California Green Jobs

An Updated Review: Phase I Estimates

May 2018
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Introduction & Summary

The concept of green jobs has increasingly been used as a tool to justify environmental policies more broadly, and the state’s expanding program of climate change regulation specifically. In so doing, both proponents and the agencies now rely heavily on these—often unsubstantiated—job claims as purported indications that regulations will proceed cost-free or at worst under costs that are absorbable and balanced by a presumed increase in jobs.

The current path the state has chosen to a low-carbon economy, however, will not be painless. Consumers and employers already face growing costs from energy, fuels, housing, and commuting as a result of growing body of regulations. Combined with the evolving two-tier nature of the state’s economy, these costs also have considerably different effects on the different regions and on the income divides within each one.

As these regulations embrace more of the economic and daily living activity within the state, these costs have the potential to grow still larger. The foundational statutes behind the state program (AB 32) acknowledged this situation, mandating that the agencies adopt policies that are “cost effective” and seek ways to reach the climate goals at the lowest overall cost. But instead of allotting effort to analysis of cost effectiveness—in part driven by the ambitious time schedule to reach the goals—the concept of green jobs is used to argue that regulations will be cost free if not an economic benefit overall. As stated by Harvard economist Robert Stavins (2008) in the early stages of the AB 32 program:

Given that the debate about whether to implement AB 32 is over, the CARB should shift its attention away from defending its position that AB 32's implementation will save Californians money – a position based on flawed analysis and inconsistent with decades of economic analysis on this important challenge. Instead, it should focus on analyzing how it can design policies that minimize the cost of meeting AB 32's target, assessing the economic risks associated with implementing AB 32 and how best to reduce those risks, as well as evaluating the distributional and competitiveness impacts of AB 32's implementation and how best to mitigate those impacts.

This current report builds on prior Center analyses of green job claims (2015, 2016) by providing additional background on three basic questions:

- What Is a Green Job? Reviews the current range of green/clean energy job definitions, estimates, and distributions across job type and industry. Based on this information, develops a preliminary estimate of California green jobs for use in the subsequent study phases.

- What Is the Economic Significance of Green Jobs? Assesses green jobs in terms of current claims of their significance to the California economy, including case study summaries of individual green job industries.
• What Is the Cost of Green Jobs? Contains initial assessments of the cost of key green job components for use in the subsequent study phases.

As indicated, this report is the first phase of a broader Center analysis of this issue. The initial estimates contained in this document—adjusted as necessary as the result of any comments we receive from outside reviewers—will form the basis for the next two steps: (1) a survey of California employers that will be used to refine the estimates and (2) an analysis of the net employment effects on California’s economy, an element that generally is missing from the current estimates developed by the various advocacy groups. The resulting analytical structure will then be used by the Center to develop periodic updates on this issue.

In approaching this project, the goal is to develop a more consistent and transparent base of information of this topic and thereby provide more of a basis for consideration of job creations and job impacts in discussions on California’s current policy trajectory. In so doing, this effort is intended to bring more information to the table on a topic that to date has been treated more in a manner best summarized by a similar recent review on this issue:

Exacerbating the situation is the fact that the most disruptive innovations arise from short-lived start-ups whose survival in the search for capital and market share depends, in part, on hyperbole that drives valuation. The ecosystem of disruptive innovation – where everyone and everything claims it will disrupt exponentially – is noisy, making it hard to assess which ideas will survive. As in much of the Fourth Industrial Revolution, the business model for this democratic, decentralized mode of innovation tends to yield a large-scale churn in ideas and a few “blockbuster” success stories. Success is typically equated with prescience when luck often plays the bigger role. Parts of the media exacerbate these problems of finding signal in all the noise, often reporting as truth what the new class of billionaires says without scrutiny.

*World Economic Forum (2018), p.4*

**What Is a Green Job?**

**Definitions of Green Jobs have changed as the focus of regulations has changed.** The concept of green jobs creation began with the start of the modern environmental movement, often cited as a beneficial byproduct as new regulations were adopted. Quantification efforts arrived later particularly as this concept has been used in tandem with various policy initiatives, notably green jobs from fiscal stimulus during the recent recession and more currently associated with climate change efforts. Green job definitions, however have changed as the focus of those policies has shifted, moving from a more generalized notion to an increasing measure of “clean energy” that now includes various components such as nuclear, natural gas, and hydroelectric that previously would have been excluded if not banned under the prior definitions. Consequently, it is challenging to compare the various estimates over time let alone reach definitive conclusions on whether such jobs are growing or even whether they constitute structural and presumably positive economy change.

**Reports quantifying green jobs rely heavily on including indirect job contributions.** Except for a few of the early efforts, the bulk of green job quantification reports, including the most recent and most often cited and including some components within the prior agency estimates as well, do not measure green jobs as a distinct and evolving industry, but instead are more attempts to measure
what employment results when employers, consumers, and government spend money. In this respect, any job that has been touched directly or indirectly by “green” money in turn becomes reclassified as green. Consideration of indirect jobs is important, but this is a measure of the economic effect of green jobs, whether they produce a broader, more robust, or more resilient effect within the economy compared to more traditional job and consumer effects stemming from the cost of the policies that underlie the green jobs creation.

Reports quantifying green jobs rely heavily on reclassifying long-standing jobs. All the prior quantification reports incorporated some level of reclassification in order to achieve their reported numbers. Long-standing jobs such as park workers, environmental regulators, garbage workers, and water and sewage treatment are included in the totals. Some of the more recent green/clean energy job estimates also include large components from activities such as public transit and from technologies such as hydroelectric, nuclear, and natural gas that are specifically excluded under various elements of California’s climate change program. This aspect is addressed in the estimates prepared for this project, with separate numbers that can be used to assess the importance of this factor in the prior estimates.

Reports quantifying green jobs rely heavily on part time and temporary jobs. By incorporating indirect jobs to augment the final tallies, most of the prior quantification reports include large elements from temporary, largely construction and services jobs that may last a matter of weeks or for several months. Few of the reports provide distributions that make this allocation clear, but in the ones that do, this temporary component exceeds more than half of the final amount. This aspect will be explicitly addressed in the subsequent phase of this project, and clearly identified as such. In addition, none of the job estimates are calculated as full time equivalent. This reflects to some extent the nature of even the underlying agency data, but most of the quantification reports classify a job as “green” if a worker spends at least 50% of their time on the covered green activities, and in some cases as little as 25%. The prior estimates from Employment Development Department (EDD; 2010) are one of the few to provide data to show the importance of this treatment. As measured by workers spending at least 50% of their time, EDD estimated 263,000 green jobs in the state. Measured by the 25% standard, the total was nearly two-thirds higher at 432,840—the more frequently reported number.

What Is the Economic Significance of Green Jobs?

Prior quantification reports show green/clean energy jobs are only 1% to 2% of total nonfarm jobs. While 500,000 green jobs (3.0% of nonfarm jobs) is the most frequently cited number for California—with this number used in various policy and political statements going back to at least 2007 and continuing through 2018—estimates of the direct jobs are considerably lower. Prior estimates of total direct green jobs range from 1.2% to 1.4% of nonfarm jobs, while estimates of clean energy jobs range from 1.0% in a report done for Air Resources Board (Environmental Business International, 2011) to the equivalent of about 2% in some of the more recent advocacy reports that contain much higher shares of part time jobs.

Growth in green/clean energy jobs does not demonstrate the resiliency of California’s economy under its high regulation model. Several of the green/clean energy job quantification reports show high growth from their measured totals in recent years, often accompanied by claims that this growth demonstrates that the state’s economy can produce superior jobs performance even
under and in fact as a result of high regulation. These numbers, however, do not demonstrate sustainable resiliency, but instead reflect the fact that large numbers of construction jobs will be created when government requires a large number of generation plants to be built in a short time, that consumers will buy more of a product if government heavily subsidizes the cost, and that the associated green/clean energy jobs will decline just as quickly when the construction is complete and when the subsidies threaten to go away.

- **Higher jobs growth overall for California since the recovery began in 2010 instead has come from a different source—the Bay Area high tech industries that are among some of the least regulated in the country. The Bay Area with 19% of the population accounted for 30% of the jobs recovery since 2010, and 39% of the net jobs growth compared to pre-recession highs in 2007.**

- **Real GDP in the Bay Area grew at an average annual rate of 4.7% since 2010, producing 44% of the total net growth in California through the end of 2016. The rest of California—largely reliant on industries more directly affected by the state’s high regulatory and tax conditions—grew only half as fast at 2.4%.**

- **As measured by real GDP, the Bay Area economy in 2016 was 28% larger than it was in 2007—taking into account both recovery and expansion growth—while the rest of the state was only 11% larger, or about the same as the 10% expansion experienced by all states other than California.**

**Green/clean energy jobs do not ensure continued jobs growth as emissions continue to be reduced.** Even picking just the most generous estimates, green/clean energy jobs accounted at most for an apparent 6% - 8% of total new jobs from 2010 to 2016, and as little as 2% if only direct jobs are considered or if the combined direct/indirect numbers are adjusted for their high component of temporary and part time factors. Moreover, these jobs—as calculated by the methods used in these prior reports—are likely to decline, as already shown by a 14,000 job loss in the latest Solar Foundation estimates, and as currently planned renewable generation capacity winds down in California and the related construction jobs instead move to other states including Texas—the generally acknowledged contra-example of California’s high regulation/high tax economic model.

The emission reductions California has achieved to date are not associated with creating green/clean energy jobs, but instead largely come from other sources.

- **A major component of the emissions reduced to date have not come from jobs growth but from jobs loss. Air Resources Board documents put the total emissions reduced by job losses during the recession at about one-third of the total required to meet the 2020 target. Other estimates put the recession-related reductions at as much as half.**

- **The most recent, partial emissions data shows 16.4 MMTCOe net reduction from sources required to file under the Mandatory Reporting Regulation. Of this amount, the primary reductions came from: 9.7 MMTCOe from imported electricity that produced little or no clean energy jobs in the state, 7.1 MMTCOe from in-state production of electricity primarily as 38 TWh of natural gas generation were largely replaced by a 30.3 TWh increase in**
conventional hydroelectric generation due to better weather, and 2.1 MMTCOe from oil and gas production as production levels and the associated high wage, blue collar jobs continued to drop.

- California’s emission reductions under its high regulatory model also show little difference from performance achieved elsewhere in the nation. In the latest California data, total climate change emissions in 2015 were 2.2% above their 1990 level. In the latest national data, total climate change emissions in 2016 were 2.4% above their 1990 level.

**Prior green/clean energy job quantification reports do not demonstrate that these jobs will be a sustainable source of jobs as the state continues its current policies.** As indicated, these jobs continue to be too few in number, too dependent on temporary construction and related service jobs levels, and too limited in the range of wage levels offered to provide more than a small component of the state’s total job needs in the future. In addition, a review of four cases—electric vehicles, solar energy, recycling, and Prop. 39 energy efficiency retrofits—where the state has targeted specific industries for green/clean jobs expansion illustrates the limited returns that are possible unless and until the state also addresses the broader competitive factors limiting their expansion:

- As with its economy overall, California remains competitive for green/clean energy jobs in the higher wage, knowledge components, the mixed wage sales and service components, and the shorter term, mixed wage installation and construction jobs. As shown through the history of the case examples, a broader range incorporating wage levels supporting middle class households has been missing or provided solely through the shorter term construction components. Even when such jobs if not the entire market began in the state such as for electric vehicles and solar panels, the more fundamental, unaddressed competitive factors have instead seen the state’s green policies generate these related jobs over time in other states and other countries.

At a time when the US as a whole is nearing achievement of its long-held energy dependence goals, California’s policies combined with the failure to match its green/clean energy promises with the competitiveness reforms essential to creating them here means this state is going in the opposite direction, becoming more reliant on energy components and related goods manufactured increasingly overseas.

- Many green/clean energy jobs remain reliant on continued subsidies, either through mandates or direct payments. Even in the case of the recycling programs that have existed since the 1980s, the promised technology breakthroughs and economics of scale still have not been realized. Job levels remain subject to the continued flow of subsidies—in some cases sensitive to momentary or even potential shifts in their availability.

- Subsidies are no substitute for the fundamental competitive operating factors required to generate the full wage range of job opportunities in the state. While state policies may serve to launch an industry, employers will still need to operate at profit levels allowing their continuance and growth, and they face many of the same competitive challenges employers within the much larger traditional industry base already face. The case examples illustrate the failures that occur when policy promises for a green jobs role in fulfilling a portion of the
state’s future jobs growth do not deal with these constraints as well. By failing to address these competitive factors, the broader range of the job benefits from state policies has followed two courses: green jobs for those activities that have no choice but to be in the state and greener pasture jobs where operating costs have driven the location decision.

- The promises of green/clean energy jobs when state policies are first considered demonstrate a poor record in matching the jobs that are actually produced. Even in the Prop. 39 case where tracking of actual jobs created was statutorily mandated, the difficulties of doing this accounting forced the state to fall back on modeling estimates instead. And even accepting those estimates as valid, the program produced only one-fifth to one-quarter of the green jobs promised at its inception, and only one-twentieth based on the first three years of actual jobs data. The continued reliance of the agencies on estimates produced by advocacy groups promoting the subsidies rather than an independent analysis that looks at the trade-offs involved risks producing further examples of promises not matching results.

**Preliminary California Estimates**

**Preliminary Estimate, California Green/Clean Energy Direct Jobs, 2016**

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Based on preliminary estimates, there were 171,300 green/clean energy direct jobs in California in 2016, a total of 361,300 if existing government and other jobs are reclassified as green/clean energy as well. Based on the data, data sources, and methodologies—especially US Bureau of Labor Statistics—contained in the prior quantification reports, a preliminary estimate by industry was developed and applied to the most recent complete Quarterly Census of Employment & Wages for California in 2016. In the table below, jobs are shown by industry, including both private and government jobs, in the first set of columns. The second set shows the estimated jobs by owner, with Government including all public jobs regardless of industry. The table also breaks out this second set to indicate which jobs represent essentially new industry components that have
evolved in recent years (Net jobs) vs. those that substantially existed prior to the current state policy structure (Reclassified) such as jobs in public transit, solid waste, and other utilities.

To put these results into context:

- This direct job estimate is generally in line with the prior, comparable estimates. The combined level of 361,300 direct jobs represents 2.2% of total jobs in 2016.

- As indicated, reclassifying jobs as “green” remains a major component of the overall numbers, in this instance comprising 53% of the total. The net direct jobs that can be more clearly connected to current state policies represents only 1.0% of total jobs in 2016.

- Government jobs also remain a major determinant of overall green job levels, accounting for 30% of the total. Private green jobs at 254,000 in 2016 represent only 1.8% of all private jobs. Netting out the reclassified portion puts the figure at 1.2%.

Next steps will estimate the effect of green/clean energy job costs on net jobs levels. The primary purpose of this project is to produce a more current and transparent estimate of green jobs in the California economy. This report summarizes the background and steps used to create the preliminary estimate. This estimate will then be used as the base for the project’s subsequent steps: (1) validation and additional calibration of the estimate through an employer survey and (2) a more complete assessment of the jobs stemming from the underlying state policies through a net impact comparison of green jobs created by those policies vs. reduction in other jobs as a result of the costs of those policies.

What Is the Cost of Green Jobs?

Construction, compliance, energy, and subsidy costs will be used to assess the net job effects from the state’s policies. Without exception, the current green/clean energy job quantification reports only consider one side of the jobs equation. While relying on indirect jobs to augment their totals, none assess the indirect job losses associated with the costs of complying with the associated state policies credited with creating the green/clean energy jobs. Preliminary estimates of the main cost components that will be analyzed in the next steps of this project are:

- Clean energy construction and installation. The primary source of the jobs contained in the quantification reports is the 147 generation plants that finished or were under construction in 2016, along with 20 that were retired. Using the available cost factors, total estimated costs for the 147 was $11.8 billion, although not all this amount was expended in 2016. Related ongoing operations levels will be incorporated along with these one-time costs. Based on building permit data, photovoltaic installations accounted for another $2.0 billion in 2016.

- Electricity bills. California has long had electricity rates substantially above the average for the other states, but this difference has accelerated markedly since 2011 as the cost of renewables generation has been incorporated into the rate base. In 2016, the change in this cost difference produced higher electricity costs of $6.6 billion, distributed as $2.2 billion paid by residential users, $3.0 billion by commercial, and $1.3 billion by industrial. These
costs had a greater relative impact on the lower income interior regions, which show electricity usage 50% to 60% above the higher income coastal areas.

- **Fuel costs.** While most cost estimates generally consider only the production cost differences stemming from the state’s regulations, the full impact on consumers and employers (public and private) stems both from this component and the continued isolation of the state’s fuel markets caused by those regulations that have produced periodic volatility in California prices. As measured by difference in average California and US prices (net of taxes), consideration of both factors shows additional costs of $7.5 billion in 2016: $4.5 billion to households and $3.0 billion to employers. Looking only at the production cost component, total costs are $4.7 billion of the total amount. As with electricity but not to the same extent currently, these costs are also borne to a somewhat larger degree by the interior regions compared to the higher income coastal areas.

- **Compliance costs.** In 2016, regulated facilities spent a total of $2.6 billion in the four cap and trade allowance auctions, of which $0.9 billion was paid for state allowances and $1.7 billion was paid to investor owned and publicly owned utilities. The portion attributable to in-state refineries is incorporated into the additional fuel payments discussed above, while portions paid by other industries would be a separate entry. In addition to these proceeds, the covered facilities spent additional, unknown amounts to reduce emissions—through process changes and controls or through shifting operations outside the state—and development of offset projects.

    Cap and Trade revenues were allocated to an estimated $1.4 billion of programs in the state budget, with some overlap with the subsidy payments below.

    The primary fees tacked onto consumer purchases to support the state’s recycling jobs totaled $1.5 billion in 2016, with a portion of the amount for containers paid in redemptions. In addition, households and employers also supported these activities through rising recycling fees on their periodic local garbage and utility bills for which there is no immediate estimate.

- **Subsidy costs.** In addition to the elements already included above, the direct subsidy costs that can be currently estimated are: $636.5 million for federal energy efficiency tax credit (solar tax credit is not available); state solar incentive payments at $53.0 million; Clean Vehicle Rebate Project payments at $101.3 million; associated ZEV subsidy from manufacturer sales of ZEV and CAFE credits at $150 – 200 million.

**Several related costs are not included.** The cost elements cover the primary job-creating policies that can be quantified. In so doing, however, there are a number of potential and actual costs that are not included, due to the difficulty of developing a cost estimate, lack of data, or the more qualitative nature of their impact.
What Is a Green Job?

Definitions in Current & Prior Studies

While the generalized concept of green jobs has been in use for some time, quantification efforts primarily began during the recent recession when green jobs were promoted as a potential countercyclical measure and as a beneficial by-product of the federal and some state regulatory agendas.

The available studies have addressed green jobs in California from a broad range of perspectives, from treating green jobs as categories over which there would be little dispute such as solar installation and maintenance and industrial-scale composting; to entries that are essentially relabeling such as bicycle repair, bike delivery services, tree cutting and pruning, public transit jobs, and gas station jobs related to bio-diesel; to ones that arguably fall somewhere in between such as hauling and reuse of construction debris that have operated for some time prior to popularization of the term but have increased in recent years as a result of regulatory mandates. There is little consistency in these definitions, and efforts at quantification have evolved the definitions over the years as the nature of regulations these studies have sought to promote have changed.

In his 2008 Blueprint for Change campaign document, President Obama’s agenda contained a measure to expand green jobs: “Create 5 Million of Green Jobs. Obama and Biden will invest $150 billion over ten years to deploy clean technologies, protect our manufacturing base and create millions of new jobs.”

Subsequently, the American Recovery and Reinvestment Act (ARRA, 2009) provided $90 billion for this purpose, with green jobs very broadly defined: $29 billion for improving energy efficiency, including home retrofits; $21 billion in incentives for renewable generation, such as solar and wind; $10 billion for modernizing the electric grid; $6 billion to promote advanced vehicles and a domestic battery industry; $18 billion for high-speed rail and other trains; $3 billion for research into carbon capture for coal plants; $3 billion for job training; and $3 billion for clean manufacturing tax credits.

In conjunction with this initiative, the federal data agencies initiated separate but short-lived efforts to quantify green jobs progress.

US Department of Commerce in a one-time study (US Department of Commerce, 2010) defined “green products or services” as ones:

... whose predominant function serves one or both of the following goals:

- **Conserve Energy and Other Natural Resources**: This includes products or services that conserve energy to reduce fossil use and promote water, raw material, land, and species and ecosystem conservation; or

- **Reduce Pollution**: This includes products or services that provide clean energy or prevent, treat, reduce, control or measure environmental damage to air, water and soil. The remediation, abatement, removal, transportation, or storage of waste and contaminants also are considered to reduce pollution.
US Bureau of Labor Statistics (BLS) approached the issue as an ongoing data base project, and adopted a definition (BLS, Green Goods and Services FAQs) fairly consistent with the Commerce version in its generalized version:

The BLS definition of green goods and services includes jobs in businesses that produce goods and provide services that benefit the environment or conserve natural resources. These goods and services are sold to customers, and include research and development, installation, and maintenance services.

The details of the definition, however, brought in a far broader range of economic activities:

Green goods and services fall into one or more of the following five categories:

1. *Energy from renewable sources.* Electricity, heat, or fuel generated from renewable sources. These energy sources include wind, biomass, geothermal, solar, ocean, hydropower, and landfill gas and municipal solid waste.

2. *Energy efficiency.* Products and services that improve energy efficiency. Included in this group are energy-efficient equipment, appliances, buildings, and vehicles, as well as products and services that improve the energy efficiency of buildings and the efficiency of energy storage and distribution, such as Smart Grid technologies.

3. *Pollution reduction and removal, greenhouse gas reduction, and recycling and reuse.* These are products and services that:
   - Reduce or eliminate the creation or release of pollutants or toxic compounds, or remove pollutants or hazardous waste from the environment.
   - Reduce greenhouse gas emissions through methods other than renewable energy generation and energy efficiency, such as electricity generated from nuclear sources.
   - Reduce or eliminate the creation of waste materials; collect, reuse, remanufacture, recycle, or compost waste materials or wastewater.

4. *Natural resources conservation.* Products and services that conserve natural resources. Included in this group are products and services related to organic agriculture and sustainable forestry; land management; soil, water, or wildlife conservation; and storm water management.

5. *Environmental compliance, education and training, and public awareness.* These are products and services that:
   - Enforce environmental regulations.
   - Provide education and training related to green technologies and practices.
   - Increase public awareness of environmental issues.

In California, the Employment Development Department (EDD) in the year prior launched a separate but comparable effort to that of BLS. The EDD approach was done in conjunction with the Green Jobs Council created by AB 3018 (Nunez, 2008). EDD’s definition of “green goods and services” is generally consistent with the BLS (EDD, 2010):

LMID defined a green job as one whose activities: 1) generate and store renewable energy; 2) collect and/or process recyclable materials; 3) manufacture, distribute, construct, install, and maintain energy efficient products; 4) foster education, environmental
consulting, regulatory compliance, and awareness; or 5) manufacture natural and sustainable products.

The specifics, however, broadened further from the BLS list of activities:

Generating and storing renewable energy. This category of green goods and services includes alternative energy generated by, but not limited to: wind, solar, water, biofuels, biomass, hydrogen fuel cells, and geothermal.

Recycling existing materials. Corporations involved in the collection and processing of recyclable materials, including firms running a recycling or wastewater plant. It includes environmental clean-up and remediation but does not include companies that provide bins for recyclable paper, glass and cans.

Energy efficient product manufacturing, distribution, construction, installation and maintenance. Companies involved in the research, development, and manufacturing of products such as solar panels, energy efficient light bulbs and vehicles. It also includes construction companies that install and repair these products in new or existing residential or commercial real estate, as well as real estate planning and land development.

Education, compliance and awareness. Training providers for curricula such as solar panel installation, energy auditing, sustainability management, and environmental careers. It also includes environmental consulting, companies involved with governmental or legislative compliance, conservation and wildlife programs, trading and offsets, and social assistance.

Natural and sustainable product manufacturing. Firms that create products using natural materials. Also includes businesses that produce safe, nontoxic products; bamboo products; products out of previously-recycled materials, and agricultural firms that practice sustainable farming.

While the agency definitions show an expansive approach in the specifics, they generally keep to a green jobs concept centered on jobs associated with or created through regulations under the environmental quality and natural resources regulatory/management programs. The identified industries generally reflect those created through compliance actions mandated on the rest of economy, products and services marketed on the basis of their presumed environmental benefits, and services associated with state, local, and nonprofit management programs.

More recent quantification reports have instead moved away from this focus to one defined more as “clean energy,” “clean tech,” or “advanced energy” jobs as the regulatory focus has moved away from the environment in general to concentrate more on climate change issues. In the recent more frequently cited numbers prepared by the advocacy organizations, a typical definition now covers the following (AEE, 2014):

... an advanced energy firm is defined as being directly involved with researching, developing, producing, manufacturing, distributing, selling, or implementing components, goods or services related to alternative fuels and vehicles; energy efficiency; renewable, nuclear, and natural gas electricity generation; smart grid; and other related technologies. This can include supporting services such as consulting, finance, tax, and legal services related to advanced energy. It does not include farm workers involved in growing feedstock (corn, soy, etc.) for advanced fuels.
Advanced energy employees are defined as full-time and part-time permanent employees who support the advanced energy portion of the business, including administrative staff and excluding interns and other temporary workers.

Other estimates such as those from Brookings Institution (Muro, 2011), E2 (2017), Environmental Business International (2011), Next10 (various years), Solar Foundation (2017), and US Department of Energy (DOE, 2016, 2017) are based on yet other, generally inconsistent definitions. Key differences among all the definitions fall within the following general points:

- The definitions and subsequent estimates differ widely on whether they attempt to measure direct jobs or some amalgam of direct, indirect, and even induced employment. For example, expansion of a solar manufacturing company or creation of a solar installation business unarguably would be counted as direct green jobs, as likely would a portion of employment in companies providing parts essential to the solar panel production process, research and development to design the products, or consultants specializing in sizing and placement of rooftop systems. As a business or an industry, they evolved in response to a shift in the market, regardless of whether it evolved as a result of mandates and subsidies or from changing consumer preference.

An electrical contractor or other construction firm doing work on a utility solar project would not. Nor would an accounting firm that did the books for those businesses, regardless of whether they wore green shades or not. Their employment levels may have changed for a specified period as a result of investments in a “green” development, but employment within their industry would have changed regardless of whether the investment dollars had been made in a solar plant or a more traditional fossil fuel plant. There is nothing uniquely “green” about their business or industry. Their jobs may be related to the impacts related to “green” investments, but there is nothing intrinsically “green” about these jobs that differs from how they were 20, 30, or 50 years ago. Few of the estimates make this distinction in their overall job claims or if they do, gloss over the precise distribution.

This aspect is the key difference among the various estimates. As discussed below, some of the documents attempt to identify and quantify green jobs as an emerging producer of new goods and services, brought on in many cases by government mandates and subsidies but in others by consumer preferences for “greener” purchases or those with a definable lower impact on the environment. The bulk of the estimates, including the most recent and most often cited, however are simply an attempt to measure what employment results when employers, consumers, and government spend money. In that respect, any job that has been touched directly or indirectly by “green” money in turn becomes reclassified as green. The estimates in this respect largely represent advocacy pieces claiming some jobs will be created from the expenditures—an outcome that would result from expenditures on any investment or purchase, green or not—with no attempt to assess whether the expenditures create the most efficient level of jobs, create lasting jobs, or do so without longer term effects on consumer costs and subsequent changes resulting to other jobs within the state’s economy.

- While these job estimates are used to defend and promote the state’s climate change policies, a number of the industries within the definitions are excluded from those policies. Nuclear, large hydro, and natural gas facilities are covered in the AEE and other estimates, but none
of these qualify under the Renewable Portfolio Standard component of the climate change policies, and pumped storage hydro is specifically excluded from the recent energy storage procurement component. While these jobs are used to bolster the overall employment tallies used to promote additional rounds of climate change mandates and subsidies, they are excluded in the climate change regulations and their expansion severely hindered by the overall body of state and local permitting, regulation, and CEQA-related litigation. Agencies relying on these jobs components to bolster the jobs credentials of their programs claim them as proof of costless progress on one hand, but apply those same programs to hinder them on the other.

- The earlier agency estimates incorporate government employment, essentially counting the regulators who design the regulations to mandate the spending that creates much of the green jobs that are then incorporated into the estimates. Other than the early Next10 documents, the various advocacy group reports generally do not contain sufficient methodology information to determine whether this is the case for the other estimates as well. On the other hand, some element of government employment likely is applicable, particularly the components of publicly owned utilities (POUs) who build and operate alternative generation plants, primarily as a result of recent state climate change legislation. Incorporating workers within sewerage and water agencies would be less clear. While their work has clear environmental implications, these jobs have existed in some form going back to Roman times. Relabeling may be appropriate depending on the purpose of a specific study, but clarity in the contribution from this source—as is the case with the BLS numbers—should also be a component.

- Many of the estimates incorporate a significant degree of relabeling. Some of the definitions are so broad as to essentially redefine all of the state’s utility employment as green. Construction contractors are relabeled as green or clean energy because the systems they now install are Energy Star or otherwise energy efficient. Jobs are counted because a worker spends as little as 25% of their time on “green” activities. While these elements produce higher green jobs counts, they provide little in the way of analysis on the key point—are the state’s policies in fact creating a sustainable jobs base?

Several of these points are explored further in the subsequent sections.

**Current & Prior Estimates**

The following discussion summarizes the primary green job estimates in the California economy and the national estimates on which some are based, and identifies the results and some of the key differences among them.

**Agency Estimates: Commerce**

Unique to the documents considered in this report, the US Department of Commerce (2010) estimates were developed on based on the nature of products and services being sold rather than classifying the nature of the business itself. Data was based primarily on an identification of green product and service codes used in the 2007 Economic Census. Rather than establishment based, these estimates derive from the provision of goods and services, and therefore constitute more of an
estimate of the actual industry segment rather than employment coming from green expenditures. The estimates cover only private employment, and also exclude agriculture, rail transportation, educational institutions, political organizations, and private households.

Total estimated jobs range from 1,821,000 (1.5% of US total) in 2007 under the narrow definition of green product and service codes, to 2,382,000 (1.8%) under the broadest definition. Applying the private sector share from the BLS estimates, a comparable figure for California from this base would be 186,000 to 244,000.

**Agency Estimates: EDD**

EDD (2010) conducted a one-time survey to estimate green jobs in conjunction with the Green Collar Jobs Council under the Workforce Investment Board, and consequently focused on occupations as the primary data point. The survey asked companies to identify the number of workers spending at least 25% of their time on the identified “green” activities. As a result, the final tally presents mixed results, containing both employment in the production of green goods and services along with a significant share of employment as a result of green expenditures and employment related to regulatory compliance rather than production activities. This estimate along with the BLS effort also contains some of the highest incidence of relabeling, including government employment along with long-standing jobs such as in waste management, public transit, and various utilities.

The estimates by industry are shown in the table below along with a comparison to the BLS numbers. The disaggregation differs between the two, with EDD showing the distribution for all ownership (private and government), and includes various enterprise functions (e.g., utilities, manufacturing) incorporated with the private numbers. The BLS numbers separate the distribution by ownership, with all government activities regardless of nature included under that industry.

The survey identified a total of 263,220 workers spending 50% or more of their time on the identified green activities in 2009, and 432,840 working anytime on green activities. The 263,220 number therefore is closer to a full-time equivalent but the larger number is used in the comparisons below.

**Agency Estimates: CARB**

Under contract to California Air Resources Board (CARB), Environmental Business International (2011) prepared an estimate of clean energy jobs in California, including base year job estimates in 2009 and revenue projections through 2020. The analysis identifies employment within the defined “clean energy” industry rather than estimating job results from green expenditures. The range of businesses is generally consistent with definitions used for this industry grouping in other clean energy estimates: low-carbon power (including nuclear and hydro), carbon capture and storage, energy efficiency and demand response, energy storage, green buildings, transportation, carbon markets, adaptation, and consulting and research. There is a degree of relabeling—for instance, construction jobs for green buildings, public transit jobs—but this analysis is one of the few to provide details on where this is used and how the delineation between “green” and “non-green” was determined.
The results show a California total of 122,917 jobs in 2009, and 137,941 in 2010, comprising 13% of all clean energy jobs in the US, and 1.1% of total California jobs. Job distribution is shown by the clean industry segments above and is not broken down by NAICS industry.

This study is the only one to compare its analysis and results to comparable efforts. The 2009 level of 122,900 is slightly below the 142,000 jobs contained in the renewable energy/energy efficiency components of the EDD (2011) estimates, and significantly lower than the 174,000 jobs total contained in the Next10 estimate for 2009. The differences, however, are explained by variations in data sources and methods, and the fact that the higher Next10 estimate includes other environmental sectors and green consumer categories (as does the complete EDD estimate). Given the nature of the data, this report concludes that all three estimates are considered within the same “ballpark” for the clean energy components.

*Agency Estimates: BLS*

**Green Job Estimates by Industry: EDD vs. BLS**

<table>
<thead>
<tr>
<th></th>
<th>EDD 2009</th>
<th>BLS 2010</th>
<th>BLS 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Resources &amp; Mining</td>
<td>33,640</td>
<td>16,313</td>
<td>16,906</td>
</tr>
<tr>
<td>Utilities</td>
<td>17,950</td>
<td>4,528</td>
<td>7,899</td>
</tr>
<tr>
<td>Construction</td>
<td>61,300</td>
<td>37,180</td>
<td>54,070</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>88,810</td>
<td>31,957</td>
<td>36,417</td>
</tr>
<tr>
<td>Trade</td>
<td>60,620</td>
<td>22,915</td>
<td>23,789</td>
</tr>
<tr>
<td>Transportation &amp; Warehousing</td>
<td>13,080</td>
<td>15,076</td>
<td>14,151</td>
</tr>
<tr>
<td>Information</td>
<td>4,810</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial Activities</td>
<td>5,170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional, Scientific &amp; Technical Services</td>
<td>41,820</td>
<td>41,596</td>
<td>43,279</td>
</tr>
<tr>
<td>Management of Companies &amp; Enterprises</td>
<td>4,320</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administrative &amp; Waste Services</td>
<td>26,540</td>
<td>47,464</td>
<td>50,022</td>
</tr>
<tr>
<td>Education &amp; Health Services</td>
<td>27,080</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leisure &amp; Hospitality</td>
<td>16,800</td>
<td>3,701</td>
<td>4,103</td>
</tr>
<tr>
<td>Other Services</td>
<td>13,190</td>
<td>8,250</td>
<td>9,069</td>
</tr>
<tr>
<td>Government (EDD – Public Administration)</td>
<td>16,030</td>
<td>103,463</td>
<td>91,759</td>
</tr>
<tr>
<td>Unclassified</td>
<td>1,680</td>
<td>10,436</td>
<td>8,781</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>432,840</td>
<td>342,879</td>
<td>360,245</td>
</tr>
<tr>
<td><strong>Private</strong></td>
<td></td>
<td>239,416</td>
<td>268,486</td>
</tr>
</tbody>
</table>

BLS developed their estimates of jobs related to provision of green goods and services beginning with an initial identification of potential industries, consisting of 325 industries at the 6-digit NAICS level. This step was then followed by a supplemental survey to firms covered by the Quarterly Census of Employment & Wages (QCEW), to develop the final estimates for 2010 and 2011. Detailed estimates were developed for the US, along with 2-digit NAICS estimates for each of the states from the 2011 data. Similar estimates developed from an occupation approach provide additional information on wages and number of establishments at the national level.

Similar to the EDD effort, the BLS numbers are mixed results, containing both employment in the production of green goods and services along with employment as a result of green expenditures during the identified periods (primarily construction). The emphasis of the survey examples, however, is focused on production activities, and this indirect element within the estimates is less
pronounced than in the case of EDD and more importantly can be better determined through the more detail breakdowns available in the data files. BLS also provides the most detailed methodological information along with a two-year base of estimates.

The BLS Green Goods & Services data is based on revenue shares. Survey respondents were asked to allocate employment based on their estimated sales share for green goods and services vs. non-green. Consequently, there is no equivalent measure of whether the employment captured in the estimates is full time or some percentage as part time. A related Green Technologies & Practices Survey conducted an alternative measure of green employment by asking respondents to report on the number of workers spending at least 50% of their time on the identified green practices, and captured both employment related to the production of goods and services as well as internal regulatory compliance and related employees. Based on occupational data, this second survey also contains estimates of wage distributions by industry. This approach is the one used in many of the reports discussed below.

The BLS estimates cover total wage and salary jobs in the QCEW survey universe (95.3% of civilian employment at the time of the surveys), but does not include self-employed.

For California, the 2010 estimate was 239,416 private jobs (10.6% of US total) and 342,879 total jobs (10.2%). The 2011 estimate was 268,486 and 360,245, respectively. The government jobs included are difficult to break out by activity in the California data as the distributions are given by total jobs rather than by ownership. Consequently, it is difficult to derive a complete split between green jobs representing new industries and enterprises and green jobs that are primarily reclassification entries, but Public Administration (the primary regulatory and administrative component) comprises 4.4% of the total (16,030 jobs). The national data, however, is available by both NACIS and ownership, and can be used to produce additional insights into this distribution.

**Agency Estimates: California Community Colleges**

As part of the overall state focus on green jobs development, the Centers of Excellence program (Community Colleges, 2012) identified existing and projected jobs within the solar industry from 2011 data. The estimate was based on a survey of companies providing products and services for both rooftop and utility scale solar projects. The 2011 job level was estimated at 47,854 to 49,630.

Developed for use in training students for jobs within the industry, these estimates were focused only on directly related jobs and provide a snapshot of employment within the industry itself, without additions for indirect and other jobs stemming from development expenditures.

**Agency Estimates: IRENA**

The International Renewable Energy Agency (IRENA, various dates) has released estimates of global and selected national employment within renewable energy fields since 2013. The reports provide estimates by country of indirect and direct employment in renewable energy, comparable to the clean energy definitions used in many of the advocacy reports: large hydro, solar heating and cooling, wind energy, bioenergy, solar photovoltaic, and other technologies. Comparing these numbers to those in the other reports such as DOE, these estimates appear to be more closely tied to employment within the defined renewable energy industry rather than estimating job results from
green expenditures. However, the estimates also rely on several of the advocacy reports below, and the lack of detailed methodology makes it difficult to determine the extent to which expenditure-related employment such as construction is included.

**Global Employment, Renewable Energy**

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>% of World</th>
<th>China</th>
<th>Brazil</th>
<th>EU</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>612,000</td>
<td>10.7%</td>
<td>1,747,000</td>
<td>833,000</td>
<td>1,166,000</td>
</tr>
<tr>
<td>2013</td>
<td>625,000</td>
<td>9.6%</td>
<td>2,640,000</td>
<td>894,000</td>
<td>1,145,000</td>
</tr>
<tr>
<td>2014</td>
<td>724,000</td>
<td>9.4%</td>
<td>3,390,000</td>
<td>934,000</td>
<td>1,200,000</td>
</tr>
<tr>
<td>2015</td>
<td>769,000</td>
<td>9.5%</td>
<td>3,523,000</td>
<td>918,000</td>
<td>1,169,000</td>
</tr>
<tr>
<td>2016</td>
<td>806,000</td>
<td>8.2%</td>
<td>3,955,000</td>
<td>1,058,000</td>
<td>1,225,000</td>
</tr>
</tbody>
</table>

*Source: IRENA, various dates*

The IRENA employment estimates for the US are shown in the table above. As indicated, the US share of global employment has steadily declined as other nations have increased their share, especially as much of the associated manufacturing has grown more rapidly in Asia rather than in California and the US, and as the perceived urgency of the need for renewable technologies has been matched in other countries by faster project development schedules with fewer regulatory and litigation barriers.

Using the 13% share factor from the CARB study above, comparable California employment from this estimate base would range from 80,000 in 2013, to 100,000 in 2016.

**Agency Estimates: DOE**

DOE (2016, 2017) has compiled estimates of energy-related jobs, broken down by energy source, NAICS, and for 2016, by state. This report was done by the same contractor as for the AEE, E2, and Solar Foundation advocacy documents described below and as such, provides additional methodological background to assess those considerably more generalized numbers as well as additional source and detail information for the surveys used in those documents.

This work is based on the BLM methodology described above, starting with likely industries taken from the QCEW base, and following up with an additional survey to identify energy-related jobs within a larger range of establishments.

As with the BLM and EDD estimates, the results combine a mixture of both direct and indirect jobs and reflect the purpose of these reports to describe more the importance (i.e., impact) of energy to jobs within the states rather than an accounting of the industry itself. The reports, however, are also among the few that provide sufficient detail to make estimates on these distinctions. For example, just over half of the jobs shown for California are in construction and trade. Another eighth of the California jobs estimate is covered by repair and maintenance of motor vehicles, jobs associated more with consumer spending than uniquely green practices. This allocation of indirect jobs also does not appear to be fully consistent. For example, Construction forms a significant component of the estimates for most technologies, but is shown at zero for fuels employment in California in spite of ongoing construction by the state’s fuel producers for compliance with the climate change (e.g., low carbon fuel formulation) and other environmental regulations and development of biofuel and related sources.
The numbers also count jobs regardless of the amount of time spent on energy-related activities, similar to several of the other documents discussed in this section. No distribution is given by hours, but an illustration is given in the case of solar employment. Of the total 373,807 solar jobs estimated for 2016, 69% of workers spent more than 50% of their time on “solar-related work,” and the remaining 31% spent less. Roughly, this distribution translates into about 222,000 equivalent full-time positions from the 373,807 mostly part time jobs.

Overall energy jobs for California in 2016 broken out by industry:

<table>
<thead>
<tr>
<th>Industry</th>
<th>Jobs</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>760</td>
<td>0.1%</td>
</tr>
<tr>
<td>Mining</td>
<td>16,140</td>
<td>1.7%</td>
</tr>
<tr>
<td>Construction</td>
<td>305,820</td>
<td>33.0%</td>
</tr>
<tr>
<td>Utilities</td>
<td>56,540</td>
<td>6.1%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>133,140</td>
<td>14.4%</td>
</tr>
<tr>
<td>Trade</td>
<td>148,350</td>
<td>16.0%</td>
</tr>
<tr>
<td>Professional, Scientific &amp; Technical Services</td>
<td>146,600</td>
<td>15.8%</td>
</tr>
<tr>
<td>Other Services</td>
<td>119,740</td>
<td>12.9%</td>
</tr>
<tr>
<td>Total</td>
<td>927,080</td>
<td></td>
</tr>
</tbody>
</table>

The same California jobs broken out by technology:

<table>
<thead>
<tr>
<th>Technology</th>
<th>Jobs</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Power Generation</td>
<td>203,270</td>
<td>21.9%</td>
</tr>
<tr>
<td>Fuels</td>
<td>68,980</td>
<td>7.4%</td>
</tr>
<tr>
<td>Transmission, Distribution &amp; Storage</td>
<td>155,360</td>
<td>16.8%</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>301,350</td>
<td>32.5%</td>
</tr>
<tr>
<td>Motor Vehicles</td>
<td>198,120</td>
<td>21.4%</td>
</tr>
<tr>
<td>Total</td>
<td>927,080</td>
<td></td>
</tr>
</tbody>
</table>

Total California energy-related jobs as estimated in this document comprised 11.8% of the US total in 2016.

A rough approximation of “clean energy” jobs can be made from these numbers, combining the following categories: solar, wind, hydro, and other electric power generation; corn ethanol and biomass fuel; smart grid and micro grid; and energy efficiency other than traditional HVAC. Combined, these result in 403,710 jobs in 2016, with the only major missing component being alternative fuel vehicles. Adding in total manufacturing for motor vehicles and parts—although not all such manufacturing in the state is related to alternative fuels—brings the total to 432,440.

**Foundation Estimates: Brookings**

Brookings Institution (Muro, 2011) compiled a detailed estimate of green jobs on the national, state, and MSA level, focused on identifying employment directly related to production and provision of products and services with “an environmental benefit.” This orientation extended to the product/service supply chain, with the inclusion of only those components “that add value uniquely to clean products, whether by supplying a special part or a service, using skills or technologies that are unique to the clean economy. For example, home weatherization, energy retrofitting, and solar panel installation require skills that distinguish those services from traditional maintenance work or roofing.” In this respect, the study sought to
distinguish its estimates from those approaching the issue as estimating jobs from green expenditures:

Finally, some industry and impact studies estimate “direct” and “indirect” employment. By contrast, this study measures only employment in establishments that directly produce goods and services with environmental benefits, or produce uniquely tailored goods and services that add value to products with an environmental benefit. Studies of “indirect” jobs, for their part, use information on cross industry purchases to claim that one industry stimulates the creation of jobs in another. This method is useful for regional impact studies that estimate the effect of business relocations and national impact studies that estimate the effect of government stimulus during a downturn. In both cases, the source of added revenue can be thought of as external and temporary. However, such an approach is not appropriate for a study like this one where there is no external source of revenue. No establishment generates its own revenue out of nothing, and so every direct job is some other industry’s indirect job.

Consequently, the job totals reported here will be lower than many studies which include “indirect” jobs. This isn’t to deny that clean economy firms are involved in rich networks of business relations with traditional “non-clean” firms; it is simply to say there is no reason to think of these general suppliers or customers as components of the clean economy sector.

This approach has the advantage of being firmly rooted in economic activity connected to supply and demand in competitive markets, rather than just voluntary business philanthropy. This focus, along with a “direct” jobs count from actual companies, makes the measurements akin to industry data from government agencies and provides the sort of straightforward information needed for strategic thinking about investments.


While this approach makes this study more applicable as an estimate of employment within an industry grouping, there still is a degree of relabeling involved in the final numbers. For example, Public Administration accounts for 21.5% of the identified jobs on the national level, and Waste Management and Remediation another 11.2%. No similar breakdowns are available on either the state or MSA level. Construction, on the other hand, is limited to specialties that have evolved in response to identifiably green products.

Data on firms and employment was developed through detailed analysis of Dun & Bradstreet data. Within the target NAICS, this work involved detailed assessments of individual firms and their product offerings.

Total California jobs in 2010 are shown at 318,156, up from 239,064 in 2003. The California estimate was 11.9% of the US total in 2010. While additional wage information is provided at the occupational level, state data is limited to a total average annual wage of $46,400 in 2009, below the overall state average of $51,600.

Advocacy Estimates: Next 10

Next 10 (various dates) is a nonprofit organization formed and chaired by F. Noel Perry, that has published a wide range of documents on energy, environmental, and other issues in California. The group previously published annual estimates and projections of “green economy employment.”
The Next 10 methodology builds on the Brookings procedures discussed above and applies them specifically to California. As such, these estimates continued the approach of attempting to identify employment directly related to production and provision of products and services rather than the expenditure impacts contained in most of the other efforts. The Next 10 numbers are similarly shown by green segment rather than NAICS industry. Some additional details on NAICS, regions, and other factors are illustrated in the reports through charts, but in most cases without the supporting data. Government regulatory jobs do not appear to be included in the totals, but the lack of details on the data and details make this difficult to determine. Public jobs related to energy production—including the state and local power agencies—are likely in the totals given the technologies covered. These caveats aside, the estimates provide a more focused assessment of green jobs as an industry, concentrating on direct jobs as was attempted in the Brookings effort.

The estimates show 159,000 California jobs in 2008, rising to a peak of 196,000 in 2012, and easing to 185,000 in 2013 in the final published estimate.

**Advocacy Estimates: Solar Foundation**

The Solar Foundation (various dates) is a nonprofit organization “. . . advancing the use of solar and solar-compatible technologies worldwide.” Since 2010, the organization has estimated the number of national solar jobs, defined as workers spending at least 50% of their time on solar-related work. State estimates were included beginning in 2015.

As indicated above, the estimates are based on the same methodology and survey method used by the Foundation’s contractor for their work on the DOE estimates, using a survey of known solar companies and a much smaller sampling of potentially solar-related companies. As with the DOE numbers, these estimates combine both direct jobs within the solar industry along with indirect jobs related to expenditures on solar projects. The reports do not include NAICS break outs to enable a determination of the distribution in this regard, but instead are listed as “sectors” composed of installation (52% of jobs in 2017), manufacturing (15%), sales and distribution (12%), project development (14%), and all others (7%).

Total California estimates: 75,598 in 2015; 100,050 in 2016; and 86,414 in 2017. California in each year accounted for about 35% of the US totals. Only the US totals are provided for years before 2015.

Comparing these estimates with the other sources suggests that the more recent Solar Foundation numbers likely incorporate more indirect jobs than previous years’. Applying the 35% California factor from the group’s reports to their 2011 US figure of 100,237 solar jobs results in an estimated 35,100 California solar jobs, somewhat below the Community Colleges estimate of 48,600 direct solar jobs in that year. In the later years, the California estimate of 100,050 solar jobs in 2016 is essentially the same as for all renewable energy jobs (not just solar) in California derived from the IRENA estimates as above (100,000). Applying the 35% factor to only the solar jobs component of the IRENA estimate for the US would still result in a comparable level of only 89,000 solar jobs in California that year.
The degree of indirect jobs within these estimates is also reflected in a comparison with similar agency data. The most recent Solar Photovoltaic Cell/Module Ships Report from US Energy Information Administration shows a US total of 53 reporting companies in 2016, with combined full time equivalent employment of only 6,021. Reports are mandatory from the companies that comprise about 90% of all solar shipments, and cover manufacturers, subsidiaries and business units of overseas manufacturers, importers, and exporters. Most of the reporting companies are engaged in manufacturing, design, development, and distribution while 6 were also engaged in installation. The Solar Foundation numbers show significantly higher manufacturing employment than what is reflected in this ongoing reporting. The differences related to installation activities are more explainable as the Solar Foundation numbers likely reflect a broader universe of installation companies than those subject to the mandatory federal reporting.

**Advocacy Estimates: AEE**

Advanced Energy Economy (AEE) is nonprofit organization formed and chaired by Tom Steyer, whose listed mission is: “...transforming public policy to enable rapid growth of advanced energy companies.” The estimates have been issued from its associated Advanced Energy Economy Institute. Two estimates of California “advanced energy” jobs have been issued (AEE, 2014, 2016).

Prepared by the same contractor as for the DOE, Solar Foundation, and E2 estimates, the estimates are based on the same methodology, beginning with selected NAICS and using a survey of known energy along with additional sampling of potential energy-related companies. Retail trade is specifically excluded, and government regulatory jobs do not appear to have been included although this conclusion is not certain due to the limited methodology and core data provided. Given the technologies included, some level of public employment likely is included related to state and local agency employment in power generation and distribution.

The estimates cover advanced energy employees, defined tautologically as “...full-time and part-time permanent employees who support the advanced energy portion of the business, including administrative staff and excluding interns and other temporary workers.” Advanced energy includes the hydro, nuclear, and natural gas (advanced) technologies excluded from the state’s climate change policies. Although not specified in the reports, subsequent articles discussing the results indicate that the numbers include workers spending less than 50% of their time on the defined energy activities. Employment estimates are broken out as “segments” composed of building energy efficiency (63% of jobs in 2015), advanced generation (28%), advanced transportation (4%), advanced grid technologies (4%), and advanced fuels (1%).

Specific NAICS break downs are not included directly, but appear to have been used to develop a separate “value chain” distribution: Construction (“installation, maintenance & repair,” 42% of jobs in 2015), Manufacturing (5%), Trade, Transportation & Warehousing (“trade, distribution & transport,” 8%), Professional, Technical & Scientific Services (“engineering, research & professional services,” 32%), and Other Services (“other,” 12%). While this crosswalk may not be exact, it indicates the extent to which the estimates cover both direct jobs and indirect jobs arising out of expenditures on advanced energy products and services.
Another indication of this indirect component is the extent to which the numbers differ from other estimates by the same contractor. The AEE numbers come out much higher, suggesting the inclusion of yet additional indirect jobs:

- Solar generation is shown in this estimate as by far the largest component of advanced electricity generation at 111,300 jobs in 2015, compared to only 75,600 for all solar jobs as estimated for the Solar Foundation report above.

- Building energy efficiency jobs alone are shown at 321,200 jobs 2015, compared to 301,350 for all energy efficiency jobs in the DOE report above.

- Total advanced (clean) energy jobs, not including retail trade, are shown at 507,700 in 2015. A rough estimate of the “clean” energy job portion of the DOE estimates from that year—including retail trade—came out at only 432,400.

Total estimated jobs for California are 411,655 in 2013; 431,834 in 2014; and 507,703 in 2015.

Advocacy Estimates: E2

E2 is a non-profit associated with Natural Resources Defense Council, formed to “...promote policies that not only improve our air, water, and public health, but also create jobs and provide better economic returns using fewer natural resources.” The organization released an estimate (E2, 2016) of clean energy and clean transportation jobs for the US and individual states in 2015 and 2016. The estimates were developed by the same contractor as for the DOE, Solar Foundation, and AEE numbers discussed above using the same methodology and jobs base. There is no indication of whether the indicated jobs cover all workers or just workers spending more than 50% of their time on the listed energy activities, but the high numbers relative to the other estimates done by this contractor indicate it is the former. Jobs in retail trade are excluded, and government regulatory jobs do not appear to have been included although those related to power generation and distribution likely are given the technologies covered.

Details are not provided on which jobs were selected for inclusion in the estimates, but the numbers are grouped by categories generally consistent with those in the contractor’s DOE reports: renewable generation (31.2% of California jobs in 2016), energy efficiency (58.0%), advanced grid (5.9%), advanced transportation (4.2%), and clean fuels (0.7%).

The degree of indirect jobs in the estimates is illustrated by the high level for Construction at 46%. There are, however, even further differences from the other estimates done by the same contractor:

- Solar jobs are shown at 152,900 in 2016, compared to 100,050 in the Solar Foundation report. The number, however, is the same as in the DOE report, and appears to have been taken from that work even though the DOE numbers include retail jobs.

- Construction jobs are shown at 234,100 in 2015, compared to 213,200 in the AEE report.

- Advanced transportation at 4.2% of jobs in 2015 is less than half the share shown through use of the DOE numbers.
• Energy efficiency numbers in this estimate come in at 295,700, coming closer to the DOE numbers when the retail trade difference is considered, but still differing substantially from the AEE estimates.

Additional differences exist as well. These differences aside, however, the estimates show some of the highest estimates among all the above reports at 508,929 in 2015, and 519,540 in 2016.

Comparison of the Estimates

The charts above illustrate the significant variation in the different estimates of California green and clean energy jobs. In comparing the numbers, it is important to keep in mind such differences as the sectors covered, the degree of public employment included (with EDD and BLS having the
highest shares), and the extent to which part time jobs (as low as 25% of their time on green activities) are included. The differences, however, show the effect these factors have on the various estimates, along with the role played by indirect jobs have in inflating the numbers by contrasting the reports attempting to develop industry/sector estimates (Commerce, Next 10, CARB, likely IRENA) vs. a one-sided look at expenditure impacts.

The first chart compares estimates for the broader green jobs category. While BLS and Brookings produced fairly comparable results as shown by the closeness of the 2010 estimates, they contain roughly one-third indirect jobs when compared against the Next 10 direct job estimates. EDD with a much higher incidence of tangentially-green jobs is the outlier in this group. Taking instead the EDD estimate for only those workers spending 50% or more of their time on green activities puts this source closer to the BLS/Brookings ballpark.

The clean energy estimates show much wider variation. Prepared by the same consultant, the DOE, AEE, and E2 numbers show greater consistency, although the clean energy number derived from the DOE data remains below. The far greater degree of indirect jobs contained in these estimates is illustrated by how much they differ from the more direct job estimates from the earlier CARB analysis and estimates derived from the IRENA numbers.

The extent of indirect jobs within the DOE, AEE, and E2 numbers is further illustrated by considering the distribution by NAICS industry, as shown in the following table.

<table>
<thead>
<tr>
<th></th>
<th>DOE 2015</th>
<th>AEE 2015</th>
<th>E2 2015/6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture &amp; Forestry</td>
<td>0.1%</td>
<td>n/a</td>
<td>4.1%</td>
</tr>
<tr>
<td>Mining</td>
<td>1.7%</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Construction</td>
<td>33.0%</td>
<td>42.0%</td>
<td>46.0%</td>
</tr>
<tr>
<td>Utilities</td>
<td>6.1%</td>
<td>n/a</td>
<td>4.4%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>14.4%</td>
<td>5.0%</td>
<td>14.7%</td>
</tr>
<tr>
<td>Trade, Transportation</td>
<td>16.0%</td>
<td>8.0%</td>
<td>13.1%</td>
</tr>
<tr>
<td>Professional,</td>
<td>15.8%</td>
<td>32.0%</td>
<td>14.7%</td>
</tr>
<tr>
<td>Scientific &amp; Technical</td>
<td>12.9%</td>
<td>12.0%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Other Services</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As indicated, construction alone constitutes one-third to nearly a half of the clean energy estimates, reflecting the fact that most of the indicated jobs in this period came from construction of generating plants and associated infrastructure to comply with the state’s Renewable Portfolio Standard along with installation services related to solar panels, charging stations, building efficiency measures, and similar components. These are primarily temporary jobs resulting from expenditure for green investments, rather than development of permanent jobs capable of providing longer term economic benefits from the state’s policies. Many of the supporting jobs within Trade, Professional Services, and Other Services stem from this temporary stimulus as well.

Another means of estimating the split between direct and indirect jobs is by applying direct-effect employment ratios from an input-output model. This ratio indicates the number of jobs in all industries resulting from an additional job within a specific industry as the various inputs—supplies, components, services—are acquired to increase output. Using ratios from a 2015 California RIMS II model obtained from US Bureau of Economic Analysis and applying them to the AEE segment
distribution from that year produces (using the most applicable of the 368 available industry ratios) a rough estimate of 302,000 direct jobs compared to the 507,700 total jobs contained in the AEE estimate.

This number, however, should be considered rough for three primary reasons: (1) the segments used in the AEE report do not directly match to the RIMS II industries, and only the most applicable one was used; (2) the RIMS II ratios are based on full-time equivalents while as discussed above, the AEE numbers have a high component of part-time activities used to determine jobs; and (3) input-output models are by their nature static models while the clean energy industry attempting to be captured is at least intended to reflect a structural change in the economy. This ballpark exercise, however, is useful in showing the direct job component is closer to 1.9% of total Nonfarm jobs, rather than the higher percentages claimed in the advocacy reports.

**Policy Use of the Estimates**

Regardless of the differences in the green job estimates—including both the details of those estimates and resulting totals—the figure used within the state’s policy debates centers on a single number—500,000 jobs created or projected to be created.

> Today, Britain’s environmental industries are the fastest growing sector of the country's economy, growing from about 135,000 jobs to over 500,000 jobs in just the last 5 years.  
>  
> Senator Barbara Boxer, Green Jobs Created by Global Warming Initiatives,  
> Hearing Before the Senate Committee on Environment and Public Works, September 25, 2007

> Investments in the clean tech sector have risen fourfold in the past 5 years, and rose 78 percent in 2006 to $2.9 billion--and are projected to grow to about $10 billion by the end of this decade (creating 500,000 new jobs).  
>  
> Statement of Vinod Khosla, Green Jobs Created by Global Warming Initiatives,  
> Hearing Before the Senate Committee on Environment and Public Works, September 25, 2007

> According to a just released survey, California has 500,000 green jobs today, the highest percentage (3.8% of total employment) of any state analyzed. For comparison’s sake, the green job percentages of other sample states are 3.3% (Washington), and 3% for both Oregon and Michigan.  
>  
> “Green Jobs You Can Believe In,” Center for Energy Efficiency & Renewable Technologies, April 20, 2010

> One such industry is clean energy. We need to lead again. California has tremendous potential in renewable energy. Peak electricity demand in California today is 65,000 megawatts (MW), and California has the ability to produce at least 1.3 million MW of renewable energy—concentrating solar, wind, solar photovoltaic (PV), small hydro, geothermal, and biomass—roughly twenty two times our current electricity capacity.  
>  
> Below is my plan to get us there. It will produce a half a million new jobs in the next decade.  
>  

> "Since AB32 was passed, $3 billion in venture capital has been spent in California,” said Steyer, who has been joined by a host of top Silicon Valley investment and tech leaders in opposing the initiative.
“It represents the seed capital in the start of the revolution of how energy is produced around the world,” he said. “California has been a place that has led intellectual and economic revolutions, specifically aerospace and (the Internet). And AB32 is a statement; we want to lead the (green-tech) revolution.”

He cited a new report by the Clean Economy Network, a national coalition of entrepreneurs, investors and researchers, that suggests the state has reaped 500,000 jobs in clean tech, including 93,000 in manufacturing and 68,000 in construction.

“Schultz, Steyer Join Forces to Battle Prop. 23, San Francisco Chronicle, July 25, 2010

A green economy is not an abstract concept. It is already starting in places where leaders understand that the right solutions lead to job growth and give America an edge in a forthcoming multitrillion dollar global market. Some reports estimate that a clean energy industry can provide 3.2 million jobs. As just one example, since initiating its clean energy plan, Assembly Bill 32, California has added 500,000 green jobs.

“AB32 has added 500,000 green jobs,” CNN Opinion, August 24, 2010

[Governor Jerry] Brown also said his focus on renewable energy would create 500,000 new green jobs by 2020. . . Brown promised to appoint a "czar" to oversee renewable energy and job growth, but instead the governor chose an advisor to handle job growth issues more broadly.


Former Secretary of State George Shultz and San Francisco businessman/philanthropist Tom Steyer, Senior Partner of Farallon Capital Management, today announced that they will co-chair “Californians for Clean Energy and Jobs.” The group will back state, regional, and local clean energy policies, support implementation of the state’s landmark climate change law (AB 32), and promote renewable energy jobs, projects, and businesses.

“Californians for Clean Energy and Jobs” Re-launched, Ella Baker Center for Human Rights, April 18, 2011

More than 500,000 people are employed in “green jobs” in California and that number is expected to ramp up in the coming years, according to a report released last week.


Steyer argued that the move toward renewable energy would create jobs for individuals in that area of the state. Steyer said that businesses and jobs are being created in the renewable energy field at a record pace. He claimed that there are 500,000 clean tech jobs, a 17% increase this year.

“Tom Steyer in Conversation – And Some Follow up Questions,” Fox & Hounds, July 23, 2015

In August 2016, E2 released a report detailing the impact of California’s climate change regulations since the Global Warming Act of 2006 (AB32) became law in California. The report’s findings were substantive and played a key role in the passage of SB32 this year. . . California stakeholders invested $48 billion in renewable energy, energy efficiency, transportation and other climate projects since 2006. These investments by both public and private entities produced more than 500,000 jobs in California.

“California’s Climate Change Leadership Created 500,000 Jobs,” TriplePundit, October 31, 2016
We need look no further than to California to find a partnership between labour, business and government that has so far resulted in the creation of more than 500,000 family-supporting jobs that support California’s climate goals.

Darryl Walker & Lis Matthaus [Green Jobs BC], “Opinion: The Need to Take the High Road To a Low-Carbon Economy,” Vancouver Sun, December 5, 2016

"President Trump is basically telling California's more than 40,000 clean-energy businesses and the 500,000 workers they employ that they don't matter to him," he said.


"Clean energy is in fact a pillar of our economy that employs now more than half a million Californians. That's nearly ten times more the number of coal mining jobs that exist in the entire nation. So, clean energy is the future."

Senator Kevin de León quoted in “Do California's clean energy jobs equal 10 times the nation's coal mining jobs?,” Politifact California, June 2, 2017

California is by far the nation’s clean-energy leader and it is paying workforce dividends with the creation of well over 500,000 clean energy jobs in the Golden State – 10 times more than there are coal jobs in the entire nation.

“Leader on the Environment and Clean Energy,” kevindeleon.com (US Senate campaign website), accessed April 5, 2018

This number has even found its way onto state agency websites, repeating job claims from advocacy promotional materials rather than conducting independent assessments more in keeping with the AB 32 mandates to explore and identify the most cost effective measures.

Green jobs are growing faster than any other industry. From 2007 to 2008, jobs in green businesses grew 5% while total jobs in California fell 1%. The green economy could soon become the nation's fastest-growing job segment, accounting for roughly 10% of new jobs over the next 20 years – up to 4.2 million new green jobs – 500,000 in California. (Source: Many Shades of Green: Diversity and Distribution of California’s Green Jobs, Next 10, U.S. Metro Economies: Current and Potential Green Jobs in the U.S. Economy, U.S. Conference of Mayors)

California Air Resources Board, California’s Climate Plan, Driving the Development of a Green Economy, https://www.arb.ca.gov/cc/cleanenergy/clean_fs2.htm, accessed April 5, 2018
What Is the Economic Significance of Green Jobs?

Green Jobs as a Share of the Economy

Discussing green/clean energy jobs within the context of their overall contribution to the California economy cannot be done without first considering a number of factors related to this employment.

Permanente vs. Temporary Jobs

First, as discussed in the previous section, the various green jobs counted within the estimates generally fall within two components:

- Green jobs that legitimately represent new industries within the state, providing new products and services as a result of regulatory mandates or of changing consumer preferences and willingness to pay for green offerings. These jobs represent a structural change within the economy as new products/services or new production processes arise, and generally constitute more permanent or longer term jobs within the state as long as the state offers competitive conditions.

- Green jobs that are counted as such in the various estimates, but that result indirectly from expenditures on green goods and services or investments in facilities such as solar and wind generation plants that are required to provide them. These jobs are typically represented by construction but, as illustrated by the expansive definitions in some of the previously discussed estimates, may extend to various administrative and other support services as well. These jobs are temporary, and generally represent the type of indirect and induced jobs typically counted in economic impact estimates.

For example, of the 500,000 jobs number generally cited in the political claims on this issue, applying the available industry distributions provided in some of the reports indicates that about 220,000 are construction jobs that may last a matter of days in the case of a roof top solar system, to a matter of months in the case of an alternative energy power plant construction or of a LEED building. These are still jobs and still jobs associated with green investments, but they are jobs that would arise regardless from comparable investments on similar developments within the traditional economy. They are not uniquely “green” nor are they longer term jobs that can replace those that are been reduced or precluded as a result of the underlying “green” regulations and policies.

Effect of Subsidies on Growth Estimates

Second, many of the jobs contained within the estimates rely on some level of subsidy, a point made clear by Berkshire Hathaway, the second leading wind power producer in the US:
"I will do anything that is basically covered by the law to reduce Berkshire's tax rate," [Warren] Buffett told an audience in Omaha, Nebraska recently. "For example, on wind energy, we get a tax credit if we build a lot of wind farms. That's the only reason to build them. They don't make sense without the tax credit."

US News & World Report, May 12, 2014

For the component of the green/clean energy job estimates driven by subsidies, the level of jobs and associated projections therefore rely to some or greater degree on how long those subsidies will last. As examples:

- Sales of roof top solar systems have been highly sensitive to the level of state and federal tax credits, subsidies from other ratepayers in the form of solar energy credits, and pricing systems that buffered buyers from utility “stranded costs” otherwise shared over a shrinking base of non-distributed ratepayers. Sales of electric vehicles have similarly been affected by direct subsidies in the form of personal tax credits, broader based subsidies from non-ZEV vehicle buyers coming from regulations promoting the sale of regulatory credits such as for ZEV and CAFE mandates, and related benefits such as use of HOV lanes and charging stations at parking facilities. While longer term prospects still rely on the hoped-for improved efficiencies and reductions in product cost, the current and near-term levels of employment in the benefitting industries are therefore sensitive to both the actual and perceived permanence of these subsidies.

For example, the most recent Solar Foundation (2017) report showed a 3.8% drop nationally and a 14% drop in California solar jobs between 2016 and 2017, due primarily to uncertainty over the federal tax credit, uncertainty the industry had previously used to promote higher sales in 2016:

A slowdown from the record-setting industry expansion seen in 2016. Installed capacity doubled between 2015 and 2016 in anticipation that the 30% federal investment tax credit would expire. In 2017, solar installations continued at a more moderate pace.

Solar Foundation (2017), p. 4

This report also notes that the steeper drop in California also came from changes in the subsidies provided through pricing policies, resulting in reduced solar sales and changes in company marketing practices as the utilities have moved more to time of use (TOU) rates for valuing the solar credit component:

Most residential customers do not have experience with TOU rates. Consequently, installers are having difficulty explaining the complex economics to prospective customers. Solar sales have declined every time a utility shifts its service area to net metering 2.0 with TOU rates. Other factors, such as rainy weather and changing industry business models, have also tripped the California market. Many residential companies have been cutting sales acquisition spending and shifting away from third party ownership to focus more on profit and less on market expansion.

Solar Foundation (2017), p. 20

- In addition to tax credits, subsidies for the sale of alternative electricity generation also come from higher rates on residences, employers, and other ratepayers as retail providers purchase
alternative generation at higher wholesale costs. Built into the rate base, these subsidies are more lasting and result in a higher degree of more permanent employment within the benefiting industries, but this outcome also produces a likely reduction in jobs elsewhere in the economy as disposable household income is shifted to utility bills from other household spending. This point is addressed further in subsequent sections.

- Green/clean energy jobs related to regulatory compliance spending fall somewhere in between. Regulations mandating specific air or water quality measures result in jobs related to the installation, maintenance, and reporting for the required compliance equipment and related actions. Homeowners completing renovations now find they must now include additional expenses for energy efficiency and water conservation retrofits under state law, increasing their overall housing costs but producing compliance-related jobs that are incorporated into the estimates. While such regulations generally are ongoing, the level of compliance costs taken cumulatively may in turn have an effect on the jobs within traditional industries required to support the green jobs component.

Associated with this point is the fact that subsidized jobs will grow quickly when subsidies are high. Most of the job estimates contained in the prior section apply to periods when such subsidies were indeed high, when green jobs were the focus of stimulus spending under the federal American Reinvestment & Recovery Act (ARRA) and when green jobs related to construction of utility-scale plants was pushed by ambitious schedules under the state’s Renewable Portfolio Standard and comparable AB 32 regulations. To claim that such jobs grew faster than other jobs during this period is not an indication of their sustainability and promise, but instead a reflection of the fact that such jobs in this period were the result of conscious government decisions that gave priority to their growth over the considerably larger base of jobs within the economy.

Effect of State’s Business Climate

Finally, green businesses must still operate within California and face the same high operating costs as traditional businesses for fuel, energy, land and buildings, taxes, and regulations. While green jobs and individual industries may initially develop in the state, their longevity and longer term prospects as a continuing source of employment growth is subject to being able to withstand these competitive differences. Furthermore, the type of job they are capable of providing—as indicated by wage level and number of usual hours worked—will be affected as well. The rapid erosion of solar manufacturing jobs and the failure to secure a greater share of manufacturing related to electric vehicles are two cases in point.

As another example, the specifics of California’s current storage procurement mandate on the state’s utilities were structured heavily to promote “market transformation” through provisions intended to encourage use of nontraditional storage technologies such as large-scale batteries. The primary jobs associated with that “transformation,” however, will largely remain outside the state. The core strategic minerals such as cobalt (Congo) and lithium (South American and Australia) are mined and refined largely in other countries, the battery components manufactured primarily in Eastern Asia, the batteries assembled in other states (e.g., Tesla’s Gigafactory 1 in Nevada) and other nations, and recycled most likely at the only two current facilities in British Columbia and Ohio. The related California jobs will more likely be those related to R&D and design on one end of the wage scale and temporary installation along with O&M jobs that will be lower when compared to the ongoing,
largely unionized jobs associated with fueling and operation at the traditional power plants they will replace.

**Green Jobs Are at Most 2% of the California Economy**

Green/clean energy jobs remain a small component of total jobs within the state. The table below summarizes this point by taking the various estimates discussed previously, and presents them as a percentage of nonfarm jobs in each of the applicable years. As indicated in the table above, the resulting estimates differ widely, but generally indicate that these job components remain in the low single digits, even when taking into account the substantial augmentation through indirect jobs contained in some of the reports.

The estimates that more closely measure direct jobs (Next 10, CARB) show green/clean jobs at only 1.0% – 1.3% of total nonfarm jobs in the state, with Brookings at 2.2%. The estimates that contain the most augmentations by counting indirect and temporary jobs (AEE, E2, DOE) still show a total share of only 3.1% - 3.7%. Netting out just the construction jobs from these augmented estimates—without adjusting for other indirect jobs as well—takes their share down to about 2%, or within the ballpark range shown in the direct job estimates.

**Green Job Estimates: Share of California Nonfarm Jobs**

<table>
<thead>
<tr>
<th>Year</th>
<th>Green Jobs</th>
<th>Clean Energy Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Commerce</td>
<td>Next 10</td>
</tr>
<tr>
<td>2007</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>1.0%</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1.2%</td>
<td>3.0%</td>
</tr>
<tr>
<td>2010</td>
<td>1.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>2011</td>
<td>1.2%</td>
<td>2.5%</td>
</tr>
<tr>
<td>2012</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>1.2%</td>
<td>0.5%</td>
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<td>2014</td>
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<td>0.5%</td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td>0.6%</td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td>0.6%</td>
</tr>
</tbody>
</table>

*Source: see text*

**Green Jobs as an Economic Driver in a Highly Regulated State**

In spite of these low employment shares, green/clean jobs continue to be cited as presumed demonstration of California’s superior job performance under its high tax/high regulation economic model. Such claims have even crept into state agency regulatory documents, with references to promotional job pieces developed by advocacy groups rather than demonstrating these conclusions through their own, independent analysis:

California’s strategic vision for achieving at least a 40 percent reduction in GHG emissions by 2030 is based on the principle that economic prosperity and environmental sustainability can be achieved together. Policies, strategies, plans and regulations to reduce GHG emissions help California businesses compete in a global economy and spur new investments, business creation, and jobs to support a clean energy economy. California’s
portfolio-based climate strategy can achieve great success when accompanied by consistent and rigorous GHG monitoring and reporting, a robust public process, and an effective enforcement program for the few that attempt to evade rules. The transition to a low-carbon future can strengthen California’s economy and infrastructure and produce other important environmental benefits such as reductions in criteria pollutants and toxic air contaminants, especially in California's most vulnerable communities.

Actions that are presented in this Scoping Plan provide economic opportunities for the future, but progress toward our goals is already evident today. For example, in 2015, California added more than 20,000 new jobs in the solar sector. This was more than half of the new jobs in this industry across the nation. Employment in the clean economy grew by 20 percent between 2002 and 2012, which included the period of economic recession around 2008. Shifting to clean, local, and efficient uses of energy reinvests our energy expenditures in our local economies and reduces risks to our statewide economy associated with exposure to volatile global and national oil and gas commodity prices. Indeed, a clean economy is a resilient economy.

Even accepting these metrics as a measure of the state’s competitive status under high regulation, the complete series instead demonstrates the opposite. The subsequent report from the uncited source (Next 10) for the “20 percent between 2002 and 2012” showed a loss in its following year, a 13,000 job loss in 2013. After estimating a 20,000 gain in 2015, the subsequent report from the uncited source for the solar jobs estimate (Solar Foundation) instead showed a nearly 14,000 job loss in 2016. With reported sales as measured by megawatts down by 16%, the estimated jobs are likely to continue dropping in 2017 as well. At best, a more complete review indicates the variability of these estimates—as a result of many of the factors previously discussed—rather than demonstration of the “resilient” results predicted in this excerpt from CARB.

Neither of these numbers nor those in the other estimates provide a sufficiently accurate accounting to demonstrate a “resilient” economy. The estimates rely too heavily on indirect spending impacts. The numbers are too small when considered in the context of the overall economy, even less when it’s acknowledged that significant shares of the incorporated jobs involved spending less than 25% of their time on the subject activities. “Resiliency” is also not demonstrated when presumed growth of 20,000 jobs in one year is followed by a loss of 14,000 in the next, otherwise strong jobs recovery year. And the ability to compete in a global economy is not shown when even the referenced studies acknowledge that the state’s green industries have had little effect beyond our own boundaries. The Solar Foundation study (2018) cited in the CARB excerpt also indicates sales of California firms in that year were only 3% to other countries, with 77% dependent on in-state activity.

**Primary Emission Reductions Came During Economic Downturn**

The strongest reduction in greenhouse gas (GHG) emissions experienced to date in California is not associated with a growth in jobs green or otherwise, but instead came during the significant overall jobs decline experienced during the recent recession. As illustrated in the chart below (both emissions and jobs are indexed to 2014 to show relative change), California achieved a net reduction of 48.8 tonnes from the peak in 2004 to the most recent inventory results in 2015. Of this total,

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40.1 tonnes—82%—occurred in the years 2008 to 2010 coincident with a period of significant job loss in the state. CARB emissions data shows the biggest dips in this period coming from transportation (-21.2 tonnes) and from electricity generation—both in-state (-7.4 tonnes) and imports (-16.2 tonnes) as both usage dropped and generation mix changed—as emissions-related activities by both employers and households dropped and as the jobs mix within the state’s economy underwent a substantial structural change. After 2010—the year when jobs recovery finally began in this state and the same year when CARB adopted the “early action” items under AB 32—to 2015, net emission reductions have been only 5.7 tonnes. As of 2015, California emissions were 2.2% above the 1990 benchmark goal set in AB 32.

The initial California results for 2016 so far cover only those facilities required to file under the Mandatory Reporting Regulation, accounting for just over three-quarters of the total contained in the state’s inventory. These partial results (CARB, November 6, 2016) show a 4.8% reduction in the level of reported emissions from these sources, but the bulk of these reductions come from factors
other than the state’s regulations and policies. Of the total 16.4 MMTCOe net reduction from this partial accounting, the three largest sources were: 9.7 MMTCOe from imported electricity that at best produced only negligible in-state jobs, 7.1 MMTCOe from in-state production of electricity, and 2.1 MMTCOe from oil and gas production as production levels and the associated high wage, blue collar jobs continued to drop. This second largest component—in-state electricity generation—as well was more the result of improved weather rather than policy as US Energy Information Administration data shows total in-state generation from natural gas dropped 38.2 TWh (-16.4% from 2015) and was largely replaced by a 30.3 TWh increase in conventional hydroelectric generation (+109.6%) as winter rains and snow recovered from drought conditions. In-state solar and wind generation combined contributed only a third as much at 10.5 TWh (+19.5%), and even these sources were partially overset by a 1.9 TWh (-5.2%) drop in other renewables generation.

US emissions show a similar although somewhat more variable pattern, with the exception that the peak came in 2007. Total emissions between 2004 and 2015 show a net reduction of 676 MMTCOe, of which 63% came during the contraction period in the years 2008 to 2010. The most recent results (US EPA, 2018) show US emissions declining an additional 1.9% in 2016, taking the level below the prior low in 2012, similar to the California results for 2011 compared to 2014. US EPA shows emissions in 2015 at 4.4% above the 1990 level. The 2016 results are 2.4% above, or generally comparable to California’s results in 2015.

Earlier CARB documents acknowledge the role played by the recession in the state’s progress to date. Updated forecasts for the Scoping Plan (CARB, 2015) identified 51 MMTCO2e reduction resulting from the “economic downturn,” accounting for just over a third of all emissions reductions then identified as required to meet the 2020 target. Other analyses (Cullenward, 2017) place the recession’s contribution closer to half of the emission reductions achieved through 2015.

Jobs Growth since Recovery Began in 2010 Driven by Bay Area and Not Green Jobs

California jobs growth seen since 2010 has not come from green jobs. Instead, the bulk came primarily from three sources:

- A disproportionate share—30%—came from the Bay Area, a region whose economic base is in industries who are among some of the least regulated in the country and who still maintain compensation and financial models that have moderated the effect of the state’s high rates. Based on high technology and information industries, these jobs have also been less affected directly by the state’s climate change policies, compared to the traditional industry base found in much of the rest of the state.

EDD data shows that the Bay Area, with 19% of the state’s population, accounted for 30% of total (recovery) nonfarm jobs growth between 2010 and 2017 and 39% of net (expansion) jobs growth between 2007 and 2017.

US Bureau of Economic Analysis (BEA) data shows that Bay Area’s real GDP grew at an average annual rate of 4.7%, producing 44% of the net increase in state GDP between 2010 and 2016. The rest of California—largely reliant on industries more directly affected by the state’s high regulatory and tax conditions—grew only half as fast at 2.4%.
As measured by real GDP, the Bay Area economy in 2016 was 28% larger than it was in 2007—taking into account both recovery and expansion growth—while the rest of the state was only 11% larger, or about the same as the 10% expansion experienced by all states other than California.

Rather than strong, “resilient” growth coming in tandem with increasing regulation, the Bay Area numbers instead indicate the state’s higher growth in this period has come primarily as the result of an industry center largely outside those regulations.

- Another 20% of recovery jobs came from growth in lower wage industries (Retail Trade, Accommodation & Food Services, and Other Services) in the portion of California outside the Bay Area. This factor alone is a better illustration of changes that have occurred in the California economy outside the Bay Area since the recovery, with a greater component of jobs being created in lower wage, lower hour service jobs rather than middle-class wage levels within the traditional industry base. These jobs also carry a significantly lower emissions profile than the higher pay manufacturing and construction jobs they replaced. Rather than resiliency, this factor illustrates the growing two-tier economic divide in the state that has evolved since the recovery.

- Another 13% came from growth in Health Care & Social Assistance in the portion of California outside the Bay Area, a substantial share of which was associated with the major expansion in state spending on related programs along with the general aging of the population. Rather than green jobs, this portion of the state’s jobs expansion remains more dependent on the continued health of the state’s volatile revenue structure, which in turn is over dependent on economic activity within the Bay Area as well.

In sharp contrast, green/clean energy jobs during this period—combining the most generous estimates—at most accounted for an apparent 6% - 8% of total new jobs from 2010 to 2016, and as little as 2% if only direct jobs are considered. However, because jobs are counted as green/clean energy in the estimates if as little as 25% of their time is spent on the related activities, the actual—putting aside the other issues with the estimates discussed previously—contribution is substantially less when this double counting is considered.

**California is Not the Only State Demonstrating “Resiliency”**

Because indirect construction jobs are such a large component of the green/clean energy estimates, the California numbers naturally show elevated levels in recent years as a result of heightened construction for utility-scale projects coming as a result of compliance with the state’s Renewable Portfolio Standard. These numbers are likely to change in the coming years as construction winds down. The chart below—showing planned capacity additions qualifying under the various “clean energy” technologies, including both projects now under construction and those that are planned—indicates California also is likely to slip behind over the next 4 years based on this portion of the metric. California is third behind Texas and Pennsylvania when considering all of the technologies included in the estimates (renewables, advanced natural gas, nuclear), and still second behind Texas when only renewables are counted. Several other states would nudge out California as well if the related jobs are measured in relative rather than absolute terms.
These prospective clean energy jobs should also be considered against the backdrop of energy prices among the three leading contenders. As indicated by US Energy Information Administration data:

- From 2004 to 2017, the average residential electricity rate jumped 23.9% in California, going from 14.75 cents per kWh to 18.27 cents. The average annual residential electric bill grew $228 (22.9%) in this period.

- In Pennsylvania—a state model generally falling somewhere between the other two in this list—rates grew 12.8%, from 12.70 cents to 14.32 cents. The average residential electric bill grew only $37 (2.8%).

- In Texas—the generally cited opposite of California’s high regulation-high tax approach—rates declined, going from 11.60 cents to 11.18 cents (-3.6%). Average electric bills dropped even further—by $171 (-10.3%).

Note that within this period from 2010 to 2016 (2017 data not yet available), Energy Information Administration data shows Texas (with only 69% of California’s population) added alternative energy at a higher pace than California. Total in-state generation from non-hydroelectric renewable sources grew by 64.3 TWh to a total of 119.9 TWh, compared to California at a growth of 48.3 TWh to 98.9 TWh. Total in-state generation from non-GHG sources altogether (renewable, hydroelectric, and nuclear) grew by 66.1 TWh to 206.7 TWh in Texas, compared to California’s 12.8
TWh growth to 194.6 TWh total largely as the result of deep cuts in nuclear. Texas as the alternative model to California’s approach was able to achieve these higher levels—along with the associated green jobs—while reducing overall costs to ratepayers.

Viewed from this component, the relative number of “clean energy” jobs contained in the various estimates are not so much an indicator of resiliency in the California economy, but more a reflection of regulatory decisions that accelerated the related construction while shifting the costs to the rate paying base. Comparison with other states also indicates that at minimum equal or better job results can be obtained through other approaches, and at best can achieve these job results at lower overall costs to households and other ratepayers, thereby creating greater efficiency overall in a state economy.

**Sidebar: Electric Vehicles**

Electric vehicles constitute one area where the state has a formal policy stating its intention to proactively promote green jobs. At its inception, this strategy made sense from a number of perspectives:

- California in essence created the market for a modern-day electric vehicle industry through its clean air regulations. Beginning with CARB’s LEV I regulations in 1990, California has required some level of Zero Emission Vehicles (ZEV) to be offered for sale within the state. As subsequently revised, these requirements now also apply to the nine states which have adopted the California program: Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Vermont. In 2017, California contained 53% of all ZEV sales (battery electric vehicles and fuel cell vehicles) in the US, 51% if plug-in hybrids are included in the total.²

- Even though job levels are down from previous peaks, California still retains the largest manufacturing base in the nation, with 10.5% of total manufacturing jobs in the most recent data. Southern California remains the country’s largest manufacturing center, a position it took over from the New York City region in the second half of the 20th Century. This resource provides a core of experienced workers along with a substantial network of existing supply and sales channels, training resources, and related R&D centers.

- California also has a long history in the auto industry, previously hosting more than a dozen major auto assembly plants throughout the state. In the most recent EDD data, motor vehicle and related parts and body and trailer manufacturing still averaged 31,800 jobs (average annual salary of $74,300) in 2017, compared to 45,100 in 1990. In fact, the availability of an extant assembly line at the former NUMMI plant in Fremont was a key factor in avoiding potential regulatory, permit, and CEQA delays and thereby securing Tesla, the state’s only remaining plant currently producing vehicles, electric or otherwise.

- Beginning in the 1980s, the state also emerged as a major auto design center, starting in Southern California and moving to the Bay Area as technology and R&D have become more

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critical to a more broadly defined vehicle industry that now includes ride sharing apps, self-driving vehicles, electrification, and an increasing range of high technology components.

- The nature of manufacturing jobs is changing. While some components, in particular some consumer products that function more as commodities, still rely on low-cost labor models, increasing use of automation and need for higher skilled labor in these operations has made other regions more competitive, as shown in the relatively higher growth in other parts of the US and in advanced economies such as Germany that have retained strong manufacturing sectors in the face of growing global competition. Manufacturing growth, however, has followed to regions that address the competitive needs for these jobs.

In 2012, the Governor issued Executive Order B-16-2012 setting a goal of 1.5 million ZEVs on the state’s roads by 2025. Components of this Order specifically embraced green jobs development by incorporating provisions to secure related manufacturing jobs development:

[By 2015] The State’s manufacturing sector will be expanding zero-emission vehicle and component manufacturing . . .

[By 2020] The private sector’s role in the supply chain for zero-emission vehicle component development and manufacturing State will be expanding . . .

[By 2025] The zero-emission vehicle industry will be a strong and sustainable part of California’s economy;

Executive Order B-16-2012

Rather than identify and address competitive constraints affecting the potential expansion of manufacturing jobs within the state, the subsequent implementation planning for this Order instead called primarily for data collection and conversations:

Moving forward, state government will play a central role connecting regions to share best practices, gathering economic data to measure ZEV market growth and ensuring our workforce is trained to meet future needs.

Governor’s Office (2016), p. 31

Subsequently, Executive Order B-48-18 expanded the sales target to 5 million ZEVs by 2030. The green jobs related component of this Order shifted to developing temporary construction jobs through the installation of charging infrastructure. However, the more permanent jobs goals envisioned under the manufacturing provisions in the earlier Order remain in place.

While a Faraday Future operation at a former tire plant in Hanford still appears to be under development, the state has to date been unable to secure any significant manufacturing operations related to the ZEV mandate beyond Tesla. Manufacturers in fact have been choosing locations anywhere but California as their preferred option. As listed in the Center’s quarterly updates on this issue, these plants include the following that have been announced since 2016:

- Tesla: Nevada (batteries, components), Minnesota (automation), Germany (automation), China
- BMW: Germany
• Daimler: Alabama, China
• Dyson: TBD (United Kingdom, Singapore, Malaysia, or China)
• Ford: China
• GAC Motor: China (for export to US)
• GM: China
• GM/Honda: Michigan (fuel cell power systems)
• Giant Motors/JAC: Mexico
• Honda/Hitachi: Kentucky, Japan, China
• LG Chem: Michigan (batteries)
• LG Electronics: Michigan (components)
• Lucid Motors: Arizona
• Rivian Automotive: Illinois
• SF Motors: Michigan (R&D)
• Toyota: China
• Volkswagen: Virginia (charging stations), Germany, China
• Volvo: China
• Workhorse: Ohio

The competitive challenges California faces in actually securing green jobs of this type is well illustrated by Tesla’s location decision related to its Nevada Gigafactory. California remained competitive on many fronts, including proximity to the Model 3 assembly line in Fremont, access to renewable energy, and even development of draft legislation containing $500 million in tax incentives. A key deciding factor, however, remained that “California’s circuitous project approval process could take too long — a big risk to the Gigafactory timeline.”

These broader regulatory, permit, CEQA, and overall operating cost parameters are not a new issue. Rather than identifying these potential constraints up front and developing means to address them in a way to become competitive for the green manufacturing jobs envisioned in the Executive Order, the state instead waited until they became a problem and then choose to propose selective changes that would apply to only one manufacturer rather than reforms that would promote jobs in this industry more broadly.

This challenge is illustrated in the following chart which compares manufacturing jobs recovery and expansion since February 2010 in both California and in the other states, with jobs in both regions indexed to the February 2010 level. As shown, growth has been stronger outside California, with significant acceleration beginning after Fall 2016 for these middle class wage jobs. Overall, California had a net gain of 71,000 manufacturing jobs in this period, while the other states combined gained 1.09 million.

Instead of being on the forefront of electric vehicle manufacturing, California now sees this industry shifting to other states and on a global scale, more rapidly to China. The state—as with growth elsewhere in its two tier economy—remains competitive for the higher end knowledge jobs

associated with this industry but once again is facing a shrinking component of the middle class wage jobs that could have resulted.

In this respect, California is repeating much of its prior experience with the vehicle manufacturing industry. Increasing regulatory costs combined with broader changing industry conditions to make continued operations in this state uncompetitive. Increasing regulation in this case helped produce job losses rather than a “resilient” economy result. The primary jobs creation in this instance came not from the regulations themselves, but through regulatory credits other employers were able to “mine” as they sought to remain competitive in the state, namely air quality credits such as those from Ford’s former San Jose plant and GM’s former plants in Los Angeles County.

The state is now embarked on a similar outcome. The use of regulations and subsidies will likely increase ZEV sales within this state—to the extent envisioned under the Executive Orders remains to be seen. But regardless of whether those goals are met, the vehicles will be sold here, and the jobs to produce them will now largely go elsewhere. And in this process, the state’s actions are not as likely to reduce GHG emissions overall but to shift where they are produced—directly as manufacturing takes place in locations without similar regulations, indirectly as products are transported over larger distances to the California market, and through regulation as higher sales produced by subsidies and mandates in this state result in credits—both for ZEV and CAFE purposes—that facilitate the continued movement of the market elsewhere to larger and less fuel efficient vehicles.

For example, the most recent data from CARB shows a total ZEV credit balance across all vehicle classes and manufactures of 1.079 million in 2016 (468,363 for ZEVs alone) compared to a total transfer of 72,976 credits in the period September 1, 2016 to August 31, 2017. Tesla, in its most recent 10-K filing for 2017, reported total revenues from the sale of regulatory credits (ZEV and CAFE) at $360.3 million, or 16.2% of total gross margin for the year.

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Sidebar: Prop. 39

The California Clean Energy Jobs Act (Proposition 39, 2012) is an initiative statute that revised the provisions for calculating corporate income tax. Projected funds are deposited in the General Fund and for the first five fiscal years (about $550 million annually) allocated to energy efficiency and clean energy generation projects at schools.

This measure was one of the first to be promoted on its potential for creating green jobs:

Prop 39 aims to address this loophole and direct savings and revenue from the venture into education and green energy initiatives. This means improving the energy efficiency of schools and public buildings, as well as creating many jobs across the green energy sector. This is vital for California, a state that prides itself on its green credentials and solutions.

“California Businessman Tom Steyer to Speak About Sustainable Energy,” cleanenergyjobsact.com, September 4, 2012

The measure requires financed projects to be selected in part “based on in-state job creation and energy benefits for each project type.” Subsequent implementing legislation further required the Energy Commission to report annually on total expenditures, energy savings, effective cost of saved energy, and employment effects from each year’s completed projects. Grant recipients were to monitor and report the related data for the Commission’s use.

The actual results, however, have varied and illustrate the potential gaps that can arise between political claims on green jobs and the actual results.

While the claims at the program’s inception promised that 11,000 green jobs would be created annually, the initial results from the grantee reports instead showed only 1,700 created over the first three-year period:

Voters in 2012 approved the Clean Energy Jobs Act by a large margin, closing a tax loophole for multistate corporations. The Legislature decided to send half the money to fund clean energy projects in schools, promising to generate more than 11,000 jobs each year.

Instead, only 1,700 jobs have been created in three years, raising concerns about whether the money is accomplishing what voters were promised.


Subsequent reviews bumped this number up. The most recent assessment report (Zabin, 2018) showed total direct and indirect jobs near the target level, at 11,729 (plus an additional 6,842 induced jobs). However, this number differs from the initial claims in several respects:

- This level is a total over a four-year period, resulting from cumulative state spending from 2014 to 2017. Adjusting for this factor, rather than 11,000 green jobs annually, the $1.388 billion in state expenditures instead produced the annual equivalent of only 2,039 direct jobs over the four-year period, 2,933 if indirect jobs are included as well.
• More importantly, the 11,729 jobs number is only an estimate. It was developed not by using any actual jobs data from grantee reports, but instead from using the cumulative expenditures and estimating jobs from the IMPLAN input-output model.

In other words, the same general method used to develop the job claims to promote the initiative was used to estimate the jobs produced from the initiative. But even accepting this shift from the stated (and statutory) evaluation criteria, the reported job benefits fall well below those promised the voters when they passed this measure.

Sidebar: Recycling

Creation of green jobs has long been a component behind justifications for the state’s recycling programs. Such jobs are created as recyclable materials are collected and transformed into new products. The promise of such jobs, however, has not always been fulfilled to the same extent in the actual results for a variety of reasons.

Development of sustainable markets for the related green jobs is affected by the degree of both the consistency in quantity and quality of the material flows. In 2011, AB 341 raised the state’s recycling goal from 50% to 75% by 2020. The state’s overall recycling rate, however, has been going in the opposite direction. After reaching 50% in 2012-2014, CalRecycle’s data shows the state rate dipping to 47% in 2015, and 44% in 2016.

With few exceptions, these jobs rely on subsidies paid by households and employers in the form of monthly utility payments and through recycling fees paid on a wide range of products such as beverages, electronics, tires, mattresses, and others. These fees in turn are used to subsidize the collection and sorting which except for some items such as aluminum, are not sufficiently profitable to operate on their own based on revenues from selling the recycled materials. The matching of subsidy levels to required operating levels, however, is a heavily bureaucratic process while the market forces affecting the value of recycled materials is more immediate and affected by price swings in the underlying, competing virgin materials. Like any other central planning process, the state’s recycling agencies have often been slow to react to events such as recent drops in oil and commodity prices that undercut the value of recycled materials, producing a sharp drop in the related recycling jobs:

Mark Oldfield, communications director for CalRecycle, estimates that in peak years, there were between 2,200 and 2,300 recycling centers in the state, but as of today, the database shows 1,680. Processing centers, which take recyclables from these centers, have closed, too. There are 183 active ones in California, down from 196 in 2016 and 217 in 2015. “Recycling Centers Continue to Struggle, Driving California Recycling Rates Down,” San Jose Mercury-News, June 18, 2017

As with other green job industries, many of the jobs created by these green policies are not created within the state. In assessments of the green jobs potential from the new 75% goal (CalRecycle, 2013; Tellus, 2014), this point is explicitly addressed. The CalRecycle report acknowledges that the type and number of recycling jobs are affected by “issues such as the difficulty of siting and financing new manufacturing and composting or anaerobic digestion facilities in California.” While estimating that as many as 110,000 jobs could be created by the state’s new 75% goal, the Tellus report also states that “not all of the estimated job creation would take place within California or even the United States.”
Moreover, not even all of the current recycling jobs are created in the state. While the collection jobs are necessarily retained here, a large component of the reprocessing and remanufacturing jobs are shipped to other locations. Recent estimates by CalRecycle indicate a third of recycled materials are exported:

CalRecycle estimates that a third of all recyclable material generated in California annually is currently exported to foreign markets, and 62 percent of that goes to China. This movement of materials is critical for allowing the state and local jurisdictions to reach their recycling and diversion goals.

*National Sword, China’s New Policy on Recyclable Material Imports, CalRecycle, http://www.calrecycle.ca.gov/Markets/NationalSword/

No comparable estimates on the percentage of California recyclables sent to other states for reprocessing and remanufacturing are available. This level of exports, however, reflects that the state’s environmental policies—in the absence of accompanying reforms to actually foster in-state green jobs—serve more to shift the location of environmental effects than to secure the potential economic benefits:

A documentary by Chinese filmmaker Jiu-Liang Wang, “Plastic China,” has captivated global audiences, including at this year’s Sundance Film Festival. The story follows an 11-year-old girl living and working among piles of imported scrap plastic in a workshop in the Chinese countryside, and it has drawn attention to China's status as a waste-processing superpower and the toll that is taking on its people and environment.

“Oh, Scrap: China, the Biggest Buyer of America’s Trash, Wants No More,”
Wall Street Journal, October 8, 2017

The continuation of this outlet, moreover, is now in doubt as a result of China’s recent “National Sword” policy. Going into effect in March 2018, this new policy limits the import of contaminated recyclable materials and increases inspections of all such imports. The expected results include reduced import demand from China, increased domestic costs for collection and sorting, still uncertain effects on overall recycling rates, and increased diversion of previously “recyclable” materials to disposal.

**Sidebar: Solar Panels**

Solar energy was an early focus of green jobs promotion at both the state and federal level. Panel installation was promoted through a range of subsidies including income tax credits and favorable utility rate payments as mandated through California Public Utilities Commission. Manufacturing was similarly promoted through low cost loans, direct subsidies, and targeting of employment training programs. Related measures along with the Renewable Portfolio Standard were directed at utility-scale projects.

As with electric vehicles, California’s competitive factors early on limited the types and sustainability of green jobs it was able to secure from these programs. The early rise and fall of solar manufacturing in the state is illustrated in the chart below, with in-state production peaking in 2010 and the state’s competitive factors instead first leading to creation of the related green jobs in other states and subsequently with the state’s incentive programs promoting these jobs instead in other
countries. Note that US production is not reported beginning in 2013 as concentration in manufacturing reached the point where the nondisclosure provisions in the data had been reached.

![Photovoltaic Cell & Module Shipments by Origin](image)

Details on the movement of these green jobs out of California by company are provided in a Senate research paper on this topic:

- Why is manufacturing such a small subset of California’s solar industry? For one thing, making photovoltaic cells and modules is a highly automated process that does not require many workers. But solar company officials also cite many other reasons – including labor costs, regulations, and government incentives – to explain why they choose to manufacture elsewhere.

  . . . In 2010 and 2011 alone, for example, three California-based solar companies announced plans to open manufacturing facilities in Mississippi.

  . . . In May 2011, for example, Siliken Solar moved its 130-worker solar panel assembly operation from Otay Mesa in San Diego County to Tijuana.

  . . . Similarly, Solaria Corporation keeps its headquarters in Fremont, but does most manufacturing in India. In October 2011, at a legislative hearing on a state sales tax break for green manufacturers, Senator Bob Huff asked Solaria human resources vice president Melissa Zucker why the company chose to produce solar modules overseas. . . “California is absolutely the place where we want to be from an innovation standpoint,” she said. “We are able to attract incredibly smart, forward-thinking people who are passionate about the technology. It is a difficult state to manufacture cost-effectively in, as all of you are aware.”

  . . . In 2010, the California Legislature carved out a small exemption [CAEATFA] to the sales and use tax on manufacturing equipment for renewable energy and clean transportation companies. . . The solar companies that haven’t pursued the sales tax break include Calisolar of Sunnyvale, whose executives chose to expand in Mississippi. Calisolar chief executive
officer Roy Johnson had heralded the new tax break in April 2010, when former Governor Arnold Schwarzenegger signed SB 71.

“Many believe it’s not possible to be competitive manufacturing in Silicon Valley,” stated Johnson in a company press release, “but with innovative technology and a level playing field created by this legislation, Calisolar is well positioned to effectively compete in a global market.”

Rather than install new equipment and hire more workers in Sunnyvale, however, Calisolar shifted its business focus to solar silicon production in Mississippi. The company laid off more than 100 Sunnyvale workers. In February 2012, Calisolar even erased California from its name, changing it to Silicor Materials.

• . . . Paradoxically, the company that embraced the program first and used it most enthusiastically, Solyndra, filed for bankruptcy in August 2011 and fired more than 1,000 workers at its Fremont plant.

Besides state assistance, Solyndra had attracted tens of millions of venture capital dollars and a $535 million federal loan guarantee. But Solyndra officials said they simply could not compete with heavily subsidized Chinese solar panel manufacturers.

By the time the company shut down, Solyndra had used $25.1 million in sales or use tax exemptions, $11 million more than all the other SB 71-qualified companies combined had used by March 2012. CAEATFA had authorized the company to waive up to $35 million in taxes. State officials said they did not expect reimbursement, because Solyndra had not duped the state. The company bought equipment, as promised, and put people to work on it – just not for as long as anyone hoped. In fact, CAEATFA staff had visited Solyndra’s factory in June 2011, two months before it filed for bankruptcy and noted that the company had purchased, installed and put to use about two-thirds of the equipment it said it would. They even reported being amused by the company’s robots and forklifts, which played music while moving around the Solyndra factory.

• . . . With only a couple of exceptions, the companies producing green goods that qualified for SB 71 exemptions do not have large operations cranking out products with thousands of California employees.

Consider, for example, SB 71 tax break recipient First Solar Inc. The Tempe, Arizona, company is one of the world's largest makers of thinfilm photovoltaic cells. First Solar operates factories in Ohio, Germany, and Malaysia. Before SB 71 passed the Legislature in 2010, the company had about 130 employees in California, most in the San Francisco area working on project development.

With the passage of SB 71, the company decided to build a pilot development and production facility in Santa Clara. Company officials told CAEATFA staff that they planned to invest roughly $40 million in the pilot plant and put 180 people to work.

First Solar had used nearly the entire $3.4 million sales tax exemption allotted it by CAEATFA when global forces triggered a restructuring. . . . In January 2012, they laid off 63 workers in Santa Clara, including engineers and technicians.
Another company doing only small-scale production in California is Solaria Corp. Thanks to SB 71, the company avoided use tax on equipment it brought to Fremont from its factory in India. It had used $258,678 of its tax exemption award as of March 2012.

Approximately 117 people now work at Solaria’s Fremont plant near its research and development center, according to company officials. They say that they benefit from the synergy of doing at least some manufacturing near their innovation hub.

“There’s no comparison to having the engineers being able to put on their lab coats and go in the back to see what’s going on with the process,” said Solaria President Suvi Sharma. “That is a very critical part in the lifecycle of development. High-volume manufacturing is a different entity altogether.”

Similarly, SunPower Corp., based in San Jose, manufactures solar cells and panels in Malaysia and the Philippines. With the enactment of SB 71, the company opened a small production facility in Milpitas with 100 or so jobs – the company’s first manufacturing operation in the U.S.

Six-year-old Stion Corporation considered building a large plant near its San Jose headquarters to manufacture thin-film solar modules. It opted instead to build a factory in Hattiesburg, Mississippi. The factory opened in September 2011 and is expected to eventually employ 1,000 people. . . Stion officials say they will also break ground this year on a factory in South Korea.

San Jose-based SoloPower Inc. similarly chose to put its biggest factory out of state. SoloPower announced in January 2011 that it would build a factory in Oregon to make flexible, thin-film photovoltaic modules. By March 2012, the company had begun to hire engineers and technicians for its Portland factory, which is expected to employ 450.

. . . In mid-2011, after California awarded Bloom [Energy] $208 million to lower the price of its fuel cells for customers, Bloom announced that it would build a fuel cell factory in Newark, Delaware. At full production, the factory is expected to employ 900 people.

. . . In the last few years, Oregon and Mississippi have done especially well luring California companies. Calisolar, Stion, Twin Creeks Technologies, Soladigm, Peak Sun Silicon Corp., Solexant, Solaicx, SolarWorld Industries America Inc., Sanyo Solar, and SoloPower have all moved to or opened operations in Mississippi and Oregon in recent years. Most of the companies started in the Silicon Valley.

“Our company won’t even consider building a factory in California,” said Gary Kanaby, director of wind energy sales for Ohio-based Molded Fiber Glass Companies. The company has made wind tower nose cones and the fiberglass housings for turbine machinery at a small factory in Adelanto in San Bernardino County for 25 years, Kanaby said. But when the company needed to expand, the winner was South Dakota, where the company recently built two factories with a workforce of more than 350.

. . . SMA Solar, a German manufacturer of inverters for solar photovoltaic systems, maintains its U.S. headquarters in Rocklin. But in 2009, when the company sought to expand manufacturing in the U.S., it chose Colorado, not California.
Steve Taber founded Nordic Windpower in Berkeley in 2007 to make two-blade, utility-scale wind turbines. He located the company headquarters in the Bay Area and said that he considered locating the manufacturing in California. But after analyzing costs, his investors chose factories in Pocatello, Idaho, and Kansas City, Missouri. In 2011, after Taber left the company, his successors moved its headquarters from Berkeley to Kansas City.

Top concerns of the California Manufacturers & Technology Association include the state's sales tax on manufacturing equipment (California is one of only 12 states with such a tax) and the time and uncertainty associated with permitting, said Dorothy Rothrock, senior vice president of the association.

California needs to analyze the costs of its regulations, she said, so policymakers can eliminate those that are counter-productive. Government incentives will not heal wounds created by bad policies, said Rothrock: “If you're using that kind of approach as the basis for bringing back your economy, you're on the wrong track.”

[All quotes from Vogel (2012)]

More recently, at least three companies announced plans to resume solar panel manufacturing in the US as a result of the recent tariffs. None chose to do so in California. Of the three, China’s JinkoSolar Holding Co. selected Jacksonville, FL; First Solar Inc, is opening a new factory in Ohio; and SunPower Corp. acquired SolarWorld and announced plans to revive its manufacturing in Oregon.

As indicated in the outcomes listed above, California has been able to secure a relatively small number of manufacturing jobs but primarily only those associated with R&D operations and with the knowledge job components in which the state retains some competitive edge. These jobs, however, do not exist throughout the state but, along with much of the other higher wage jobs growth experienced since the recession, are concentrated within the Bay Area.

Moreover, a shift in manufacturing operations over a longer term will also begin to affect the higher wage knowledge jobs as well as the focus of R&D moves out of the research and regulatory realms, and into the commercial. Using patents as one indicator of competitiveness for innovation jobs and
enterprises, this process is illustrated in the chart above. In this data—which covers patents for all renewable energy technologies, solar as well as others—the shift in technology innovation quickly followed the shift in the underlying manufacturing base from the US to the Northeastern Asian countries. Using other data sources, California still accounts for a significant share of US patents—in 2015, 29% of all domestic patents—but the broader flow of innovation has followed manufacturing for renewable energy as it has moved overseas. Moreover, the data in the chart also shows an increasing concentration of this innovation, with the four countries shown accounting for 55% of renewable energy patents in 2000 and growing to 78% in 2013.

Sidebar Observations

The results of the Sidebar examples presented above suggest the following points:

• As with its economy overall, California remains competitive for green jobs in the higher wage, knowledge components, the mixed wage sales and service components, and the shorter term, mixed wage installation and construction jobs. In the examples, a broader range incorporating wage levels supporting middle class households has been missing or provided solely through the shorter term components. Even when such jobs began in the state, the more fundamental competitive factors have instead seen the state’s green policies generate these related jobs over time in other states and other countries. By failing to address these competitive factors, the broader range of the job benefits from state policies has followed two courses: green jobs for those activities that have no choice but to be in the state and greener pasture jobs where operating costs have driven the location decision.

• Many green jobs remain reliant on continued subsidies, either through mandates or direct payments. Even in the case of the recycling programs that have existed since the 1980s, the promised technology breakthroughs and economies of scale still have not been realized. Job levels remain subject to the continued flow of subsidies—in some cases sensitive to momentary or even potential shifts in their availability.

• Subsidies are no substitute for the fundamental competitive operating factors required to generate the full wage range of job opportunities in the state. While state policies may serve to launch an industry, employers will still need to operate at profit levels allowing their continuance and growth, and they face many of the same competitive challenges employers within the much larger traditional industry base already face. The examples discussed above illustrate the failures that occur when policy promises for a green jobs role in fulfilling a portion of the state’s future jobs growth do not deal with these constraints as well.

• The promises of green jobs when state policies are first considered demonstrate a poor record in matching the jobs that are actually produced. Even in the Prop. 39 case where tracking of actual jobs created was statutorily mandated, the difficulties of doing this accounting forced the state to fall back on modeling estimates instead. And even accepting those estimates as valid, the program produced only one-fifth to one-quarter of the green jobs promised at its inception, and only one-twentieth based on the first three years of actual jobs data. The continued reliance of the agencies on estimates produced by advocacy groups promoting the subsidies rather than an independent analysis that looks at the trade-offs
involved risks producing further examples of promises not matching results, as state policies continue to expand their cost effects on the broader traditional jobs base and overall household incomes.
Preliminary California Estimates

The primary purpose of this project is to produce a more current and transparent estimate of green jobs in the California economy. This section summarizes the steps used to create the preliminary estimate. This estimate will then be used as the base for the project’s next steps: (1) validation and additional calibration of the estimate through an employer survey and (2) a more complete assessment of the jobs stemming from the underlying state policies through a net impact comparison of green jobs created by those policies vs. reduction in other jobs as a result of the costs of those policies.

General Provisions

In general, the procedures used in this report draw on the previous analysis of the various estimates published on green/clean energy jobs creation in California. Similar to many of the estimates discussed in the prior sections, our initial estimate of California green jobs begins with the prior BLS work. This is one of the few works with sufficient documentation to construct comparable numbers, and provides the detail required to delineate between potentially direct and likely indirect jobs as contained in the aggregated numbers found in many of the other reports. Where the available public data is incomplete including due to nondisclosure requirements in the data series, other sources are applied including the detailed breakdowns in CARB (Environmental Business International, 2011), Commerce (2010), Next 10 (various dates), and Brookings (Muro, 2011) along with the more generalized distributions in the other reports.

Base Data

The base data is developed from the Quarterly Census of Employment & Wages (QCEW) data, which is broken down by detailed NAICS industry and available from BLS and EDD by the number of wage and salary jobs, number of establishments, and various other metrics. Estimates in this report are derived from the 2016 annual average data, and will be updated to 2017 after the fourth quarter data is released.

In some cases, the QCEW data is subject to nondisclosure due to the agency data restriction policies. These are handled by using the next highest available NAICS level where data is reported, or estimating from the establishment numbers based on recent employment factors from prior quarters or using comparable national rates.

The QCEW job numbers—as is the case with all the green job estimates considered in this report—are not full time equivalents. Instead, they count the number of jobs by month and average them over the year regardless of whether they are part time, full time, temporary, or permanent. Similarly, the BLS green jobs factors used in the estimate below were not derived from a survey of jobs, but are instead based on the estimated distribution of survey respondent sales between green goods and services and non-green applied to total employment. This approach differs from that used in many of the other estimates covered above, which counted an employee as green/clean energy if they spent as little as 25% of their time on the covered activities. Consequently, there will be some
differences arising out the fact that the nature of the “jobs” being measured differences widely across the different sources. This difficulty in translating job numbers into full time equivalents, however, is a common feature of both the reports reviewed in this document as well as the standard publicly reported jobs data series.

The important difference to note, however, is that the jobs contained in the estimate below are from the same base as is reported by the agencies in the quarterly data and is comparable to those as counted in the original BLS green jobs estimates as well as those by EDD. This factor allows for more consistent comparisons to the overall trends in the state economy, a feature missing in some of the other estimates reviewed here.

Allocation Factors

In most instances, the green job components by industry are developed from the green job rates developed in the BLS estimates, and updated by applying the changing industry mix and industry employment levels shown in the 2016 QCEW data. The BLS estimates provide the most detail in the national numbers at up to 6-digit NAICS. The California results are presented only at the 2-digit level. Consequently, where these are applied, the national rates are used but adjusted as required using the aggregated California indications.

The detailed BLS green jobs rates are available for two years, both 2011 and as revised for 2010. Generally the 2011 rate is applied when the two years are close, and selected based on what distribution information is available in the other years in cases where the two years differ more substantially (e.g., distributions in the other estimate reports, indications of whether the subject industry was growing or slowing, or shifting over more to green offerings).

As discussed in the specifics below, other sources are used in some cases where more current or additional data is available. These include the other reports along with other publicly available data sources.

In some cases, the QCEW data is subject to nondisclosure due to the agency data restriction policies. These are handled by using the next highest available NAICS level where data is reported, or are estimated from the establishment numbers based on recent employment factors from prior quarters or using comparable national rates.

Direct vs. Indirect Jobs

The estimates attempt to focus on direct jobs and delineate between these and the significant level of indirect jobs incorporated into many of the prior estimates, including the BLS numbers. This difference is generally clear for the goods producing NAICS, but not in all cases. For example, the BLS estimates include jobs in a number of construction industries due to factors such as “installation of LEED-eligible drywall” or “use of LEED-eligible paints meeting VOC limits.” These jobs—which would be required for the construction of any building—are simply defined as green due to the materials used being classified as green. On the other hand, BLS includes some site preparation jobs based on the use of “LEED-eligible demolition contractors.” In this case, the jobs are in an establishment providing services specifically certified as having a distinct production process resulting in a “green” outcome.
Services allocation is less clear. BLS estimates include jobs under general automotive repair due to “repair of parts for hybrid cars.” Again, the allocation is based on the “green” nature of the materials involved and bypasses the fact that owning a car generally requires availability of jobs capable of repairing it at some point. On the other hand, “repair of emissions control systems” along with smog check businesses is directly related to jobs that were created solely as a result of the need for producers or consumers to comply with specific regulations. As another example, jobs are classified as “green” because they involve the “repair of Energy Star certified telephones.” The basic jobs, however, were created because people buy telephones. A “green” telephone designation—unless the components required to make it “green” resulted in the phones breaking substantially less or more frequently—has no discernible effect on the overall level of those jobs. In other examples, “environmental/eco-tourism” tour operators along with “environmental testing services” and “environmental legal services” are jobs that exist largely as a result of changing consumer preferences or state policies, but television broadcasting and radio stations would still likely find content to fill their airtime without “environmental content” specific to their media.

The focus on direct jobs reflects the policy use of green/clean energy job estimates as a purported measure of the resiliency of the California economy in the face of growing regulation. The California economy in recent years has undergone significant structural change, first as a result of the recession and subsequently as a result of increased state regulation of the economy through environmental regulations, notably the climate change program. The direct jobs created in response to this second factor are a measure of the related structural shifts. Measuring the resulting “resiliency” can then done by assessing the degree the structural shifts rely on continued subsidy payments and policies, and whether they support indirect jobs within the economy to the same degree as jobs within traditional industries that are now negatively affected by those policies.

This delineation is not to say the indirect jobs are unimportant. They still provide income and employment to the population and they contribute to the overall health of the state economy. However, such indirect jobs would still result at some level with or without the current state policies directing them to their current levels. California employers, governments, and households would still be using electricity and other forms of energy but likely produced in a different form. Payments that now go to higher energy rates would still remain in the economy as consumption on other goods, investment, or savings. A more appropriate measure of resiliency is the overall net effect, an element missing from most of the previous estimates considered in this document.

**Government Jobs**

Government jobs are included in the estimate below primarily to the extent they represent enterprise activities. For example, publicly owned utilities operate hydroelectric and some alternative energy facilities as do a number of water agencies. A number of other enterprise activities, including public transit, water supply, sewerage, solid waste, and parks, are included in the BLS estimates. While they operate today and in some cases have expanded as a result of state and federal “green” policies and regulations, they also constitute historically provided public services and as such form a prime component of the jobs that have reclassified as such in the green jobs studies. These are addressed in the estimates developed for this report but are handled as discussed below. Additional government jobs related to public administration—primarily those involved in the development and
administration of the regulations and in the management of government parks and other resources holdings—are also included, but covered as well under the reclassified grouping.

Reclassified Jobs

As indicated, a number of jobs incorporated into the green/clean energy estimates come from long-standing industries that have existed prior to, and in some cases in spite of, current “green” policies. Most of the estimates incorporate jobs for technologies specifically excluded from components of the climate change policies, including conventional hydroelectric, pumped storage hydroelectric, nuclear, and some natural gas facilities. In fact, some of these jobs are being eliminated as the combined effect of the broader set of state policies are resulting in the closure of these facilities as opposed to higher emissions sources. As discussed above, a number of government enterprise activities and traditional regulatory functions similarly predate the current regulatory frameworks.

For the purposes of making this report’s estimates inclusionary, these jobs are incorporated largely as they are treated in the BLS accounting. However, where delineation is possible, the results indicate the portions representing reclassification rather than those resulting from the state’s current regulatory framework.

Estimates by Industry

The following summaries adjustments made to the BLS factors by industry.

Agriculture, Forestry, Fishing & Hunting

Most estimates incorporate the following components:

- Organic farming is generally treated as a green good that has evolved from consumer preferences rather than mandated through regulation. Estimates for crop and animal production were developed from sales and acreage estimates for California (USDA, 2017), applied to total California production numbers from USDA for 2016. These shares were then applied to the related job numbers for each component of the industry. While some studies (Finley, 2017) indicate that organic operations have somewhat higher labor needs than traditional operations at about 2-12% higher, the numbers are also affected from the premium built into the organic sales numbers and differing yields associated with the acreage numbers. Consequently, no adjustments were made for this factor. Related support activities are from the BLS factors.

- The BLS factors also include a component related to grain use for biofuel. However, compared to operations in other states, California biofuel facilities are generally less likely to use processes that shift food crops to industrial uses, and instead rely on feedstocks such as wastes and imported feed grain that is processed for fuel and then sent on to feeding operations. No component is included for this purpose but is instead incorporated in the other industry estimates.
• Forestry and logging includes sustainable certified timber and wood chips and waste for biomass and other purposes. Derived from the BLS factors as are the related support activities.

**Utilities**

Includes totals for hydroelectric, nuclear, solar, wind, geothermal, and biomass power generation. Jobs related to “advanced natural gas generation” are estimated using the factors in the most recent AEE report. All other components are from the BLS factors. Jobs related to hydroelectric, nuclear, and advanced natural gas are labeled as reclassified due to two factors: (1) the primarily stem from technologies in use prior to the state’s current regulatory regime, and (2) except for small hydro, all are precluded from the Renewable Portfolio Standard component of the climate change program. Energy Commission data shows small hydro as measured by capacity represents 12% of total hydroelectric capacity in the state. However, these projects tend to be highly automated compared to the larger projects, and capacity has not changed appreciably since 2001, well before the current regulatory structure.

Note that the nuclear jobs related to San Onofre no longer are for the production of a product or service like the other components of this estimate, but instead are now focused on the decommission process.

The government numbers include totals for related power generation along with BLS factors applied to totals for Water Supply and Irrigation Systems and Sewage Treatment Facilities. The last two components are labeled as reclassified.

**Construction**

Applies BLS factors for those components deemed “green” based on the process or construction specialty used, and does not incorporate components tagged as “green” in the BLS numbers based on the use of “green” materials or components in an otherwise typical construction activity. These additional construction jobs will be covered in the indirect estimates of the subsequent project phase. The reclassified component is primarily from in-house construction jobs related to the government-owned utilities covered above.

**Manufacturing**

Applies BLS factors in most cases, but with adjustments for vehicle component manufacturing and for Tesla’s facility in Fremont based on industry sources.

**Trade**

Applies BLS factors in most cases, but with adjustments for recycling operations. The reclassified component consists of Used Merchandise Stores, while recycling components are not included in this designation.
Transportation & Warehousing

Applies BLS factors. The covered (private and government) jobs are primarily with bus, rail, and other transit systems, and are consequently are treated as reclassified.

Information

Applies BLS factors. Reclassified jobs cover media jobs which BLS designates as green for reporting environmental content, for example jobs developing environmental content for otherwise extant radio, television, and newspaper outlets.

Financial Activities

Applies BLS factors. No reclassified industries.

Professional, Scientific & Technical Services

Applies BLS factors. Reclassified jobs cover some of the government components.

Management of Companies & Enterprises

Applies BLS factors. No reclassified industries.

Administrative & Support & Waste Management & Remediation Services

Applies BLS factors. Most of the waste related jobs are designated as reclassified except for a portion of Waste Collection based on the state-wide recycling rate and for materials sorting activities.

Educational & Health Services

Applies BLS factors. No reclassified industries

Leisure & Hospitality

Applies BLS factors. Museums, Parks and Historical Sites jobs are designated as reclassified.

Other Services

Applies BLS factors. Various repair activities are designated as reclassified.

Public Administration

To reflect some of the functions incorporated into the EDD estimates, incorporates jobs related to Administration of Environmental Program and a component of Utility Regulation & Administration.
based on the relevant portion of the Public Utilities Commission positions. Both entries are designated as reclassified.

Summary Results

The summaries contained in the table below show the estimates distributed both: (1) by ownership (private and government), with private distributed by industry and all enterprise activities included in the government component; and (2) by industry, with the government enterprise activities included within the industry numbers and public administration (primarily the number of jobs accounted by administration of environmental programs) as a separate entry.

Preliminary Estimate, California Green/Clean Energy Direct Jobs, 2016

<table>
<thead>
<tr>
<th>By Industry</th>
<th>Total</th>
<th>By Owner</th>
<th>Total</th>
<th>Reclassified</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, Forestry, Fishing &amp; Hunting</td>
<td>18,300</td>
<td>Agriculture, Forestry, Fishing &amp; Hunting</td>
<td>18,300</td>
<td></td>
<td>18,300</td>
</tr>
<tr>
<td>Utilities</td>
<td>28,000</td>
<td>Utilities</td>
<td>10,700</td>
<td>7,800</td>
<td>2,900</td>
</tr>
<tr>
<td>Construction</td>
<td>3,700</td>
<td>Construction</td>
<td>3,100</td>
<td></td>
<td>3,100</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>60,700</td>
<td>Manufacturing</td>
<td>60,700</td>
<td></td>
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</tr>
<tr>
<td>Trade</td>
<td>31,100</td>
<td>Trade</td>
<td>31,100</td>
<td>16,300</td>
<td>14,800</td>
</tr>
<tr>
<td>Transportation &amp; Warehousing</td>
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<td>Transportation &amp; Warehousing</td>
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<tr>
<td>Information</td>
<td>4,200</td>
<td>Information</td>
<td>4,000</td>
<td>800</td>
<td>3,200</td>
</tr>
<tr>
<td>Financial Activities</td>
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<td>Financial Activities</td>
<td>100</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Professional, Scientific &amp; Technical Services</td>
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<td>Professional, Scientific &amp; Technical Services</td>
<td>35,700</td>
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<td>35,700</td>
</tr>
<tr>
<td>Management of Companies &amp; Enterprises</td>
<td>8,100</td>
<td>Management of Companies &amp; Enterprises</td>
<td>8,100</td>
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<td>8,100</td>
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<tr>
<td>Administrative &amp; Support &amp; Waste</td>
<td>51,300</td>
<td>Administrative &amp; Support &amp; Waste</td>
<td>50,600</td>
<td>34,700</td>
<td>15,900</td>
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<tr>
<td>Management &amp; Remediation Services</td>
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<td>Management &amp; Remediation Services</td>
<td>3,000</td>
<td></td>
<td>3,000</td>
</tr>
<tr>
<td>Educational &amp; Health Services</td>
<td>4,300</td>
<td>Leisure &amp; Hospitality</td>
<td>3,400</td>
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<td>0</td>
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<td>Leisure &amp; Hospitality</td>
<td>107,300</td>
<td>Government</td>
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<tr>
<td>Other Services</td>
<td>6,900</td>
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<td>1,700</td>
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<td>5,200</td>
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<tr>
<td>Total</td>
<td>361,300</td>
<td>Total</td>
<td>361,300</td>
<td>190,000</td>
<td>171,300</td>
</tr>
</tbody>
</table>

To put these results into context:

- This direct job estimate is generally in line with the prior, comparable estimates. The combined level of 361,300 direct jobs represents 2.2% of total jobs in 2016.

- As indicated, reclassifying jobs as “green” remains a major component of the overall numbers, in this instance comprising 53% of the total. The net direct jobs that can be more clearly connected to current state policies represents only 1.0% of total jobs in 2016.

- Government jobs also remain a major determinant of overall green job levels, accounting for 30% of the total. While some of the government jobs are enterprise activities that are also directly affected by state policies, the effect of these policies on job creation within the private sector is somewhat lower. Private green jobs at 254,000 in 2016 represents only 1.8% of all private jobs. Netting out the reclassified portion puts the figure at 1.2%.
• A rough comparison with the 2011 BLS estimate for California can be made by adjusting the 2011 total for indirect jobs, primarily within Construction. Doing so results in private green jobs growing at an annual rate of about 3.4%, or just slightly above the overall growth rate of 3.1% for all California private jobs. The somewhat higher growth rate is to be expected given the high regulatory push for these jobs in this period. The closeness of these rates, however, is consistent with an earlier EDD analysis (EDD, 2013) of growth rates between green and non-green jobs, which concluded: . . . results also showed no discernible difference in the likelihood that a green or non-green firm would experience a net job gain.
What Is the Cost of Green Jobs?

A proper evaluation of the contribution from the state’s policies requires a look at both the jobs created and the jobs that may have been negatively affected through the operation of those policies. These will be analyzed in an input-output analysis in the next phase of this project. Some of the preliminary components and related cost estimates are presented below.

Clean Energy Construction

The primary source of the substantial number of construction jobs included in some of the other estimates comes from the construction of alternative energy generation plants and the installation of solar and other distributed energy components in recent years. The elevated number of estimated construction jobs tracks the higher activity in these areas produced as a result of regulatory mandates, short compliance timeframes, and a range of financial subsidies.

### New California Operating Generators, 2016

<table>
<thead>
<tr>
<th>Technology</th>
<th>Number of Plants</th>
<th>Nameplate Capacity (MW)</th>
<th>Estimated Cost ($ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batteries</td>
<td>8</td>
<td>100.0</td>
<td>$86</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>13</td>
<td>33.2</td>
<td>$51</td>
</tr>
<tr>
<td>Natural Gas Fired Combined Cycle</td>
<td>4</td>
<td>422.8</td>
<td>$260</td>
</tr>
<tr>
<td>Natural Gas Fired Combustion Turbine</td>
<td>6</td>
<td>536.8</td>
<td>$418</td>
</tr>
<tr>
<td>Other Natural Gas</td>
<td>1</td>
<td>1.4</td>
<td>$1</td>
</tr>
<tr>
<td>Other Waste Biomass</td>
<td>2</td>
<td>2.4</td>
<td>$4</td>
</tr>
<tr>
<td>Solar Photovoltaic</td>
<td>90</td>
<td>2,799.1</td>
<td>$8,736</td>
</tr>
<tr>
<td>Total</td>
<td>124</td>
<td>3,895.7</td>
<td>$9,556</td>
</tr>
</tbody>
</table>

Source: US Energy Information Administration, Preliminary Monthly Electric Generator Inventory, Generator Construction Cost Data

### California Generators under Construction, 2016

<table>
<thead>
<tr>
<th>Technology</th>
<th>Number of Plants</th>
<th>Nameplate Capacity (MW)</th>
<th>Estimated Cost ($ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batteries</td>
<td>3</td>
<td>39.9</td>
<td>$34</td>
</tr>
<tr>
<td>Conventional Hydroelectric</td>
<td>1</td>
<td>6.9</td>
<td>$4</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>3</td>
<td>4.9</td>
<td>$10</td>
</tr>
<tr>
<td>Natural Gas Fired Combined Cycle</td>
<td>3</td>
<td>672.3</td>
<td>$413</td>
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<tr>
<td>Natural Gas Fired Combustion Turbine</td>
<td>1</td>
<td>7.2</td>
<td>$6</td>
</tr>
<tr>
<td>Onshore Wind Turbine</td>
<td>3</td>
<td>314.1</td>
<td>$481</td>
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<tr>
<td>Other Waste Biomass</td>
<td>2</td>
<td>6.0</td>
<td>$9</td>
</tr>
<tr>
<td>Solar Photovoltaic</td>
<td>24</td>
<td>415.6</td>
<td>$1,297</td>
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<tr>
<td>Total</td>
<td>43</td>
<td>1,499.9</td>
<td>$2,254</td>
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</tbody>
</table>

Source: US Energy Information Administration, Preliminary Monthly Electric Generator Inventory, Generator Construction Cost Data

Preliminary data from US Energy Information Administration shows 124 California generation plants completed in 2016. Estimated costs shown in the table above are based on that agency’s unit...
cost data for 2015, and will be updated as the 2016 data is released. Total costs will be distributed based on construction time for each of the plants.

Generators under construction or completing construction in 2016 and planned for operation in a subsequent year covered an additional 43 plants. Estimated costs shown in the second table above similarly use the 2015 cost factors.

Counterbalancing a portion of these additions, 20 generators ceased operations that year.

### California Retired Generators, 2016

<table>
<thead>
<tr>
<th>Technology</th>
<th>Number of Plants</th>
<th>Nameplate Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geothermal</td>
<td>2</td>
<td>38.0</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>7</td>
<td>8.9</td>
</tr>
<tr>
<td>Natural Gas Fired Combustion Turbine</td>
<td>5</td>
<td>114.6</td>
</tr>
<tr>
<td>Natural Gas Steam Turbine</td>
<td>3</td>
<td>1,479.0</td>
</tr>
<tr>
<td>Other Waste Biomass</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>1,641.7</td>
</tr>
</tbody>
</table>

Source: US Energy Information Administration, Preliminary Monthly Electric Generator Inventory

For other solar installations, Construction Industry Research Board (CIRB) Energy Permit Summary Report shows a total of 117,616 building permits for photovoltaic systems in 2016, with a total reported valuation of $2.038 billion. The CIRB reports are based on monthly canvassing of city and county building departments throughout the state.

In all these cases, these are one-time costs that vary depending on the level of construction in any given year. Operating employment associated with the new generation plants, however, is an ongoing source of direct jobs.

### Utility Costs

California’s Renewable Portfolio Standard (RPS) briefly predated the climate change program, first established in SB 1078 (2002) and subsequently accelerated in SB 107 (2006) to require 20% of electricity sales to be from renewables by 2010. The target was progressively increased following adoption of the AB 32 early action items in 2010, eventually with the 50% by 2030 target set under SB 350 (2015).

California has long had higher electricity prices than the rest of the US, in part due to previous renewables mandates that built higher cost generation into the state’s rate base in the 1970s and early 1980s. As indicated in the chart below, the difference in electricity rates between California and the rest of US moderated to a narrower band in the 1990s, but then spiked during the Electricity Crisis at the beginning of the 2000s. The price gap then began to subside again, in part driven downwards during the contraction period of the recent recession. Prices have since begun to accelerate rapidly since 2011 as RPS compliant generation has been incorporated into the rate base, meeting or exceeding—especially in the case of residential rates—the previous price gap seen during the Electricity Crisis. Average prices for the rest of the US have been relatively level or declined compared to the California trend.
Therefore using 2011 as the base year, the cost to ratepayers from the state’s policies can be estimated by using this change in the difference, assuming changes in the US average overall reflects broader forces affecting the cost of generation while those specific to California are reflected in the premium shown in the chart much as they were at the beginning of this century.

Applying the incremental difference to electricity consumption in 2016 results in a total cost of $5.0 billion, consisting of an additional $1.7 billion for residential ratepayer bills, $2.3 billion for commercial, and $1.0 billion for industrial. Related costs for transportation ratepayers are minor given the significantly lower use.

Ratepayers within the investor owner utility territories have received rebates from the utilities’ sale of emission allowances under cap and trade. Public Utilities Commission documents indicate a total of $249 million was set aside for this purpose in 2016. These revenues are separate from the electricity sales amounts used in the rate calculations and, as discussed in the Compliance Cost section below, more fully represent a cost to other employers subject to the cap and trade requirements.

Unlike the one-time costs identified for construction and installation above, however, these additional costs are ongoing and currently accelerating. The comparable costs for 2017 were higher at $6.6 billion, with $2.2 billion paid by residential, $3.0 billion by commercial, and $1.3 billion by industrial.

Moreover, these costs are not born uniformly across the state. While ratepayers in the higher income coastal areas benefit from milder climate through lower electricity use, those in the hotter interior regions face electricity use that is 50% to 60% higher. While data on actual costs is not available due to the variability in utility providers and rates, the range of the cost impact difference can be seen in average household use, as estimated in the following chart from Energy Commission and Department of Finance data.
Natural gas use also differs across the regions in a similar pattern, but the difference in price between the California and the rest of the US has been more stable, in part because this energy source has not yet been subject to as high a level of regulation under the state’s current policies. Extreme absolute differences do exist especially in the case of industrial prices, but changes in price difference to date have been more dependent on pipeline capacity and costs of transportation and differences in seasonal fluctuations between California and the other states.

**Fuel Costs**

Price differences comparable to those in electricity are found in the cost of gasoline and diesel. While other fuels sold in the state such as jet fuel largely track the national averages, regulations focused on gasoline and diesel combined with differences in tax rates have produced a substantial price gap due to two factors:

- The cost of producing these fuels for sale is higher in California. Since 1991, California has maintained separate formulation requirements beginning for air quality purposes that differ significantly in cost from those applied to fuels produced elsewhere in the US and world. And while national rules have changed over time after a lag to approach California’s, rather than allowing the rules and costs to converge, the state has continued to issue new requirements both for air quality and in recent years for climate change policies as well. In addition to these production costs, California prices have gone higher as a result of applying cap and trade not just to production but to use of fuels as well, and as a result of last year’s action to raise fuel taxes.

- The second price component comes from creation of California as a fuel island. The continuing process of California-only specifications largely limit fuel supply from what can be produced by the state’s refineries and to limited supplies of compliant blending stocks imported into the state. This supply constrained market limits access to broader national and world sources, and delays potential responses to any disruption such as unforeseen refinery outages during the twice-yearly formulation turnover. California consumers and employers, consequently, have been subject to frequent price variability.
While several previous estimates have been made of the likely cost premium stemming from the regulatory components of the first factor, the full impact from current regulations really stems from both—both the added cost from regulatory and tax policy plus the price instability stemming from maintaining the state’s fuel market separate from the rest of the world.

Adjusting for differences in fuel taxes, California gasoline (all grades) prices averaged 42.4 cents a gallon higher than the US average in 2016, and diesel (on-highway, all types) 31.0 cents higher. Note that this data understates the difference as the US average incorporates the much higher California prices. However, sufficient data is not available to net the state component out.

There is also insufficient data to translate this price premium directly into total costs, but an estimate can be made from the US Bureau of Labor Statistics, Consumer Expenditure Survey. The most recent data shows household expenditure levels for gasoline and motor oil in three California MSAs as shown in the table below. Using the average 2015-16 California gasoline price produces the average household gasoline consumption and a weighted average that can be used for state estimates.

<table>
<thead>
<tr>
<th>MSA</th>
<th>Cost</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles</td>
<td>$2,607</td>
<td>860</td>
</tr>
<tr>
<td>San Francisco</td>
<td>$1,961</td>
<td>650</td>
</tr>
<tr>
<td>San Diego</td>
<td>$2,652</td>
<td>880</td>
</tr>
<tr>
<td>Weighted Average</td>
<td></td>
<td>810</td>
</tr>
</tbody>
</table>


The weighted average combined with total households from Department of Finance results in total estimated household consumption. Use by employers (private and government) is estimated by subtracting that amount from the total Net Taxable Gasoline Gallons reported for 2016 by California Department of Tax and Fee Administration. Household use of diesel is very low in California, and diesel total reported for 2016 by the Department is allocated fully to employers.

Applying the California price premiums—net of tax differences—shown above results in the cost impact estimates in the table below. Note that because of the assumptions behind this estimation approach, these numbers should be treated as an “up to” estimate.

<table>
<thead>
<tr>
<th></th>
<th>Households</th>
<th>Employers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>$4.5</td>
<td>$2.1</td>
<td>$6.6</td>
</tr>
<tr>
<td>Diesel</td>
<td>—</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Total</td>
<td>$4.5</td>
<td>$3.0</td>
<td>$7.5</td>
</tr>
</tbody>
</table>

Source: see text

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5 Taken from American Petroleum Institute, Motor Fuel Taxes, Rates Effective 4/1/2016.
Again, the cost impact is annual. For comparison, the gasoline continued to grow in 2017 by about another 2 cents (roughly, $200 million), while the diesel difference grew by about another 4 cents ($120 million).

An alternative, lower cost estimate can be derived from cost factors estimated for the various regulatory components from CARB, Energy Commission, and Legislative Analysts’ Office. Combining the per gallon costs from the reformulated rules, cap and trade, and low carbon fuel standards, the equivalent 2016 amounts from these sources were 25 cents a gallon for gasoline and 28 cents for diesel. These factors result in lower estimates of $4.7 billion total in 2016 ($2.6 billion households and $2.1 billion private and government employers; both gasoline and diesel). This amount, however, does not address the market separation factor which at times far exceeds the regulatory cost component.

As with electricity but not to the same extent currently, these costs are also borne to a somewhat larger degree by the interior regions compared to the higher income coastal areas. While precise sales data is not readily available, the geographic distribution can be shown through the Energy Commission’s Annual Retail Fuel Outlet Report, which includes estimates of retail sales by county. This distribution is shown in the following table compared to population shares taken from the Department of Finance estimates.

As indicated, Los Angeles and Bay Area regions have lower gasoline sales relative to their population, while Inland Empire, Sacramento, and Central Valley are higher. Orange County and San Diego are the current exceptions to this trend.

This disparity in cost impacts is likely to grow as the state pursues policies to promote and subsidize the sale of zero emission vehicles (ZEV). In 2016, data from the Clean Vehicle Rebate Project shows Los Angeles and Bay Area accounting for 66% of all ZEV purchases (true ZEVs and plug-in hybrids) in 2016 and 61% in 2017.

This data source, however, covers only ZEVs for which a state rebate was issued, and those rebates became subject to income limits after March 2016 ($500,000 gross income for joint filers through November 2016 and $300,000 after). Comparing the rebate totals to total ZEV sales from
California New Car Dealers Association quarterly reports, the rebate data covers only 59% of sales in 2016 and 48% in 2017, indicating that high income buyers continue to be the primary purchasers of these vehicles and continue to do so even without access to the state rebates. These high income buyers in turn are more likely to reside in the coastal regions than in the interior. In the absence of significant price reductions, this consumption trend is likely to continue as the state pursues its goal of 5 million ZEVs by 2030, further shifting the incidence of the regulatory fuels cost to the lower income interior regions as traditional fuel vehicles become more concentrated there. Significant cost reductions in ZEVs and their energy technology could result in greater geographic diffusion, but these results have yet to be seen.

**Compliance Costs**

Beyond direct energy regulation, the largest component of overall compliance cost related to the climate change policies is contained under Cap and Trade. In 2016, regulated facilities spent a total of $2.6 billion in the four allowance auctions, of which $0.9 billion was paid for state allowances and $1.7 billion was paid to investor owned and publicly owned utilities. The portion attributable to in-state refineries is incorporated into the additional fuel payments discussed above, while portions paid by other industries would be a separate entry. A portion of the amount earned by the investor owned utilities was used to fund the California Climate Credit rebates cited above, but due to its source, remains largely a cost to other employers in the state. This flow, however, will be addressed.

### Estimated Cap & Trade Expenditures, 2016 ($ million)

<table>
<thead>
<tr>
<th>Program</th>
<th>Agency</th>
<th>2016 Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-speed rail</td>
<td>High-Speed Rail Authority</td>
<td>$354</td>
</tr>
<tr>
<td>Affordable housing/sustainable communities</td>
<td>Strategic Growth Council</td>
<td>283</td>
</tr>
<tr>
<td>Low carbon vehicles</td>
<td>Air Resources Board</td>
<td>229</td>
</tr>
<tr>
<td>Transit and intercity rail capital</td>
<td>Transportation Agency</td>
<td>209</td>
</tr>
<tr>
<td>Low-income weatherization and solar</td>
<td>CSD</td>
<td>50</td>
</tr>
<tr>
<td>Transit operations</td>
<td>Caltrans</td>
<td>71</td>
</tr>
<tr>
<td>Transformational Climate Communities</td>
<td>Strategic Growth Council</td>
<td>70</td>
</tr>
<tr>
<td>Agricultural energy and efficiency</td>
<td>Food and Agriculture</td>
<td>53</td>
</tr>
<tr>
<td>Sustainable forests and urban forestry</td>
<td>Forestry and Fire Protection</td>
<td>20</td>
</tr>
<tr>
<td>Green infrastructure</td>
<td>Natural Resources Agency</td>
<td>40</td>
</tr>
<tr>
<td>Waste diversion</td>
<td>CalRecycle</td>
<td>23</td>
</tr>
<tr>
<td>Water efficiency</td>
<td>DWR</td>
<td>10</td>
</tr>
<tr>
<td>Wetlands and watershed restoration</td>
<td>Fish and Wildlife</td>
<td>1</td>
</tr>
<tr>
<td>Active transportation</td>
<td>Caltrans</td>
<td>5</td>
</tr>
<tr>
<td>Black carbon wood smoke</td>
<td>Air Resources Board</td>
<td>3</td>
</tr>
<tr>
<td>Other technical assistance and administration</td>
<td>Various</td>
<td>19</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$1,438</strong></td>
</tr>
</tbody>
</table>

Source: LAO, 2017

In addition to these proceeds, the covered facilities spent additional, unknown amounts to reduce emissions—through process changes and controls or through shifting operations outside the state—and development of offset projects. Using the difference between the emissions cap and reported emissions in 2016 and using the settlement price as the upper bound on unit costs, these additional measures would have been the equivalent of up to an additional $0.5 billion applicable to 2016. However, it is difficult to apply this amount in an employment impact analysis as not all of the
expenditures necessarily occurred in California (for example, CARB compliance data shows offset allowances with an equivalent value of up to $0.1 billion were surrendered in 2016), reductions may have been the result of investments made in prior years, and reductions may have been the result of solar or other renewables installations that are already incorporated into some of the previous numbers, including the direct job components above.

Effects from these payments also have to be considered against those from expenditures of the cap and trade revenues in the state budget. The individual components are summarized above, with the 2016 calendar year estimates derived from the fiscal year amounts. Note that the total includes funds from auctions in prior years.

The primary fees tacked onto consumer purchases to support the state’s recycling jobs are shown in the following table, with the fiscal year amounts translated into calendar year estimates. These comprise the major state recycling fees, with a portion of the amount for containers paid in redemptions. In addition, households and employers also support these activities through rising recycling fees on their periodic local garbage and utility bills. While no immediate estimate of the second component is available, it will be explored further in the subsequent phase.

**State Recycling Fee Estimates, 2016**

<table>
<thead>
<tr>
<th>Fee Source</th>
<th>2016 Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beverage Container Redemption Fees</td>
<td>$1,304.0</td>
</tr>
<tr>
<td>Used Oil Recycling Fund</td>
<td>24.0</td>
</tr>
<tr>
<td>Tire Recycling Management Fund</td>
<td>42.5</td>
</tr>
<tr>
<td>Electronic Waste Recovery &amp; Recycling Account</td>
<td>85.7</td>
</tr>
<tr>
<td>Carpet Stewardship Account</td>
<td>0.3</td>
</tr>
<tr>
<td>Architectural Paint Stewardship Account</td>
<td>0.2</td>
</tr>
<tr>
<td>Used Mattress Recycling Fund</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1,456.8</strong></td>
</tr>
</tbody>
</table>

Source: Department of Finance

**Subsidy Costs**

In addition to items already previously, other subsidies supporting jobs contained in the estimates include the following:

- Federal personal income tax credits apply to solar panels, other renewable energy installations, and certain energy efficiency improvements. The latest IRS data (2015) shows a total of $636.5 million to California taxpayers, of which 76.1% was claimed on returns with $100,000 or more adjusted gross income. Comparison expenditures for these funds, however, are less clear as the most likely alternative use is reduction of the federal deficit.

- Similar to state incentives, federal tax credits also apply to purchase of qualifying ZEVs. The summary IRS data for California lumps the amount claimed in with all other tax credits, with the likely result that any amount will instead be estimated from sales data.
California also provides comparable credits and other payments. Tax credits are not provided for solar and other energy efficiency improvements but instead payments have been primarily through the utilities, in particular California Solar Initiative. In 2016, California Distributed Generation Statistics data shows a total of $53.0 million incentive payments for solar systems. ZEV rebates are through the Clean Vehicle Rebate Project, which shows a total of $101.3 million in payments in 2016 primarily from Cap and Trade funds.

Additional payments are through the creation and trading of regulatory credits, both ZEV credits applicable to manufacturers within California and the other participating states and CAFE credits applicable to the broader vehicle market. For example, in 2016, Tesla’s 10-K filing shows a total of $302.3 million earned from regulatory credits, or $3,970 per vehicle sold that year. Assuming this factor is similar for other BEVs, the total amount from all California BEV sales in 2016 would have been around $150 million. Incorporating a similar but lower value factor for PHEVs, the grand total in state would have been over $200 million.

There are two implications from this estimate. First, it represents the amount that is transferred to the higher income buyers of ZEVs as these costs are incorporated into the price of other, non-ZEV vehicles bought by middle and lower income consumers, first in higher priced new vehicles and through upward price pressures on used as well. Second, while the ZEV credits are volume-limited, the CAFE ones are not. As ZEV sales increase in this state either through regulation or subsidies, the net effect may not so much be to reduce the target emissions, but to transfer the location of at least a portion through a credit process that produces higher emitting vehicle sales elsewhere in the US than what would otherwise occur.

Costs Not Included

The cost elements that are included above address the main components of the green/clean energy jobs addressed in the estimates previously reviewed in this report. These elements also cover the primary policies that can be quantified much as the estimates presented in the previous section cover those jobs that are more clearly identifiable. In so doing, however, there are a number of potential and actual costs that are not included, due to the difficulty of developing a cost estimate, lack of data, or the more qualitative nature of their impact. These additional factors include the following.

State policy has not yet grappled with the growing tensions between housing needs and the ancillary effects resulting from how many of the state’s green/clean energy policies have been approached. Rapidly rising housing costs coming from constrained housing supply now represent the greatest threat to the state’s economic resiliency—costs that now overwhelm household budgets to the point that steps to upward mobility are no longer viewed as an opportunity but as a risk with uncertain outcomes weighed against disastrous downsides, limits to mobility that cement the two-tier economic divide in place, the human costs of growing homelessness, and a foundational risk to continued expansion in the Bay Area economy, the primary source of the state’s jobs, income, and fiscal recovery over the past decade. By opening up new CEQA litigation avenues to delay or preempt new housing approvals, by increasing design mandates on top of construction costs that are already exorbitantly high, by transportation planning that bypasses the housing reforms required to
fulfill the stated goals, and by urban visions that in practice preclude middle class housing, the functioning of these policies combined with existing constraints have primarily served to raise costs even higher. The precise amount is difficult to quantify, but it contributes heavily to the barriers that have limited green/clean energy jobs—along with traditional middle class wage jobs—to the small share they currently comprise within the state, while promoting their growth elsewhere.

No estimates are incorporated for costs related to the various energy efficiency provisions adopted through the Energy Commission. While these regulations generally add to the cost of goods such as consumer products, conceptually the regulations are based on the contention that the intended energy savings are sufficient to balance or exceed these costs. Employment effects may differ depending on how consumers would otherwise allocate their disposable incomes and where the goods are produced—in state or in another location. Available data, however, is limited, and most analyses are engineering projections done at the time of regulation adoption. Far less effort has been made to measure whether these projections are validated through actual use. Additional review of this issue will be made for the subsequent phase of this project.

Other industry-specific components within the climate change Scoping Plan applicable to 2016 are not addressed. Similarly, vehicle regulations are primarily addressed through the components above. Additional review for relevant cost analyses will be made for the subsequent phase of this project.
Concluding Observations

One of the first works exploring the topic of green jobs and their potential to produce offsetting economic benefits from growing regulation in the country also carried a dire warning about what could happen if it was not done right:

The worst-case scenario, equally possible, is a bipolar economy: high-paying, long-hour, relatively green information-age work for those hooked into the global market and low-paying, temporary jobs for those who are not. This future, already manifest in places, includes trophy homes; telecommuting; second-home sprawl; and jet-setting, recreational consumerism for the privileged. For the not-so-privileged, it offers daily job insecurity, falling wages, and trailer parks. Furthermore, this emerging dystopia exports many of its environmental impacts beyond the boundaries of the Pacific Northwest, through the global production lines for goods such as Range Rovers and petroleum.

* Durning (1999), p. 4

Written almost two decades ago, this passage all too closely describes the two tier economy that has evolved in this state as a result of the current state policy trajectory, with high jobs and high income growth in the Bay Area and with the exception of defined pockets, predominance of low wage and part time jobs growth elsewhere.

Green/clean energy jobs have a positive role to play in the state’s economic future, much as they have in the past. But achieving results to match the promise will not happen automatically.

- The higher wage, permanent jobs associated with green policies react to the same business conditions as other traditional job sources in the state do. Securing job benefits of green policies is a potential economic strategy, but the state must also take a hard look at the conditions that already caused many of these jobs to go elsewhere—excessive permitting, high housing costs, high energy costs, and other high operating costs resulting from the broader body of state-only regulations. The state has acknowledged these barriers when pursuing individual investments—for example, Tesla’s Gigafactory—but the solutions offered then have been tailored to a single case rather than broader reforms promoting this growth—and in traditional jobs as well—for investments no matter what their size.

- While the rest of the country has moved to reduce substantially its reliance on foreign energy sources, California has moved in the opposite direction. By launching new energy markets for renewable sources but then failing to address the competitive barriers to secure a broader share of the accompanying job and income benefits, California has indeed created new green and clean energy jobs, but as discussed in the Sidebar examples, just not within the state.
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