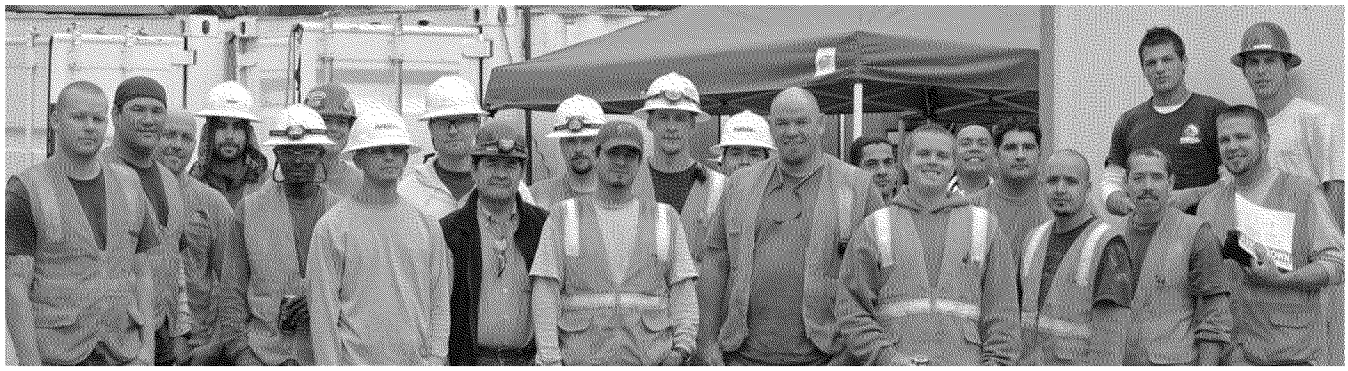
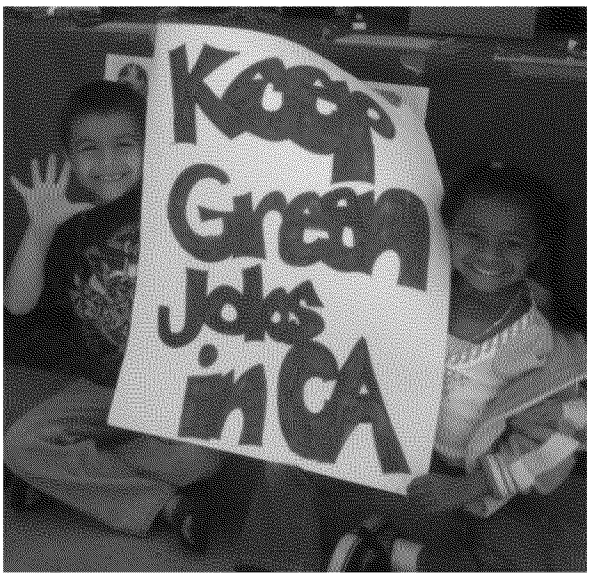
# ATTACHMENT 2



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# Should Green Jobs Be Outsourced?

*A Case Study of Lost Jobs and Lost Opportunities*

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## Executive Summary

The proposed Sempra 1250 megawatt (MW) tieline connecting the California grid to envisioned new wind-farms in Mexico is not just about electricity. It is also about foregone opportunities, lost human capital investment, lost worklives, lost tax revenues, and diminished economic development prospects; and also, it is about which regulatory authority, California or Mexico, should oversee the environmental impacts of building green generation capacity for the California grid. Finally, it is about undoing some of the economic benefits and jobs stimulated by the first set of federally subsidized, utility-scale, solar projects fast-tracked by the Interior Department.

Approving the Sempra tieline into Mexico will result in:

- 5 years of lost construction work
- 3000 lost construction job-years including 2450 lost to Imperial County, California residents
    - (At 27.9%, Imperial County has the highest unemployment rate in the country)
- 3450 lost job-years overall in Imperial County (2450 construction plus 1000 spinoff jobs)
- 9800 lost job-years in California, including Imperial County
- 15,000 lost job-years in the US. including California
- $550 million in lost wages (plus additional losses in benefits) over 5 years
- $300 million loss in local, state and federal business and personal taxes
- $4.5 million loss in local human capital investment in Imperial County
- 103 Imperial County youth deprived of apprenticeship training and skill acquisition
- $127 million net present value of lost lifetime wages and benefits associated with foregone training
- 40 permanent operation and maintenance jobs lost in Imperial County amounting to 1000 lost job-years over 25 years
- $78 million in the net present value of lost wages and benefits in Imperial County from the lost operations jobs in addition to the aforementioned $550 million in lost wages associated with lost construction and related spinoff jobs

Sempra, the parent company of San Diego Gas & Electric, proposes to outsource 1250 MW of green electrical generating capacity to Mexico by connecting a one-mile tieline from Mexico to the Southwest Powerlink electrical transmission line close to the San Diego County and Imperial County border. (See map below: Figure 1) This proposal, if approved, would outsource to Mexico 5 years of work for 600 construction workers, 489 of whom otherwise would have been residents of Imperial County, and 111 of whom would have traveled from other parts of California, Arizona and Southern Nevada to work in Imperial County. In total, 3000 direct, on-site construction job-years (600 workers times 5 years) will be taken from the U.S. construction labor market and transferred to Mexico. In addition to these lost

construction jobs, 40 permanent operation and maintenance jobs will be lost. Over a 25 year lifespan of these types of facilities, 40 lost operations jobs amount to 1000 lost local job-years taken from the Imperial County labor market. Overall, the U.S. labor market would lose 4000 job-years in direct, construction and operation work by approving Sempra's proposal. Almost 90% of these direct job-losses would be lost in the Imperial County labor market itself.

Imperial County can ill-afford to lose any jobs. In April, 2011, Imperial County's unemployment rate stood at 27.9%, the highest county unemployment rate in the nation. Construction employment in Imperial County is down 50% from early 2008. The loss of 489 long-lasting construction jobs in this small county of 170,000 people, at this time of deep economic crisis simply rubs grit and salt into an already gaping wound. But the job losses from Sempra's proposal do not stop at the construction-site gate nor at the county line.

The loss of direct construction employment would lead to a spinoff of an additional 1000 lost job-years elsewhere on other types of jobs in the local Imperial County labor market. Because the Imperial County population is small, the spinoff losses from outsourcing these jobs to Mexico will spread to the overall California and U.S. labor markets through supply-chain and consumer-chain channels. In total, outsourcing this work to Mexico will mean that the U.S. labor market will lose from 10,000 to 15,000 job-years, a multiple of from 3 to 5 times the direct job-years lost on the construction work itself. These 15,000 lost job-years correspond to net present value of $550 million in lost earnings.

With the loss of direct construction work alone, comes more than $4.5 million of lost human capital investment through the loss of more than 100 apprentices whose 5 years of training would have been financed by this construction work. Over the courses of their worklives, in net present value, collectively these workers will lose $127 million in reduced wages and benefits due to this lost training.

Of the 103 apprentices that would have been on this Imperial County work, 75 would have been electrician apprentices. Each of the 75 skipped-over electrical apprentices regrettably will forego more than $36,000 of human capital investment in classroom and lab training that contractors otherwise would have invested in them. This lost human capital investment is equivalent to what the State of California invests for the first three years of a student's undergraduate training at the University of California. Outsourcing this type of work to Mexico is like closing a university in the harm that it does to post-secondary education for blue-collar workers in Imperial County.

The loss to these individuals is also a loss to Imperial County which will lose the services and economic development advantages of having 103 additional, highly skilled construction workers within the local construction labor force. Given that the total size of Imperial County's construction labor force is about 2000 workers, this amount to a 5% loss in the total skill makeup available to local construction contractors. Because long-term local economic development is partially a function of near-run local human capital accumulation, the dead-weight loss of this training will prove to be a permanent drag on future economic development in Imperial County.

The loss of construction jobs and consequent loss of spinoff jobs during the period of construction alone reduces local, state and federal tax revenues by almost $300 million. More lost tax revenues are associated with the absence of these power-generating facilities within the County over the 25-year, expected lifetime of this power generation. Sempra's tieline proposal is about importing electricity, but it is also about outsourcing jobs, foregoing human capital investments, lost careers and lost tax revenues.

This Report begins on page 12 with an Introduction. A map of the Sempra proposal, a set of frequently asked questions (FAQs), the author's bio, and a Table of Contents precede the Introduction. Readers may review the FAQs prior to reading the Report to familiarize themselves with some of the conceptual issues and conclusions of the Report; or refer back to the FAQs and map as needed.

## Map of Sempra's Proposed Cross-Border Transmission Tieline

This map of Sempra's proposal will help the reader visualize Sempra's cross-border transmission request:

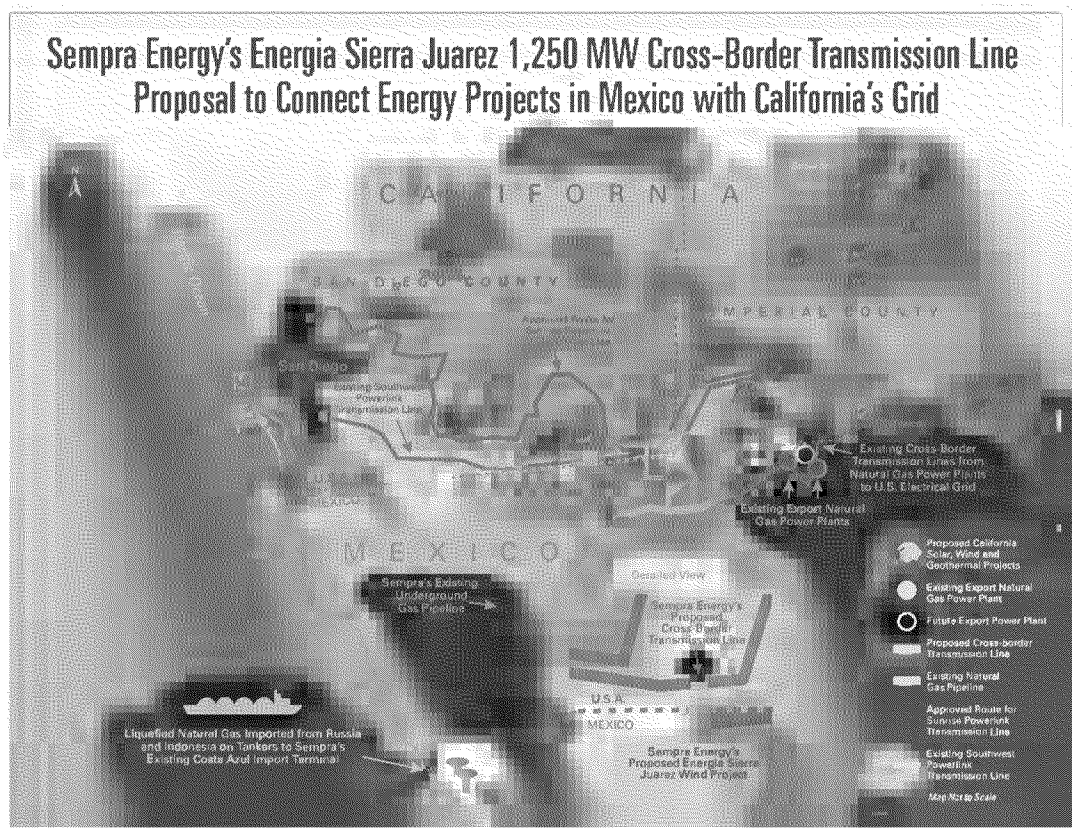



**Figure 1: Map of Sempra Energy's proposed Sierra Juarez 1250 MW one-mile, cross-border transmission tieline connecting proposed wind farms in Mexico to an existing U.S. Southwest Powerlink transmission line on the border of Imperial and San Diego counties.**

## FAQs: Concepts and Conclusions

These frequently asked questions will help the reader understand some of the conceptual issues and conclusions found in this report. They may be reviewed now or referred to as needed while reading the report. The report itself begins with the Introduction section below.

### What is a "job" in analyzing job losses?

Whenever someone gets hired, that person has a new job. But that new job could last 4 months, 4 years or 40 years. Obviously, there is a lot more work, income and spinoff effects from 40 years of work compared to just 4 months of work. So in analyzing job losses or job gains, economists have standardized the concept of "job" as a "job-year." A job-year is 52 weeks of 40 hours of work per week, or 2080 hours equaling one year's worth of work. When an economist looking at the economic impact of building a new

solar farm says that this solar farm will create 3000 new jobs on the construction site, that economist means 3000 new job-years.

## Does that mean there will 3000 construction workers on the construction site?

Not necessarily. If a construction project requires 3000 job-years, and the construction will last one year, than we would expect, on average, 3000 construction workers on that worksite. However, if the job is expected to take 5 years, then we would expect, on average, there would be 600 construction workers on the worksite at any given time. (600 workers time 5 years equals 3000 job-years).

## What are the spinoff or multiplier effects of 3000 new jobs from a new construction site?

Any construction site requires materials as well as workers. The materials bought for the new construction site will create new jobs somewhere else in order to make and transport these new construction materials to where the new construction is taking place. This new upstream demand will create new jobs spun-off from the new construction work. Also, the workers on the new construction site will spend their new wages buying food, paying for their homes, buying cars, gas and other consumer goods and services. This new consumer demand will create new spinoff jobs downstream in the consumer market.

## If a new green power-plant is built in Mexico instead of in the U.S., wouldn't the American construction workers just go work somewhere else?

Sure, if there was full employment. But today we have the worst labor market since World War Two. California is one of the hardest hit states while Imperial County, with an unemployment rate of almost 28% in April 2011, is *the hardest hit* county in the nation. Furthermore, construction employment in Imperial County is only half of what it was in early 2008. So a job lost to Mexico in the aftermath of the Great Recession means an unemployed American construction worker stays unemployed.

## How do you calculate the multiple number of spinoff jobs from a new construction site?

The new construction jobs are called the "direct" employment effect of the new work. The new spinoff upstream supply-chain jobs are called the "indirect" employment effect. The new spinoff downstream consumer-chain jobs are called the "induced" employment effect. The "multiplier" effect is the multiple number of new indirect and induced spinoff jobs that are created by the original new direct construction jobs. So the total number of new jobs is the direct jobs plus the indirect jobs plus the induced jobs. The multiplier is the total number of jobs divided by the original new direct construction jobs.

The multiplier effect from the original number of new direct construction jobs depends on how big an area you are looking at. In a small county such as Imperial County, the multiplier will be small because the upstream supply-chain and the downstream consumer-chain will both be short. The solar panels built for a solar farm will not be built in Imperial County. So any new jobs created by a demand for solar panels will not create those new jobs in Imperial County. (That new demand might not even create new jobs in California if those panels are imported from China).

But as you lift your gaze from Imperial County to California or higher still to the U.S. economy as a whole, the supply-chains and the consumer-chains will get longer; and the potential for new spinoff jobs making the construction materials or making the consumer goods to meet this new demand will grow substantially. Still, the new demand coursing through these supply-chains and consumer-chains will not stay completely in the United States in any case. If the solar panels come from China, or if a newly employed construction worker goes to Wal-Mart and buys an MP3 player made in Korea, some of the new spinoff jobs created by this new construction site will be created overseas.

Standard computer programs have been created to estimate the within county, within state, and within U.S. new-jobs-effect of a new construction site. These programs have been used widely to estimate the number of new jobs from new green electrical generating facilities, new bridges built on interstate highways, new companies coming to town or old companies leaving, etc.

## What is the multiplier that you use to calculate the jobs lost from building 1250 MW of green electrical generating capacity in Mexico and importing that electricity to the U.S. rather than building that same capacity here?

For photovoltaic construction work, we calculate that the multiplier for Imperial County is 1.4, for California, it is 3.3 and for the U.S. as a whole it is 4.9. This means that for every 1 new direct job on this type of construction, there would be 0.4 new upstream and downstream spinoff jobs elsewhere in Imperial County; there would be 2.3 new upstream and downstream jobs in California; and there would be 3.9 new upstream and downstream jobs in the U.S. as a whole. The longer the potential supply-chains and consumer-chains, the larger the multiplier effect. These new jobs will be lost if Sempra is allowed to build its 1250 MW cross-border transmission tieline to Mexico.

## How many jobs in total would be lost in the U.S. if Sempra is allowed to build a 1250 MW transmission line and import green energy from Mexico?

We calculate that 3000 direct construction jobs would be lost with 2445 of those being lost by Imperial County construction workers. These 3000 jobs are measured in job-years, so if it took 5 years to put in place 1250 MW of photovoltaic generating capacity, then 600 individual construction workers would lose 5 years worth of work each while 489 of those individuals would be Imperial County residents.

In addition to these lost construction jobs, there would be almost 400 supply chain jobs and 600 consumer chain jobs (measured in job-years) lost in Imperial County for a total Imperial County loss of 3439 jobs (again measured in job-years). But California (counting Imperial County) would lose more. The loss of the original 3000 construction jobs would lead to a total loss of 9787 California jobs with more new jobs lost in the consumer-chain than in the supply-chain.

But the U.S. (counting California) would lose the most. The original 3000 lost construction jobs would lead to almost 15,000 lost new jobs overall with half of that overall job loss coming from lost consumer demand, a 30% from lost producer demand and 20% from the lost direct construction jobs themselves. These 15,000 lost job years imply $550 Million in lost earnings.

## What would be the tax loss associated with these lost jobs?

At the federal, state and local levels taken together, the tax revenue loss would be almost $300 million.

## You have talked about lost construction jobs. Wouldn't there also be lost jobs running these facilities?

Yes. It would take about 40 workers to manage, operate and maintain 1250 MW of photovoltaic solar capacity. These one or several facilities would last about 25 years each before they would have to be rebuilt. So 1000 job-years of work in Imperial County would be lost over a 25 year period (40 workers times 25 years). Plus, quite often, when the useful life of a power plant ends, the utility rebuilds at the same location. So actually, building in Mexico as opposed to building in the U.S. may create unending Mexican benefits and unending Imperial County job losses.

## Construction workers do not stay on one job indefinitely. Are there any long-term losses that continue past the lost jobs on the actual construction work itself?

Yes. Had Sempra built its green generation capacity in Imperial County instead of Mexico, contractors on the U.S. side of the border would have invested more than $4.5 million over 5 years in classroom and lab instruction for the more than 100 apprentices that would have worked on this job.

For electricians, the largest group of apprentices, contractors would have invested more than $36,000 over 5 years in classroom and lab instruction, plus provided hands-on, supervised on-the-job training. This lost human capital investment means that these 103 would-be apprentices will forego skills development, get less well-paying work, and each earn, a net present value in today's dollars, almost $1 million less over their worklives than they would have earned had they received this training. To give you an idea of the value of this lost training, the foregone human capital investment due to this lost work is equivalent to about what the State of California invests in the education of a University of California undergraduate over his or her first three years.

Outsourcing a large, long-lasting construction site is like closing down a university. Indeed, construction apprenticeship training is the largest system of privately financed higher education in the United States creating well-paid, middle-class, blue-collar jobs by investing huge sums in human capital on local youth while essentially putting each apprentice on scholarship because each apprentice earns while he learns. To make the apprenticeship system work, contractor-paid-for apprenticeship programs rely upon projects like the type Sempra proposes to outsource to Mexico. Imperial County also loses because local communities rely upon human capital investment in their young people to build a key component of future local economic development, namely a skilled local construction labor force.

## Would the new green electrical generating capacity built in Imperial County create new jobs overseas?

Sure. To the extent that either the contractor buys imports to build the project, or the workers buy imported consumer goods, some of the new demand from this construction will generate overseas jobs. But the biggest impact will be new domestic job creation because lots of the construction materials such as cement or fencing or wiring will be domestically made. And while we all buy some imported goods when we go to the store, still many consumer goods and most consumer services are still made in the U.S.A. So the biggest spinoff of new jobs will be domestic.

## If the new green power generation was built in Mexico, wouldn't that create new jobs in the U.S.?

Sure. But the biggest new job benefits of building this green power in Mexico would go to Mexico. First of all, the new direct construction jobs would all be Mexican. Second, while Mexican consumers also buy imports, some from the U.S., nonetheless, most of their consumer services will be domestically provided and many of their consumer goods will be Mexican made. Also, just as American buy Japanese and Korean cars, so do Mexicans. So while building across the border will create some new jobs in the U.S., primarily through supply-chain channels, this new spinoff-job creation coming to the U.S. will be diluted because the U.S. will not be the only source of foreign goods Mexicans will buy, and the new consumer-chain demand will still primarily snake through the Mexican domestic consumer sector.

## You say that Sempra intends to build wind farms in Mexico, yet you use as your alternative the building of solar farms in Imperial County. Why?

Currently a megawatt of wind energy is cheaper than a megawatt of solar energy, although solar energy costs have been falling. The places where wind farms can be built are relatively limited and probably all of California's wind resources that can be developed responsibly with due consideration for environmental impacts will, in fact, be developed whether or not Sempra is allowed to construct its tieline.

California requires that all utilities and other electricity providers in California get 33% of their electricity from renewable energy sources such as geothermal, wind and solar by the year 2020. To achieve this goal, all of the geothermal and all of the wind resources in the state that can be developed responsibly with appropriate consideration of environmental impacts will be developed; and still the 33% renewable-energy generation standard will not be fully met. So to build up to this 33% goal, utilities will have to develop solar resources as well. Thus, at the margin, if 1250 MW of wind energy is not developed for the California grid in Mexico, then 1250 MW of solar capacity will be built in California. While the construction of thermal solar-farms are breaking ground now, the recent decline in the cost of photovoltaic solar generation will mean that future solar farms will likely be photovoltaic.

## You point out that wind energy is cheaper than solar energy. Isn't it better to build across the border in Mexico to capture this wind resource in order to benefit from the cheaper cost of wind?

Picking up an additional large wind farm in Mexico would probably lower San Diego Gas & Electric's green electrical generation costs somewhat. And these savings would mostly be passed on to at least some SDG&E customers.

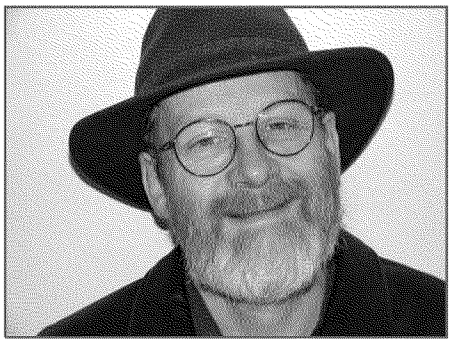
However, the U.S., and especially California, carefully evaluates the potential environmental harm of building any type of power plant--gas, solar or wind. Mexico does not have as careful an environmental review. So the cheaper wind-generated electricity built in Mexico may have hidden environmental costs that could make that imported wind-energy cost artificially low.

In any case, Mexico needs its own green-energy generation capacity , including wind and solar. Mexico disproportionately relies upon high-sulfur-content oil for much of its electrical generation This form of power production generate more pollution with consequent increased health hazards. By building a captive wind-farm in Mexico tied to the California grid, Mexico is deprived of this wind-resource. So

another hidden cost of the proposed "cheaper" wind farm is more pollution and more health hazards in Mexico.

So, while there may be some cost savings to SDG&E associated with capturing a Mexican wind resource for Sempra's sole use, this savings has to be balanced against the potential environmental, pollution and health hazards Sempra's proposal entails for Mexico along with the costs in lost American jobs, lost domestic training, lost local income and lost U.S. tax revenues outlined in this report.

## About the Author



Peter Philips is a labor economist specializing in the construction labor market. He is the nation's recognized expert on the economics of prevailing wage laws and one of the foremost experts on the construction labor market, generally. Philips has related interests in construction worker safety, health economics and economic history. Philips received his B.A. from Pomona College and his M.A. and Ph.D. from Stanford University. He is Professor of Economics and former chair of the Department of Economics at the University of Utah.

Philips' most recent books include *Building Chaos: An International Comparison of the Effects of Deregulation on the Construction*, (with Gerhard Bosch, 2003) and *The Economics of Prevailing Wage Laws*, (with Hamid Azari-Rad and Mark Prus, 2005). Philips most recent journal articles include "Health Insurance and Worker Retention in the Construction Industry," *Journal of Labor Research*, "Effect of Multiemployer Collective Bargaining on Employer-Provided Health Insurance in the Construction Industry," *Journal of Labor Research*, "A Case Study of Labor Turnover on a Large Industrial Construction Project," *Journal of Construction Engineering & Management*, (all with JaeWhan Kim), and "Analysis of the Impacts of the Number of Bidders upon Bid Values: Implications for Contractor Prequalification and Project Timing & Bundling," *Public Works Management & Policy*, (with Sheng Li).

Philips has received many awards for his teaching and research including the prestigious University of Utah Presidential Teaching Scholar, and the University of Utah, Graduate Student & Postdoctoral Scholar Distinguished Mentor.

## Acknowledgement, Disclosure and Disclaimer

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# Introduction

Context: On January 28, 2010, Secretary of the Interior, Kenneth Salazar, told Congress that 13 envisioned, utility-scale, solar electrical generating facilities in California, Arizona and Nevada were being put on fast-track for approval. Should these projects pass environmental and technical review by December, 2010, they would be eligible for economic stimulus funding under the 2009 American Recovery and Reinvestment Act.[1] These 13 projects, taken together, would put in place about 4500 megawatts (MW) of renewable energy generation capacity and create 40,000 new jobs. These new jobs would include both construction, operation and maintenance workers as well as spinoff jobs up the supply-chain and in the downstream consumer market where new workers would spend their incomes.

Eleven months later, in November, 2010, Secretary Salazar approved the second largest solar farm ever on U.S. lands, the 500 MW thermal-solar Amargosa Farm Road Solar Project, in rural Nye County, Nevada, north of Las Vegas. This project will create 1300 construction jobs and up to 200 permanent operation and maintenance jobs over the lifetime of the facility.[2] There would be additional spinoff jobs created as well in both the supply-chain and consumer-chain feeding off this project.

*There is a zero sum game afoot. If 1250 MW of wind or other green energy generation is built in Mexico designed to be imported to the U.S., that 1250 MW of green energy capacity will not be built in the U.S.*

One month later, in December, 2010, Secretary Salazar approved the 110 MW thermal-solar Crescent Dunes Energy Project, the ninth utility-scale solar project to receive approval under the Administration's initiative to encourage the rapid but environmentally responsible development of renewable energy on public lands. Again in Nye County, Nevada, near the small desert community of Tonopah, the 110 MW Crescent Dunes project will employ about 450 construction workers at a time when Las Vegas area construction employment is about 60% below its peak achieved before the Great Recession. [3]

On June 17, 2011, Secretary Salazar, joined with California Governor, Jerry Brown, to break ground on the world's largest solar power plant, the 1000 MW Blythe Solar Power Project in the small Riverside dessert community of Blythe, California. This thermal-solar project will create 1000 construction jobs per year with a spinoff of another 3000 new jobs in the supply-chain serving this construction project plus new jobs in the consumer market feeding off the wages these new construction and supply-chain workers earn.[4] With California, Nevada and Arizona suffering some of the highest state unemployment rates in the country, and with construction employment in these states down 30% to 60% from their peak four years ago, these jobs could not have come at a better time.[5] And the promise of more to come is good news indeed.

Case Study: But more jobs will not come to the U.S. labor market if these new renewable facilities are built in Mexico. One of the misconceptions regarding job creation from the building and operating of renewable energy electrical generating facilities is the notion that these jobs cannot be outsourced. This is a report about the loss of American jobs due to the outsourcing of the construction and operation of green, electrical power-generation to Mexico. Specifically, we analyze the economic impact of a proposal to build

a 1250 MW cross-border transmission tieline from Southern California into Mexico in order to import wind-generated electricity from Mexico onto the California grid. The flurry of utility-scale, green-energy construction described above is responding to higher state standards for renewable energy generation required in the energy mix that utilities use.

**Tradeoff:** There is a zero sum game afoot. If 1250 MW of wind or other green energy generation is built in Mexico designed to be imported to the U.S., that 1250 MW of green energy capacity will not be built in the U.S. Because, in the foreseeable future, utilities will not go beyond their mandated quota for green energy generation, if it is built there, it will not be built here. Consequently, there is a tradeoff between jobs created in the U.S. to build these plants and jobs created in Mexico should those plants be built there. Not only is there a tradeoff between the direct employment of workers building and operating these green power plants, but also there is a tradeoff in the spinoff jobs derived from these direct workers either spending their income domestically in the U.S. or in Mexico. The tradeoff also extends to local, state and federal tax revenues with either American or Mexican governmental entities benefiting depending on where these jobs land.

*Allowing Sempra to build a line to import up to 1250 MW of green electricity from Mexico would, in one stroke, offset 25% of the job-creating benefits of these 13 fast-tracked, federally subsidized projects announced by Interior Secretary Salazar.*

How big is this tradeoff? In the case study under review, the 1250 MW transmission line proposed by Sempra, the parent company of San Diego Gas & Electric, would allow for the outsourcing of 600 construction jobs, each lasting 5 years, plus an additional 2400 supply-chain and consumer-chain jobs that would have been stimulated by these new construction jobs. These supply-chain and consumer-chain jobs would also last for 5 years supported by the 5-year construction phase required to build 1250 MW of green electrical generation capacity. Altogether, in the construction phase, almost, 15,000 American job-years and a corresponding $550 million in earnings would be lost by outsourcing the construction of this green electrical generation capacity to Mexico.

In addition about 40 permanent operation and maintenance jobs would be lost to Mexico over the 25 years that is the expected lifetime of these types of electrical generation facilities. Multiplying 40 jobs times 25 years yields another 1000 job-years lost after the five-year construction period.

**Perspective:** How does the construction-period job-loss associated with the Sempra 1250 MW transmission tieline compare with the envisioned 40,000 jobs Secretary Salazar foresaw from the construction of 13 solar facilities that together would generate 4500 MW of green electricity? One way to answer this, is to focus on the megawatts of green electrical generating capacity that will not be built in the U.S. if it is built in Mexico and imported here.

Sempra proposes a cross-border transmission line that would permit the outsourcing of 1250 MW green electrical generating capacity. This equals about 25% of the nameplate capacity of Secretary Salazar's 13 fast-tracked projects. So, in rough terms, allowing Sempra to build a line to import up to 1250 MW of green electricity from Mexico would, in one stroke, offset 25% of the job-creating benefits associated with these 13 fast-tracked, federally subsidized projects. That would entail the loss of 10,000 of the anticipated 40,000 jobs.

But in these calculations, the definition of "jobs" is important. Typically, economists doing this type of analysis use the concept of a "job-year." A job-year is 2080 hours of work done by one person or even by a combination of part-time workers adding up to 2080 hours. (This is a job "year" because 2080 hours is 40 hours per week times 52 weeks). The 40,000 new jobs Secretary Salazar mentioned in his Congressional testimony probably referred to job-years.

With this understanding, the 1250 MW capacity Sempra proposes to outsource, means that approving Sempra's plan implies the loss of 10,000 job-years in the American labor market. In our own calculations, explained in detail in Sections 3 through 5 below, we estimate that almost 15,000 job-years would be lost if Sempra's proposal is approved. So, in general terms, approving Sempra's proposed tieline would offset somewhere between one-quarter to one-third of the envisioned job benefits Secretary Salazar envisions from the 13 green-energy, utility-scale projects that were fast-tracked in January 2010.

Sections in Report: This report begins with a discussion of the issue at hand in **Section 1**. We explain the push for green-energy, electrical-generation capacity; the requirements established through California's renewable energy portfolio standards; Sempra's proposed tieline that would connect envisioned, wind-farms in Mexico dedicated or captive to the California grid; and why this proposal means that 1250 MW of green, electrical-generation capacity will not be built in the U.S.

*Approving Sempra's planned tieline connecting the California grid to a set of envisioned, captive wind-farms in Mexico would displace somewhere between 10,000 and 15,000 job-years from the American labor market.*

Because Sempra's proposed tieline would connect to the Southwest Powerlink transmission line which runs from Imperial County to San Diego County, and because Imperial County has abundant solar energy potential, we model the loss of these jobs to Mexico as a loss centered in Imperial County, California.

In **Section 2**, we provide an economic context for the analysis of job losses and tax revenue losses associated with outsourcing 10,000 to 15,000 job-years to Mexico. Lost jobs and lost tax revenues may always be regretted and typically, in reports like these, the value of jobs lost or gained is calculated simply by the amount of earnings that those jobs would have generated. But in the aftermath of the Great Recession, when the American labor market is struggling to regain employment levels attained three years ago, the economic context of jobs foregone is more salient.

The fact is that the American labor market is more deeply mired in job losses than at any time since World War Two. California, Nevada and Arizona are among the hardest hit among all the states hammered by the Great Recession. Imperial County, a place of abundant solar resources, has, at the time of this writing, the highest unemployment rate of any county in the United States, at almost 28%. Construction employment in Imperial County is half what it was when the Great Recession hit. So Section 2 underscores the meaning of job losses and job outsourcing in the context of historically extraordinarily severe troubles in the American, Californian and Imperial County labor markets.

In **Section 3**, we benchmark our estimates of the underlying data required to model and calculate job losses tied to this outsourcing. We review four other recent comparable analyses done on

three photovoltaic solar farms soon to be built in California. While Sempra proposes to tie yet-to-be-built wind-farms in Mexico to the California grid, we assume that the supplanted operation in California due to this outsourcing would be a photovoltaic solar farm. The bases for this assumption are explained in detail in Section 3.

We use these four reports as benchmarks to ensure that our assumptions regarding the direct employment of construction workers building and operating 1250 MW of photovoltaic solar capacity are moderate and well within professional practices. A key assumption that we make is that 36% of the skilled craft workers in our model of constructing solar facilities in Imperial County would be travelers from outside the county. We also assume the apprentices and laborers would come from within Imperial County, and we anticipate that building this amount of generating capacity would take 5 years and require, on average, 600 construction workers per year.

In **Section 4**, we estimate the occupational mix and wages required to build 1250 MW of photovoltaic solar power in Imperial County and calculate the average earnings for all workers on the project. We pay careful attention to crew mix and apprenticeship ratios as well as considering wage rates, benefits and payroll taxes. These are key inputs to the next section of the analysis.

In **Section 5**, we calculate the lost jobs, lost earnings and lost tax revenues associated with outsourcing 1250 MW of green electrical generating capacity to Mexico. We begin by pointing out something typically missed by other analysts. Large, long-lasting industrial construction involves apprentices as well as journeyworkers, and entails hourly contributions to apprenticeship training programs along with the usually considered hourly wages, health insurance and pension contributions.

We calculate that more than $4.5 million in human capital investment would be lost by outsourcing this work to Mexico. More than 100 apprentices that would have been trained will not be trained. For the 75 skipped-over electrical apprentices that would have been trained on this work absent outsourcing, each will lose more than $36,000 per year in foregone income due to the absence of training that otherwise would have been provided. The net present value of these lost earnings across all 75 apprentices is almost $75 million that otherwise would have been spent in Imperial County over their 40 year worklives. Imperial County, in turn, loses out on that within-county $75 million in local citizen income, consequent consumer demand and further loss in local taxes. Perhaps even more important, Imperial County will also be out 103 young, well-trained construction workers with all the support for economic development projects that such $4.5 million in human capital investment could have provided.

Section 5 follows this analysis of lost human capital investment with an analysis of lost jobs and lost tax revenues using IMPLAN and JEDI, two standard regional economic impact computer programs.[6] We show in a footnote that the JEDI and IMPLAN programs yield comparable results for California when JEDI is set to assume that no solar panels used building 1250 MW of photovoltaic electrical generation capacity are built in California. When JEDI alternatively assumes within-state supplies of solar panels, the job loss impact rises fairly dramatically. Solar panel manufacturing capacity in California is currently limited but growing. Nonetheless, the more conservative approach is to assume that solar panels are likely to be imported.

In our main analysis, we assume away this domestic solar panel supply chain effect. We provide job loss calculations separately for Imperial County, for California, and for the U.S. As the circle of potential impact widens, the job losses rise. In job-year terms, construction period job losses rise from a

bit more than 3400 lost jobs in Imperial County to over 9700 lost in California to almost 15,000 lost for the U.S. as a whole.

In addition to these construction period job losses there is the aforementioned 1000 job-year losses of operation and maintenance work after the 1250 MW solar generating capacity is put in place. Overall, for the 5-year construction period, the 15,000 job-year loss for the U.S. labor market involves a corresponding almost $300 million loss in local, state and federal tax revenues. Additional tax revenues would be lost over the 25 year period of operations after construction is completed.

These jobs and tax revenues are lost when the work building and operating 1250 MW of green electrical generating capacity in Imperial County, California is outsourced to Mexico. The proposed Sempra tieline is not just about electricity. It is also about foregone opportunities, forsaken human capital investments, lost worklives and diminished economic development prospects.

## Section 1: The Issue--Economic Losses from a Proposed Cross-Border Transmission Line Linking 1250 MW of Electrical Generating Capacity in Mexico to the California Grid

On January 8, 2010, President Barack Obama announced $2.3 billion in tax credits to stimulate the promising clean energy sector of an otherwise stagnating U.S. economy:

> The jobs numbers that were released by the Labor Department this morning are a reminder that the road to recovery is never straight, and that we have to continue to work every single day to get our economy moving again. For most Americans, and for me, that means jobs. It means whether we are putting people back to work.... Building a robust clean energy sector is how we will create the jobs of the future -- jobs that pay well and can't be outsourced....I don't want the industries that yield the jobs of tomorrow to be built overseas. I don't want the technology that will transform the way we use energy to be invented abroad. I want the United States of America to be what it has always been -- and that is a leader -- the leader when it comes to a clean energy future.
>
> **Barak Obama**, Remarks by the President on Jobs and Clean Energy Investments, January 08, 2010[7]

At the same the President proclaimed the importance of domestic clean energy jobs, and Secretary Salazar announced to Congress that 13 fast-tracked solar projects were in the pipeline, Robert Rogan, senior vice president of eSolar, a solar farm developer, said that their upcoming 92 megawatt solar facility would create 400 on-site construction jobs, 20 new permanent operation and maintenance jobs, and more new jobs created by the companies that supplied the materials for this solar-farm project. But in this hearing, Senator Kit Bond (R-Mo), ranking member on the Senate Green Jobs and the New Economy subcommittee, argued that most good jobs in utility-scale green energy construction go overseas. Senator Bond pointed out that

> First Solar [a developer of utility-scale solar farms] does most of its manufacturing in Malaysia and that eSolar imports most of its solar components from China and just signed a deal to outsource manufacturing to that country. "Don't get me wrong, I'm not critical of the companies here today," Bond said. "But at a time of great economic need for America's workers, we need proposals that will maximize the creation of jobs here in America, not in Asia, when we're talking about federal subsidies."[8]

When Interior Secretary Salazar predicted that 13 utility-scale solar construction projects would create 40,000 new American jobs, he was vulnerable to Senator Bond's criticism that some of these anticipated new jobs would be in construction-material supply-lines snaking their way to labor markets outside the U.S.[9] Senator Bond is correct in pointing out that currently most solar panels are manufactured overseas. So some of the job-creating spin-off effects from supply-chains serving the building of solar farms in the U.S. will spill over to job creation outside the U.S.[10] What did not seem possible is for the construction jobs, themselves, to spill out of the U.S. labor market. But this report is a case study of just such a prospect.

*"But at a time of great economic need for America's workers, we need proposals that will maximize the creation of jobs here in America, not in Asia, when we're talking about federal subsidies."*

*Sen. Kit Bond (R-Mo)*

In electrical generation, construction jobs can be outsourced if the electrical generation facility is built outside the U.S., and the electricity is imported onto the U.S. grid. When these American construction jobs are lost, spinoff jobs are lost too. An unemployed American construction worker buys less from local merchants, pays less in local taxes and with this diminution in local demand and local tax revenues more jobs are lost in the local private and public sectors.

This is a case study of the lost American jobs, lost local, state and federal tax revenues and diminished economic development that would occur in Imperial County, California and in the state of California, and the U.S. overall, should a proposal by San Diego Gas and Electric's parent company, Sempra, to build a 1250 megawatt (MW) transmission line across the U.S.-Mexican border be approved. The purpose of this 1250 MW tieline is to import future wind-generated electricity from Mexico into Southern California, effectively outsourcing renewable energy construction and generation. (See map of the proposed cross-border transmission tieline above in Figure 1.)

San Diego Gas & Electric (SDG&E) is obliged by California state law to have 33% of the electrical energy it provides to customers come from renewable energy sources such as geothermal, wind and solar by 2020. Given the price of renewable energy generation relative to gas-fired power plants and other traditional sources of electricity, it is unlikely that SDG&E will exceed its quota for green energy once met. In addition, 75% of the generation SDG&E procures after June 1, 2010 must come from plants connected to a California balancing area authority. In practical terms, this means that the new electrical generation capacity for California will primarily be built in California with the consequent positive local job creation and local spinoff economic development that comes with new jobs. However, as we shall see, Sempra's proposal to build a transmission line across the border to connect wind generation in Mexico to the California grid will have the effect of making a piece of Mexico part of a California balancing area authority with a consequent loss in local jobs and local economic development within California.

Most electrical generation capacity connected to a California balancing area authority is located within California, itself. There are small enclaves in rural Nevada and Arizona.[11] For our purposes, this means that almost all the people building and operating these new facilities will be spending most of their income and paying most of their state and local taxes within California. So not only will Californians and others in the United States have new jobs from building and operating these facilities, they will create new spinoff jobs in California by buying local consumer goods and services. Thus, the requirement to have 75% of new capacity within the various California balancing area authorities stimulates employment and economic development within California.

Nonetheless, Sempra's proposed transmission line coming from Mexico would connect the upcoming, dedicated-for-export-to-California, Mexican wind plant(s) to a California balancing area authority. Even though the proposed electrical generation would be in Mexico, it would all go to Southern California and all fall within the California balancing area authority oversight. Thus, technically these foreign facilities would count under the 75% California quota for new electrical generation capacity. So California would capture this Mexican wind resource, but the economic stimulus in California from building and operating this resource would, for the most part, be lost.

*There are two-fold benefits derived from California's 33% renewable energy generation and 75% domestic sourcing requirements. First, environmentally, these requirements reduce greenhouse gas emissions while second, economically, these requirements create incentives to develop domestic renewable resources, stimulate jobs, increase tax revenues and encourage local economic development. The economic channel of these two streams of domestic benefits is truncated when these green jobs are outsourced to Mexico.*

There are two-fold benefits derived from California's 33% renewable energy generation and 75% domestic sourcing requirements. First, environmentally, these requirements reduce greenhouse gas emissions while second, economically, these requirements create incentives to develop domestic renewable resources, stimulate jobs, increase tax revenues and encourage local economic development. The economic channel of these two streams of domestic benefits is truncated when these green jobs are outsourced to Mexico.

Also, while not examined in this report, building the 1250 MW of generating capacity in Mexico shifts environmental review authority from one of the world's most careful and diligent systems for considering environmental impacts associated with U.S. and California environmental regulations to a perhaps less stringent review on the Mexican side of the border.[12] As the Solar Energy Industries Association states:

> The laws and regulations governing power plants' environmental compliance in the United States, particularly in California, are among the most stringent and detailed in the world with regard to mitigating the possible impacts of such facilities on wildlife.[13]

So building 1250 MW of green energy capacity for the California grid, but having that energy come from Mexico, could substantially diminish the overall environmental benefit of this green energy capacity by placing the environmental decisions regarding how and where to build this capacity within a less rigorous Mexican regime of environmental oversight and regulation.[14]

Energía Sierra Juárez U.S. Transmission, the tieline subsidiary of Sempra Generation, proposes to connect an envisioned wind farm in Northern Baja Mexico to an existing U.S. electrical transmission line, the Southwest Powerlink, by hooking onto the California electrical grid near the border between San Diego and Imperial counties in California. This one-mile, generation tieline would have the capacity to import up to 1250 MW of renewable energy generated in Mexico by connecting this Mexican electrical generating capacity to the California grid.[15]

Sempra Generation states that "Energía Sierra Juárez is a response to environmental public-policy initiatives and increasing demands for renewable energy projects that reduce greenhouse gas emissions."[16] The key environmental public-policy that Sempra is responding to with its Energía Sierra Juárez proposal is the California Renewables Portfolio Standard:

> Established in 2002 under Senate Bill 1078 and accelerated in 2006 under Senate Bill 107, California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources by at least 1% of their retail sales annually, until they reach 20% by 2010.[17] Governor Arnold Schwarzenegger signed Executive Order (EO) S-21-09 on September 15, 2009 directing the California Air Resources Board (CARB) to adopt regulations requiring 33 percent of electricity sold in the state come from renewable energy by 2020.[18]

On April 12, 2011, California Governor Jerry Brown signed legislation that codified the 33% standard into law meaning that the Schwarzenegger executive order was here to stay.[19] San Diego Gas & Electric, recently signed two new solar power purchase agreements totaling 237 MW of generating capacity helping towards its renewable goals under the 33% standard.[20] However, SDG&E still has a considerable ways to go over the next ten years. At the time of this writing, the California Public Utilities Commission indicated that SDG&E was lagging California's other two large investor owned utilities in their current renewable procurement status. While Southern California Edison was at almost 20% renewable and Pacific Gas and Electric at almost 18%, SDG&E trailed behind at almost 12% renewables.[21] So SDG&E has a considerable path ahead in sponsoring the development of renewable energy generation capacity. The proposed development of wind farms in Mexico tied into the Southwest Powerlink which flows from Imperial County to San Diego County would be a part of the effort by SDG&E and its parent company, Sempra, to meet the 33% renewable regulation.

However, there is a zero-sum-gain with winners and losers afoot. There is a tradeoff between building renewable energy generating capacity in California and building that same capacity in Mexico if the Mexican capacity is dedicated to importing renewable energy electricity to California. Constructing 1250 MW of renewable energy generation capacity in Mexico and transmitting that power across a 1250

MW cross-border transmission tieline onto the California grid will displace 1250 MW of electrical generating capacity on the U.S. side of the border.

This tradeoff is straight forward. As noted, California utilities must source 33% of their electricity from renewable energy generation facilities by 2020. The cost of renewable energy generation as compared to natural gas-fired generation, a cheaper alternative, will keep these utilities from surpassing their required green-energy quotas. If a California utility is allowed to draw green energy from Mexico and count it towards its green energy quota, that utility will have no incentive to develop a comparable amount of green energy generation capacity in California.[1]

Currently, the most cost efficient of these green electrical power plants are geothermal and wind. The geothermal plants are particularly attractive because they continuously generate electricity while wind and solar facilities generate power when the wind blows or the Sun shines. Not all geothermal sites will be developed within California because power plants of all types must pass muster under California's strict environmental impact rules and geothermal's unique engineering challenges. But all of the technically feasible geothermal sites within California that can qualify under carefully crafted and strict environmental regulations will be built.

*There is a tradeoff between building renewable energy generating capacity in California and building that same capacity in Mexico if the Mexican capacity is dedicated to importing renewable energy electricity to California.*

However, California utilities will not be able to meet their renewable energy generation quotas with geothermal power alone. Given current technology and pricing, California utilities will also have to develop all the available wind resources in California that can also qualify under California and U.S. environmental protection regulations. And still the quotas set by recently passed law will not be met by 2020. Consequently, utilities will also need to develop California's solar resources with large and small solar energy facilities. Rooftop solar will play a role, but due to higher costs associated with lack of scale-economies, large-utility-scale solar farms will be needed also.

There are two types of large-scale solar facilities, solar thermal facilities which use mirrors to collect solar energy to create steam to drive electrical generators, and solar photovoltaic facilities which uses photovoltaic panels to gather and translate the Sun's energy directly into electricity. Given technical advances in solar panel technology and manufacturing, along with other factors causing a dramatic drop in the price of solar panels, most new solar facilities will be photovoltaic rather than thermal.

[1] Renewable electrical generation facilities include wind, solar thermal, solar photovoltaic, small hydro and geothermal power plants, along with a few other minor technologies.

If 1250 MW of renewable energy is imported from Mexico, and if California utilities are allowed to credit this energy towards their 33% renewable quota, 1250 MW of domestic California renewable energy generation capacity ***will not be built***. This domestic solar generation capacity will not be built because given the price of renewable energy versus carbon-based energy (primarily gas-fired power plants), California's utilities will not go beyond their quota for renewable energy generation set for them by California law. In short, there is a tradeoff between building renewable energy generation capacity in California and building renewable energy generation capacity in Mexico connected to the California power grid. If it is built there to be sent here, it will not be built here.

And what will not be built here by 2020 is 1250 MW of photovoltaic generation capacity. All technically feasible environmentally permitable geothermal power plants will be built. All environmentally permitable wind power farms will be built. But 1250 MW of environmentally permitable solar photovoltaic capacity will not be built in California if 1250 MW of renewable energy generation capacity is built in Mexico, credited as California renewable power and transmitted from Mexico to the California grid.

This report analyzes the jobs that will be lost if 1250 MW of green energy capacity is built in Mexico but credited as California's own domestic green energy generation capacity. This amounts to analyzing how many jobs will not be created in building 1250 MW of photovoltaic generating capacity in California. It also entails analyzing how many jobs in the supply chain and downstream consumer market will not be created if 1250 MW of photovoltaic generating capacity is not built in California. It also involves calculating all the local state and federal tax revenues that will be lost if this green generating capacity is not built domestically.

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We will assume for simplicity that this lost 1250 MW of photovoltaic generating capacity would have been built in Imperial County. This makes sense because the cross-border transmission line Sempra is proposing would tie into the Southwest Powerlink, an existing transmission line in California that connects Imperial County to San Diego. The Southwest Powerlink has the ability to transmit renewable energy from Imperial County to the San Diego metropolitan market. Our assumption also makes sense because Imperial County has abundant solar resources well above the foregone 1250 MW of photovoltaic capacity that would be lost; and Imperial County has more than enough solar resources that could qualify for permits under California's strict environmental standards.[22] Finally, it makes sense because it is the San Diego utility, San Diego Gas and Electric, and its parent company, Sempra, who want to use green electricity from Mexico to count towards their California quota of domestic green electric generating capacity. Thus, Sempra's closest alternative to its Mexican proposal is Imperial County.

# Section 2: Economic Context

This report analyzes the national, California and Imperial County economic losses from constructing and operating 1250 megawatts (MW) of new green electrical generating capacity in Mexico and sending that electricity north. Local and regional economic loss analysis typically measures the impact of lost jobs at a lost worksite in terms of foregone wages, lost tax revenues and lost spinoff jobs dependent upon the local consumer spending from the foregone wages and the foregone business spending associated the original lost jobs. This we will do.

But while new jobs are always needed and lost jobs always regretted, in the wake of the Great Recession, new jobs are needed now more than ever. So we begin by drawing the economic context within which the local economic impact analysis of 1250 MW of lost generating capacity in Imperial County will be made.

*Thus, the loss of 1250 MW of photovoltaic electrical generating capacity in Imperial County entails the loss of many fairly long-lasting construction jobs, plus the loss of careers in electrical utility operations, plus the loss of new careers for new apprentices in high-skilled, well-paid construction work, plus the loss of downstream spinoff jobs that would have been created by these lost construction and operation jobs, plus the loss of local, state and federal tax revenues that would have been generated by these lost jobs, lost careers and lost spinoff jobs.*

The Great Recession has hit the US labor market harder than any recession in the lifetime of most people living today. California has been hit harder than most states. And Imperial County has been hit as hard as or harder than any other county in the country.

**In April 2011, the latest available data at the time of this writing, Imperial County's unemployment rate was 27.9%--the highest county unemployment rate in the country.** This one-out-of-four unemployed was a substantially higher county unemployment rate than other well-known, hard-hit counties such as Miami-Dade County, Florida (13.2%), or Clark County, Nevada (Las Vegas 12.1%), or Wayne County, Michigan (Detroit, 12%), or Genesee County, Michigan (Flint, 10.8%) or Essex County, New Jersey (Newark 10.7%) .[23] So while jobs are needed everywhere, jobs in Imperial County are needed more than almost anywhere.

Three kinds of jobs would have been created by the construction and operation of a 1250 MW photovoltaic electrical generating capacity in Imperial County. The first and most obvious are about 600 annual construction jobs required to build this capacity. Most construction jobs are short-lived. These jobs would have lasted much longer than most because we estimate that it would take about five years to put in place this amount of green power.

Once built, about 40 management, operations and maintenance employees would have been required for 25 or more years to work this facility or these facilities over their expected lifetime. Currently no one photovoltaic facility in place or planned generates more than 550 MW of power. So probably more than one facility would be required to put in place 1250 MW of photovoltaic generating capacity. But because solar facility sizes have been growing exponentially in recent years, one possibility would be a single large 1250 MW solar farm.

So this solar farm or farms would have created both construction jobs and utility careers. But these solar farms would have also created construction careers.

The work made available building 1250 MW of photovoltaic capacity would finance more than $4.5 million in apprenticeship classroom training plus valuable on-the-job experience. These funds and this work would have brought more than 100 new apprentices into the Imperial County construction industry.

Once turned out as journeyworkers, these newly skilled electricians, ironworkers, piledrivers and operating engineers would have entered well-paid, high-skilled, union construction careers. Over the lifetime of their careers, each of these new journeyworkers would have earned a present value of almost $1 million per worker *more* in income than they otherwise would have earned had they not received this skill-enhancing apprenticeship training.

Thus, the loss of 1250 MW of photovoltaic electrical generating capacity in Imperial County entails the loss of many fairly long-lasting construction jobs, plus the loss of careers in electrical utility operations, plus the loss of new careers for new apprentices in high-skilled, well-paid construction work, plus the loss of downstream spinoff jobs that would have been created by these lost construction and operation jobs, plus the loss of local, state and federal tax revenues that would have been generated by these lost jobs, lost careers and lost spinoff jobs.

*All of these job and career losses are exacerbated by the aftermath of the Great Recession where job growth has been painfully sluggish and halting. Because Imperial County is one of the worst hit by the Great Recession, the proposal to outsource to Mexico 1250 MW of jobs building and operating California green energy generation rubs salt into an already gaping wound of unemployment in Imperial County.*

And all of these job and career losses are exacerbated by the aftermath of the Great Recession where job growth has been painfully sluggish and halting. Because Imperial County is one of the worst hit by the Great Recession, the proposal to outsource to Mexico 1250 MW of jobs building and operating California green energy generation rubs salt into an already gaping wound of unemployment in Imperial County. So we begin by assessing how deeply wounded is the labor market in Imperial County.

## The Great Recession and Unemployment: Imperial County among the Hardest Hit

We are in a slow recovery from the deepest jobs recession since the Great Depression. Figure 2 shows how severely the Great Recession and subsequent slow recovery have affected the U.S. labor market in comparison to previous recession since the World War Two (WWII). Starting at the upper left corner in Figure 1 at 0% job loss (and month zero shown on the horizontal axis), each colored line moving to the right represents in percentage terms, the path of job loss over the course of the downturn and recovery for each of the postwar recessions.[24]

As each line dips towards increasing percentages of job losses relative to the previous peak of employment, the US labor market shrinks. As these lines bottom out, job losses stop. As each line rises, employment begins to rebound back towards the peak established prior to that recession.

Months, shown at the bottom of the figure, tick by. Eventually, each line except for the most recent recession (in red), comes back to 0% shown as a black dashed line in Figure 2. This means that at the month where the job-loss-line crosses the dashed 0% line, the economy has regained the employment height achieved prior to that recession. These job recession/recoveries vary in length from 9 months to 47 months. The current national job recession is in its 41st month. But it is far from over.

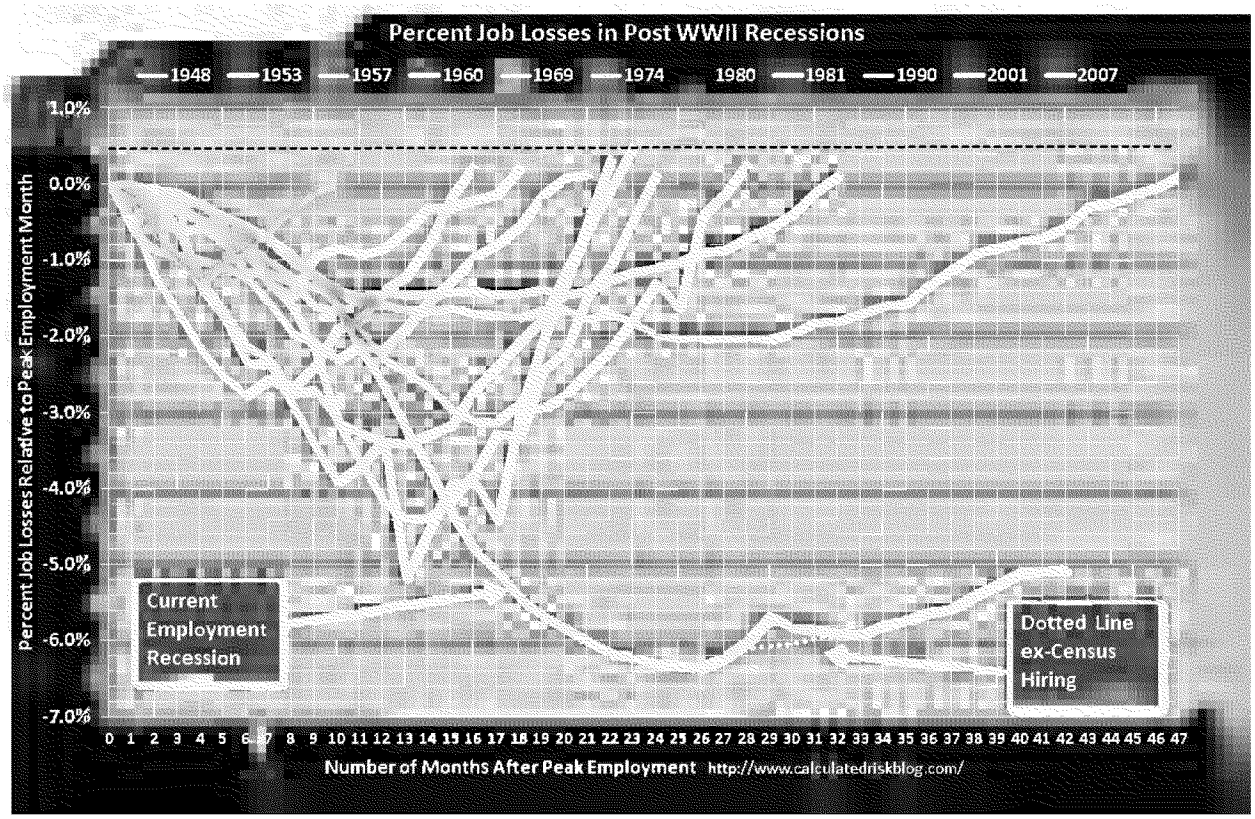



**Figure 2: : Relative impact of post-WWII recessions on total non-farm employment**

The Great Recession (in red) has brought the deepest job market losses of any recession since the Great Depression; and the Great Recession promises to last substantially longer than any other post-WWII recession before employment regains the level attained in January, 2008. We have waited three-and-one-half years for normal times to return; and a simple extrapolation of the red line shown in Figure 1 suggests that we may have two or more years yet to go.

Figure 2 based on 2010 annual average state unemployment rates, shows that among states, the labor markets in Nevada, California and Michigan have been hit the hardest by the Great Recession. As of April, 2011, Nevada's seasonally adjusted state unemployment rate was 12.5% and California's was 11.9%--the two highest state unemployment rates in the country.

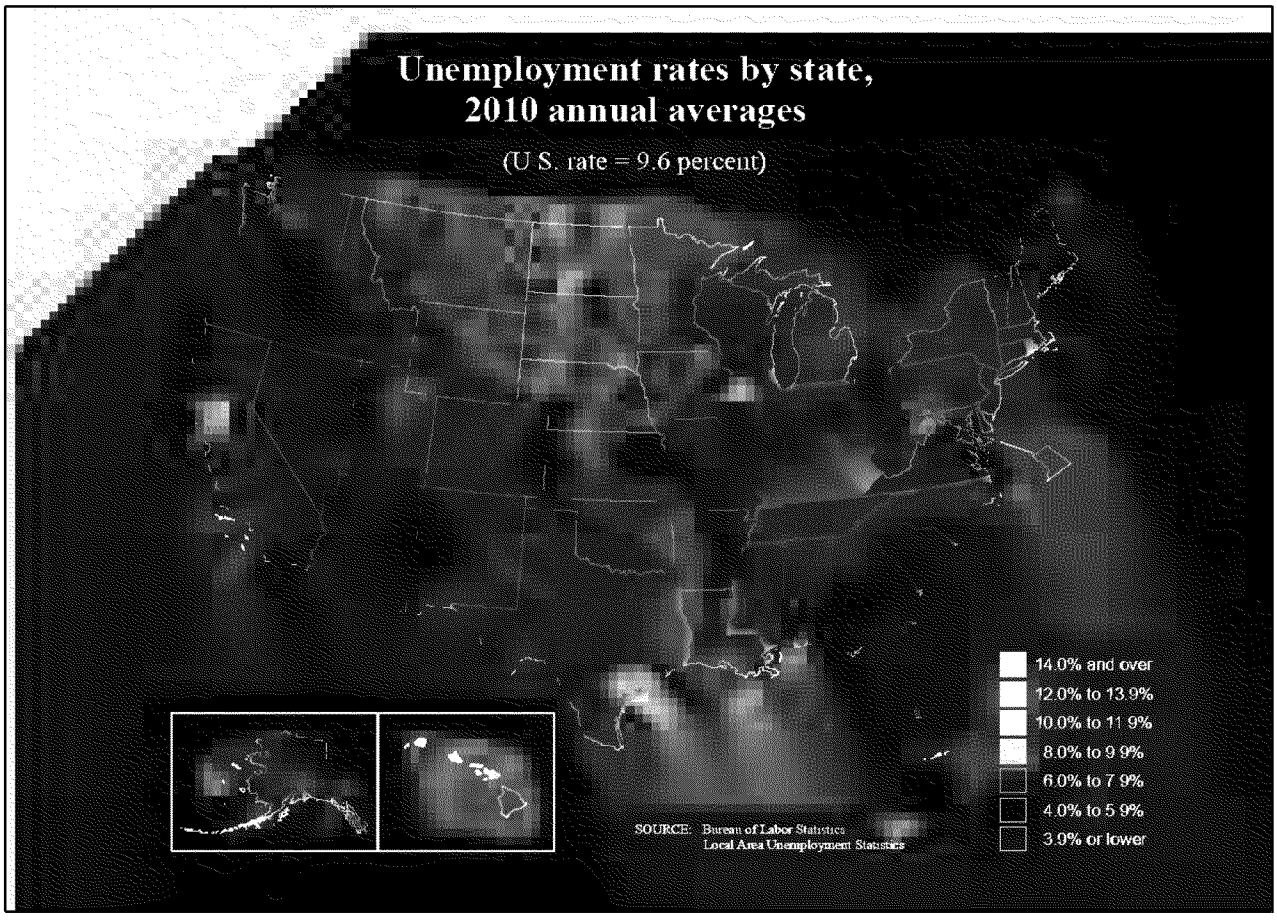



**Figure 3: Annual average unemployment rate by state, 2010**

Figure 4 shows that the unemployment rate in Imperial County, California, is among the highest in the nation.[25] However, this map understates the severity of unemployment in Imperial County because the black fill-color for Imperial County refers to unemployment rates of 14% ***and over***. Imperial County's unemployment rate is well over 14%. As mentioned, in April, 2011, Imperial County's unemployment rate was 27.9%, both the highest in California and also the highest in the country.[26]

Figure 3 *shows California's unemployment rate is among highest of any state in the nation.*

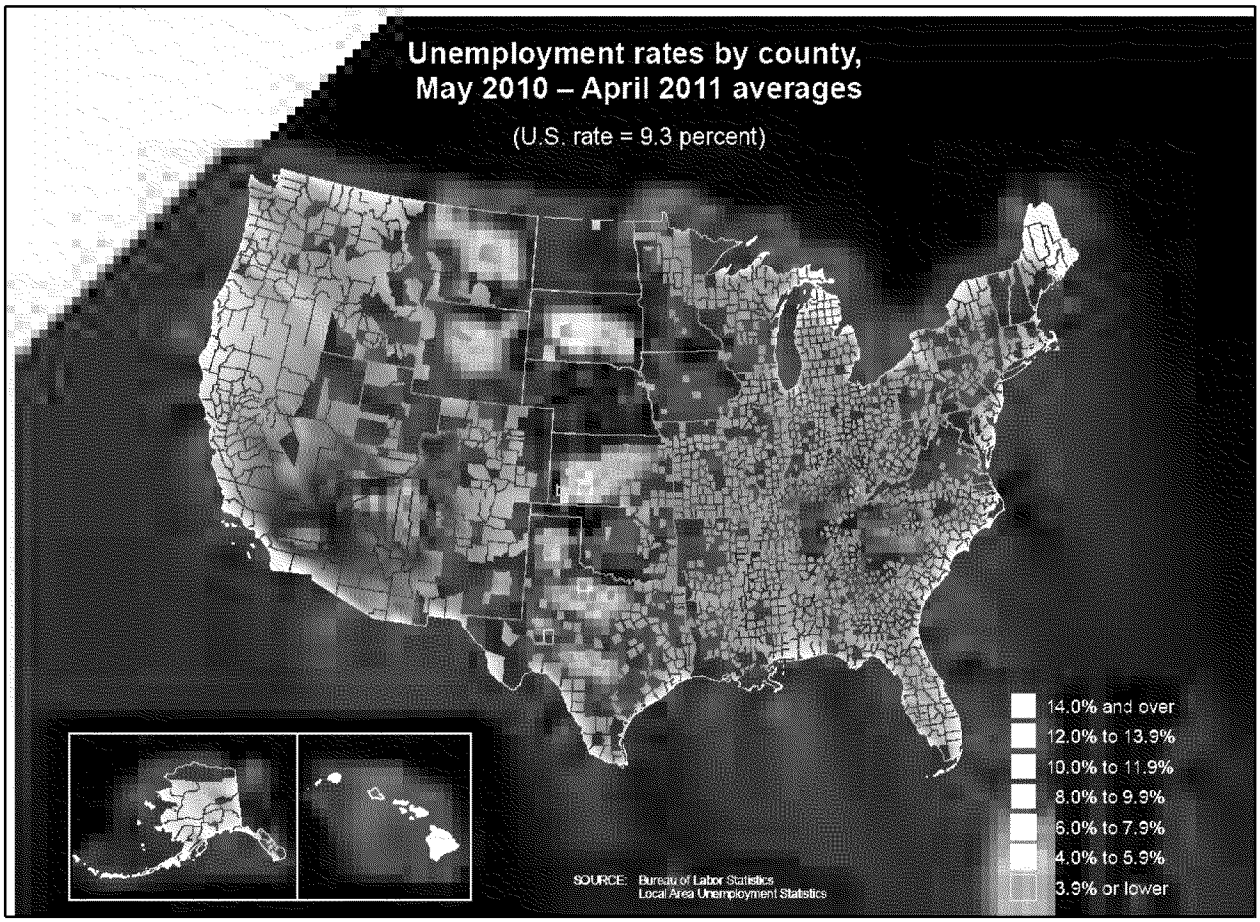



**Figure 4: Annual average unemployment rate by county, April 2010 to March 2011**

So Figure 5 uses a more sensitive scale of unemployment rates for California counties showing more precisely how dire conditions in Imperial County are. For these April, 2011 data, Imperial County has the highest unemployment rate, and Marin County has the lowest. Both of these are smaller counties and smaller counties tend to have more extreme labor market conditions. In this case, Marin County is small, well-to-do, and is avoiding the main thrust of the Great Recession while Imperial County is small, poor and receiving the full force of the economic crisis.

*Figure 4 shows Imperial County's unemployment among highest in the nation. In April 2011, it was the highest.*

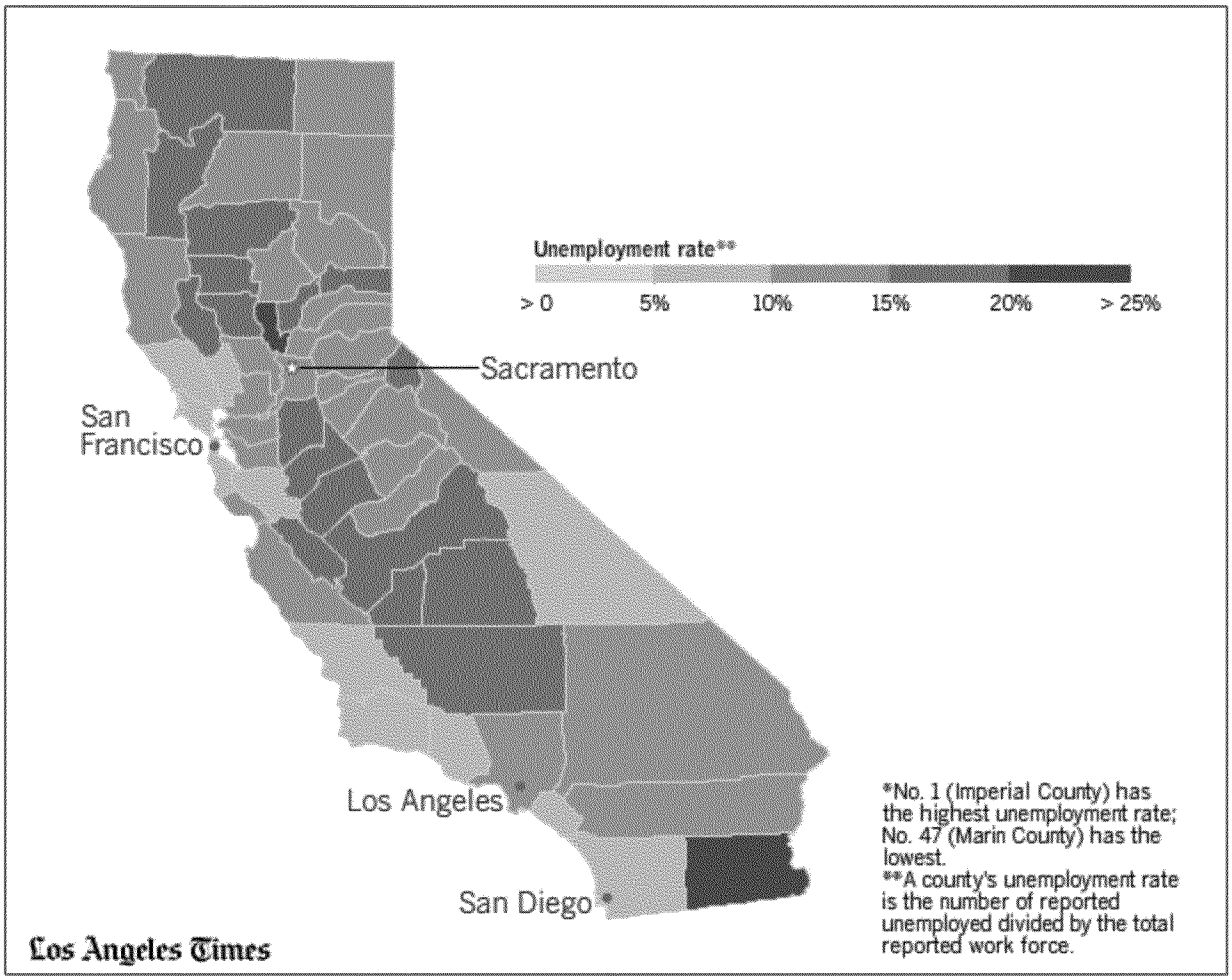



**Figure 5: Unemployment rate by county in California, May, 2011**[27]

In 2009, Imperial County had a population of 166,874.[28] There were 75,120 workers in Imperial County's labor force in April 2011. As suggested above, to some extent high local unemployment rates can be partially an artifact of small size. However, Imperial County has significantly higher unemployment than counties of similar size in California. Figure 6 shows that for 16 California counties with labor force sizes ranging between 40,000 and 150,000 in population, Imperial County has anywhere from one-third to three times higher unemployment than these comparable counties in April, 2011.[29]

*Figure 5 shows Imperial County's unemployment highest in California.*

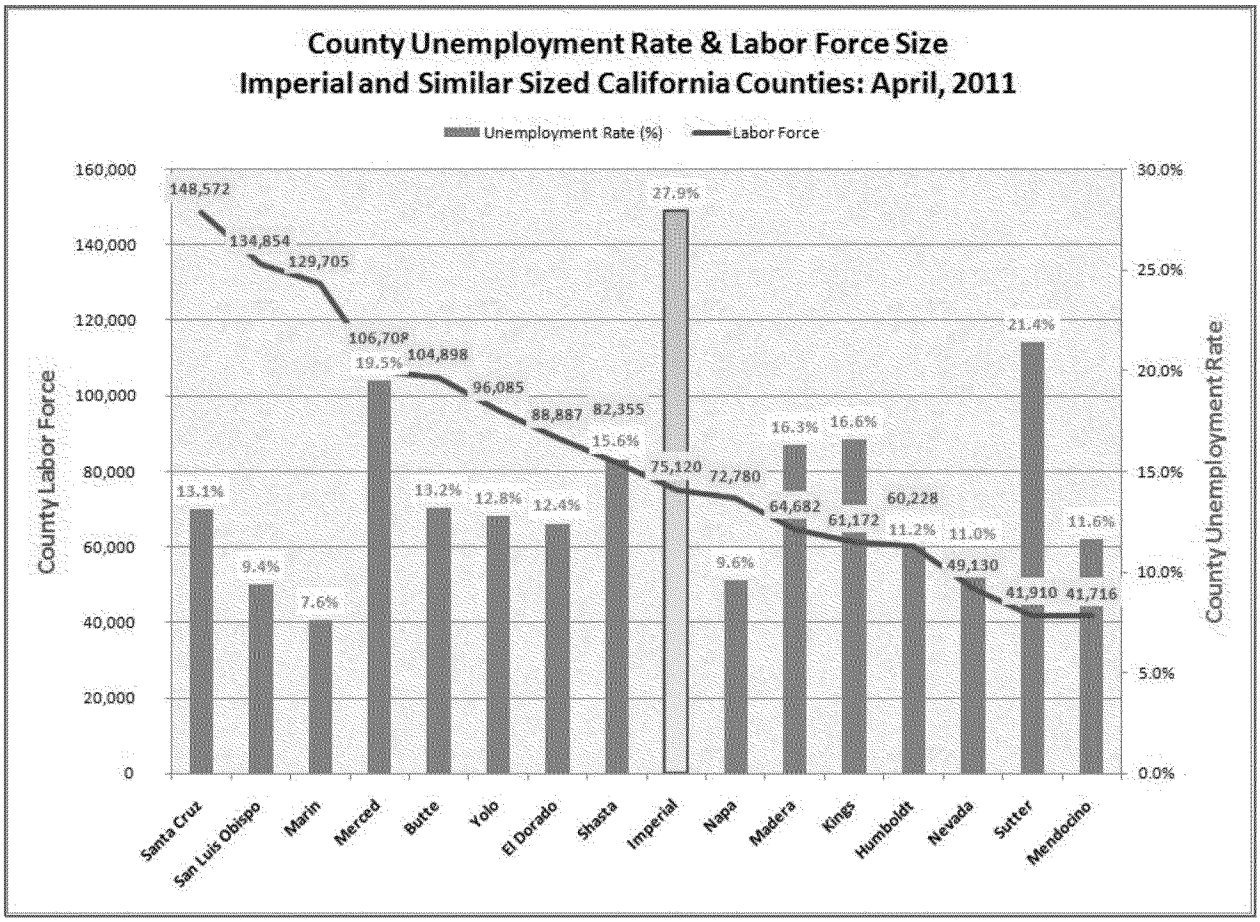



**Figure 6: Imperial County unemployment rate compared to similar sized California counties, March 2011**

Unemployment rates can also be regionally concentrated. And indeed, as mentioned, California has more than its national share of the job losses caused by the Great Recession. Nonetheless, Figure 7 shows that compared to the surrounding California counties of San Diego, San Bernardino, Riverside, Orange and Los Angeles, Imperial County's unemployment is substantially higher--more than twice as high as Los Angeles, San Bernardino and Riverside, and three times higher than Orange, and San Diego.[30] In short, the Great Recession has pounded Imperial County.

*No county in the U.S. has been hit harder by the Great Recession than has Imperial County*

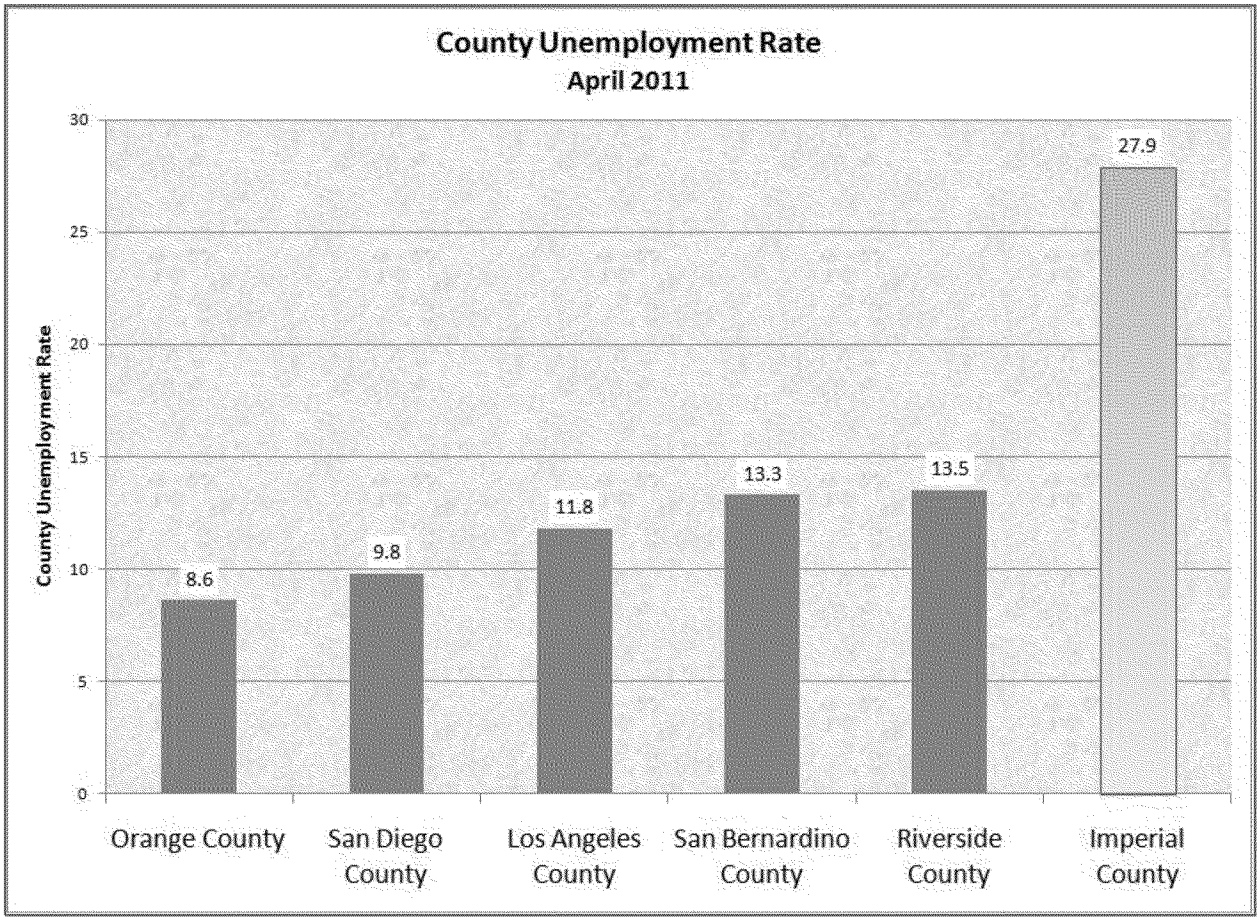



**Figure 7: March 2011 unemployment rate in Imperial and surrounding counties**

Figure 8 shows that however bad employment losses in the Great Recession look relative to previous recessions since WWII, as shown in Figure 2, things look worse when you look at California compared to the US during the Great Recession, itself.[31] The solid lines in Figure 8 are percentage losses in total employment for the US (blue), California (green) and Imperial County (red). As also seen in Figure 1, the blue solid line in Figure 8 shows that the US has lost about 6 percent of all jobs compared to an employment peak in January 2008. In contrast, California has lost about 8 percent of all its jobs since an employment peak in July, 2007 (green solid line). So California has experience one-third more job loss compared to the U.S. as a whole.

Labor market outcomes are even worse when you look at Imperial County (red solid line) compared to California. Imperial County entered the Great Recession a bit later than did the state or the country. Nonetheless, after Imperial County employment peaked in April, 2008, the County has lost about 10 percent to 15 percent of its workforce. In percentage terms, this is twice the national job loss, and at least 50% greater job loss than overall losses in California.

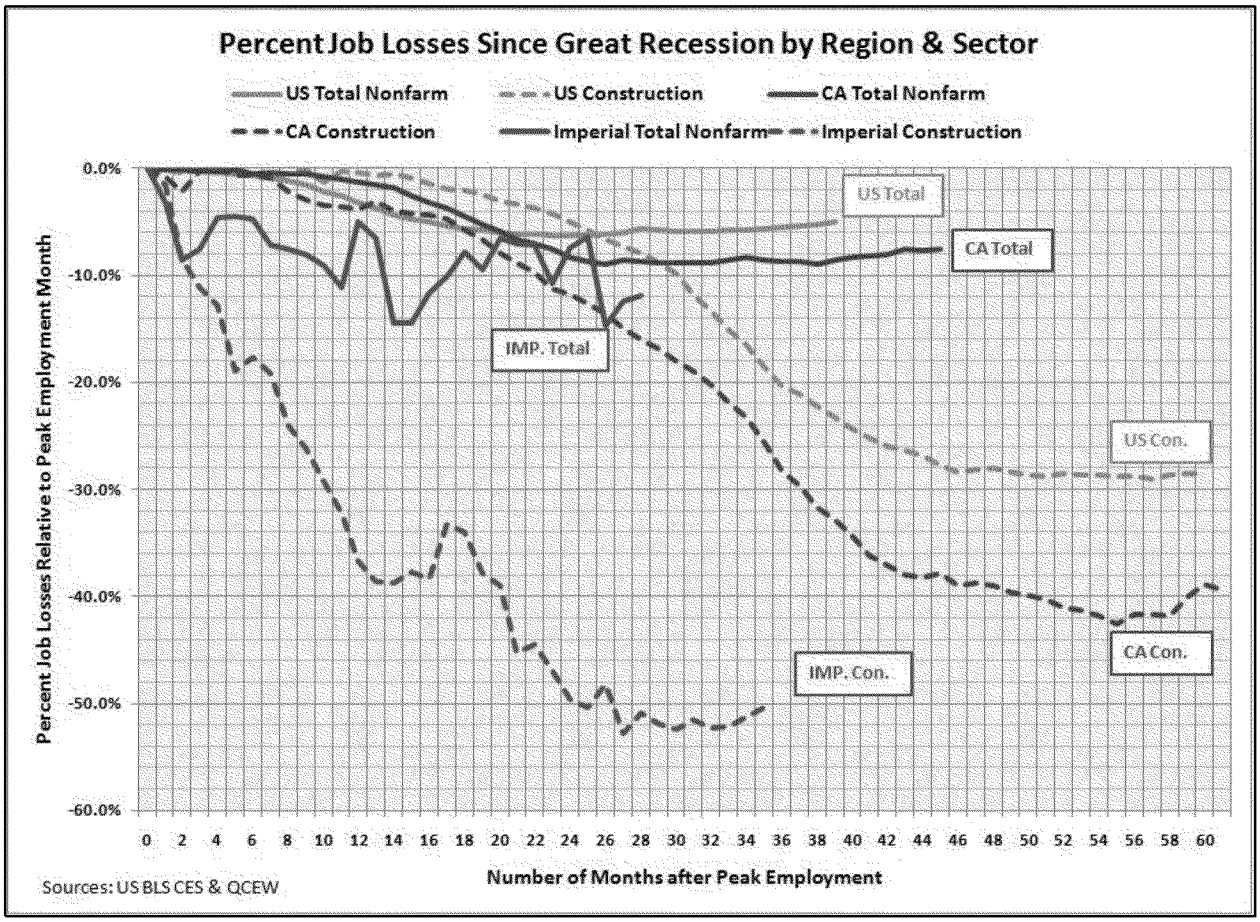



**Figure 8: Percent job losses for the US, California and Imperial County since peak employment for total and construction employment**

The story for construction, however, is much worse. In Figure 8, construction is represented by dotted lines. US construction has lost almost 30 percent of all employment since the Great Recession hit construction in April 2006 (blue dotted line). So nationally, (again in percentage terms) construction job loss is five times greater than total job losses.

California construction has lost over 40 percent of all its jobs since February 2006 (green dotted line). Imperial County construction again came late to the recession; but since October 2007, *more than 50 percent* of all Imperial County construction jobs have been lost (red dotted line). ***Thus, in percentage terms, no county in the U.S. has been hit harder by the Great Recession than has Imperial County, and ground zero for this labor market implosion has been the Imperial County construction industry.***

*Since October 2007, more than 50 percent of all Imperial County construction jobs have been lost.*

# Section 3: Benchmarking Comparable Recent Studies

Two large-scale, central-station photovoltaic solar farms are nearing construction in San Luis Obispo County, California. The 250 MW California Valley Solar Ranch and the 550 MW Topaz Solar Farm, envisioned to be built at about the same time, together amount to 800 MW of solar generating capacity. Also the 550 MW Desert Sunlight Solar Farm is nearing construction in eastern Riverside County. All of the projects have received conditional loan guarantees from the US Department of Energy.[32] The two San Luis Obispo sites have been studied by both proponents and more skeptical analysts. The eastern Riverside site has been analyzed by proponents.

We will use these studies of the prospective local economic impact of building and operating 1350 MW of photovoltaic electrical generation capacity in rural California locations to create benchmarks for our analysis of the foregone opportunities in Imperial County foreshadowed by the prospect of building 1250 MW of green electrical generation capacity in Mexico instead of Imperial County.

All estimates of future economic impact of a new project depend upon the analyst's assumptions. Analysts must make informed assumptions regarding how many workers it will take to build the project, what the workers will be paid, how much materials and other business services which are required in the building and operating of the project will be bought locally, how long it will take to build the works, how much it will cost, etc. These and other assumptions are placed into a computer model that calculates the multiple effects of an initial changes, in this case the initial change being the building and operating a photovoltaic electrical generation facility. All of the aforementioned studies have used the same computer models that we will use, IMPLAN and JEDI. So any differences in estimating local economic impact are due, primarily, to differences in assumptions.

Usually these differences in assumptions make sense--for example, one project is bigger than another so naturally analysts assume that more workers will be required to build the bigger project. Wages might be different in different locations. One project may be on an accelerated timeline involving more scheduled overtime leading the analyst on that project to assume higher annual earnings per capita on that project due to overtime earnings. As discussed below, the primary difference in results in these various reports will be due to differences in assumptions regarding how many local construction workers and how many travelers would work on these projects. Because of the importance of this assumption, we will discuss our approach in some detail below.

Differences in local impact estimates can also be due to differences in the size of the local economy. Larger local economies have more businesses, more workers and a greater ability to meet the needs of a new project with local labor, supplies and services. Being able to meet the new needs locally creates more spinoff jobs in the local economy. San Luis Obispo County is a small county with about 270,000 people. Riverside is a much larger county with almost 2.2 million people. So when "local" means "county," a solar farm placed in Riverside County (albeit in eastern Riverside County) will purchase more labor and business services" locally" (i.e. within the county) compared to a comparably sized solar farm in a smaller county such as San Luis Obispo County or Imperial County which has a population of about 170,000 people. San Diego County would likely supply Imperial County in ways similar to the urban part of Riverside County supplying eastern Riverside County.

Indeed, large solar farms are not going to be placed in heavily populated areas with well established supply chains. Eastern Riverside County is really very similar to Imperial and San Luis Obispo counties. To some extent, what we call "local" is an artifact of the way data are collected on a county-by-county basis. In California, solar farms will be placed in rural counties such as Imperial and San Luis Obispo or in rural segments of more populated counties such as Riverside and San Bernardino.

One of the truly promising aspects of the green-power-generation initiative in California is that it promises to bring jobs to many of these rural areas. These large facilities can help provide an engine for rural economic growth creating denser economic development that in turn feeds on itself as these counties or rural segments of counties gain a greater economic foundation to meet more of their own local needs.

In any case, we review these four previous studies in order to provide benchmarks for judging our assumptions and conclusions regarding the local economic impact of building a 1250 MW photovoltaic electrical generating capacity in Imperial County. Because these three projects have been closely evaluated by others for their local economic impact, and because San Luis Obispo, Riverside and Imperial Counties are economically, geographically and/or demographically similar, we will compare our assumptions and conclusions to these four studies of three projects to help evaluate our conclusions regarding the loss of employment and wages associated with not building and operating 1250 MW of solar generating capacity in Imperial County.

*We will compare our assumptions and conclusions to these recent four studies of three other California solar farms to help evaluate our conclusions regarding the loss of employment and wages associated with not building and operating 1250 MW of solar generating capacity in Imperial County.*

## The California Valley Solar Ranch (CVSR)

Of the three projects reviewed here, the 250 MW California Valley Solar Ranch Project (CVSR) may be closest to ground breaking. This project envisions building a 250 MW solar photovoltaic power plant at a cost of $450 million in California Valley, San Luis Obispo County, California. This planned facility is in the pre-construction phase, expects to break ground in the third quarter of 2011,[33] anticipates 32 months of construction employing 681 full-time-equivalent (FTE) job-years worth of workers.[34]

We have a schedule of anticipated employment by month and craft for this project which allows us to describe the project's force curve and crew mix. Because an individual worker may work only part of the year on this project and be replaced by another for the remainder of the year, we need a standard unit to describe a "job." Following a standard convention in regional impact analysis, we define an "FTE job-year" as 2080 hours of work done by one worker or some combination of several workers replacing each other over the course of the 2080 hours which is 52 weeks times 40 hours per week. Figure 9 uses the percent of total hours anticipated for this facility to show how the project would ramp up over the first ten months of construction, run fairly steady for the next two years, and then finish off over a two month period of slower final-completion work.[35] This is a typical construction force curve for this size and type of project.

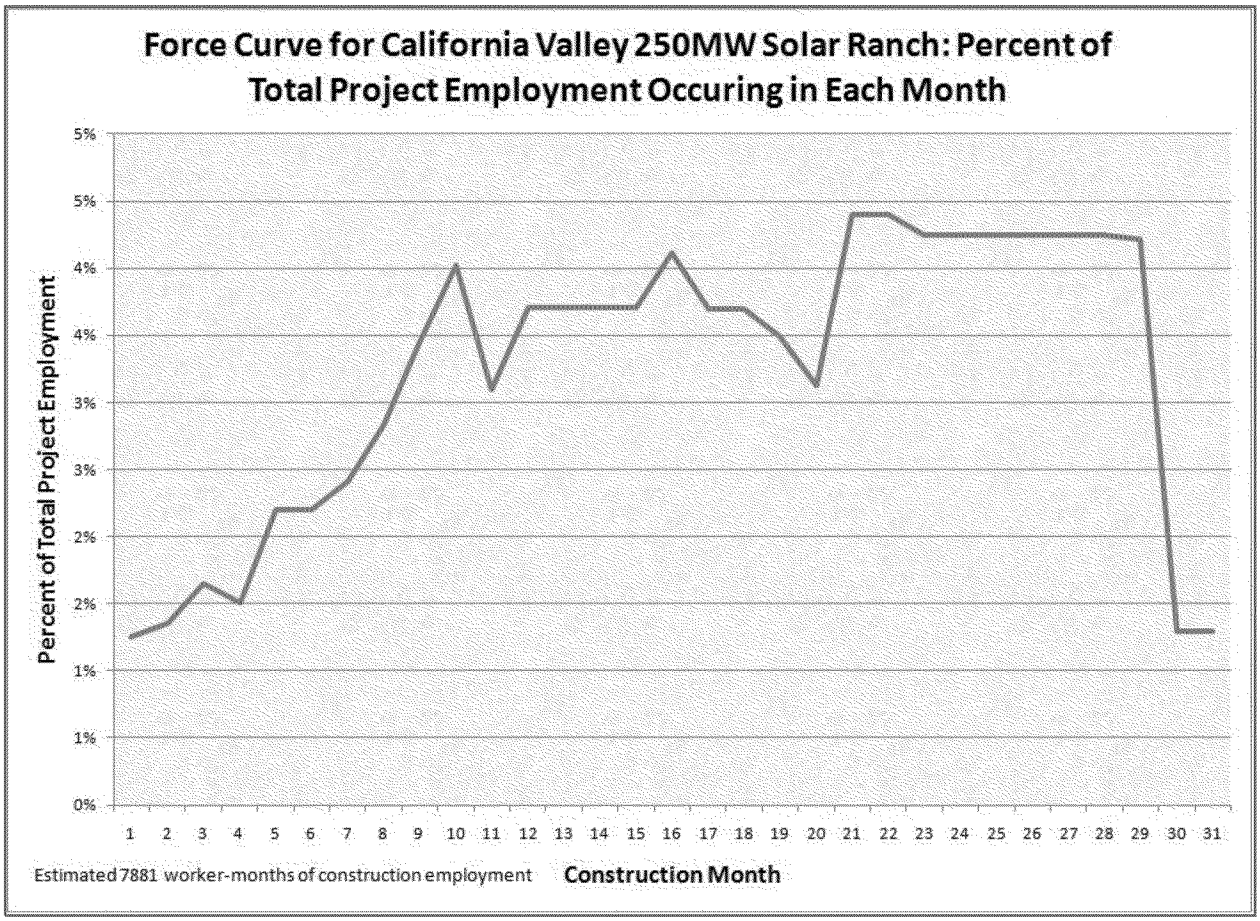



**Figure 9: California Valley 250 MW Solar Ranch Force Curve**

Figure 10 shows the distribution of work across craft occupations and administrative/professional workers on the project. Electricians account for just over 40% of the work while laborers and ironworkers together account for about 35% of the hours on the project. Piledrivers, operating engineers and carpenters together account for about 11% of the hours while administrators, professional, security and other personnel also account for about 11% of the hours on the job. In our own analysis, we will use this crew mix to help calculate the average wage on project like these based on wage rates by occupation in Imperial County.

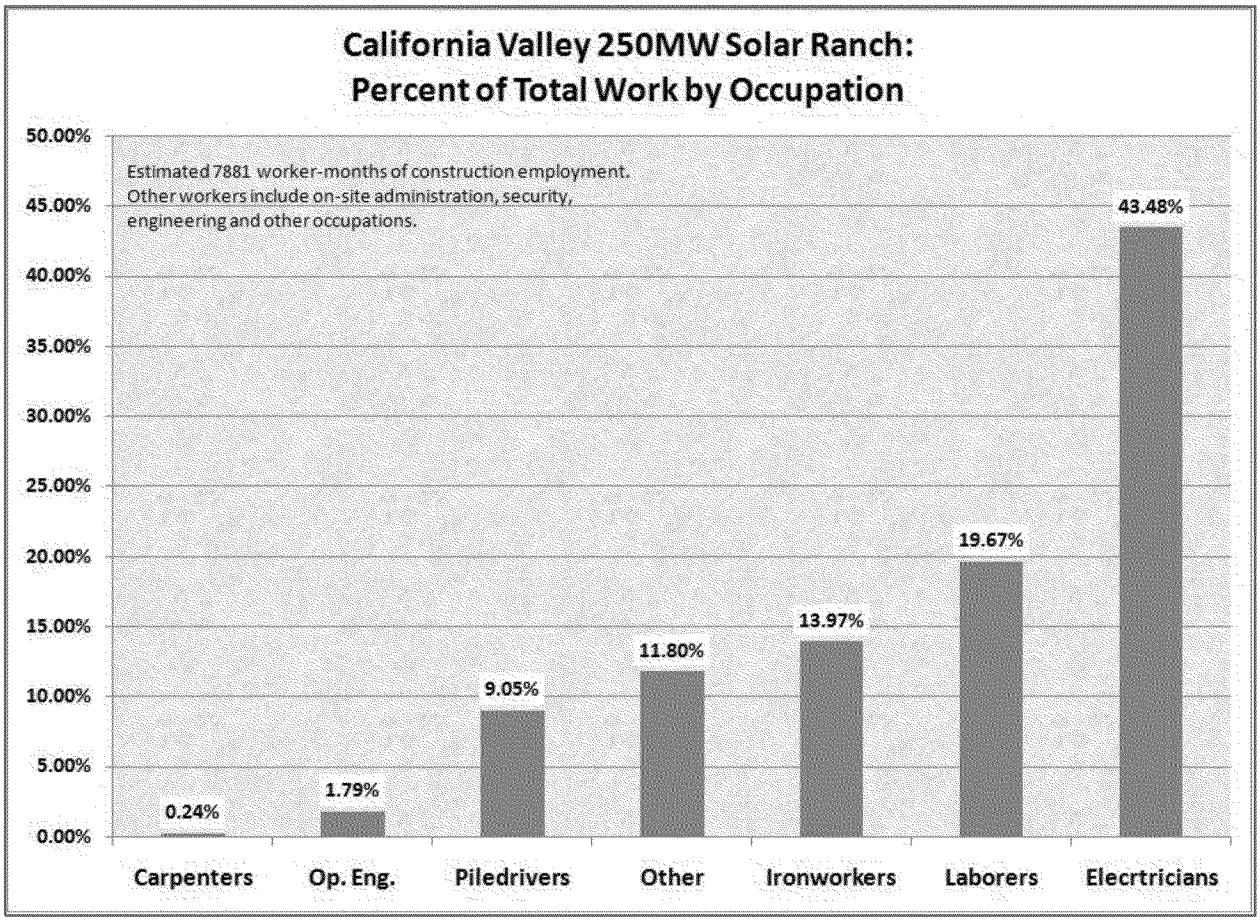



**Figure 10: California Valley 250 MW Solar Ranch Occupational Composition (crew mix)**

Thus, on a large-scale photovoltaic solar project, we can expect a ramp-up period followed by fairly steady construction with a fairly brief wrap-up period prior to completion. Electricians will be the predominant craft on the project installing the solar panels. Operating engineers will do the initial dirt work of preparing the site. Ironworkers and piledrivers will set up the foundations. The "other" category is primarily administrative, engineering and supervisory personnel. We will use this information below to estimate the number and types of apprentices on this type of work as well as to help us calculate the number of local workers as opposed to traveling construction workers who will be found on this type of project. As mentioned, this information will also help us calculate an average wage across occupations.

## Four Economic Impact Reports

We have four economic impact reports covering three photovoltaic solar projects to review. **i)** As part of the Environmental Impact Report (EIR) for the California Valley Solar Ranch project, Stephen F. Hamilton, Chair of the Economics Department at California Polytechnic State University at San Luis Obispo along with Darin Smith and Tepa Banda of Economic & Planning Systems, Inc., released a study of the local employment and fiscal impact of the CVSR in December, 2010. **ii)** Stephen Hamilton again, along with Mark Berkman of the Brattle Group released a similar report for the nearby Topaz Solar Farm in March, 2011. **iii)** In January, 2011, the Aspen Group, also as a part of the CVSR EIR, released a study

that combined the impacts of CVST and Topaz together because these two projects would occur in the same county at approximately the same time.[36] **iv)** Finally, in May of 2011, Wesley Ahlgren of the Coachella Valley Economic Partnership and Mark Berkman of the Brattle Group released an economic impact study of the Desert Sunlight Solar Farm to be built in eastern Riverside County.

Thus, at the time of this writing, over the space of the previous seven months, four reports covering three large photovoltaic solar farms projected for two counties, and ranging in nameplate capacity from 250 MW to 550 MW to a combined 800 MW, have been released. The three projects collectively account for 1350 MW of photovoltaic electrical generation capacity. The authors drew information from the developers, SunPower and First Solar, upon which they based their a) local input purchase, b) employment and c) wage assumptions. In one case, the Aspen Group provided two sets of wage assumptions, one based on the builder's information and another based on state wage surveys. In all cases, a time frame for construction and operation came from the developers.

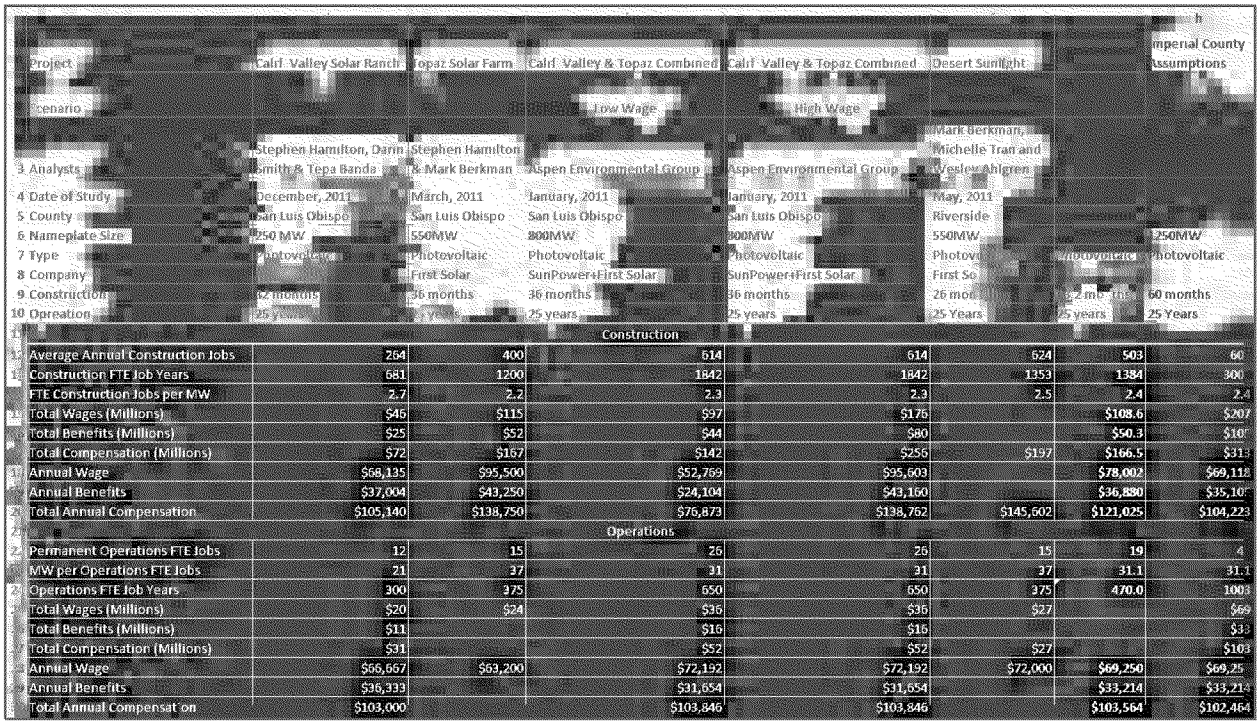
In terms of perspective, three reports were done in association with the developer while the Aspen Group's report was done on behalf of the County for the EIR. So three might be more optimistic regarding the beneficial impacts of these projects and Aspen might be somewhat more skeptical.

*In terms of perspective, three reports were done in association with each project's developer while the Aspen Group's report was done on behalf of the County for the EIR. So three might be more optimistic regarding the beneficial impacts of these projects and the fourth might be somewhat more skeptical.*

Table 1 shows many of the relevant assumptions used by these various analysts to assess the economic and fiscal impacts of building these three photovoltaic projects in the near future. In column b, for the 250 MW California Valley Solar Ranch in San Luis Obispo County, based on information provided by SunPower, Hamilton, Smith and Banda assumed the construction project would last 32 months; on average 264 FTE construction, supervisory, on-site engineering and other personnel would be employed annually. On average, these workers would earn $68,135 per year in wages and an additional $37,004 in benefits. Over the 32 months of expected construction, these 264 FTE jobs would amount to 681 FTE job-years. Total wages from these new jobs would amount to $72 million in new wages (681 times $68,135) and total benefits would add up to an additional $25.2 million (681 times $37,004).[37]

Hamilton, Smith and Banda do not explicitly consider overtime wages that may be earned on this project. Recall an FTE job-year is 2080 hours of work (40 hours per week times 52 weeks). Using FTE jobs is standard for this kind of analysis and all the reports under review use this concept. However, this approach assumes away the possibility of overtime. Overtime is not uncommon in industrial construction, particularly when a contractor is seeking to accelerate towards the project's final completion, or the contractor at various points in the construction process tries to avoid bottlenecks along the critical path by using overtime to complete strategic tasks. Furthermore, contractors intending to accelerate construction from the outset may include scheduled overtime in their initial planning. While overtime is common in industrial construction, it is often ignored in analyses like the ones under review here.[38] Following this custom, we will ignore the possibility of overtime in our estimates of economic impact as well.

**Table 1: Analysts assumptions for various photovoltaic solar projects in San Luis Obispo and Riverside counties and assumptions for Imperial County[39]**



| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| 1 Project | Calif. Valley Solar Ranch | Topaz Solar Farm | Calif. Valley & Topaz Combined | Calif. Valley & Topaz Combined | Desert Sunlight | | | Imperial County Assumptions |
| 2 Scenario | | | Low Wage | High Wage | | | | |
| 3 Analysts | Stephen Hamilton, Darin Smith & Tepa Banda | Stephen Hamilton & Mark Berkman | Aspen Environmental Group | Aspen Environmental Group | Mark Berkman, Michelle Tran and Wesley Ahlgren | | | |
| 4 Date of Study | December, 2011 | March, 2011 | January, 2011 | January, 2011 | May, 2011 | | | |
| 5 County | San Luis Obispo | San Luis Obispo | San Luis Obispo | San Luis Obispo | Riverside | | | |
| 6 Nameplate Size | 250 MW | 550MW | 800MW | 800MW | 550MW | | | 250MW |
| 7 Type | Photovoltaic | Photovoltaic | Photovoltaic | Photovoltaic | Photovo | | w/photothermal | Photovoltaic |
| 8 Company | | First Solar | SunPower+First Solar | SunPower+First Solar | First So | | | |
| 9 Construction | 12 months | 36 months | 36 months | 36 months | 26 mon | | 12 months | 60 months |
| 10 Operation | 25 years | Ye | 25 years | 25 years | 25 Years | | 25 years | 25 Years |
| 11 | | | Construction | | | | | |
| 12 Average Annual Construction Jobs | 264 | 400 | 614 | 614 | 624 | 503 | | 60 |
| 13 Construction FTE Job Years | 681 | 1200 | 1842 | 1842 | 1353 | 1384 | | 300 |
| 14 FTE Construction Jobs per MW | 2.7 | 2.2 | 2.3 | 2.3 | 2.5 | 2.4 | | 2.4 |
| 15 Total Wages (Millions) | $45 | $115 | $97 | $176 | | $108.6 | | $207 |
| 16 Total Benefits (Millions) | $25 | $52 | $44 | $80 | | $50.3 | | $10 |
| 17 Total Compensation (Millions) | $72 | $167 | $142 | $256 | $197 | $166.5 | | $31 |
| 18 Annual Wage | $68,135 | $95,500 | $52,769 | $95,603 | | $78,002 | | $69,118 |
| 19 Annual Benefits | $37,004 | $43,250 | $24,104 | $43,160 | | $36,880 | | $35,10 |
| 20 Total Annual Compensation | $105,140 | $138,750 | $76,873 | $138,762 | $145,602 | $121,025 | | $104,223 |
| 21 | | | Operations | | | | | |
| 22 Permanent Operations FTE Jobs | 12 | 15 | 26 | 26 | 15 | 19 | | 4 |
| 23 MW per Operations FTE Jobs | 21 | 37 | 31 | 31 | 37 | 31.1 | | 31.1 |
| 24 Operations FTE Job Years | 300 | 375 | 650 | 650 | 375 | 470.0 | | 1003 |
| 25 Total Wages (Millions) | $20 | $24 | $36 | $36 | $27 | | | $69 |
| 26 Total Benefits (Millions) | $11 | | $16 | $16 | | | | $33 |
| 27 Total Compensation (Millions) | $31 | | $52 | $52 | $27 | | | $103 |
| 28 Annual Wage | $66,667 | $63,200 | $72,192 | $72,192 | $72,000 | $69,250 | | $69,25 |
| 29 Annual Benefits | $36,333 | | $31,654 | $31,654 | | $33,214 | | $33,214 |
| 30 Total Annual Compensat on | $103,000 | | $103,846 | $103,846 | | $103,564 | | $102,464 |

Notes for column h, Table 1:

- total FTE construction-job-years=3000=1250 MW* 2.4 job-years per MW;
- annual construction jobs = (total FTE construction job-years)/(5 years);
- average annual construction wage income =average hourly wage rate*annual hours worked= $33.23*2080 (see below for derivation of hourly wage rate);
- for average construction annual benefits plus payroll taxes see Table 5 and its discussion below;
- average annual permanent operation jobs = 40=1250 MW/31.1 where 31.1=average MW per operation job on other projects;
- operation job_years=1003=40*25 years;
- operation average annual wage income=average for other projects in Table 1
- operation average annual benefits= average for other projects in Table 1
- total annual compensation including payroll taxes=annual wages+benefits
- total wages (millions)=annual average wage*FTE job_years
- total benefits (millions)=annual average wage*total FTE job_years

In addition to these 264 construction workers and 681 construction job-years in column b for CVSR, Hamilton, Smith and Banda assumed that there would be 12 permanent FTE jobs operating and maintaining the 250 MW facility after it was constructed; they assumed a 25-year worklife for the facility, thus creating 300FTE operation and maintenance job-years over the life of the facility (12 jobs times 25 years). On this project, Hamilton, Smith and Banda assumed that operation and maintenance workers would receive, on average, $66,667 in wages (in today's dollars), $36,333 in benefits (including payroll taxes) for an annual total compensation of $103,000. Over 25 years, these new jobs would inject into the economy $20 million in wages (300 FTE job-years times $66,667) and $11 million in benefits (300 FTE job-years times $36,333) for a total of $31 million in new dollars from new jobs.[40]

Hamilton, Smith and Banda do not consider how many of the construction workers on this project would be new apprentices. Nor do they consider the economic impact over their career of apprentices becoming journeyworkers, gaining new skills and earning more than they otherwise would have if the opportunities of investment in training not been created by this facility. Thus, while we will see that in other ways this Hamilton, Smith and Banda study is perhaps the most optimistic among the reports under review, on this key issue of human capital formation, these optimists understate one of the key benefits of the CVSR project. The benefit of substantial human capital investment in a local apprentice on a project such as this is both immediate and lifelong. And it is a benefit that accrues not only the apprentice-turned-journeyworker but also to the community that enjoys the long term economic development advantages of more human capital in their labor market and more spending over a lifetime in their consumer market.[41]

In column c of Table 1, for the Topaz project in San Luis Obispo County, Hamilton plus Berkman of the Brattle Group (Berkman will be involved in the Riverside study), based on information from First Solar, assume an annual average of 400 construction workers over 36 months are required to build this 550W solar facility. This amounts to 1200 FTE job-years over 36 months with average annual wages of $95,000 and benefits of $43,250. These jobs would inject $167 million in wages into the local economy which they define as San Luis Obispo plus adjacent Kern counties. Defining the local area larger allows for more workers to be "local" and more supplies to be provided "locally" resulting in a larger local impact. We will see this difference in our own work below when we compare the loss associated with not building 1250 MW of green electrical generating capacity in Imperial County to the wider loss experienced by the overall California economy from that same initial failure to build this capacity within the state.

*Thus, in looking at the consequences of building 1250 MW of green electrical generating capacity in Mexico, as we lift our gaze from analyzing the resulting loss for Imperial County, to the loss for California, to the loss for the U.S. as a whole, not building and operating in Imperial County has a greater and greater negative impact in terms of lost spinoff jobs. All of these lost jobs, in turn, mean greater lost tax revenues not only at the local level, but also at the California state level, and ultimately in other states as well and at the national level.*

Larger economic regions have longer supply chains and denser consumer markets allowing for greater spinoff benefits from an initial new economic activity. In these studies under review, the question posed is how will the new facility they are considering benefit the local county or region in which the facility is located compared to building this facility somewhere else in California? In our case, it is not a matter of building somewhere else in California or even somewhere else in the United States: the Sempra proposed alternative in our case is building in Mexico.

Consequently, the loss associated with approving the Sempra tieline and importing dedicated-for-export green-energy from Mexico is a loss not only for Imperial County, nor only for California, but also for the U.S. as a whole. As we move our perspective from the county to the state to the nation, supply lines and consumer services lengthen and deepen. As we expand our geographic scope, there simply are more Americans out there standing ready to meet the new supply-chain demands for building this green capacity in Imperial County and meet the consumer-chain demands of workers with new money to spend.

Thus, in looking at the consequences of building 1250 MW of green electrical generating capacity in Mexico, as we lift our gaze from analyzing the resulting loss for Imperial County, to the loss for California, to the loss for the U.S. as a whole, not building and operating in Imperial County has a greater and greater negative impact in terms of lost spinoff jobs. All of these lost jobs, in turn, mean greater lost tax revenues not only at the local level, but also at the California state level, and ultimately in other states as well and at the national level.

Returning to Hamilton and Berkman's analysis of the 550 MW Topaz project, they assumed 15 operation and maintenance FTE-jobs per year over 25 years with an annual average wage of $63,200. Hamilton and Berkman do not provide an assumption regarding operation workers' benefits. Similarly, in column f for the Desert Sunlight project in Riverside County, Berkman along with Tran and Ahlgren again do not provide a benefit estimate for operation personnel.

While in some respects, the two Berkman reports are the more optimistic of the four reports under review, this assumption of zero benefits and no payroll taxes for operator and maintenance workers downplays the positive benefits of these new facilities.

The CVSR and Topaz studies were based on information from two separate developers, SunPower and First Solar. These two developers provided substantially different construction worker average, annual, FTE total compensation including payroll taxes. SunPower indicated a total compensation of $105,140 while First Solar planned for $138,750 in total compensation. It appears that First Solar was planning to schedule substantial overtime due to the fact that it planned to build a larger 550 MW Topaz project in about the same time as the 250 MW CVSR project with only some additional workers. The CVSR project assumes 32 months to put in place 250 MW while the Topaz project assumes only 4 additional months to put in more than twice the nameplate capacity (550 MW vs. 250 MW) with only half again more workers (400 vs. 264). So the total compensation discrepancy between these two projects is probably due to differences in scheduled overtime on the bigger Topaz project.

The Aspen Environmental Group was asked to provide a separate assessment of the economic and fiscal impact of the CVSR project. Aspen chose, in part, to combine CVSR with Topaz in order to get a sense of what the full impact of 800 MW of photovoltaic solar construction scheduled for about the same time in about the same location would be on the local economy.[42] Reflecting a more conservative approach, Aspen defined "local" as San Luis Obispo County excluding Kern or other adjoining counties.

Aspen also presents a low-wage scenario (column d) with wages based on government wage survey data and a high wage scenario (column e) based on First Solar data. Aspen's low-wage scenario is naïve for two reasons.

First, typically government surveys of construction wages yield average wages lower than the wages paid on industrial construction. This is because government surveys include both industrial and residential construction workers in the same average wage. Because industrial construction requires greater skills than residential construction, averaging the two sets of wages puts apples and oranges together yielding an estimated wage lower than those prevailing on industrial construction projects. Second, in the case of the CVSR project, a project labor agreement has been signed based on wages reflecting industrial construction wage rates and not the lower average wage rates of government surveys which meld residential and industrial wages together.

Aspen's presentation of this low-wage scenario reflects its skeptical or conservative stance relative to the more optimistic reports under review. But in this instance, Aspen's skepticism may not be warranted because its low wage scenario relies on surveys that are not particularly germane to this type of construction work.

In any case, Aspen assumes 1842 FTE job-years in both their high-wage and low-wage scenarios for the two CVSR and Topaz projects taken together. This is very close to the assumptions of the other analysts in considering each job separately (681+1200=1881 FTE job-years). The Aspen low-wage scenario is only a low-wage scenario for construction workers. They have only one estimate of total compensation for maintenance and operations personnel and their estimate of operator compensation estimate is very much in line with those of the other reports at about $103,000 per year including benefits and payroll taxes.

Berkman, Tran and Ahlgren (column f) analyze the impact of the 550 MW Desert Sunlight project in eastern Riverside County. They assume 1353 FTE job-years to put this facility into place over 26 months.[43] The San Luis Obispo Topaz and Riverside Desert Sunlight projects are both 550 MW jobs. They are roughly comparable in expected construction FTE job-years (1200 over 36 months for Topaz vs. 1311 jobs over 26 months for Desert Sunlight). The higher Desert Sunlight construction FTE manpower requirements may be due to the planned accelerated schedule (26 vs. 36 months). Differences in planned overtime probably explains the differences in construction worker total compensation estimates across all three projects--Desert Sunlight with the fastest schedule ($145,602) vs. Topaz with a slower schedule but fewer workers per megawatt ($138,750) vs. the smaller CVSR project ($105,140) with a slower schedule and more planned workers per megawatt.

Developers and contractors on large industrial projects sometimes have strong economic interests in accelerating construction to get to market faster even if it means a considerable increase in construction labor costs either through scheduled overtime or overmanning the job. Much of the variation in total compensation for construction workers found in Table 1 may well reflect variations in developer/contractor strategies regarding the use of overtime in building the project. Both 550 MW projects (Topaz and Desert Sunlight) assume a 25 year life with 15 operators annually employed.

We will return to Table 1 later to compare our assumptions to these previous reports. We will be seeking a middle ground between the more conservative Aspen approach and the more optimistic approaches of the other reports.

# Section 4: Estimating Employment and Earnings

## Hourly Compensation Assumptions for Imperial County

In our analysis, we will use the prevailing wages and benefits for construction crafts in Imperial County as the basis for calculating construction worker earnings in the building of photovoltaic solar capacity there. Table 2 shows the hourly wage rate, health, pension, vacation and apprenticeship training contributions for the various construction trades typically found building photovoltaic electrical generation utility construction projects. (See Figure 10). The apprenticeship hourly wage rate in Table 2 is set at 60% of the journeyworker hourly wage rate reflecting a mixture of beginning and advanced apprenticeship wage rates. (Apprentices start out at 40% or 50% of the journeyworker wage, and this percentage rises as the apprentice works towards graduation.) At 2080 hours, annual wage income for

these crafts runs between $54,371 (laborers) to $77,688 (carpenters). These wage incomes do not assume any overtime and fall within the range of wage incomes shown for the other analysts' reports in Table 1 some of which may include scheduled overtime earnings.

**Table 2: Hourly wage rates, benefits and training contributions by craft, Imperial County**[44]

| | Journey worker hourly wage | Apprentice hourly wage (=60% journeyworker) | Health | Pension | Vacation | Training | Total Compensation except Pension | Apprentice Total Compensation except Pension |
|---|---|---|---|---|---|---|---|---|
| Laborer | $26.14 | | $5.76 | $4.60 | $2.42 | $0.64 | $39.56 | |
| Electrician | $36.65 | $21.99 | $6.48 | $4.35 | $0.00 | $0.86 | $48.34 | $33.68 |
| Piledriver | $37.28 | $22.37 | $3.95 | $3.41 | $3.30 | $0.42 | $48.36 | $33.45 |
| Carpenter | $37.35 | $22.41 | $3.95 | $3.41 | $3.30 | $0.42 | $48.43 | $33.49 |
| Ironworker | $33.00 | $19.80 | $7.88 | $7.56 | $3.92 | $0.72 | $53.08 | $39.88 |
| Operating Engineer | $35.83 | $21.50 | $10.70 | $5.55 | $2.82 | $0.89 | $55.79 | $41.46 |

Annual total compensation including apprenticeship contributions at 2080 hours per year runs between $69,572 for a piledriver apprentice to $116,043 for an operating engineer. Again these total compensation estimates fall within the range for other analysts shown in Table 1 (although their estimates include payroll taxes while these calculations, as yet, do not). In order to calculate an average hourly wage rate and an average annual total compensation (sans payroll taxes), we need to estimate the mix of apprentices and journey workers as well as the mix of crafts that would build photovoltaic solar farms.

## Employment Assumptions for Imperial County Projects

For each of the previous studies, row 14 of Table 1 shows the FTE worker job-years required to put in place one megawatt of nameplate capacity (which equals total job-years/total megawatts). These worker-years-per-megawatt ratios range from a low of 2.2 in the Hamilton and Berkman report for the Topaz project to a high of 2.7 in the Hamilton, Smith and Banda study of the CVSR project with an average of 2.4 across all projects. Some of this variation has to do with how accelerated the construction of the project is. Projects using more overtime will require fewer workers because each worker is working more. We will assume the average of 2.4 FTE-worker-years per megawatt-put-in place to calculate the total FTE job-years required to build 1250 MW of nameplate photovoltaic solar capacity in Imperial County.

This assumption results in an estimated 3000 FTE worker-years to build 1250 MW of photovoltaic solar capacity shown in Table 1 column (3000 FTE job-years=2.4 times 1250). The other projects shown in Table 1 range in size from 250 MW to 550 MW to a combined 800 MW for the two San Luis Obispo projects. These projects are assumed to take from 26 months to 36 months to complete. We will assume that putting 1250 MW of nameplate capacity in place in Imperial County will take 5 years. This assumption allows the total capacity to be on-line by 2020 helping to meet California's new green electrical generation requirements.[45]

There is a tradeoff associated with the assumption regarding the length of projects and their local economic impact. For any given size project, the shorter the assumed length of construction, the more overtime must be paid to accelerate construction or the more workers per megawatt must be employed to finish quickly. Thus, shorter projects generate more total wage income per megawatt due to scheduled overtime or alternatively to crowding the job with more workers. By itself, this means a greater offsite

local impact of the new work due to more disposable income for workers to spend in the local community. On the other hand, accelerated work puts pressure on the local labor market due to increased labor demand per megawatt installed. Thus, while overtime may simply mean using local workers more intensively, crowding the job with more workers may mean more travelers which in turn may mean more wage income spent outside the local community. In assuming 5 years to construct 1250 MW of solar capacity in Imperial County, we are seeking a balance between these two affects. We are assuming a longer set of jobs or jobs stung seriatim over a longer period, which means that this nameplate green-electrical capacity will more easily be built with local labor; but we are also assuming no overtime which means the local labor will earn less. This reflects the kind of balancing of assumptions analysts must do in estimating the local economic impact of building new industrial capacity and also our effort to make moderate assumptions.

Table 1 (column h) shows that if it takes 3000FTE worker-years to build 1250 MW of photovoltaic generation capacity, and if the construction projects together lasts 5 years, on average, 600 FTE workers would be employed per year. With a local Imperial County construction labor force of about 2000 workers and currently, with about 50% of these workers unemployed, it is conceivable that local workers could meet the 600 FTE workers-per-year required by the envisioned Imperial County facilities.[46] All the previous reports except Aspen do assume that local construction workers would build the facilities they reviewed.

However, because some of the skills required on these types of projects are scarce, in the case of Imperial County, it probably is too aggressive to assume that all the workers could be recruited locally. Laborers and apprentices will probably all come from the local labor force given the extraordinarily high local unemployment rate and the limited skill barriers confronting beginning apprentices and laborers.[47] Some already trained journeyworkers for the other crafts are likely to travel to this work from San Diego and other Southern California counties or perhaps even from Nevada or Arizona. Some professional and engineering staff may move to Imperial County for the duration of these projects which for our purposes would make these professional quasi-local workers in the sense that they would be spending much of their income locally.

Only the Aspen Group report among the studies summarized in Table 1, explicitly divides the construction workforce between county-local and outside-the-county traveling construction workers. Aspen assumes that 64 percent of the workers on the CVSR and Topaz sites come from San Luis Obispo County.[48] Assuming, as they do, that fewer construction workers are sourced locally reduces their estimate of the economic impact of new jobs because traveling construction workers spend less in the local community where the construction job takes place.

Aspen's approach reflects their more conservative or skeptical stance regarding the local benefits of these solar projects built in rural areas. With a modification, we will follow Aspen's conservative assumption. Aspen does not distinguish between apprentices and journeyworkers; nor do they distinguish between laborers and the more skilled crafts. While a large project may require some already skilled construction workers to travel from elsewhere, apprentices can be sourced locally especially in places such as Imperial County where a well-paid construction career is worth going into and overall unemployment rates are high. With typical apprenticeship ratios of 3 journeyworkers to 1 apprentice[49] and a construction time frame of 5 years, many new entrants to industrial construction could be trained on this facility. We will estimate the number of apprentices by craft on this project below. Further below,

we will estimate the long-term local impact of creating a new generation of skilled construction workers in Imperial County.

Here we will assume that the apprentices on this job will be locally sourced. We will also assume that the laborers on this job will also be locally sourced. Figure 10 (above) shows the projected occupational composition for the CVSR project. We use these percentages in Table 3 to calculate the estimated local and nonlocal workers for the Imperial County projects. The percent of each craft plus administrative and professional workers among all FTE workers is shown in the first row of Table 3. For 3000 FTE job-years, these percentages are translated into FTE job-years per occupation in row 2. Based on an apprenticeship ratio of 3 journeyworkers to 1 apprentice, the number of FTE apprentice job-years by occupation is shown in row 3. Rows 4 and 5 reflect the assumption that all apprentices on the job are locally sourced. There are an estimated 514 FTE local apprentice job-years which over a 5 year construction period is about 103 FTE apprentices on the projects each year.

Thus the 5-year construction of this 1250 MW of solar capacity means that at least 100 Imperial County young people would have entered well-paid construction careers had this capacity been built in Imperial County instead of Mexico. But given that many of these apprentices would be rotated out of this work into other jobs elsewhere in order to expand their work experience, probably many more Imperial County youth would have become skilled construction craft workers due to this new work opening the door for them. We will discuss the lost economic value and impact of this foregone opportunity in more detail below.

*So our assumption for skilled craft workers will be the same as Aspen's (the most skeptical analysis) that 64 percent of the skilled craft journeyworkers will be local to Imperial County and 36% will be travelers. In contrast to Aspen, we will assume that all the apprentices and laborers on the project will come from Imperial County. Our assumptions balance the differences between the more conservative Aspen approach with the more optimistic approaches of the other analysts.*

Row 6 in Table 3 shows the estimated number of journeyworkers by occupation plus professional and supervisory workers while rows 7 and 8 show the locally sourced and travelers among these workers. As stated above, we assume that all the laborers on the project would have come from Imperial County and also we assume that the professional workers either would have come from Imperial County or more typically, for this kind of industrial construction, we assume that these professional workers would have moved to Imperial County for the duration of the project.[50]

Row 9 shows the basic results in Table 3. For occupations other than laborers and professionals, we assume that 36% of the journeyworkers and 0% of the apprentices for a combined 27% of these FTE craft workers would have been travelers from outside Imperial County. We assume that laborers, apprentices and professionals would have been all local (or in local residence) with the result that overall, we estimate that 19% of the FTE construction workers on this project would have been from outside Imperial County and 81% will be local. This compares to Aspen's assumption that 64% would be local and the other reports' assumption that 100% would be local. Again our approach reflects the kind of balancing of assumptions required to estimate the local economic impact of building an industrial project such as a 1250 MW of solar capacity.

**Table 3: Estimated number and percent local FTE workers vs. travelers on Imperial County projects**

| | | Carpenters | Op. Eng. | Piledrivers | Admin. Super. & Other | Ironworkers | Laboerers | Elecrtricians | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Percent of total FTE worker-years | 0.24% | 1.79% | 9.05% | 11.80% | 13.97% | 19.67% | 43.48% | 100% |
| 2 | Total FTE worker-years (rounded) | 7 | 54 | 271 | 354 | 419 | 590 | 1305 | 3000 |
| 3 | Apprentices | 2 | 13 | 68 | 0 | 105 | 0 | 326 | 514 |
| 4 | Local apprentices | 2 | 13 | 68 | 0 | 105 | 0 | 326 | 514 |
| 5 | Traveling apprentices | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | Journeyworkers or professionals | 5 | 40 | 204 | 354 | 314 | 590 | 978 | 2486 |
| 7 | Local journeyworkers | 3 | 26 | 130 | 354 | 201 | 590 | 626 | 1931 |
| 8 | Traveling journeyworkers | 2 | 14 | 73 | 0 | 113 | 0 | 352 | 555 |
| 9 | Percent from outside Imperial County | 27% | 27% | 27% | 0% | 27% | 0% | 27% | 19% |

Source: see Figure 10; note components may not sum to total due to rounding error

Because the envisioned facilities would have operated for 25 years, we assume that all the operations personnel would have been either local or would have moved to Imperial County and become local. Based on the average megawatts per FTE operations and maintenance workers assumed in the various reports summarized in Table 1, we assume that there will be 40 maintenance and operating workers for this 1250 MW of solar facilities. (See Table 1.)

## Average Hourly Wage Rate and Annual Earnings

Table 4 takes information on FTE job-years by craft and journeyworker/apprentice from Table 3 and combines it with hourly compensation information from Table 2 to calculate total compensation by local journeyworkers and apprentices and travelers on this project. Rows 2 through 5 in Table 4 show the FTE job-years by craft broken down by local and traveling journeyworkers plus apprentices. As in Table 3, we assumed that all the apprentices plus all the laborers would have been locally sourced. Column e in row 2 shows the FTE job-years for the professional, administrative, engineering and other non-craft workers on these sites. Again, as in Table 3, we assume that the professional workers would have been either locally sourced, or more likely, would have moved to Imperial County for the duration of the projects.

**Table 4: Calculating total compensation by craft**

| | a | b | c | d | e | f | g | h | i |
|---|---|---|---|---|---|---|---|---|---|
| | | Carpenters | Op. Eng. | Piledrivers | Admin. Super. & Other | Ironworkers | Laborers | Elecrtricians | Total |
| 1 | FTE job-years | | | | | | | | |
| 2 | Local journeyworkers/professiona; | 3 | 26 | 130 | 354 | 201 | 590 | 626 | 1931 |
| 3 | Local apprentices | 2 | 13 | 68 | 0 | 105 | 0 | 326 | 514 |
| 4 | Traveling journeyworkers | 2 | 14 | 73 | 0 | 113 | 0 | 352 | 555 |
| 5 | Total FTE job-years | 7 | 54 | 271 | 354 | 419 | 590 | 1305 | 3000 |
| 6 | Total Hourly Wage plus Health & Vacation | | | | | | | | |
| 7 | Local journeyworkers/professiona; | $48.43 | $55.79 | $48.36 | $50.00 | $53.08 | $39.56 | $48.34 | |
| 8 | Local apprentices (=60% journeyworker) | $33.49 | $41.46 | $33.45 | | $39.88 | | $33.68 | |
| 9 | Traveling journeyworkers | $48.43 | $55.79 | $48.36 | | $53.08 | $39.56 | $48.34 | |
| 10 | Total FTE compensation | | | | | | | | |
| 11 | Local journeyworkers & professionals | $349,714 | $2,989,647 | $13,104,496 | $36,817,663 | $22,210,725 | $48,550,225 | $62,960,077 | $186,982,546 |
| 12 | Local apprentices | $125,954 | $1,157,100 | $4,720,663 | $0 | $8,691,320 | $0 | $22,847,015 | $37,542,051 |
| 13 | Traveling journeyworkers | $196,714 | $1,681,677 | $7,371,279 | $0 | $12,493,533 | $0 | $35,415,043 | $57,158,246 |
| 14 | Total Local Compensation | $475,668 | $4,146,747 | $17,825,159 | $36,817,663 | $30,902,045 | $48,550,225 | $85,807,091 | **$224,524,597** |
| 15 | Total Traveler Compensation | $196,714 | $1,681,677 | $7,371,279 | $0 | $12,493,533 | $0 | $35,415,043 | **$57,158,246** |
| 16 | Total Compensation | $672,382 | $5,828,424 | $25,196,437 | $36,817,663 | $43,395,578 | $48,550,225 | $121,222,135 | **$281,682,842** |

Rows 7 through 9 transfer the hourly total compensation including apprenticeship contribution information from Table 2. While we have precise information on compensation for the construction crafts from prevailing wage determinations, we must estimate the professional and other non-craft, on-site, hourly total compensation rate; and we set that at $50 per hour. This reflects a mixture of better-paid professionals and other non-professional white collar workers that would have been on-site.

Rows 11 through 13 in Table 4 multiply the FTE job-years shown in rows 1 through 4 times the corresponding hourly compensation rates shown in rows 7 through 9 times 2080 hours per year. (Again, this 2080 hour figure assumes no overtime).

Column i provides totals for each row with the punch lines found in rows 14 through 16. Row 14 shows the total local wages plus benefits (including training contributions which do not go to the worker but rather to the local training program) paid on this project. Line 15 shows the total for travelers and line 16 shows the grand total for compensation.

A set of calculations similar to those of Table 4 shown in a footnote yield an average hourly wage rate of $33.23 with traveling workers earning, on average, $35.97 per hour and a local average hourly wage rate of $32.60.[51] Locals include apprentices and laborers who would have earned less relative to journeymen craft workers pulling down the local wage relative to travelers. On an annual basis, across crafts and including both journeyworkers and apprentices, the average wage rate of $33.23 yields an annual wage income excluding benefits of about $69,000 per year.

*We calculate an average hourly wage rate of $33.23 across all crafts including laborers and apprentices. The average annual income plus benefits of all workers on these projects is $93,894 with an average hourly total compensation of $45.14.*

*Adding the employer share of payroll taxes (6.2% for Social Security, 3.4% for Unemployment Insurance and 1.45% for Medicare) adds 11% to total compensation yielding an average hourly payroll cost of just over $50, and an average annual per capita payroll cost of $104,223.*

*This total compensation estimate of $104,223 is below most of the estimates for construction workers in previous studies shown in Table 1. Lower total compensation estimates decrease the calculation of the negative impact of not creating these new jobs.*

**Table 5: Average hourly and annual total compensation by Imperial County and traveling worker**

| Total Compensation | | |
|---|---|---|
| | Hourly | Annual |
| Imperial County | $44.15 | $91,834 |
| Travelers | $49.50 | $102,988 |
| Average | $45.14 | $93,894 |
| CA Payroll tax 11% | $50.11 | $104,223 |

Table 5 is derived from column 1 of Table 4 and shows the average hourly and annual compensation per worker by Imperial County and traveling workers. Because apprentices and laborers would have been both local and paid less, Imperial County workers, on average, would have earned less than travelers. The average annual income plus benefits of all workers on these projects is $93,894 with an average hourly total compensation of $45.14. Adding the employer share of payroll taxes (6.2% for Social Security, 3.4% for Unemployment Insurance and 1.45% for Medicare) adds 11% to total

compensation yielding an average hourly payroll cost of just over $50 and an *average annual per capita payroll cost of* ***$104,223***.

This total compensation estimate of $104,223 is below most of the estimates for construction workers in previous studies shown in Table 1 line 20, and is similar to the assumptions these studies made for the total compensation of operations and maintenance workers. (Table 1, line 30)

All other things equal, lower total compensation for construction workers leads to a smaller economic impact from the building a project. Thus, relative to the more optimistic reports reviewed above, our approach tends towards the more conservative both in terms of the number of locals who would have worked on these projects and in terms of how much they would have been paid. However, our approach is more optimistic than the low-wage Aspen scenario which has both a lower estimated wage and fewer local workers compared to our assumptions. We believe that the Aspen approach is too conservative because 1) its low wages rely upon surveys dominated by residential rather than industrial construction workers, and 2) Aspen does not consider that laborers and apprentices are likely to be almost entirely locally sourced. Otherwise, our assumptions regarding the percent of local journeyworkers is the same as Aspen's.

# Section 5: Local Economic Benefits Lost

## 1: Apprentices: More than 100 Lifetime Careers Lost with a Net Present Value Loss of $127 Million in Wages and Benefits

One advantage of the International Brotherhood of Electricians (IBEW) and other craft-oriented apprenticeship programs (operating engineers, ironworkers, piledrivers) that would have filled roughly 25% of the required craft labor supply in building this solar capacity in Imperial County is that craft training is rounded training. Apprentices learn a full range of skills in their craft enabling them not only to construct solar farms but also to build other green electrical facilities and other industrial and commercial facilities more generally. For instance, an electrical apprenticeship program includes not only the skills needed for traditional construction but the skills required to also build green energy projects:

> Electricians employ the use of a variety of green technologies including energy efficient lighting, systems and appliances; motion and occupancy sensors, dimmers, timers, and smart power strips; and PVC free cables. They install wireless switches for remodeling, electrical consumption economizers - devices that reduce energy use of AC units - and programmable thermostats as well as daylight harvesting system, which uses photosensors to detect light levels in a room. Electricians also are knowledgeable about different types of renewable energy, such as solar, wind, and geothermal, and are able to integrate these sources into a comprehensive energy efficiency system. In addition to working on commercial and residential building retrofits, they also work on wind turbine installations, parking lot electrical outlets, electrical vehicles, mass transit and light rail projects, and smart electrical grid transmission systems.[52]

Imperial County has a growing need for green skills associated with the building of centralized green electrical generating facilities and also due to the installation and retrofitting of green technologies on commercial and residential buildings. Thus, the 1250 MW of lost work that we consider here is a foregone future for young Imperial County residents. This lost work could have proved to be a major

stepping stone for Imperial County youth towards well-paying and lasting careers in an expanded and better skilled Imperial County construction workforce. In other words, this 1250 MW of work would have been a gift that kept on giving after the solar capacity, itself, was complete.

All collectively bargained agreements in California construction require paying training contributions into registered apprenticeship programs. Table 6 shows the hourly training contribution by craft for the 2011 collectively bargained agreements applicable to Imperial County. They range from 24 cents per hour of work for Operating Engineers to 86 cents per hour for electricians. The next column in Table 6 shows the percent of all work done by each craft based on the force curve provided by SunPower for the California Valley 250 MW photovoltaic solar project.[53] Total hours for this project were calculated by multiplying 2080 hours (52 weeks times 40 hours per week) against the 680 full time equivalent blue and white collar workers projected to build this 250 MW facility. The next column multiplies total hours times each craft's share of these total hours and then times each craft's hourly apprenticeship contribution. The result is an estimate of the apprenticeship training investment emerging from the building of the California Valley project with the caveat that this calculation used the training contributions that would apply to work in Imperial County. The last column multiplies these training investment sums by 5 to scale up apprenticeship training investment from a 250 MW facility to 1250 MW of photovoltaic solar generating capacity.

**Table 6: : Investment in worker training by craft from the construction of 250 MW and 1250 MW of solar generating capacity**

| Occupation | Training Contribution per Hour | Share of Total Hours | Training Investment from a 250 MW Project = Total Hours for a 250MW Project *Share*Training Contribution | Total Investment in Training from a 1250MW Project = 250MW Investment * 5 |
|---|---|---|---|---|
| Carpenter | $0.42 | 0.24% | $1,432 | $7,161 |
| Op. Eng. | $0.24 | 1.79% | $6,073 | $30,366 |
| Piledrive | $0.42 | 9.05% | $53,744 | $268,720 |
| Ironworker | $0.72 | 13.97% | $142,269 | $711,346 |
| Laborer | $0.64 | 19.67% | $178,034 | $890,169 |
| Electrician | $0.86 | 43.48% | $528,936 | $2,644,682 |
| Total | | | $910,489 | **$4,552,444** |

Sources: training contribution rates http://www.dir.ca.gov/dlsr/pwd/index.htm
Total and share of hours on project
http://www.californiavalleysolarranch.com/pdfs/Economic_Impact_to_SLO__Final1.pdf
(Total hours on 250 MW project = 680 FTE job years * 2080; total hours on 1250 MW project = 5*total hours on 250 MW project)

The results in Table 6 may surprise those not familiar with the amount of formal training that actually occurs in unionized construction. More than half of this investment on a project like the SunPower California Valley project would have gone towards the training of new electricians. SunPower estimates that there would be 294 FTE electrician job-years on their 250 MW project. Because this project is anticipated to run for almost 3 years, there would be about 100 FTE electricians on this project in any one year (equaling about 300 electrician job-years over 3 years). For 1250 MW of solar generating capacity, we could have anticipated about 5 times as many electrician job-years or about 1500 job-years for electricians over five years. This mean s that about 300 FTE electricians per year would have worked on these Imperial County projects.

With a journeyworker-to-apprenticeship ratio of 3:1, 300 FTE electricians in total would imply 225 FTE journeyworker electricians and 75 FTE electrician apprentices on the job each year over a 5 year period. The electricians' apprenticeship program lasts five years and involves 1,020 hours of classroom training and as well as 8000 hours of on-the-job training.

*Union contractors building 1250 MW of solar generating capacity in Imperial County would have at the same time invested more than $4.5 million in apprenticeship training over five years.*

> During the first three years of apprenticeship, [electrician] apprentices go through [a] compressed and vigorous curriculum two nights a week – one night for lecture and one night for hands-on applications of their skills. Apprentices are required to pass various competency assessments to successfully complete their classes. In the last two years of apprenticeship, apprentices have the choice of selecting a "career path" or specialty field. Each career path comprise of several continuing education and skill improvement classes. Typical "career path" classes consists of the following: AutoCAD, Advanced Motor Controls, Low Voltage, Electrical Certification Prep, Electronics (Analog and Digital), Fire Alarm Systems, Instructional Leadership, Service Equipment, Test Equipment, Photovoltaics, Job/Project Management, Programmable Logic Controllers.[54]

While in reality, these 75 FTE electrician apprentices eventually would have been rotated off this solar work in order to work on other types of jobs and expand their skills and experience, for simplicity, let us assume these 75 workers would have stayed until the 5 years were up and the 1250 MW of generating capacity was built. The $2,644,682 invested in their training from this job over five years would have amounted to ***a human capital investment of $35,262 for each apprentice or $7052 per apprentice per year over five years***.

To provide a perspective on this per apprentice investment, California spends approximately $13,000 per student per year for four years in the University of California system.[55] Thus, not counting the value of the on-the-job aspects of this apprenticeship training, this 1250 MW set of facilities would have invested in classroom training for each student the equivalent what the state invests in University of California student over three years ($35,000 vs. $39,000). In addition to this $35,000 investment in classroom training paid for by contractor contributions into the apprenticeship program, apprentices receive on-the-job training under the supervision of a journeyworker. While no precise figure can be placed on this on-the-job instruction, it could easily close the gap between what is invested in these apprentices and what the state invests in University of California students over three years.

Furthermore, in contrast to university students, apprentices earn while they learn: the apprentice wage starts around 50% of the journeyworker wage the first year and moves upwards about 10 percentage points per year through the apprentice's indentureship. These earnings, of course, also include solid family health insurance coverage. So continuing this comparison to formal higher education, in contrast to University of California students, each apprentice that would have been employed building this 1250 MW of capacity in Imperial County would have been, in effect, on a full scholarship with benefits. Among other losses associated with approving the Sempra tieline is the foregone human capital investment, foregone scholarships, foregone creation of a skilled local labor pool and foregone careers that would have been created by apprenticeship training on this lost work.

As mentioned above, most apprentices would have been rotated out before the completion of this solar capacity. Those moved out would have received comparable investments in their training derived from the apprenticeship training contributions generated by jobs elsewhere onto which they would have been rotated. Thus, in general, once apprenticeship openings would have been created by the construction of a 1250 MW photovoltaic electrical generating capacity in Imperial County, due to collectively bargained agreements, the process of investing more than $7000 per year in twice-per-week classroom training for each apprentice would have been set in motion. This classroom training would have been made real by on-the-job supervised experience and enriched by job rotation. In short, building 1250 MW of solar generating capacity in Imperial County would not only have created jobs, it would have created more than $4.5 million in human capital investment and accumulation which is the foundation for a lifetime of work in a career such as an electrician or iron worker or other craft worker in the construction industry.

*The $2,644,682 invested in electrical apprenticeships from this job over five years would have amounted to a human capital investment of $35,262 for each of 75 apprentices or $7052 per apprentice per year over five years.*

*To provide a perspective on this per apprentice investment, California spends approximately $13,000 per student per year for four years in the University of California system.*

*Because they earn while they learn, in contrast to University of California students, each apprentice that would have been employed building this 1250 MW of capacity in Imperial County would have been, in effect, on a full scholarship with benefits.*

This training would have come at a useful time because over the entire United States the trained construction labor force is aging.[56] Even in the prolonged aftermath of the Great Recession, trained older construction workers from the Baby Boom generation continue to retire. The training of skilled construction workers in Imperial County financed by the construction of solar generating capacity would have helped support the process of recreating a skilled construction labor force by providing some of the investment needed to replace the Baby Boom bulge of skilled construction workers as it accelerates its movement into retirement.[57]

Over their worklife, the value to a young Imperial County worker of obtaining five years of on-the-job supervised electrical training and more than $35,000 in employer-union investment in classroom training would have been substantial. Because of the skills developed through extensive formal apprenticeship training, apprentices who turn out as union electricians earn substantially more than they otherwise would absent that training. The current hourly wage rate in Imperial County for union

electricians is $36.65 which for 2000 hours in a year amounts to an annual individual income of $73,300.[58] (2000 hours allows for two weeks of unpaid vacation or unemployment per year.) In addition, this union journeyworker currently receives $6.48 per hour in health insurance contributions and $4.35 in pension contribution. At 2000 hours per year, this amounts to about $13,000 in health insurance coverage and $8700 in pension investment. With a median *family* income in Imperial County of just under $37,000, this individual income of $73,300 plus benefits amounts to a substantial annual economic gain compared to a worklife without this upfront human capital investment of $35,000 in classroom training plus 5 years of supervised on-the-job training.[59]

In rough terms, in Imperial County, the difference between the skilled worklife of an electrician and one without this human capital investment amounts to about $36,300 per year ($73,300 minus $37,000), *plus* additional pension and health benefits. Assuming that the apprentice turns out as a skilled journeyworker electrician at age 25 and works until age 65, that amounts to 40 years of additional income of $36,300 per year. Using an inflation-adjusted real discount rate of 2 percent, the net present value in today's dollars of that additional income is $993,000 per worker. This means that an approved Sempra tieline across the border and the construction of 1250 MW of green-energy-for-export in Mexico costs each Imperial County would-be electrician apprentice almost $1 million in foregone income, with the correspondingly diminished worklife, loss of family friendly benefits, reduced economic contributions to the local economy and reduced taxes paid into the local community.

*In Imperial County, the difference between the skilled worklife of an electrician and one without this human capital investment amounts to about $36,300 per year ($73,300 minus $37,000), plus additional pension and health benefits.*

*The net present value in today's dollars of that additional income over a 40 year worklife is $993,000 per worker. That would have generated in today's dollars, an additional $74,475,000 in net present value personal income in Imperial County with all the additional consumer business and additional tax revenues that would have spun out from these new skills and this new income.*

We have shown that approximately 75 apprentices would have turned out as journeyworker electricians over five years from building a 1250 MW solar capacity in Imperial County. If those 75 workers stayed within the county construction labor force over their careers, that would have generated an additional $74,475,000 in personal income in Imperial County over 40 years (calculated in terms of net present value in today's dollars). Similar personal earnings losses obtain for the other crafts. Even unionized laborers who do not run a registered apprenticeship program nonetheless invest significant sums to build the skill level of their members. A general calculation of the present value of the total lifetime personal income loss associated with losing 103 newly skilled construction workers (514 FTE apprentice job-years divided by 5) is as follows: each worker would have earned approximately $35,000 per year more than they will earn absent this training. Each worker would have experienced these gains annually for about 40 years. The net present value of these losses would be $957,000 per worker. These workers also lose top notch health insurance and pension benefits.

Across crafts, in Imperial County, these lost benefits amount to about $10 per hour. In general terms, this is about twice what they will receive in unskilled jobs in the county not counting differences in social security contributions. At 2000 hours of work per year, this benefit loss sums to about $10,000 per

year. So the wage and benefit loss derived from this failure to invest in human capital amounts to $45,000 per year over what these young workers will earn without the doors to skill investment having been opened with the loss of this 1250 MW of solar capacity.

**The net present value of this loss of wages and benefits over a 40 year worklife from age 25 when they would have turned out as a journeyworker to age 65 when they presumably would have retired is more than $1.2 million per apprentice. For the 103 lost apprenticeship positions as a group, this is an almost *$127 million* present value loss in earnings and benefits over what they will earn without this training.**

And with the loss of this 1250 MW of solar farms, Imperial County loses as well. These lost earnings and benefits will not be spent locally; they will not stimulate the local economy; they will not add to the local tax base. Equally important, increased local human capital and corresponding skills will go missing. This will leave the local construction industry less able to respond to the economic development possibilities that otherwise would have emerged over the 40 year work lives of these lost skilled workers.

*The proposed Sempra tieline is not just about electricity. It is also about foregone opportunities, lost worklives and diminished economic development prospects.*

This is why the apprenticeship training and investment dimensions of 1250 MW of photovoltaic construction is a gift that keeps on giving to multiple recipients: the workers themselves, the employers that will need them and the business community that will serve them. Salient among those potential lines of local economic growth and employment would be the various aspects of the green economy that are emerging from the Great Recession, responding to rising energy costs and likely to be important to the future Imperial County economy due to its solar potential.

Furthermore, these newly skilled workers rather than posing a potential burden on public services could also become mainstays of the local health delivery system and other local public services due to the additional health insurance contributions and tax contributions they could to the local economy. Building solar capacity in Imperial County in fact helps build the health delivery system of the County while building the local tax base over a 40 year period. All these benefits are lost when this work is lost. The proposed Sempra tieline is not just about electricity. It is also about foregone opportunities, lost worklives and diminished economic development prospects. Setting aside these broad worklife considerations, we now narrow our focus to the specific worksite jobs lost and the upstream and downstream jobs that are foregone if and when the tieline is approved.

## 2: 14,893 Lost Jobs and $551 Million in Lost Earnings

Table 7 shows the number of job-years created by building a 1250 MW photovoltaic electrical generating capacity in Imperial County.[60] Starting with the assumption derived above in Table 1 that the projects would require 3000 FTE job-years over a 5 year period with 489 local workers and 111 travelers as discussed in Table 3, an input-output computer model, IMPLAN, was used to calculate the number of jobs that would be created off-site either from the demand for construction materials and supplies or from the demand for consumer goods and services stemming from the labor incomes of these 600 FTE workers.[61]

**Table 7: On-site jobs (direct), supply chain jobs (indirect) and consumer demand jobs (induced) lost by foregoing 1250 MW photovoltaic electrical generating capacity in Imperial County: county, state and U.S. impacts.**

| | Impact Type | Imperial County | California | U.S. |
|---|---|---|---|---|
| | **Total New FTE Job-Years** | | | |
| 1 | Direct employment on construction site | 2445 | 3000 | 3000 |
| 2 | Jobs-years created by demand for input materials, supplies and services | 399 | 2706 | 4328 |
| 3 | Job-years induced by new demand for consumer goods & service | 595 | 4082 | 7565 |
| 4 | Total new job-years | 3439 | 9787 | 14893 |
| | **Jobs-per-Year for 5 Years** | | | |
| 5 | Jobs-per-year on construction site | 489 | 600 | 600 |
| 6 | Jobs-per-years created by demand for input materials, supplies and services | 80 | 541 | 866 |
| 7 | Job-years induced by new demand for consumer goods & service | 119 | 816 | 1513 |
| 8 | Total new jobs-per-year for 5 years | 688 | 1957 | 2979 |

Table 7 shows the jobs-loss for Imperial County, for the state of California, and for the U.S. as a whole of not building 150 MW of generating capacity in Imperial County. The upper panel shows the jobs loss in total FTE job-years while the lower panel shows the same loss as an annual average number of FTE jobs. (The lower panel simply divides the totals in the upper panel by 5 years). Looking at Imperial County first, not all of the 600 construction jobs per year that the projects would have required would have gone to Imperial County residents. (See Table 3). While 111 workers on the construction site would be travelers, 489 would be locals, working annually for 5 years for a total of 2445 FTE job-years of local work lost if the Sempra tieline is approved.

An additional 80 local workers annually would have had new jobs in the local supply chain that within Imperial County supports construction. Most of these 80 supply-chain jobs would have been in engineering services; commercial and industrial machinery renting, repair and maintenance; trucking; automotive maintenance and repair; ready-mix concrete manufacturing and wholesale trade (primarily construction hand-tools and materials such as fencing). The workers who would have been newly employed within the local supply chain, in turn, would have created new consumer demand in Imperial County which also would have created additional jobs from this "indirect" effect.

An additional 119 workers would have found new jobs serving the increased consumer demand associated with the employment of 489 local workers on this work. (Also the model assumes that travelers would spend 20% of their income locally on gas, food and in some cases, rental housing.) The biggest sectors of the Imperial County economy which would have added new jobs due to this increased consumer demand (the "induced" effect) are food services and drinking places, household services, physicians, dentists and other health practitioners, grocery stores, and other retail stores.

The main benefit in Imperial County from the construction of this capacity would have been the jobs building the solar farms, themselves. The spinoff-jobs are an important side-benefit but because Imperial County is economically small (albeit geographically large), and thus, the ability of the County to fill in the supply chain and meet consumer demands is limited. When we step back to the level of California, as a whole, more of what is needed to build this new capacity could be supplied by the California economy and more of what the workers on this job would have demanded in terms of consumer

goods and services could also be supplied by the California economy. To see this, in the California column in Table 7, there are 600 new workers and 3000 FTE job-years. This reflects an assumption that the travelers would have all come from California. This may not be true. Some may come from Southern Nevada or Arizona. If so, then the California column slightly overstates the California-impact of the loss of these new jobs building this capacity because these out-of-state travelers would have spent the bulk of their new income in their home state. But for the moment, let us assume all the travelers would have been from California.

With this simplifying assumption, Table 7 shows a big jump of more than a 6 fold loss of new jobs both in the supply chain and in the consumer chain due to the foregone opportunity to employ 600 new workers on these projects including 111 travelers. So while the omission of 489 newly employed *Imperial County* construction workers creates the loss of an additional 199 new jobs elsewhere (80 supply chain and 119 consumer chain new jobs), the omission of 600 newly employed *California* workers (489 from Imperial County and 111 from elsewhere in California) creates the loss of an additional 1357 new jobs in the state's industrial supply and consumer sectors. With the very high unemployment rate in California, the foregone jobs across the state are a painful loss.

*For every foregone new construction job lost in Imperial County by not building this electrical capacity in the U.S., almost 4 new jobs will be lost elsewhere somewhere in the U.S.*

*The 600 construction jobs lost in Imperial County lead to 2379 new jobs lost elsewhere in the U.S. economy, each job-loss continuing for 5 years, for a total of almost 15,000 FTE job-years of new work lost over a 5 year period.*

*And these jobs losses come at just the wrong time. While new jobs are always needed and lost jobs always regretted, in the wake of the Great Recession, new jobs are needed now more than ever.*

When we scale up to the U.S. economy, as a whole, the construction supply and consumer demand chains lengthen and even more new jobs are lost from foregoing the original 600 jobs. For every foregone new job lost in Imperial County by not constructing this electrical capacity, almost 4 new jobs are lost elsewhere somewhere in the U.S. Imperial County's 489 jobs plus the additional 111 travelers (who now in the analysis could have come from Nevada, Arizona or other states) lead to 2379 new jobs lost elsewhere in the U.S. economy, each job-loss continuing for 5 years for a total of almost 15,000 FTE job-years of new work lost over a 5 year period. All 15,000 of these new job-years are lost when this domestic capacity is replaced by facilities in Mexico using a 1250 MW transmission line to bringing this green electrical generation from across the border.[62]

Because these lost jobs are across a range of industries, occupations and locations, we need to attach an average wage income representing all of these lost jobs. **The median weekly earnings of the nation's 98 million full-time wage and salary workers of $755.[63] For 52 weeks, this amounts to $39,260. For 14,893 lost job-year across the United States, this amounts to a total net present value of lost wage income of $551 million due to approving the Sempra cross-border transmission tieline.**

## 3. Operation Employment Loss of 40 Jobs Lasting 25 Years Each for a Net Present Value Loss of $78 Million in Earnings

Table 1 column **g** shows that across the three other projects reviewed in this report, there were, on average, 31.1 megawatts of nameplate capacity per local administrative, operation and maintenance worker on these sites. We use this average to calculate the number of operations workers that would have been needed for 1250 MW photovoltaic electrical generating capacity in Imperial County. Dividing 1250 MW by 31.1 yields an estimated 40 administrative, operation and maintenance workers required for this larger Imperial County generation capacity. All of the analysts of these other facilities assumed that their sites would have at least a 25 year usable lifetime. We will assume the same.

Thus, 40 annual FTE operations workers times 25 years yields 1000 new job-years that would have been needed to operate this photovoltaic generation capacity in Imperial County. We assume the average annual wage and benefit incomes for operation workers derived from the reports on these other facilities. This amounts to $69,250 in wage income and $33,214 in annual benefits including Social Security, Medicare and Unemployment Insurance for a total of $102,464 in annual total compensation for 40 workers that is lost when the Sempra tieline is approved. This amounts to a loss of more than $4 million in new worker pay in Imperial County annually for a total loss of more than $100 million in today's dollars over the life of the facility. The net present value of this loss assuming the operation jobs would not have started until after the five years required to build this capacity is $78 million using a 2% real, inflation-adjusted, discount rate.

*The total loss in government tax revenues at all levels would be just short of $300 million. This, at a time, when the California state budget and the budgets of most county, municipal, school district and other governmental entities are in severe crisis.*

## 4. Lost Tax Revenues of Almost $300 Million

Building 1250 MW solar generating capacity in Imperial County would have increased local, state and federal tax revenues *directly* through employing workers on these projects, *indirectly* through employing workers and creating new business activities supplying these projects; and it also *inducing* new business activities and employment in serving the consumer demands of the workers on these projects and the consumer demands of workers and proprietors supplying these projects.

Using IMPLAN, we calculate that over 5 years of construction, the total loss in government tax revenues at all levels would be just short of $300 million. (Table 8) Over $100 million in state and local revenues would be lost. These calculations are based on Table 9 and Table 10 which assess the statewide loss. This allows consideration not only of lost new tax revenues that would have been generated within Imperial County but also lost new tax revenues that would have been generated outside the county. Thus, this considers the job-generating expenditures of traveling construction workers that would have worked on the project but spent their income in their home county. It also considers suppliers outside of Imperial County but within California that would have served the needs of this construction work in Imperial County. While the bulk of increased local tax revenues losses will be in Imperial County because most of the workers would have spent most of their income within their home county, the category local tax includes taxes collected at the local level anywhere in California.

**Table 8: Lost tax revenues from the foregone statewide direct, indirect and induced employment and business effects from building a 1250 MW solar power in Imperial County**

| Description | Employee Compensation | Proprietor Income | Indirect Business Tax | Households | Corporations | Total Tax Revenues |
|---|---|---|---|---|---|---|
| Total State and Local Tax | $3,304,238 | | $54,342,620 | $34,623,931 | $15,606,956 | **$107,877,745** |
| Total Federal Tax | $73,928,501 | $9,265,920 | $8,537,508 | $74,504,441 | $14,487,245 | **$180,723,615** |
| Total Slocal, State and Federal Tax | $77,232,739 | $9,265,920 | $62,880,128 | $109,128,372 | $30,094,201 | **$288,601,360** |

Table 9: Imperial County plus travelers statewide effect only on state and local tax revenues

| Description | Employee Compensation | Proprietor Income | Indirect Business Tax | Households | Corporations |
|---|---|---|---|---|---|
| Dividends | | | | | $10,407,620 |
| Social Ins Tax- Employee Contribution | $623,168 | | | | |
| Social Ins Tax- Employer Contribution | $2,681,070 | | | | |
| Indirect Bus Tax: Sales Tax | | | $25,769,411 | | |
| Indirect Bus Tax: Property Tax | | | $20,529,821 | | |
| Indirect Bus Tax: Motor Vehicle Lic | | | $509,185 | | |
| Indirect Bus Tax: Severance Tax | | | $16,022 | | |
| Indirect Bus Tax: Other Taxes | | | $5,142,488 | | |
| Indirect Bus Tax: S/L NonTaxes | | | $2,375,693 | | |
| Corporate Profits Tax | | | | | $5,199,336 |
| Personal Tax: Income Tax | | | | $27,314,493 | |
| Personal Tax: NonTaxes (Fines- Fees | | | | $5,855,108 | |
| Personal Tax: Motor Vehicle License | | | | $931,409 | |
| Personal Tax: Property Taxes | | | | $331,272 | |
| Personal Tax: Other Tax (Fish/Hunt) | | | | $191,648 | |
| Total State and Local Tax | $3,304,238 | | $54,342,620 | $34,623,931 | $15,606,956 |

**Table 10: Imperial County plus travelers statewide effect only on federal cal tax revenues**

| Description | Employee Compensati | Proprietor Income | Indirect Business | Households | Corporations |
|---|---|---|---|---|---|
| Social Ins Tax- Employee Contribution | $36,756,516 | $9,265,920 | | | |
| Social Ins Tax- Employer Contribution | $37,171,985 | | | | |
| Indirect Bus Tax: Excise Taxes | | | $3,820,854 | | |
| Indirect Bus Tax: Custom Duty | | | $1,779,409 | | |
| Indirect Bus Tax: Fed NonTaxes | | | $2,937,244 | | |
| Corporate Profits Tax | | | | | $14,487,245 |
| Personal Tax: Income Tax | | | | $74,504,441 | |
| Total Federal Tax | $73,928,501 | $9,265,920 | $8,537,508 | $74,504,441 | $14,487,245 |

## 5. Comparing Our Results to the Other Recent Impact Studies

To provide a standardized comparison of our results to those of the previous recent studies reviewed in this report, in line 1, Table 11 summarizes the total job-years *within the county* of direct construction employment, indirect supply-chain employment and induced consumer-chain employment found by various analysts for the three photovoltaic solar farms shown in Table 1.

In Table 11 in line 1, the direct construction worker job-years and other construction-site personnel required for the building of these various projects are shown. Line 1 in Table 11 is the same as line 13, Table 1 with the exception that for the Aspen Group analysis in columns c, d and for our analysis in f only local county construction workers are included.[64] This reflects the fact that the Aspen report and our report took into consideration construction travelers in analyzing county specific employment effects. The predicted total within-county indirect supply chain job-years and induced consumer chain job-years are shown in lines 2 and 3 of Table 11. Total direct, indirect and induced job-years from construction (but not subsequent operation) are shown in line 4.

*Our calculations of job impact per megawatt constructed fall in the middle of these other four reports while leaning slightly towards the more skeptical Aspen approach.*

To compare across reports, lines 5 through 8 in Table 11 divide job-years for each type of job creation by the nameplate capacity of the project or combined projects. Column f shows our results and column g shows the average results for the other four reports, excluding ours. The Aspen Group is in the Table twice because as mentioned above, Aspen provided a low-wage (LW) and a high-wage (HW) scenario. Aspen's double entry lowers the averages for workers per megawatt of capacity shown in column g, but this is perhaps fair because Aspen's is the only report under review that does not have a connection to the various project developers. Our job-year predictions fall between Aspen's more skeptical analysis and the average for all the other analyses excluding ours.

Our direct employment on the construction site workers per megawatt is midway between Aspen's and the others due to the fact that we, like Aspen, distinguish between traveling and local construction workers while the other reports do not. But because we, unlike Aspen, consider all apprentices to be local and all laborers to be local, our direct job-years per megawatt rate is higher than Aspen's. This difference drives the remaining differences shown in Table 11. With more local direct employment per megawatt compared to Aspen, there ends up being more indirect and induced employment compared to Aspen. On the other hand, with less direct employment in construction per megawatt of capacity compared to the other reports, we obtain fewer indirect and induced job-years per megawatt compared to these other reports. In terms of the overall job-years multiplier per megawatt of photovoltaic capacity installed, Aspen reports 2.4; we report 2.8; the average of the other three reports is 4.3 and the average for all the reports other than ours is 3.5.

**Table 11: A comparison of the total job-years of direct employment, indirect supply chain employment and induced consumer chain employment effects of photovoltaic construction in this and other recent reports[65]**

| | a | b | c | d | e | f | g |
|---|---|---|---|---|---|---|---|
| | Project | CVSR | Topaz | CVSR&Topaz LW | CVSR&Topaz HW | Desert Sunlight | Our Analysis | Average |
| | Location | San Luis Obispo | San Luis Obispo | San Luis Obispo | San Luis Obispo | Riverside | Imperial County | excl. |
| | Capacity | 250 MW | 550 MW | 800 MW | 800 MW | 550 MW | 1250 MW | Ours |
| | | Total Workers | | | | | | |
| 1 | Direct | 681 | 1200 | 1440 | 1410 | 1353 | 2445 | |
| 2 | Indirect | 230 | 225 | 190 | 180 | 121 | 399 | |
| 3 | Induced | 480 | 746 | 330 | 340 | 324 | 595 | |
| 4 | Total | 1391 | 2171 | 1960 | 1930 | 1798 | 3439 | |
| | | Workers per Megawatt of Nameplate Capacity | | | | | | |
| 5 | Direct | 2.7 | 2.2 | 1.8 | 1.8 | 2.5 | 2.0 | 2.2 |
| 6 | Indirect | 0.9 | 0.4 | 0.2 | 0.2 | 0.2 | 0.3 | 0.4 |
| 7 | Induced | 1.9 | 1.4 | 0.4 | 0.4 | 0.6 | 0.5 | 0.9 |
| 8 | Total | 5.6 | 3.9 | 2.5 | 2.4 | 3.3 | 2.8 | 3.5 |

Thus, we fall in the middle of these reports leaning slightly towards the more skeptical Aspen approach. The primary difference among these reports is in the treatment of construction travelers. We discuss our treatment of this issue above some length with a summary of our approach shown in Table 3.

# Conclusions

The proposed Sempra 1250 MW tieline connecting the California grid to envisioned new wind-farms in Mexico is about foregone opportunities, lost human capital investment, lost worklives, lost tax revenues, and diminished economic development prospects; and also, it is about which regulatory authority, California or Mexico, should oversee the environmental impacts of building green generation capacity for the California grid. And, it is about undoing some of the economic good and jobs stimulated by the first set of subsidized, utility-scale solar projects fast-tracked by the Interior Department.

This report focused on the economic losses to Imperial County, the state of California and the nation as a whole stemming from San Diego Gas & Electric/Sempra's proposal to import green-generated electricity from Mexico to meet its legally required quota of renewable energy generation in California instead of building that generation in California, itself. We show that if green generation capacity is built in Mexico, it displaces generation that would be built domestically. It is very unlikely, given the relative cost of renewable energy generation relative to fossil fuel energy generation that San Diego Gas & Electric will exceed its legally mandated renewable energy quota. So building green energy is a zero sum game. If it is built there, it will not be built here. In this report, we analyzed the substantial loss of jobs, the loss of income and the loss of tax revenues associated with not building this 1250 MW of renewable energy electrical generation capacity in the United States.

Should Sempra be allowed to build its proposed tie line , we demonstrate that the most likely immediate loser would be the workers, businesses and taxpayers of Imperial County, California. Sempra proposes to build its tieline across the Mexican border near the Imperial County-San Diego County border

(see map, Figure 1). Sempra proposes to connect to a transmission line carrying electricity from Imperial County to San Diego County. And Imperial County is rich in prospective photovoltaic electrical energy possibilities. So the zero sum game plays out with Imperial County the loser.

How much does Imperial County lose? For starters, Imperial County loses 2445 job-years on the lost construction sites themselves. In addition, Imperial County loses another almost 1000 job-years of off-site spinoff jobs in the supply chains and consumer chains that would have served the foregone construction work. In total, Imperial County will lose 3439 job-years of employment at a time when it is facing an unemployment rate of 27.9%, the highest county unemployment rate in the nation.

But in addition to this lost work, Imperial County also loses out on more than $4.5 million in human capital investment that would have gone into the training of more than 100 apprentices on this lost construction work. The fact that this door to better skills and better pay will not open if the Sempra tieline is approved means that more than 100 local Imperial County youth will each lose annually more than $36,000 in additional income (plus lost benefits) that they would have otherwise earned if their skills had been upgraded on this lost work. Over the 40 years of their worklives, in net present value terms, these 100 plus young people will each lose more than $1.2 million in wages and benefits due to the fact that the door to opportunity will be closed on them when the Sempra tieline is approved. Collectively, this amounts to a net present value of $127 million in lost income and benefits for workers in Imperial County. This in turn lowers the long-term tax base of the County, reduces demand for local goods and services, and serves as a continuing drag on local economic development.

Imperial County also loses out on 40 operation and maintenance jobs that would start when the construction was over and would last for 25 years. This is a total of 1000 lost job-years. With wages of more than $60,000 and benefits and payroll taxes taking total compensation to over $100,000, these lost jobs amount to a loss of $4 million annually in local payroll in Imperial County. The net present value of this lost payroll over 25 years starting 5 years from now is $78 million in today's dollars.

But Imperial County is not the only loser in any approval of Sempra's tieline. California will lose 9787 job-years, more than 6000 additional job losses over and above those lost in Imperial County alone. California's loses are greater simply because, as a small county, Imperial County imports from other regions of the state many of the supply-chain and consumer-chain goods and services that would have fed this new Imperial County work. So when Imperial County loses, California loses. And because this work is going to Mexico and not another state in the Union, the U.S. labor market as a whole loses out. We calculate that almost 15,000 job-years will be lost to the U.S. economy in its entirety from the loss of 1250 MW of generating capacity in Imperial County.

What is the value of these lost jobs? With unemployment rates stubbornly high and job growth excruciatingly slow, the human value of these lost jobs is not fully calculable in money terms. Protracted unemployment hurts children, strains marriages, drives up stress, forces families to forego health care, leads to foreclosures and blighted neighborhoods. But if we are to reduce these lost job-years to narrowly defined dollar terms alone, the median full-time wage in the U.S. is $39,260. So each lost job year costs an unemployed individual who could have had one of these jobs almost $40,000 per year plus lost benefits. The net present value of these almost 15,000 lost jobs-ears is more than $550 million in lost wages. Piled on top of these lost wages are the loss of health and pension benefits, and the loss of payroll taxes into unemployment insurance, workers compensation and social security.

From the government's perspective, the loss of jobs associated with Sempra's tieline translates into a loss of local, state and federal tax revenues. Taken together, this sums to a loss of tax revenues amounting to almost $300 million. So in a period of high unemployment, Sempra's tieline means jobs are lost: in a period of government fiscal crisis, Sempra's tieline means that tax revenues are lost. These losses should be seriously considered in any evaluation of the merits of Sempra's proposal to import captive green energy from Mexico.

The good news is, decision makers have the authority and ability to keep these jobs, skilled apprenticeship training opportunities, and tax benefits in Imperial County, in California and within the United States. During this prolonged aftermath of the Great Recession, when jobs are needed most, and nowhere more than in Imperial County, will state and federal leaders act to steer the economic benefits of building and operating renewable energy generation to California; or will they allow these jobs to slip away, leaving residents in Imperial County with merely the unfulfilled hope of a greener, more economically prosperous future?

## Endnotes

[1] US DOI, " Salazar, Abbey Describe Progress of Solar Energy on Public Lands," January 28, 2010, http://www.doi.gov/news/pressreleases/2010_01_28_release.cfm (last accessed July 4, 2011).
[2] US DOI, "Secretary Salazar Approves Second Large-Scale Solar Energy Project on Public Lands in Nevada," November 15, 2010, http://www.doi.gov/news/pressreleases/Secretary-Salazar-Approves-Second-Large-Scale-Solar-Energy-Project-on-Public-Lands-in-Nevada.cfm (last accessed July 4, 2011).
[3] US DOI, "Secretary Salazar Approves Ninth Commercial-Scale Solar Energy Project on Western Public Lands, 110 megawatt plant in Nevada will create 450 jobs," December 20, 2010; http://www.doi.gov/news/pressreleases/Secretary-Salazar-Approves-Ninth-Commercial-Scale-Solar-Energy-Project-on-Western-Public-Lands.cfm (access July 4, 2011); US BLS State and Metro Area Employment, http://www.bls.gov/sae/home.htm (last accessed June 30, 2011).
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[6] http://implan.com/V4/Index.php ; http://www.nrel.gov/analysis/jedi/about_jedi.html (last accessed July 4, 2011).
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[8] Noelle Straub, " RENEWABLE ENERGY: Interior touts fast-tracking of 13 solar projects," Environment and Energy Daily, January 29, 2010, SECTION: ON THE HILL Vol. 10 No. 9, http://www.e2.org/ext/doc/20100129EEDaily-DOItouts13solarProjects.pdf;jsessionid=67DFB8AC84C2B964BCEC69D29518B41E (last accessed July 3, 2011).

[9] Indeed, there is a larger debate regarding whether all sorts of green jobs can be outsourced. Observers in India see the green job initiative in the U.S. as a boon to Indian companies:

> Obama sounded resolute in September when he iterated that he would take big steps towards energy security in 2011 to reduce the world's largest economy's dependence on fossil fuels. If that happens, it will be good news for India - for a small but fastgrowing segment called 'outsourced green jobs'. The global green economy - ranging from solar energy to eco-friendly chemicals, from smart electricity grids to carbon accounting offshoring - is estimated at over $5 trillion, of which the US accounts for a sizeable one-fifth. As the sector continues to chug along - it was one of the few in the US that grew through the recession - green jobs are being shipped to India. According to researcher Brown-Wilson Group's Green Outsourcing report for 2009, 22,000 green jobs have been already outsourced to India last year. And, by the time the US green economy creates five million jobs, 20 per cent, or one million, would be outsourced to India.... [For example,] Chisk Inc., a California company started by Bhopal-born entrepreneur Shekhar Chitnis, is in talks with companies to get this job outsourced to its partner-offices in eight cities in India. Offshoring of "carbon tax/carbon credit accounting (work) is inevitable", Chitnis told BT.... But another emerging area, say industry insiders, is blue-collar green jobs in India. Tata BP Solar's India factories have now emerged as one of the top destinations for BP's solar photovoltaic manufacturing after it closed its Portuguese and Australian units in 2008 and 2009 and announced the closure of its US facility in 2010....California-headquartered Solar Semiconductor, which has a Hyderabad factory, is another instance. With the US market for solar panels opening up, its Vice President Ravi Surapaneni says the company may even set up manufacturing units in that country with experts from India running them. Wind energy equipment, similarly, could be another job creator....Surojit Bose, Associate Director for Sustainability in India, at PricewaterhouseCoopers, feels that a lot of research work in clean technology is waiting to be offloaded to India if the US Senate approves the comprehensive carbon legislation.
>
> Suman Layak and Rahul Sachitanand, " Green-collar jobs, the next wave." *Business Today*, November 14, 2010, http://businesstoday.intoday.in/story/green-collar-jobs-the-next-wave/0/9952.html (last accessed July 3, 2011).

[10] Not all solar panel manufacturing will be overseas. Responding to California's renewable energy portfolio standard which requires that California utilities source 33% of their power from green energy generation by 2020 (which is discussed later in this report), on April 12, 2011, SunPower and Flextronics announced the opening of a solar panel manufacturing plant in Milpitas, California, which will employ more than 100 manufacturing workers and turn out 75 megawatts of solar panels per year.

This manufacturing plant will supply panels for the construction of the 250 MW California Valley Solar Ranch discussed later in this report and which will break ground in 2011 and take 32 months to complete. Basically, the Milpitas manufacturing operation has sufficient capacity to supply this new solar farm with panels thus linking the building of this solar farm back to new supply chain jobs in U.S. manufacturing. This is an exceptional but hopeful example of how building a solar farm creates construction jobs in the U.S. plus manufacturing jobs in the U.S. supplying the needs of the local construction site.

SunPower CEO Tom Werner credited public policies for the creation of these new jobs: "Strong public policy at both the federal and state levels is paying off with job creation and capital investments from our equipment manufacturers to our dealers that install SunPower systems on homes and businesses across the U.S. and around the world,..."

It is telling that the opening of this 100 employee California manufacturing plant was reported on in India. See a SunPower Corp. News Release, "SunPower's and Flextronics' New Solar Manufacturing Plant Creates Jobs, Economic Benefits and Clean Affordable Energy," reported in *India Energy News*, New Delhi, April 12, 2011.

[11] Because these enclaves are rural, they may well be sites for future solar farms. But because these enclaves are in the U.S., they can draw from California as well as Nevada and Arizona labor pools. Thus, in contrast to an enclave in Mexico, developing green generating capacity in these Nevada and Arizona enclaves will provide new U.S. jobs, some of which may go to Californians but most of which probably will go to Nevada or Arizona workers depending upon which state each possible project is in. See: Western Electricity Coordinating Council, "[Map of] Western Interconnection Balancing Authorities," http://www.wecc.biz/library/WECC%20Documents/Publications/Balancing%20Authorities.pdf (last accessed June 27, 2011).

[12] Kevin P. Gallagher, Free Trade and the Environment: Mexico, NAFTA, and Beyond, Stanford University Press, 2004;

[13] Solar Energy Industry Association, "Utility-Scale Solar Power: Strategic Planning for Habitat Conservation," August 2010, http://seia.org/galleries/FactSheets/Factsheet_Habitat.pdf (last accessed June 29, 2011).

[14] Another consideration not covered in this report is the environmental cost overall and to Mexico of capturing Mexican green energy and pulling it onto the California grid. A large share of Mexican electricity is generated by burning high-sulfur fuel oil. Dirty emissions from burning this fuel poses a potentially large risk to both human health and the environment. So to the extent that wind energy is limited in Mexico, bringing that green energy across the border into California may increase the use of high sulfur fuel oil electrical energy generation in Mexico. This not only poses a potential threat to Mexican health and the Mexican environment, but to the extent that Mexican high sulfur fuel oil electrical generation occurs near the border with the U.S., emission pollution can potentially float across the border into the U.S. as well with concomitant risk to American health and the environment. See: M.T. López, M. Zuk, V. Garibay, G. Tzintzun, R. Iniestra and A. Fernández, "Health impacts from power plant emissions in Mexico," *Atmospheric Environment*, Volume 39, Issue 7, March 2005, Pages 1199-1209.

[15] See on the California Public Utility Commission website: "ENERGIA SIERRA JUAREZ (ESJ) U.S. TRANSMISSION GEN-TIE PROJECT SAN DIEGO COUNTY MAJOR USE PERMIT APPLICATION

AMENDED PROJECT DESCRIPTION,"
http://www.cpuc.ca.gov/environment/info/dudek/ECOSUB/TechStudies/ESJ_MUP_AmendPD.pdf (last accessed June 27, 2011). See also on Sempra Generation's website: "Sempra Generation Our Business, Projects in Operation, Energia Sierra Juarez," http://www.semprageneration.com/esj.htm On Sempra's website, it states that "Potential future phases of Energía Sierra Juárez could grow to generate as much as 1,000 MW of clean wind energy..." while on the California Public Utility Commission website, regarding the transmission line it is stated: " The proposed generator-tieline (Gen-Tie) would have the capacity to import up to 1250 MW of renewable energy generated in Northern Baja California, Mexico." (last accessed June 27, 2001). Because the transmission line's capacity is 1250 MW, we will assume that this is the benchmark amount of electrical generation capacity that would be supplanted in California.

[16] "Sempra Generation Our Business, Projects in Operation, Energia Sierra Juarez," http://www.semprageneration.com/esj.htm (last accessed June 27, 2011).

[17] California Public Utilities Commission, "California Renewables Portfolio Standard (RPS)," http://www.cpuc.ca.gov/PUC/energy/Renewables/ (last accessed June 27, 2011).

[18] California Public Utilities Commission, "33% Renewables ," http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/33implementation.htm (last accessed June 27, 2011).

[19]Chris Mehan, "California Gov. Brown says the state can do better than 33 percent renewable," Clean Energy Authority, April 14, 2011, http://www.cleanenergyauthority.com/solar-energy-news/california-makes-rps-into-law-041411/ (last accessed June 27, 2011).

[20] Chris Mehan, "SDG&E, on its way to meeting California's RPS, signs 237 more MW of solar," Clean Energy Authority, June 20, 2011 http://www.cleanenergyauthority.com/solar-energy-news/sdg-e-signs-237-more-mws-of-solar-062011/ (last accessed June 27, 2011).

[21] The exact current renewable procurement status percentages as of June 27, 2011 were: Pacific Gas and Electric (PG&E) - 17.7%; Southern California Edison (SCE) - 19.4%; and San Diego Gas & Electric (SDG&E) - 11.9%; California Public Utilities Commission, "California Renewables Portfolio Standard (RPS)," http://www.cpuc.ca.gov/PUC/energy/Renewables/ (last accessed June 27, 2011).

[22] Summit Blue Consulting, *RENEWABLE ENERGY FEASIBILITY STUDY FINAL REPORT*, Imperial Irrigation Disgtrict, April 1, 2008.

[23] County unemployment rates (preliminary, not seasonally adjusted): US Bureau of Labor Statistics (BLS), Local Area Unemployment Statistics (LAUS), COUNTY DATA, Table, http://www.bls.gov/lau/ (last accessed June 3, 2011).

[24] This chart is taken from the financial blog, Calculated Risk. The underlying data are from the US Bureau of Labor Statistics. The data through June, 2011 based on the July 8, 2011 US Bureau of Labor Statistics (BLS) Employment Situation Summary and earlier BLS data. See:
http://www.bls.gov/news.release/empsit.nr0.htm
http://cr4re.com/charts/charts.html#category=Employment&chart=JobLossesRecessionStartMay2011.jpg (last accessed July 8, 2011)

[25]US BLS, Local Area Unemployment statistics, http://www.bls.gov/lau/; see County Data, Map which links to http://www.bls.gov/lau/maps/twmcort.pdf (last accessed June 3, 2011).

[26] County unemployment rates (preliminary, not seasonally adjusted): US BLS, Local Area Unemployment Statistics, COUNTY DATA, Table, http://www.bls.gov/lau/ (last accessed June 3, 2011).

[27] Source: LA Times, June 17, 2011
http://www.latimes.com/business/la-fi-unemployment-california-2011-05-i,0,5986920.htmlstory
[28] U.S. Census Bureau, State & County Quick Facts,
http://quickfacts.census.gov/qfd/states/06/06025.html (last accessed June 3, 2011).
[29] County unemployment rates (preliminary, not seasonally adjusted): US BLS, Local Area Unemployment Statistics, COUNTY DATA, Table, http://www.bls.gov/lau/ (last accessed June 3, 2011). ; Population: US Census Bureau State & County Quick Facts,
http://quickfacts.census.gov/qfd/states/06/06083.html (last accessed June 3, 2011).
[30] US BLS, State and Local Unemployment Statistics, Local Area Unemployment Statistics (LAUS), preliminary not seasonally adjusted, http://www.bls.gov/lau/ (last accessed June 3, 2011).
[31] Author's calculation from US BLS current employment situation (CES) and quarterly census of employment and wages (QCEW) data. Peak employment month occurs in January 2008 (total US nonfarm employment), April 2006 (US construction employment), July 2007 (total California employment), February 2006 (California construction employment), April 2008 (Imperial County total covered employment) and October 2007(Imperial County covered construction employment). Imperial County data come from the QCEW and are defined as employees covered by unemployment insurance. All other data are from the CES.
[32] US DOE, Press Release, " Department of Energy Offers Conditional Loan Guarantee Commitments to Support Nearly $4.5 Billion in Loans for Three California Photovoltaic Solar Power Plants ," June 30, 2011 http://www.energy.gov/news/10404.htm ; US DOE, Press Release, " Department of Energy Offers Conditional Commitment for $1.187 Billion Loan Guarantee to Support California Solar Generation Project," April 12, 2011 http://www.energy.gov/news/10264.htm(last accessed July 3, 2011).
[33] " NRG Energy, Inc. Reports First Quarter 2011 Results," Daily the Pak Banker, May 18, 2011.
[34] Stephen F. Hamilton, Darin Smith and Tepa Banda, "Summary of Findings," Economic Impact to San Luis Obispo County of the California Valley Solar Ranch, December, 2010. (This report was done while SunPower was the project developer. The project has since been sold to NRG.
http://www.californiavalleysolarranch.com/pdfs/Economic_Impact_to_SLO__Final1.pdf
[35] Stephen F. Hamilton, Darin Smith and Tepa Banda, Economic Impact to San Luis Obispo County of the California Valley Solar Ranch, Table A-1, "Detailed Construction Employment by Type of Worker California Valley Solar Ranch Economic Impact Analysis; EPS #20133," December, 2010.
http://www.californiavalleysolarranch.com/pdfs/Economic_Impact_to_SLO__Final1.pdf (last accessed June 6, 2011).
[36] Stephen F. Hamilton, Darin Smith and Tepa Banda, "Economic Impact to San Luis Obispo County of the California Valley Solar Ranch," Appendix 14B, December, 2010
http://www.sloplanning.org/EIRs/CaliforniaValleySolarRanch/feir/apps/Ap14B_Economic_Impacts.pdf
Aspen Group, "Socioeconomic and Fiscal Impacts of the California Valley Solar Ranch and Topaz Solar Farm Projects on San Luis Obispo County," Appendix 14A
http://www.sloplanning.org/EIRs/CaliforniaValleySolarRanch/feir/apps/Ap14A_Fiscal_Impacts_Study.pdf both from County of San Luis Obispo, Department of Planning and Building, California Valley Solar Ranch Conditional Use Permit, and Twisselman Reclamation Plan and Conditional Use Permit,
http://www.sloplanning.org/EIRs/CaliforniaValleySolarRanch/index.htm (last accessed June 15, 2011);

Stephen F. Hamilton, Mark Berkman and Michelle Tran, Economic and Fiscal Impacts of the Topaz Solar Farm, March, 2011, http://topaz.firstsolar.com/downloads/TopazEconomicStudy.pdf (last accessed June 15, 2011); Mark Berkman and Wesley Ahlgren, "Economic and Fiscal Impacts of the Desert Sunlight Solar Farm," The Brattle Group, www.brattle.com, personal communication with Wesley Ahlgren, June 13, 2011, wes@cvep.com.

[37] In a DOE press release, the estimated number of construction jobs for this project was put at 350 new jobs. We have chosen the lower estimate of 286 reflecting our effort to generally make modest assumption. See:" The project, which is being built in San Luis Obispo County, CA, includes the construction of a 250 megawatt alternating current photovoltaic (PV) solar generating facility and associated infrastructure. California Valley Solar Ranch is expected to create 350 jobs during construction and 10-15 permanent jobs." US DOE Press Release " Department of Energy Offers Conditional Commitment for $1.187 Billion Loan Guarantee to Support California Solar Generation Project, April 12, 2011, http://www.energy.gov/news/10264.htm (last accessed July 3, 2011).

[38] Below we will discuss the possibility in some cases that the developer had implicitly included overtime in the information provided the economic analysts.

[39] Ibid.

[40] For underlying data see Hamilton, Smith and Banda, Pert II, tables 1, 3 and 4. Rounding error lead authors to sometimes present their assumption as 680 and sometimes 681 FTE construction jobs.

[41] Hamilton, Smith and Banda do touch on a related point of the possible synergies between Cal Poly San Luis Obispo and the development of new technologies associated with photovoltaic power. This too would be a long term advantage that could well outlast the life of the construction job, itself.

[42] They also did separate analyses of each project. For simplicity, in Table 1, we present their combined results.

[43] This include 25 FTE workers spending 20 months (or 42 FTE job-years) constructing tie-in transmission lines.

[44] These rates come from current California state prevailing wage proclamation applicable to Imperial County. See California Department of Industrial Relations, prevailing wage determinations,
http://www.dir.ca.gov/dlsr/pwd/Determinations%5CSanDiego%5CSD-023-63-3.pdf
http://www.dir.ca.gov/dlsr/pwd/Determinations%5CSanDiego%5CSD-023-31-4.pdf
http://www.dir.ca.gov/dlsr/pwd/Determinations%5CSanDiego%5CSD-023-102-3.pdf
http://www.dir.ca.gov/dlsr/pwd/Determinations%5CStatewide%5CC-020-X-1.pdf
http://www.dir.ca.gov/dlsr/pwd/index.htm (choose Imperial County here); (last accessed June 19, 2011).

[45] David R. Baker, "Brown signs law setting 33% mandate for utilities," The San Francisco Chronicle, April 13, 2011, Business; Pg. D1.

[46] Sources for the local Imperial County labor force include: US BLS Quarterly Census of Employment & Wages; http://www.bls.gov/cew/ ; US BLS, Local Area Unemployment Statistics, COUNTY DATA, Table, http://www.bls.gov/lau/ ; US Census State and County Quickfacts
http://quickfacts.census.gov/qfd/states/06000.html ;CA EDD California Labor Market Review April 2011; http://www.calmis.ca.gov/file/lfmonth/CaLMR.pdf (last accessed June 21, 2011).

[47] There are some barriers to entry for apprentices. For electricians, they must have high school algebra and other crafts they typically must have a high school diploma or equivalent. Returning local veterans

may be given preference given the skills they possibly acquired in the military and the in-place Helmets to Hardhats program most union construction apprenticeship programs have.

[48] Aspen Group, "Socioeconomic and Fiscal Impacts of the California Valley Solar Ranch and Topaz Solar Farm Projects on San Luis Obispo County," Appendix 14A , Tables 3-1 and 3-2, pp. Ap.14A-7 and Ap14A-9, http://www.sloplanning.org/EIRs/CaliforniaValleySolarRanch/feir/apps/Ap14A_Fiscal_Impacts_Study.pdf

[49] Apprenticeship ratios are set by collectively bargained contracts and/or the apprenticeship standards of particular registered programs and they can vary among crafts. Sometimes project labor agreements (PLAs) are signed for particular projects and under limited circumstances those PLAs may modify the required journeyworker -to-apprentice ratio. In our analysis, we assume the typical apprenticeship ratio of 3:1 journeyworkers to apprentices. If PLAs were signed to build this 1250 MW capacity and these PLAs lowered the apprenticeship ratio to (say) 3:2 or 3:3, then in our analysis, more workers could be sourced locally due to lowered skill barriers and thus the local economic impact of building this capacity would be greater. The less aggressive assumption is to assume, as we do, the standard apprenticeship ratio.

[50] In effect, we are assuming that professional workers will spend their incomes similarly to local workers. This is not entirely the case because traveling professional engineers, construction managers and supervisors may well have homes and families elsewhere that will drain away spending compared to permanent local residents. But this is a level of detail that is more granular than the level of this analysis.

[51] Calculation of the hourly wage rate weighted by craft-apprentice, local-traveling employment:

| | a | b | c | d | e | f | g | h | i |
|---|---|---|---|---|---|---|---|---|---|
| | | Carpenters | Op. Eng. | Piledrivers | Admin. Super. & Other | Ironworkers | Laborers | Elecrtricians | Total |
| 1 | FTE job-years | | | | | | | | |
| 2 | Local journeyworkers/professiona; | 3 | 26 | 130 | 354 | 201 | 590 | 626 | 1931 |
| 3 | Local apprentices | 2 | 13 | 68 | 0 | 105 | 0 | 326 | 514 |
| 4 | Traveling journeyworkers | 2 | 14 | 73 | 0 | 113 | 0 | 352 | 555 |
| 5 | Total FTE job-years | 7 | 54 | 271 | 354 | 419 | 590 | 1305 | 3000 |
| 6 | Total Hourly Wage plus Health & Vacation | | | | | | | | |
| 7 | Local journeyworkers/professiona; | $37.35 | $35.83 | $37.28 | $50.00 | $33.00 | $26.14 | $36.65 | |
| 8 | Local apprentices (=60% journeyworker) | $22.41 | $21.50 | $22.37 | | $19.80 | | $21.99 | |
| 9 | Traveling journeyworkers | $37.35 | $35.83 | $37.28 | | $33.00 | $26.14 | $36.65 | |
| 10 | Hourly wage rate times number of workers | | | | | | | | |
| 11 | Local journeyworkers & professionals | $130 | $923 | $4,857 | $17,701 | $6,639 | $15,423 | $22,949 | $68,621.60 |
| 12 | Local apprentices | $41 | $288 | $1,518 | $0 | $2,075 | $0 | $7,172 | $11,092.97 |
| 13 | Traveling journeyworkers | $73 | $519 | $2,732 | $0 | $3,734 | $0 | $12,909 | $19,967.34 |
| 14 | Average local wage rate | $32.23 | $30.92 | $32.17 | $50.00 | $28.48 | $26.14 | $31.63 | $32.60 |
| 15 | Average traveler wage rate | $37.35 | $35.83 | $37.28 | | $33.00 | | $36.65 | $35.97 |
| 16 | Average overall wage rate | $33.62 | $32.25 | $33.55 | $50.00 | $29.70 | $26.14 | $32.99 | $33.23 |

[52] CA Employment Development Department, Detailed Guide for Electricians in California, Green Electricians; http://www.labormarketinfo.edd.ca.gov/OccGuides/Detail.aspx?Soccode=472111&Geography=0601000000 (last accessed June 11. 2011).

[53] Table A-3, "Detailed Construction Wages California Valley Solar Ranch Economic Impact Analysis; EPS #20133," footnote 3, Stephen F. Hamilton, Darin Smith and Tepa Banda, Economic Impact to San

Luis Obispo County of the California Valley Solar Ranch, December, 2010. http://www.californiavalleysolarranch.com/pdfs/Economic_Impact_to_SLO__Final1.pdf (last accessed June 6, 2011).

[54] National Electrical Contractors Association-International Brotherhood of Electrical Workers, San Diego and Imperial County, Inside Wireman Apprenticeship Program, http://www.sdett.org/careerinsidewireman.asp

[55] University of California, Budget and Capital Resources, Cost of Education Calculations at the University of California, April, 2011; https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxib2JzYW11ZWxzZG9jdW1lbnRzfGd4OjE0MzI5Y2ZiYWVjNTExNTc (last accessed June 17, 2011).

[56] The Center for Construction Research and Training, Construction Chart Book, "Labor Force Characteristics", "Worker Age in Construction and Other Industries," 2008, p. 12, http://www.cpwr.com/pdfs/CB%204th%20Edition/9_18%20Labor%20Force%20Characteristics.pdf#page=7 (last accessed June 12, 2011).

[57] See for instance: STEPHEN SINGER, " Aging work force inspires utility worker training," KOMO New, Oct 2, 2010, http://www.komonews.com/news/business/104207944.html and Construction Labor Research Council, "CRAFT LABOR SUPPLY OUTLOOK 2005 - 2015," 2005, http://www.buildri.org/stuff/contentmgr/files/7d3dc7e76443d1386451b437d684e009/misc/2005.craft_labor_supply_report.pdf

[58] This corresponds to the California 75th percentile for electrician income of $73,077. CA Employment Development Department, Detailed Guide for Electricians in California, Green Electricians; http://www.labormarketinfo.edd.ca.gov/OccGuides/Detail.aspx?Soccode=472111&Geography=0601000000 (last accessed June 11. 2011).

[59] US Census State and County Quickfacts http://quickfacts.census.gov/qfd/states/06000.html (last accessed June 21, 2011).

[60] Local construction employee total compensation plus 11% payroll taxes amount to a total of $249,222,302. This is derived from the figure for total compensation for local construction workers in column I row 4 of Table 4 multiplied by 1.11 to include 11% in payroll taxes. An additional 20% of travelers income plus payroll taxes equals $14,445,653. Taken together, these are input into IMPLAN to calculate the resulting employment effect holding the level on the project at 3000 FTE job-years. In th California state and U.S. estimates, traveler total compensation is set at 100%.

[61] MIG, Inc., IMPLAN System (data and software), 502 2nd Street, Suite 301, Hudson, WI 54016 www.implan.com

[62] **A Comparison of IMPLAN with JEDI, an Alternative Specialized Computer Program:**

IMPLAN is a widely used program for analyzing local economic impact of new projects. JEDI is a similar input-output program developed by the Department of Energy using IMPLAN mulitpliers but adapted to the specific construction characteristics of various types of electrical power generation facilities.

One of JEDI's advantages in its specialized photovoltaic electrical generation construction program is that the user can adjust the program based on the percent of solar modules bought locally and manufactured locally. In this case, locally means California. Because the solar modules in a photovoltaic

solar farm account for about 50% of all construction material costs, the extent to which a new facility creates new domestic jobs along its supply chain depends upon whether these solar panel modules are manufactured and sold locally. Indeed, the overall impact of new solar generating capacity in California will depend significantly upon whether California ramps up its ability to manufacture these photovoltaic solar panel modules to meet new demand. There is some evidence that this will happen; but this remains an open question.

| | | IMPLAN | JEDI Percent Solar Modules Made & Bought in CA | | | | |
|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f |
| | | NA | 0% | 25% | 50% | 75% | 100% |
| 1 | Direct employment on construction site | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| 2 | Jobs-years created by demand for input materials, supplies and services | 2,706 | 4,351 | 5,729 | 7,107 | 8,485 | 9,863 |
| 3 | Job-years induced by new demand for consumer goods & service | 4,082 | 2,208 | 2,720 | 3,231 | 3,742 | 4,253 |
| 4 | Total new job-years | 9,787 | 9,558 | 11,447 | 13,337 | 15,226 | 17,115 |
| | | | | | | | |
| 5 | Jobs-per-year on construction site | 600 | 600 | 600 | 600 | 600 | 600 |
| 6 | Jobs-per-years created by demand for input materials, supplies and services | 541 | 870 | 1,146 | 1,421 | 1,697 | 1,973 |
| 7 | Job-years induced by new demand for consumer goods & service | 816 | 442 | 544 | 646 | 748 | 851 |
| 8 | Total new jobs-per-year for 5 years | 1,957 | 1,912 | 2,289 | 2,667 | 3,045 | 3,423 |

This Table reproduces the job estimates from IMPLAN shown for California in Table 7. This Table compares these results with 5 estimates derived from JEDI using 5 different assumptions regarding the purchase of solar panel modules from California manufacturers. Column **a** reproduces the California job estimates from Table 7 with total FTE job years in the upper panel and average number of jobs per year in the lower panel. Column **b** shows estimates from a JEDI model assuming that no solar panels for the project are bought from California manufacturers.

The balance between supply chain jobs and consumer-based jobs differs somewhat between the IMPLAN and JEDI models. Nonetheless, in the aggregate, the IMPLAN model and the JEDI model in column **b** (the one that assumes no panels made locally) have very similar results: IMPLAN predicts 1,957 new jobs annually including 600 on-site while JEDI predicts 1,912 new jobs annually including the 600 on-site. These models diverge once we assume, in the JEDI model, that California begins making solar modules for this project.

Once the JEDI models assume some of the solar panels come from California manufacturers, the number of supply-chain jobs grows dramatically. (Scan lines 2 and 6 from columns **b** to **f** to see total FTE job-years and jobs-per-year grow as the local sourcing of solar panels goes from 0% to 100%). The consumer-chain jobs also grow but more slowly. Their growth is due to the consumer demand created by the new jobs needed among the manufacturers of solar panels to supply this 1250 MW project. In the JEDI model, when state manufacturing of solar panels goes from 0% supplied to 100% locally sourced for this project, state supply-chain employment jumps from 870 new jobs to 1,973 new jobs.

Overall in the JEDI model, these projects accounting for 1250 MW of photovoltaic electrical generation capacity and employing 600 workers per year for 5 years will generate 1,912 jobs per year for 5

years in California if none of these jobs are in solar panel manufacturing. That jumps to 3,423 jobs per year for 5 years if all of the solar panels for this project are bought from California manufacturers.

It may be, however, that if a comparable capacity were built in Mexico, that the Mexican facilities might buy their solar panels from California manufacturers. It remains an open question whether or not California solar panel manufacturing will ramp up to meet the emerging demand for photovoltaic solar panels associated with the new construction that is coming on-line. It also remains an open question whether US construction contractors are more likely to buy US solar panels compared to Mexican contractors buying U.S solar panels. Hypothetically, if Mexican contractors bought the same number of panels from California as California contractors would have, then these *solar-panel supply chain* effects could be similar whether the solar farms were built in Mexico or California.

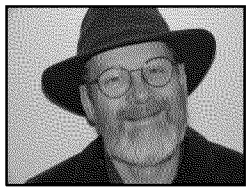
Thus, conservatively, we set aside these solar-panel specific supply-chain estimates derived from JEDI and focus on the IMPLAN results which are similar to the JEDI results with no locally bought solar panels.

[63] US BLS, Usual Weekly Earnings Summary, April 19, 2011, http://bls.gov/news.release/wkyeng.nro.htm (last accessed June 30, 2011).

[64] Aspen reports jobs rather than job-years, and to make their report consistent with in Table 11, the number of direct local construction jobs are multiplied by 3, the assumed number of years the construction projects would last. Aspen Group, "Socioeconomic and Fiscal Impacts of the California Valley Solar Ranch and Topaz Solar Farm Projects on San Luis Obispo County," Appendix 14A p. Ap.14A-12 Tables 4-1 and 4-2 http://www.sloplanning.org/EIRs/CaliforniaValleySolarRanch/feir/apps/Ap14A_Fiscal_Impacts_Study.pdf

[65] Stephen F. Hamilton, Darin Smith and Tepa Banda, "Executive Summary," Economic Impact to San Luis Obispo County of the California Valley Solar Ranch, December, 2010 Part II, Table 1, p. 4 http://www.sloplanning.org/EIRs/CaliforniaValleySolarRanch/feir/apps/Ap14B_Economic_Impacts.pdf ; Aspen Group, "Socioeconomic and Fiscal Impacts of the California Valley Solar Ranch and Topaz Solar Farm Projects on San Luis Obispo County," Appendix 14A p. Ap.14A-12 Tables 4-1 and 4-2 http://www.sloplanning.org/EIRs/CaliforniaValleySolarRanch/feir/apps/Ap14A_Fiscal_Impacts_Study.pdf ; Stephen F. Hamilton, Mark Berkman and Michelle Tran, Economic and Fiscal Impacts of the Topaz Solar Farm, March, 2011, Table 4.3 p. 11 http://topaz.firstsolar.com/downloads/TopazEconomicStudy.pd ; Mark Berkman and Wesley Ahlgren, "Economic and Fiscal Impacts of the Desert Sunlight Solar Farm," The Brattle Group, Tables 4.1 and 4.2 pp. 9-10, www.brattle.com, personal communication with Wesley Ahlgren, June 13, 2011, wes@cvep.com.

*Peter Philips*



# CURRICULUM VITAE

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June, 2011

## *SUMMARY*

**Employment:** July 1978 to June 1980, Instructor, July 1980 to June 1987, Assistant Professor, July, 1987 to June 1994, Associate Professor, July 1994 to date, Professor of Economics, Visiting Adjunct Instructor, Pitzer College, 2007-08, Visiting Professor, UCLA School of Urban Planning, 2007-08, University of Utah, Chair, Economic Department, University of Utah, Chair, Economics Department, July 1, 2008 to June 30, 2011.

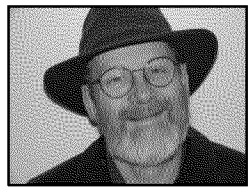
**Research:** 34 peer-reviewed journal articles; 4 non-peer-reviewed journal articles; 4 edited books and 1 co-authored book; 12 book chapters; 5 book reviews; finalist College Superior Research Award (2003); University of Utah, Graduate Student & Postdoctoral Scholar Distinguished Mentor, 2007

**Teaching:** University of Utah, College of Social and Behavioral Sciences, Superior Teacher Award (1982); Lowell Bennion University Distinguished Service Professor (1992-1993); University of Utah, Presidential Teaching Scholar (1993); Nominee, Student Choice Teaching Award, Academic Affairs Board of the Associated Students of the University of Utah, 2004; University of Utah, Graduate Student & Postdoctoral Scholar Distinguished Mentor, 2007; 15 Ph.D. theses chaired; 11 masters theses or projects chaired

## *SPECIALIZATION*

Labor Economics, Collective Bargaining, Labor History, Economics of Construction, Economics of Occupational Safety

# Peter Philips



## *DISSERTATION*

"The Evolution of Industrial Organization, Technology and Wage Structures in the California Canning Industry"

## *EDUCATION*

Pomona College, Claremont, California, B.A. 1970; Stanford University, Stanford, California, M.A., 1977, Ph.D., 1980.

## *HONORS*

California State Scholar (1966-1970)

Leland Backstrand Graduating Senior Award in Economics, Pomona College (1970)

Stanford University/Ford Foundation Fellowship (1970-71 and 1974-1977)

University of Utah, College of Social and Behavioral Sciences, Superior Teacher Award (1982)

University of Utah, College of Social and Behavioral Sciences, Dean's Research Fellow (1985 and 1988)

University of Utah, John R. Park Teacher's Fellowship (1988)

University of Utah, Lowell Bennion University Distinguished Service Professor (1992-93)

University of Utah, Presidential Teaching Scholar (1993)

Finalist, Senior Superior Research Award, College of Social and Behavioral Sciences, University of Utah, 2003

Nominee, Student Choice Teaching Award, Academic Affairs Board of the Associated Students of the University of Utah, 2004

University of Utah, Graduate Student & Postdoctoral Scholar Distinguished Mentor, 2007

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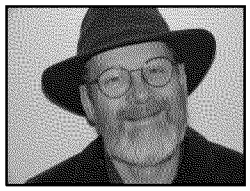


## *WORK * HISTORY*

July 1978 to June 1980, Instructor,
July 1980 to June 1987, Assistant Professor
July, 1987 to June 1994, Associate Professor
July 1994, Professor, University of Utah
Sabbatical 2007-08 Pitzer College and UCLA
Chair, 2008 to present
Economics Department,
University of Utah
Salt Lake City, Utah

## *USUAL*COURSES*

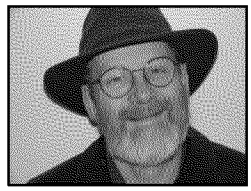
(Quarter System)
Economics 274: American Economic History
Economics 302: Intermediate Microeconomics
Economics 310: Labor Economics
Economics 512: Public Policy Towards Labor
Economics 513: Collective Bargaining
Economics 514: Wage Theory
Economics 516: Labor Market Analysis
Economics 517: Political Economy of Women's Work
Economics 715: Labor Economic Theory

(Semester System)
Economics 1740: American Economic History
Economics 3100: Labor Economics
Economics 5120: Labor Law and Collective Bargaining
Economics 7150: Labor Economic Theory
Economics 7590: Applied Econometrics
Economics 7960: Topics in Econometrics

## *PUBLICATIONS*

### 1. Published and Accepted Articles (peer reviewed):

1. "Gender-Based Wage Differentials in Pennsylvania and New Jersey Manufacturing," Journal of Economic History, May 1982, pp. 181-186.



2. "Analytical and Polemical Roots of Human Capital Theory," MidSouth Journal of Economics, Spring 1982.

3. "Industrialization, Unionization and the Labor Market Structure in the California Canneries," Industrial and Labor Relations Review, April, 1985, pp. 392-407 (co-authored with Martin Brown).

4. "On the Constancy of the Racial Wage Gap in New Jersey Manufacturing 1901 to 1980," Review of Black Political Economy, Spring 1985, pp. 71-76.

5. "Mechanization, Unionization and the Decline of the Piece-Rate System in the California Canneries," Industrial Relations, March, 1986 pp.81-91 (co-authored with Martin Brown).

6. "The Historical Origin of Job Ladders in the U.S. Canning Industry and Their Effects on the Gender Division of Labor," Cambridge Journal of Economics, June, 1986, pp. 129-45 (co-authored with Martin Brown).

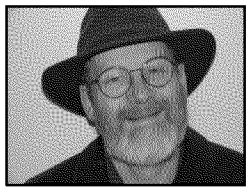
7. "Craft Labor and Mechanization in Nineteenth Century American Canning," Journal of Economic History, September, 1986, pp. 743-56 (co-authored with Martin Brown).

8. "Competition, Racism and Hiring Practices Among Early California Manufacturers," Industrial and Labor Relations Review, October, 1986 pp. 61-74 (co-authored with Martin Brown).

9. "Technological Innovation and Payment Systems," Business History Review, Winter 1987 pp. 564-601 (co-authored with Martin Brown).

10. "Doubts Regarding the Human Capital Theory of Racial Inequality," Industrial Relations, Spring, 1988 pp.251-62 (co-authored with David Kiefer).

11. "The Effect of Immigration Law on Industrial Structure and Collective Bargaining in the California Food Processing Industry", Review of Radical Political Economics Winter, 1990 (co-authored with Bill Segal). (A longer version of this paper was is a report to the U.S. Labor Department and is available from the Division of Immigration Research, U.S. Department of Labor.)



12. "The Decline of Child Labor in the U.S. Fruit and Vegetable Canning Industry", Business History Review Winter 1992 Vol. 66 pp. 723-770 (co-authored with Martin Brown and Jens Christiansen).

13. "Construction Safety Put at Risk", New Solutions, A Journal of Environmental and Occupational Health Policy, Vol. 6, No. 1 (Fall 1995) pp. 77-83.

14. "Women, Technology and the Gender Division of Labor in Manufacturing," Research in Economic History Vol. 16, 1996 (co-authored with Jens Christiansen and Mark Prus) pp. 103-126.

15. "The Effects of Unionization and State Prevailing Wage Laws on Injuries in Construction, 1976 to 1991" (with Norman Waitzman) *Abstracts* of the American Public Health Association, 124th Annual Meeting, November 17-21, 1996, New York City, entitled: *Empowering the Disadvantaged, Social Justice in Public Health*, p. 407.

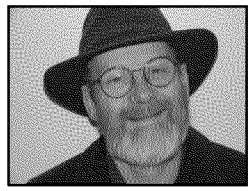
16. "A Step in the Right Direction Friedman's New Estimates of Union Membership: The United States, 1880-1912," Historical Methods, A Journal of Quantitative and Interdisciplinary History, Volume 32, Number 2, Spring 1999, pp. 87-92.

17. "Prevailing Wage Regulations and School Construction Costs: Evidence from British Columbia," (with Cihan Bilginsoy) Journal of Education Finance, Winter 2000, Vol. 25, No. 1, pp. 415-432.

18. "Making Hay When It Rains—The Effect of Scale Economies, Seasonal and Cyclical Business Patterns, and Prevailing Wage Regulations on School Construction Costs," (with Hamid Azari-Rad and Mark Prus) Journal of Education Finance, Vol. 27, No. 4, Spring 2002, pp. 997-1012.

19. "Origin of the Factoid—Prevailing Wage Laws Are Remnant Jim Crow Laws," Review of Radical Political Economics, (with Hamid Azari-Rad), September 2002, vol. 34, no 3, pp. 275-284.

20. "Impact of the OSHA Trench and Excavation Standard on Fatal Injury in the Construction Industry," Journal of Occupational and Environmental Medicine, Vol. 44, No. 10, October 2002, pp. 902-905 with (Anthony Suruda, Brad Thomas Whitaker, Donald Bloswitz and Richard Sesek).



21. "Race and Prevailing Wage Laws in Construction Industry, Comment on Thieblot," (with Hamid Azari-Rad) Journal of Labor Research, Vol. XXIV No. 1, Winter 2003, pp161-168.

22. "State Prevailing Wage Laws and School Construction Costs," (with Hamid Azari-Rad and Mark Prus), Industrial Relations, Vol. 42, No. 3, July 2003, pp. 445-457.

23. "Organizational Change and Workers' Safety in the Construction Industry: The Case of Articulated Subcontracting and Extended Division of Labor," (with Hamid Azari and Wendine Thompson-Dawson), Industrial Relations Research Association Series, Annual Research Volume, Proceedings of the 55th Annual Meeting, Adrienne E. Eaton, ed., 2003, pp. 240-47.

24. "Fatal Injuries to Teenage Construction Workers in the U.S.," (with Anthony Suruda, Dean Lillquist and Richard Sesek), *American Journal of Industrial Medicine*, Volume 44, Issue 5 (November 2003) pp. 510-14.

25. "Building for the Rich, Broadcasting to the Poor: How the N.B.A. Responded to a Changing Economy," Proceedings of the Third International Conference on Sports Economics, Panhellenic Association of Sports Economics and Managers (2004), with Cory Sinclair.

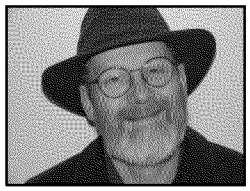
26. "Prevailing Wage Legislation and Public School Construction Efficiency: a Stochastic Frontier Approach," (with Kevin Duncan and Mark Prus) Construction Management and Economics, Vol. 24 (June 2006) pp. 625-634.

27. "Do Prevailing Wage Laws Increase the Cost of Constructing Public Schools?" (with Kevin Duncan and Mark Prus) *WorkingUSA* (forthcoming).

28. "The NBA in Black and White: Changing Fan Reaction to the Presence of Blacks in Profession Basketball—1951 to 1997," (with Cary Sinclair), Labor and Employment Relations Series, Annual Research Volume, Proceedings of the 59th Annual Meeting, 2008, (forthcoming).

29. "Analysis of the Impacts of the Number of Bidders upon Bid Values: Implications for Contractor Prequalification and Project Timing & Bundling," (with Sheng Li), Public Works Management & Policy, January 2008 vol. 12 no. 3 503-514.

30. "The Effects of Prevailing Wage Regulations on Construction Efficiency in British Columbia," (with Kevin Duncan and Mark Prus) International Journal



of Construction Education and Research, Volume 5, Issue 2 April 2009 , pages 63 -78.

31. 32. Kim, Jaewhan and Philips, Peter, "Health Insurance and Worker Retention in the Construction Industry," Journal of Labor Research, , February 2010.

32. Kim, Jaewhan and Philips, Peter, "Effect of Multiemployer Collective Bargaining on Employer-Provided Health Insurance in the Construction Industry," Journal of Labor Research, online publication, July 2010.

33. Kim, JaeWhan and Philips, Peter, "A Case Study of Labor Turnover on a Large Industrial Construction Project," Journal of Construction Engineering & Management, (forthcoming 2011).

34. Kim, JaeWhan and Philips, Peter, "Socio-Economic Factors Influencing the Failure to Measure the Blood Pressure of Children during Clinical Examinations," Journal of Clinical Hypertension, (forthcoming, 2011).

**2. Working Papers and Submitted Manuscripts:**

1. "Do Entrant and Incumbent Bidders Exhibit Different Aggressive Characters in the Construction Procurement Auction?" with Sheng Li submitted to a peer-reviewed journal September 2010)

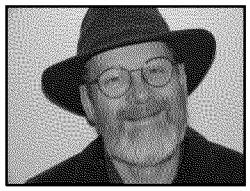
2. "Spatial Dimensions of Health Insurance Utilization in South Korea," with JaeWhan Kim, (submitted to a peer-reviewed journal October 2010)

3. " The Effect of Prevailing Wage Regulations on Contractor Bid Participation and Behavior: A Comparison of Palo Alto, California with Four Nearby Prevailing Wage Municipalities," with JaeWhan Kim (submitted to a peer-reviewed journal July 2010)

3. **Books, Chapters in Books, Edited Volumes:**

1. Three Worlds of Labor Economics, (co-edited with Garth Mangum), M.E. Sharpe, N.Y., 1988, ISBN 0-87332-455-2 and 0-87332-456-0 (pbk), 357p.

# *Peter Philips*



2. "The Male Racial Pay Gap, 1939 to 1979: A Neoclassical Story and Institutional Response," (co-authored with David Kiefer) in Garth Mangum and Peter Philips, eds., Three Worlds of Labor Economics, M.E. Sharpe , N.Y., 1988, pp. 117-43.

3. "Competition, Racism and the Substitution of White Women for Chinese Men in Nineteenth-Century California Manufacturing," (co-authored with Martin Brown) in Rajani Kanth and E.K. Hunt, eds., Explorations in Political Economy: Essays in Criticism Roman and Littlefield, 1990, pp 173-99.

4. "Explanation of Long-term Trends in the Racial Wage Gap," (co-authored with David Kiefer) in Rajani Kanth and E.K. Hunt, eds. Explorations in Political Economy: Essays in Criticism Roman and Littlefield 1990, pp 137-150.

5. "Small and Large Firms and the Gender Gap in Manufacturing Wages, "(co-authored with Susan Carter) in Katherine Abraham, ed. New Directions in Labor Markets and Industrial Relations, M.I.T. Press, Cambridge Massachusetts, 1991, pp. 213-238.

6. "The Transition from Outwork to Factory Production in the Lynn Boot and Shoe Industry, 1850 to 1880," (co-authored with Jens Christiansen) in Sanford Jacoby, ed., Masters to Managers: Historical and Comparative Perspectives on American Employers, 1850 to 1950, Columbia University Press, 1991, pp 21-42.

7. "The Effect of the Repeal of Utah's Prevailing Wage Law on the Construction Labor Market" (co-authored with Hamid Azari-Rad and Anne Yeagle) in Sheldon Friedman, Richard Hurd, Ronald L.Seeber and Rudy Oswald, eds. Restoring the Promise of American Labor Law, Cornell University ILR Press, 1994, pp. 207-21.

8. Portable Pensions for Casual Labor Markets: Lessons from the Operating Engineers Central Pension Fund, Quorum Books, 1995 (co-authored with Teresa Ghilarducci, Garth Mangum and Jeff Petersen).

9. "Samuel Gompers," (with Cory Sinclair) in Joel Moykr, ed., Oxford Encyclopedia of Economic History, Oxford University Press, (2003).

10. Building Chaos: An International Comparison of the Effects of Deregulation on the Construction, (co-edited with Gerhard Bosch) Routledge Press, London, 2003, 240pp. index.

11. "A Tale of Two Cities: the High and Low Road to the Development of the US Construction Industry," chapter 8 in Building Chaos: An International Comparison of the Effects of Deregulation on the Construction, (co-edited with Gerhard Bosch) Routledge Press, London, 2003, pp. 161-187.

12. "Introduction," co-authored with Gerhard Bosch, in Building Chaos: An International Comparison of the Effects of Deregulation on the Construction, (co-edited with Gerhard Bosch) Routledge Press, London, 2003, pp. 2-23.

13. The Economics of Prevailing Wage Laws, co-edited with Hamid Azari-Rad and Mark Prus, Ashgate Publishers, Burlington, VT, 2005, 262 pp. index.

14. "Construction Unions in the Midwest," (with Mark Price) in The American Midwest: an interpretive encyclopedia, Richard Sisson, Christian K. Zacher, Andrew Robert Lee Cayton, eds., Indiana University Press, 2007,

15. "Prevailing Wage Laws, Productivity and Construction Efficiency?" (Kevin Duncan, Peter Philips, and Mark Prus) CME25 Conference. Proceedings of the Inaugural Construction Management and Economics, "Past, Present, and Future." Edited by Will Hughes. First Published 2008, pp 1411-1418. ISBN 978-0-415-46059-0 (3 vols).

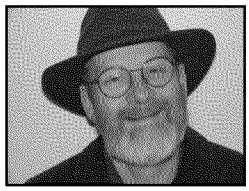
16. Construction Research at NIOSH: Reviews of Research Programs of the National Institute for Occupational Safety and Health, The National Academies Press, Washington, DC, 2008 (Richard Tucker, chair).

4. **Book Reviews:**

1. "Review of American Workers, American Unions, 1920-1965" by Robert H. Zeiger in the Journal of Economic History, December, 1987.

2. "Review of Canning Women, Cannery Lives: Mexican Women Unionization, and the California Food Processing Industry, 1930-1950" by Vicki Ruiz, in the Journal of Economic History, March 1989.

3. "Review of Canning Women, Cannery Lives: Mexican Women Unionization, and the California Food Processing Industry, 1930-1950" by Vicki Ruiz in



Business History Review March 1989. (These two reviews were separately invited and are distinct.)

4. "Review of The Economic Pursuit of Quality" by Thomas Michael Power in the Journal of Economic Literature Vol. XXVII No. 3, September 1989.

5. "Review of Manufacturing Inequality, Gender Division in the French and British Metalworking Industries, 1914-1939" by Laura Lee Downs in the Journal of Economic Literature Vol. XXXV, No. 1, March, 1997.