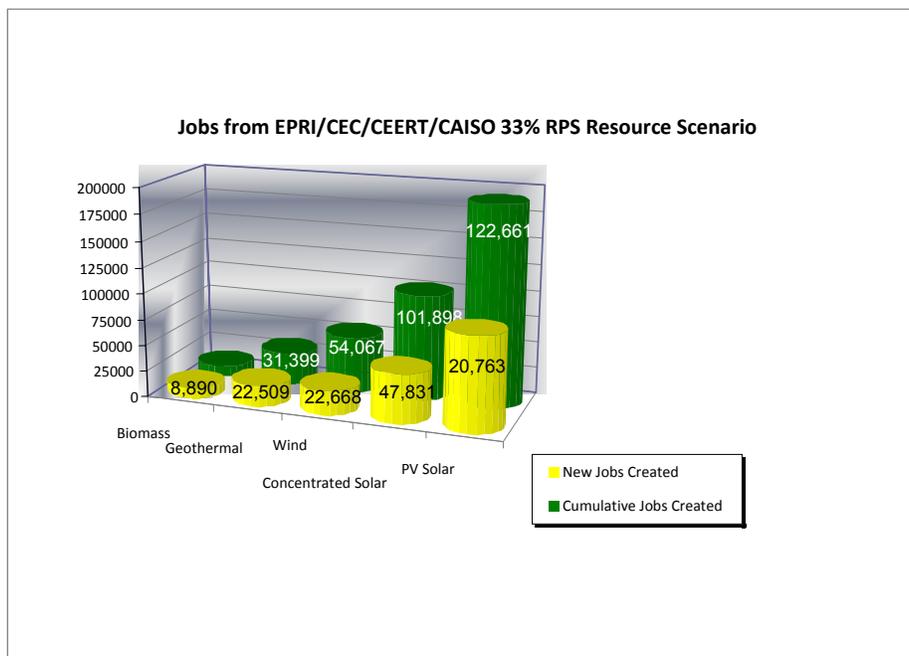
These waste-to-energy projects generated 14.1 more jobs than natural gas power plants. Under the scenarios studied by CALPIRG, geothermal steam projects came in second, generating more than 11 times as many jobs as natural gas. This same methodology showed concentrated solar power (CSP) projects generating 2.5 times as many jobs as natural gas, while solar PV generated 2.2 times as many jobs.

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. Based on the EPRI figures below, any of the renewable energy options are better from an employment perspective than natural gas plants.

| Energy Source                | Number of Jobs/MW |
|------------------------------|-------------------|
| Wind                         | 2.86              |
| CSP                          | 5.93              |
| Solar PV                     | 7.26              |
| Geothermal                   | 5.67              |
| Landfill/Digester Gas        | 5.00              |
| Natural Gas – For Comparison | >1.0              |

**Table 1 - Jobs per MW**  
Source: EPRI, CEC, 2003

If the EPRI/CEC jobs methodology is applied to the CEERT/CAISO resource mix, *approximately 122,661 manufacturing and operation and maintenance jobs could be created from new renewable energy supply under a 33 percent RPS by 2020.*



**Figure 8 - Jobs from EPRI/CEC/CEERT/CAISO 33% RPS Resource Scenario<sup>3</sup>**

If the much higher 2008 estimate for solar PV jobs published by Barclays (>43 jobs/MW) is substituted just for solar PV in this computation -- and the rest of the job figures per technology remain the same -- **the total employment figure jumps to almost 225,000 jobs.**

### III. 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.

*If measured in terms of jobs per MW, renewable energy sources generate more than 4 to 6 jobs for every 1 job associated with natural gas power plants, California's current preferred electricity fuel.*

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. 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. The results of the RETI analysis are summed up in Part IV of this report.

*According to REPP, 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. from reducing 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 manufacturing employment necessary throughout supply chains to implement a national climate response program equivalent to a 20 percent federal RPS.

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

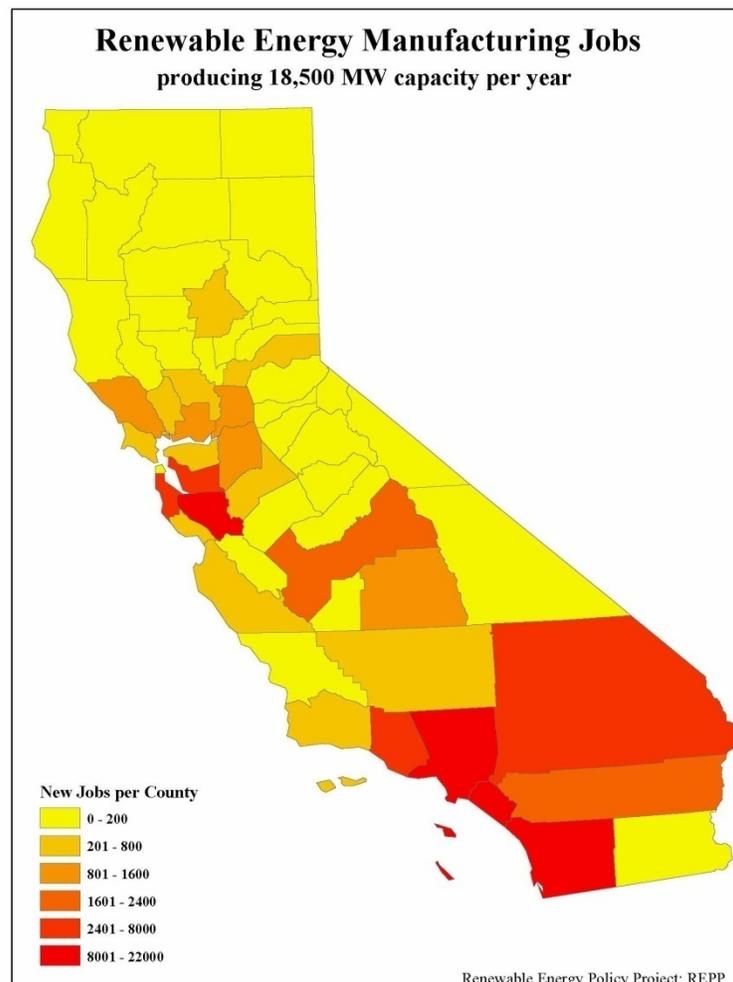
Table 2 - Manufacturing Jobs and Investment for 18,500 MW  
Source: REPP

Figure 9 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

***“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 9 - Map of New Renewable Energy Manufacturing Jobs (by county) to achieve 20% federal RPS by 2010.** Source: REPP

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 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. 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. With the forecast for perpetually rising and volatile fossil fuel prices, the time could not be better for a switch to renewable energy.”

***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, this study found that 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, exceeding 200,000 California jobs.<sup>6</sup>

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 used by the federal Energy Information Administration (EIA) to make future projections on energy supply, demand, prices and expenditures. Results from this analysis were

### **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**

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 that would 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 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:

- ***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

#### **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, which resemble 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*

*...continued on next page*

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 in 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 measures 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 clean power program.**<sup>9</sup>

Two more studies amplify how investments in renewable energy and related transmission and distribution line upgrades can help accumulate economic benefits throughout California while also delivering jobs over the long- and short-term.

- An October 2008 analysis and forecast by the Global Insight Energy Group for the United States Conference of Mayors shows that three California urban regions – Los Angeles, San Francisco and San Diego – currently rank in the top ten metropolitan areas in the country in terms of green jobs. Los Angeles, the state leader, ranked fourth behind New York, Washington, DC and Houston.

| Top Ten Metropolitan Areas |                 |
|----------------------------|-----------------|
| MSA                        | Green Jobs 2006 |
| New York                   | 25,021          |
| Washington DC              | 24,287          |
| Houston                    | 21,250          |
| Los Angeles                | 20,136          |
| Boston                     | 19,799          |
| Chicago                    | 16,120          |
| Philadelphia               | 14,379          |
| San Francisco              | 13,848          |
| San Diego                  | 11,663          |
| Pittsburgh                 | 9,627           |

Table 3 - Top Ten Metropolitan Green Jobs Areas

Global Insight also forecasted the growth in green jobs from the renewable energy sector over 30 years. **The study lists 26 California cities that are projected to generate over a half million green jobs by 2038, with Los Angeles leading the pack with 159,321 green jobs.** By the year 2038, Los Angeles, San Francisco and San Diego all remain in the Top Ten, with the next highest ranking California city being Sacramento at No. 15.

**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, months when California generally needs the most power. 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 10 – Wind Smith workers (L to R) – Victor Chat, Adrian Grannum, John Opris, Joaquin Villalobos, Mike Villalobos

| Current and Potential Green Jobs by Metro Area |               |                  |
|--|---------------|------------------|
| California                                     | Existing 2006 | New through 2038 |
| Bakersfield                                    | 913           | 7,222            |
| Chico  | 237           | 1,872            |
| El Centro,                                     | 44            | 347              |
| Fresno   | 1,053         | 8,332            |
| Hanford-Corcoran                               | 14            | 113              |
| Los Angeles-Long Beach-Santa Ana               | 20,136        | 159,321          |
| Madera   | 58            | 461              |
| Merced   | 40            | 314              |
| Modesto  | 417           | 3,303            |
| Napa   | 239           | 1,891            |
| Oxnard-Thousand Oaks-Ventura                   | 2,477         | 19,596           |
| Redding  | 434           | 3,434            |
| Riverside-San Bernardino-Ontario               | 4,224         | 33,425           |
| Santa Barbara-Santa Maria                      | 777           | 6,145            |
| Sacramento-Arden-Arcade-Roseville              | 8,236         | 65,162           |
| Santa Cruz-Watsonville                         | 813           | 6,434            |
| San Diego-Carlsbad-San Marcos                  | 11,663        | 92,285           |
| San Jose-Sunnyvale-Santa Clara                 | 3,810         | 30,147           |
| Salinas  | 441           | 3,493            |
| San Luis Obispo-Paso Robles                    | 446           | 3,528            |
| Santa Rosa-Petaluma                            | 619           | 4,897            |
| San Francisco-Oakland-Fremont                  | 13,848        | 109,570          |
| Stockton                                       | 461           | 3,649            |
| Vallejo-Fairfield                              | 533           | 4,218            |
| Visalia-Porterville                            | 522           | 4,128            |
| Yuba City                                      | 132           | 1,044            |

**Table 4 - Current and Potential Green Jobs by Metro Area**  
 Source: Global Insight

A January 2009 report by Kema, Inc. projected that 280,000 jobs can be tied directly to the development of the smart grid across the U.S., through upgrades that are also necessary to fully integrate renewable energy into our energy supply infrastructure. (While this report did not break down these projected job totals geographically, the methodology employed by Kema did account for job losses and transition issues, a major advance in job creation methodology.) **Furthermore, Kema estimated that 150,000 jobs could be created within one year with a federal investment of \$16 billion into modernizing the electricity grid.** To put that figure in context, the American Recovery and Reinvestment Act of 2009 includes \$11 billion for smart grid upgrades and a Senate version of the federal stimulus legislation includes \$16 billion for the same purpose. In addition, \$8 billion in energy loan guarantees for renewable energy power generation and transmission projects is included in the House bill, which already passed the House of Representatives on January 28, 2009.

## IV. The Need for Green Energy Infrastructure

A collaborative process entitled the Renewable Energy Transmission Initiative (RETI) has identified zones where renewable resources with quantified economic and environmental value can be developed. Based on this analysis, it is now possible to identify the most promising renewable energy areas in California. The prime purpose of RETI, however, is to identify the best transmission pathways to bring renewable energy generated at remote sites to urban areas of high demand. Without construction of this green infrastructure, California will never meet a 33 percent RPS by 2020. These transmission systems are akin to building superhighways that can benefit all Californians with high-value, carbon-free electricity.

The RETI analysis is based on Competitive Renewable Energy Zones (CREZs), a concept developed in Texas that is also now being used in Colorado, Nevada and Utah. The RETI Stakeholder Steering Committee released its draft Phase 1B study last November. Written by the firm of Black & Veatch and the RETI Environmental Working Group, this report identified 29 CREZs within California that represent 80,000 MW of potential renewable energy development. Another 40,000 MW of potential renewable resources were identified outside of state borders: geothermal and wind resources in British Columbia, Oregon and Nevada, as well as promising wind sites in Baja, Mexico. Finally, another 25,000 MW of in-state renewables not located in a CREZ were also evaluated – primarily utility-scale solar PV projects. All told, RETI identified 2,100 potential renewable resource projects with a combined generating capacity of over 153,000 MW that could be used to meet the 33 percent RPS 2020 target.

California currently produces approximately 12 percent of its energy supply from renewable sources. The Phase 1B RETI analysis assumed committed renewable projects would be completed – such as the 3,000 MW of solar PV projected to come on-line by 2016 under the California Solar Initiative. The remaining gap in energy generation beyond these committed resources needed to meet the 33 percent by 2020 RPS target was deemed the “net short” figure: 68,000 GWh/year. Since the operating profile or “capacity factor” of each renewable resource site and technology varies widely, ranging from over 90 percent for a biomass or geothermal steam facility to as low as 20 percent for some solar resources, it is impossible to come up with a precise total MW figure. That said, the RETI report estimates that 19,300 MW of new renewable energy resource development operating at a 40 percent capacity factor (and not currently planned or under construction) will be necessary to meet the 33 percent RPS. Phase 2 of the RETI analysis will recognize additional solar PV installations by 2020, slightly shrinking the “net short” needing to be filled to meet the 33 percent RPS.

### **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 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 recognizes Germany, Spain and Denmark as leaders in creating green jobs in the renewable energy sector. Germany, for example, 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. Denmark has followed a similar path. 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*

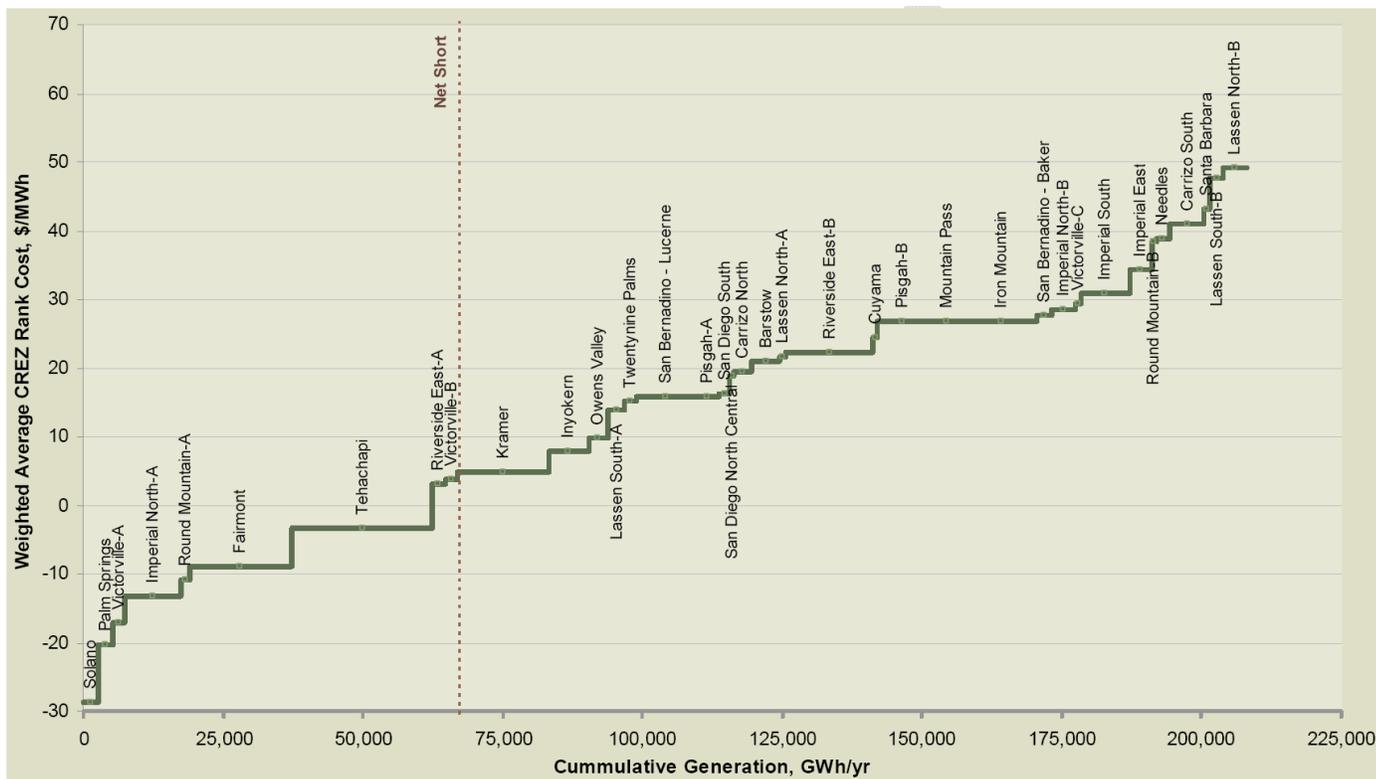


Figure 11 - Weighted Average Rank Cost (\$/MWh) for CREZ and Resource Areas.

Source: RETI, B&V

**California's richest renewable resource basins are, for the most part, in the remote southeastern portions of the state, located closest to the large population centers of Los Angeles and San Diego.**

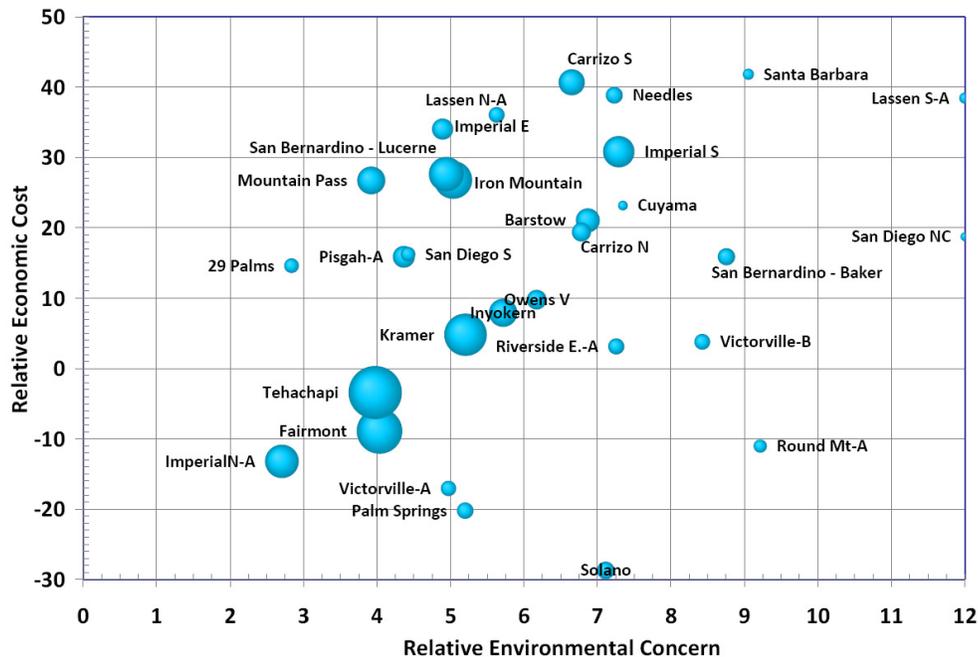
RETI not only ranked each CREZ according to economic costs, but also made estimates of environmental concern associated with each CREZ. These two analyses were then integrated, allowing policymakers to see where the lowest-cost, least environmentally damaging resource regions are located. California's richest renewable resource basins are, for the most part, in the remote southeastern portions of the state, located

closest to the large population centers of Los Angeles and San Diego. The Solano County CREZ ranks as having the most economic renewable energy resources in the state by virtue of its abundant wind resources and access to transmission lines, and is the only region from Northern California to rank among the top ten CREZs.

**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."



**Table 5 - Economic and Environmental Assessment of California CREZs.**  
 Circle size is proportional to CREZ energy potential (GWh/yr)

The lower left quadrant of the chart depicts CREZs that offer the best combination of economic and environmental ranking, with the largest blue bubbles (Tehachapi, Fairmont, Kramer and Imperial) CREZs offering the most energy potential. Transmission lines proposed by Southern California Edison (Tehachapi Renewable Transmission Project), San Diego Gas & Electric (Sunrise Powerlink) and Los Angeles Department of Water and Power (Green Path North) were incorporated into the RETI analysis and were assumed to be built. These projects, nevertheless, still face significant permitting obstacles.

A new CEERT scenario shows over 100,000 new jobs would be created if a 33 percent RPS is met with the lowest cost renewable resource regions based on RETI’s ranking. According to this analysis, the following nine CREZ would need to be fully developed to meet the 33 percent RPS (See Figure 11.) Employment calculations rely upon the EPRI/CEC 2003 estimates. Note that CSP captures just over 60 percent of new development under this methodology.

| CREZ               | Biomass | Geothermal | CSP    | Wind  | MW Total | Jobs    |
|--------------------|---------|------------|--------|-------|----------|---------|
| Solano             |         |            |        | 894   | 894      | 2,556   |
| Palm Springs       |         |            |        | 770   | 770      | 2,202   |
| Imperial North – A |         | 1,370      |        |       | 1,370    | 7,768   |
| Round Mountain – A |         | 240        |        |       | 240      | 1,360   |
| Fairmont           | 138     |            | 5,400  | 1,380 | 6,918    | 36,658  |
| Tehachapi          | 37      |            | 6,000  | 3,605 | 9,642    | 46,075  |
| Riverside East – A |         |            | 1,000  |       | 1,000    | 5,930   |
| Victorville – B    |         |            | 800    | 95    | 895      | 5,015   |
|                    | 175     | 1,610      | 13,200 | 6,744 | 21,729   | 107,564 |

**Table 6 - California’s Competitive Renewable Energy Zone Rankings**

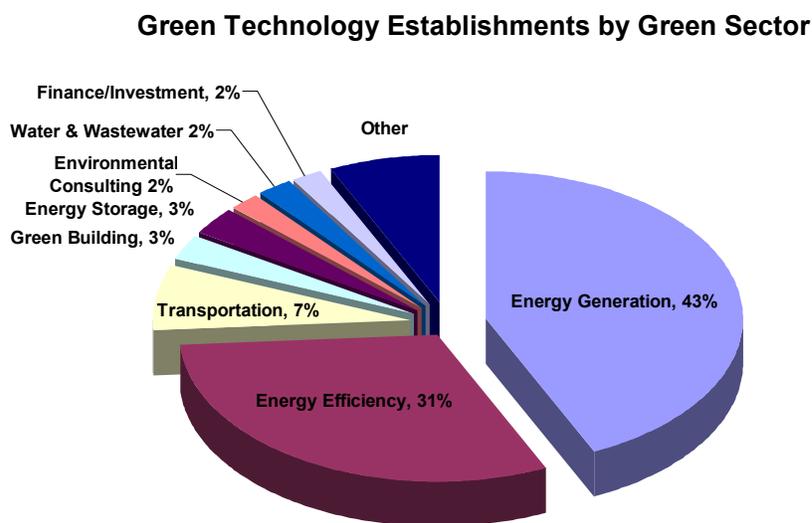
If we assume that 3,000 MW of solar PV is also constructed by 2020 based on the California Solar Initiative, this solar PV capacity would generate an additional 21,780 jobs relying upon the EPRI/CEC methodology (7.26 jobs/MW), boosting the total to 129,344 jobs for the entire renewable sector. Employing the much higher Barclay methodology (>43 jobs/MW) for solar PV would boost these figures to 129,000 and 236,564 jobs, respectively.

## V. 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.

The report also examines the geographical distribution of green businesses and employment totals.



**Figure 12 - Green Technology Establishments by Green Sector**

Source: Collaborative Economics

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.

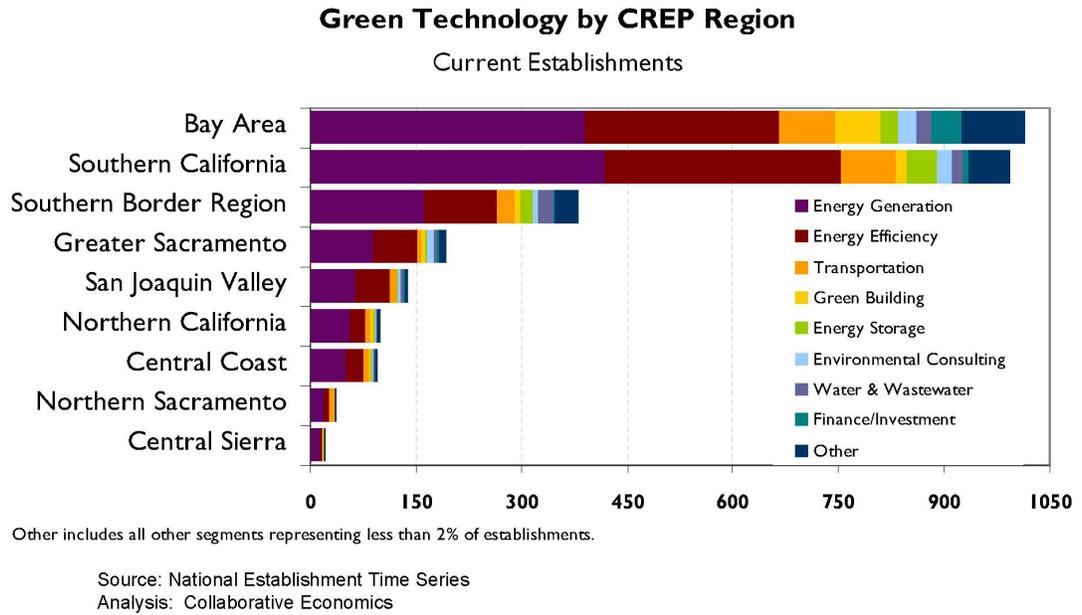


Figure 13 - Green technology by CREP Region

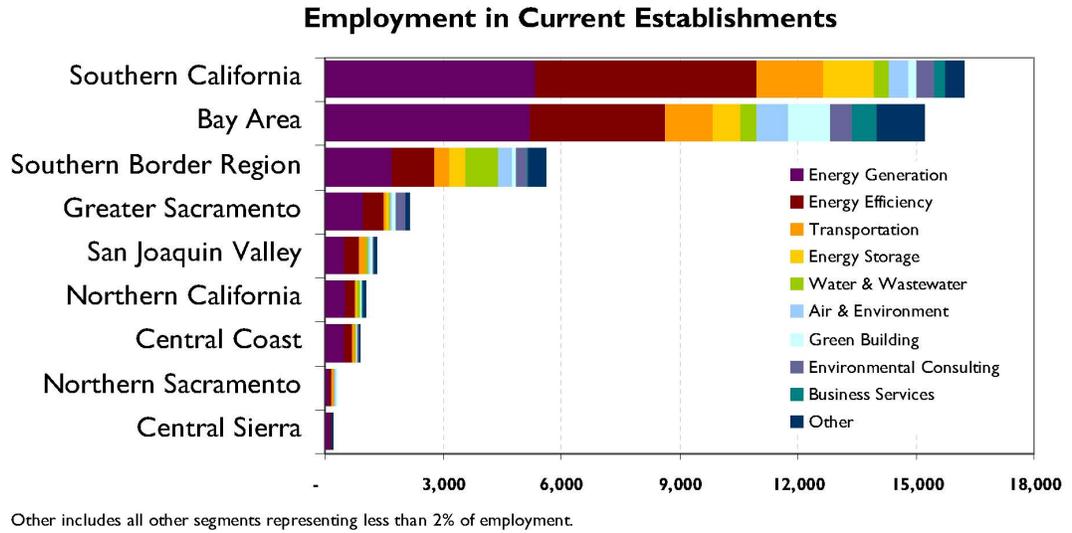
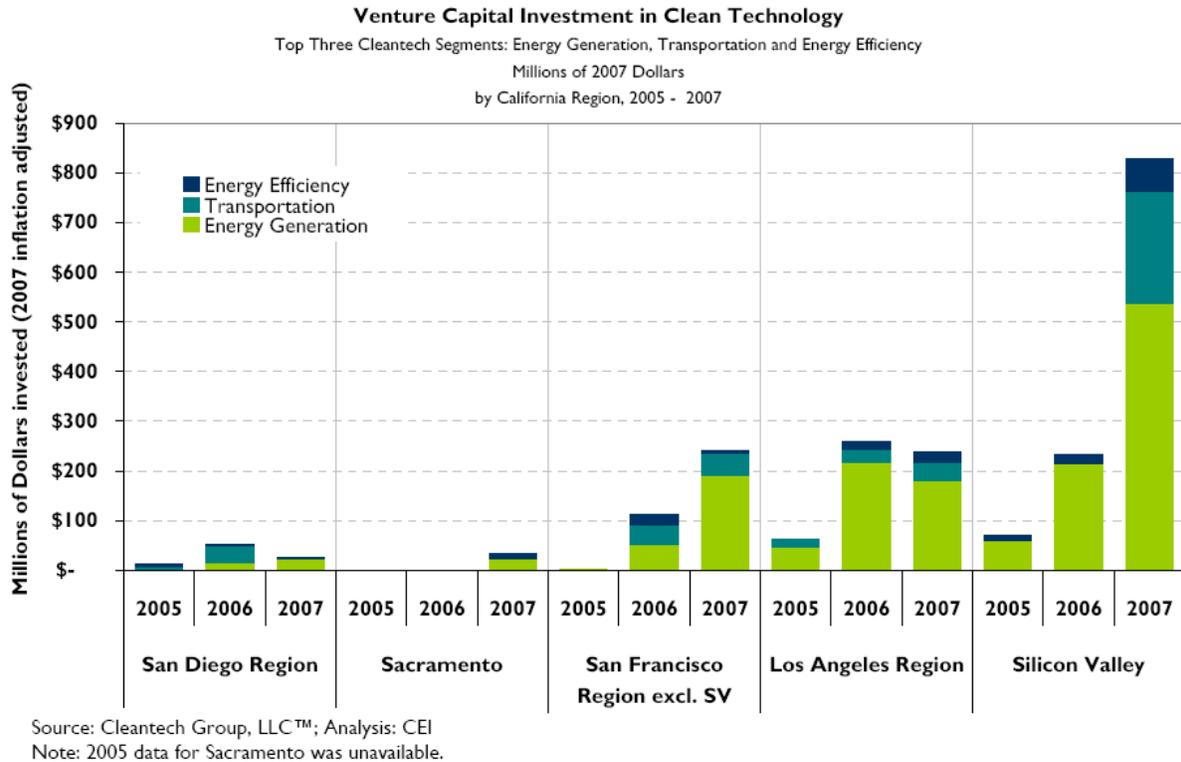


Figure 14 - Employment in Current Establishments

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 15 - Venture Capital Investment in Clean Technology**

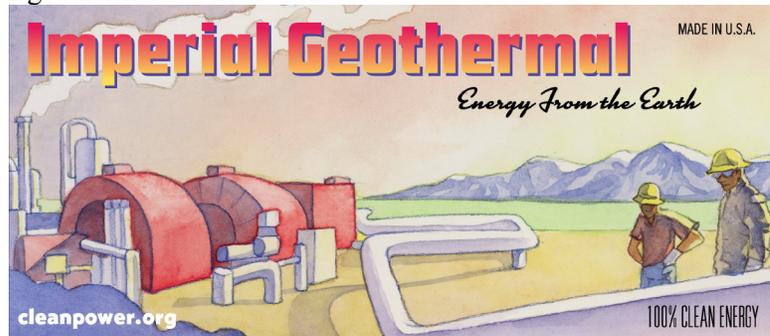
In the following sections of this report, the employment and economic impacts of increased investment in new renewable energy generation will be described for these regions of California:

- 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>10</sup>

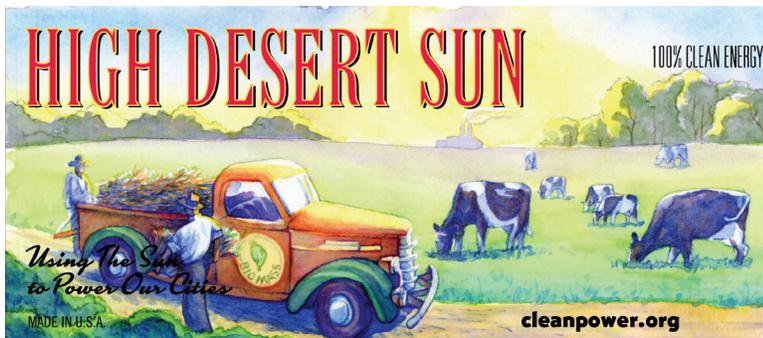
The great advantage of all solar energy technologies is that they can provide power when California most needs it: on late sunny afternoons when air conditioning demand pushes electricity consumption up to its highest levels. Geothermal steam is a critically vital resource for California because unlike 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 EPRI 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:

- 189,167 jobs in the CSP industry
- 19,278 jobs in the geothermal industry
- 5,233 jobs in the wind industry

These employment numbers – which total 213,678 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 2008 unemployment rate of 22.6 percent with approximately 16,500 people looking for work.<sup>11</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. The Sunrise Power Link proposed by San Diego Gas & Electric was approved by state regulators, but is now subject of a lawsuit. Proposals for new transmission by the Los Angeles Department of Water and Power are also nearing the necessary regulatory approvals.



## 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.

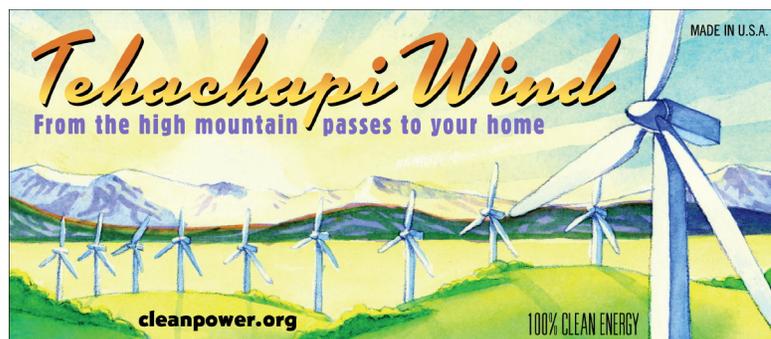
***This level of wind farm development represents a \$2 billion investment in the California economy and, according to the EPRI/CEC job ratio methodology, could create almost 12,000 jobs.***

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>12</sup> This level of wind farm development would represent a \$2 billion investment in the California economy and,

according to the EPRI/CEC job ratio methodology, would create almost 12,000 jobs. (The unemployment rate in Kern County hovers around 10 percent, with more than 35,000 people looking for work.) Efforts have been ongoing to create a master plan for new transmission lines linking up this prime wind resource.

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 often keep family agricultural enterprises in the black. While rates may vary, a modern 1.5 MW wind turbine typically pays landowners at rates of \$3,000 to \$4,000 per year.<sup>13</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.

Kern County also offers 6,000 MW of the nation’s very best Concentrated Solar Power (CSP) resources.

**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 at lower cost from giant solar farms.

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 with 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 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. The plants 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 a 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 in Spain utilizing the parabolic trough CSP technology, and has proposed new CSP projects in California as well.

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 16 - Construction of AndaSol 1 in Spain (Source: Solar Millennium, LLC)**

## The Los Angeles Region

The Southern California region employs more people in the renewable energy sector – approximately 20,000 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 has historically come 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.



### **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 17 – Clean Tech Industrial Park**  
Source: CRA/LA

### 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 environmental justice (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 earned a living wage this past 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 18 - Richmond Build

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

**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 buildings 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.*

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-locate 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 about 10 percent in December 2008, with over 400,000 people looking for work.

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



## 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 photovoltaics (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 investors alike. Because solar PV apparently 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. They remain optimistic despite having to shed jobs recently because of the financial credit crunch and Wall Street's hammering of solar stocks due to falling fossil fuel prices.

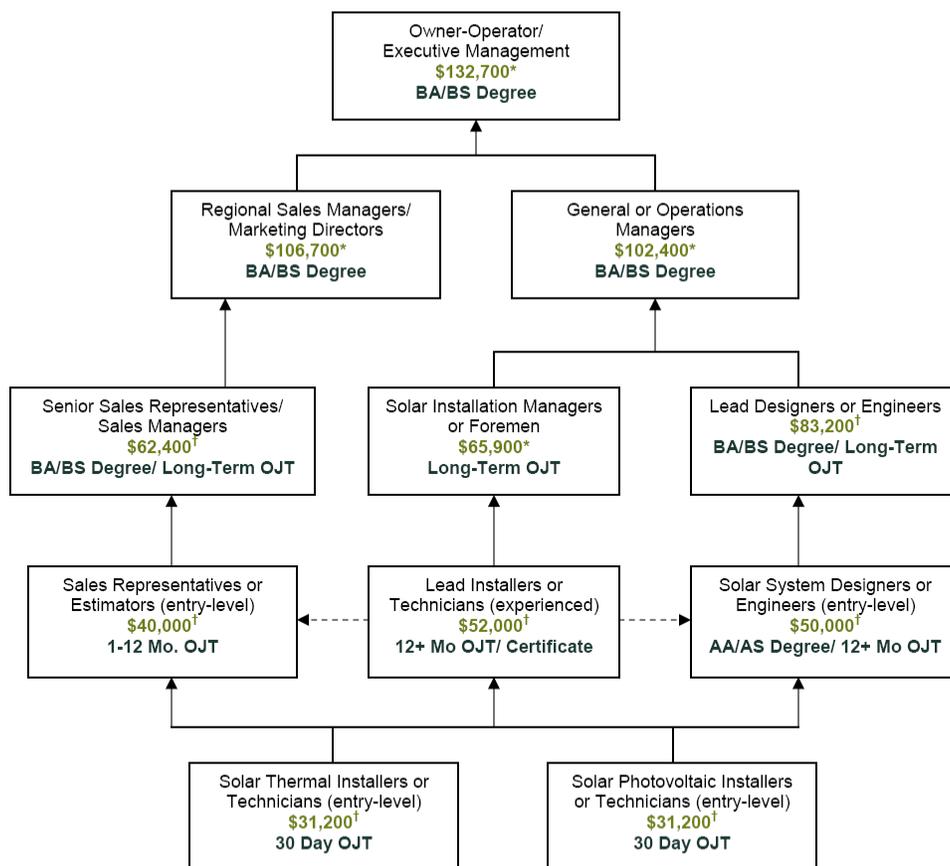
A report entitled *Environmental Scan: Solar Industry – San Francisco Bay & Greater Silicon Valley* was based on interviews of 77 of the 257 solar related businesses located in the ten-county Bay Area to assess future employment trends in the solar energy market. This report projects that 5,000 new jobs could be created statewide in the solar PV industry over the next year, 1,900 of which would be in the Bay Area.<sup>14</sup> 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 in Figure 12 - *Career Pathways for Solar Industry Occupations*.

| 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 7 - Major Bay Area Solar Firms**



† 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 19 - Career Pathways for Solar PV 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 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>15</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>16</sup>

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

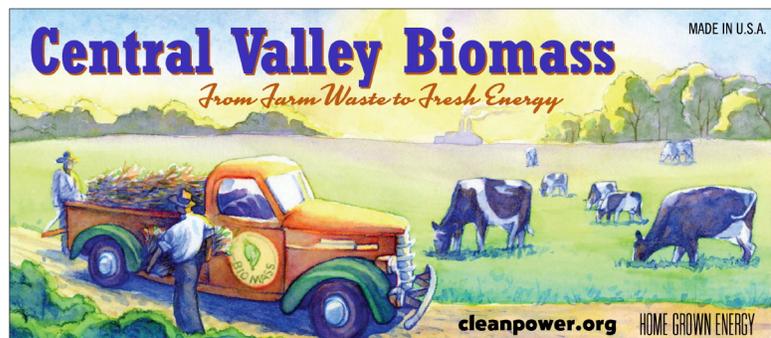
Most local citizens suspect the blame lies with the agricultural and food processing industries that dominate life in the Central Valley. "All of these industries are being courted in the Valley by civic leaders seeking economic advantages, desperately seeking a tax base to support their municipality," 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>17</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.

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.

## VI. 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. Additional reforms will also be necessary.

The current RPS law creates constraints that work at cross purposes with a mandate ostensibly aimed at increasing California's reliance on renewable generation. These constraints include:

- **Pricing:** California's current RPS measures the pricing of new renewable energy against a benchmark based on the cost of natural gas, known as the Market Price Referent (MPR).
- **Flexibility:** Flexible compliance rules allow utilities to meet their RPS goals as much as three years beyond the deadline. Additionally, utilities can meet targets with contracts rather than actual energy deliveries.
- **Contract Evaluation:** Contracts are not subject to robust standards for project viability or reasonableness, so little incentive exists for utilities to work to move from contracts to steel in the ground.
- **Transmission, Permitting, and Siting:** Transmission, permitting, and siting constraints remain a constant barrier to the timely and cost-effective delivery of remote renewable energy resources.

Nevertheless, a series of reforms can transform the projected 100,000 to 200,000 full-time jobs into real people with real jobs here in California.

- Remove the cost limitation imposed by the MPR and avoid "caps" on renewable procurement pricing since none exists for fossil fuel resources.
- Allow reasonable, transactional flexibility to overcome physical and market barriers to procurement.
- Encourage and rely on the collaborative work among stakeholders involved in RETI.
- Review projects for developer experience, technology type, commercial viability and project financeability.
- Require reasonableness reviews for project viability and pricing.
- Ensure that transparent and meaningful milestones for siting, permitting, and transmission are applied and enforced
- Enforce penalties for RPS non-compliance
- Build transmission lines to bring the lowest cost resources from remote areas into urban centers with high energy demand.

According to the Economic and Technology Advancement Advisory Committee report prepared for CARB, nearly 340,000 California manufacturing jobs had been lost over the past five years preceding the economic meltdown of 2008. California's corporate income tax apportionment formula imposes a higher tax burden on those hiring and investing within the state's borders. Levying a sales tax on manufacturing equipment installed for in-state use makes the capital-intensive expansion process significantly more

expensive in California. 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. Regardless of the positive 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.

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.

## 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<br>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;<br>BLS, 2004            | 85%             | 40                         | 8.50   | 0.10                                 | 0.07   | 0.21                                      | 0.60                    | 0.25                                      | 0.70                    | 0.03                                      | 0.08                    |

Table 8: 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 EPRI/CEC methodology featured in the CEERT scenario for a 33 percent RPS by 2020 was the only methodology available for all renewable technologies that factored in both manufacturing and operations and maintenance jobs. This methodology, though dated, was substituted for the REPP methodology used in the first version of this report released in August 2008. The REPP methodology is focused exclusively on potential manufacturing jobs that could be developed by existing companies located throughout California. REPP assumes 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 UC-Berkeley methodology figures featured in Appendix A do factor in construction, manufacturing and operations and maintenance employment, but do 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. (Preliminary numbers from UC-Berkeley on CSP implied a rate of 4.88 jobs/MW if storage is included.) UC-Berkeley “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 Union of Concerned Scientists (UCS) study relies upon an “input/output” model that poses other questions. While the UCS numbers 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 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.” Look for updates at: [www.cleanpower.org](http://www.cleanpower.org).



## Endnotes

- <sup>1</sup> D. Roland-Holst, *Economic Growth and Greenhouse Gas Mitigation in California*, University of California-Berkeley, August 2006.
- <sup>2</sup> “Solar Energy 101: Capacity Expansion in the PV Industry,” *Barclays Capital Solar Daily*, October 24, 2008.
- <sup>3</sup> This jobs calculation is based on a resource scenario that blends a July 21, 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> 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>11</sup> Cross-Border Economic Bulletin, “Why Have High Income Levels Bypassed Imperial County?” January 2001: [www.sandiegodialogue.org](http://www.sandiegodialogue.org); [www.labormarketinfo.edd.ca.gov/](http://www.labormarketinfo.edd.ca.gov/)
- <sup>12</sup> Tehachapi Collaborative Study Group, *Transmission in the Tehachapi Wind Resource Area*, CEERT for the California Public Utilities Commission, March 2005.
- <sup>13</sup> [www.awea.org/pubs/factsheets/WindyLandownersFS.pdf](http://www.awea.org/pubs/factsheets/WindyLandownersFS.pdf)
- <sup>14</sup> This optimism may be tempered if the federal investment tax credit for solar PV is not extended beyond 2008. [Hasn’t it now been extended?]
- <sup>15</sup> “A Green Industry Takes Root in California,” *New York Times*, February 1, 2008.
- <sup>16</sup> [www.labormarketinfo.edd.ca.gov/](http://www.labormarketinfo.edd.ca.gov/)
- <sup>17</sup> Alan Berube and Bruce Katz, *Katrina’s Window: Confronting Concentrated Poverty Across America*, Brookings Institution, October 2005.