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Job Impacts of California's Existing and Proposed Renewables Portfolio Standard

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INTRODUCTION

This brief presents estimates of the jobs created from California's renewable energy investments from 2003 through 2014, and forecasts job creation from continued development of renewable energy in California between 2015 and 2030 to meet a 50% renewables portfolio standard (RPS). The RPS is one of the key policy tools that comprise California's landmark climate policy, codified in AB 32, which requires California to sharply reduce its greenhouse gas (GHG) emissions to 1990 levels by 2020. The state is on target for meeting the first RPS target of 33% renewable energy by 2020, and policy-makers are now considering increasing the RPS to 50% by 2030. Meeting these targets requires both public and private investments in generation infrastructure, which have created and will continue to create new jobs in California.

We present estimates of the jobs created in California due to the construction of renewable energy capacity since the first RPS was passed. We then forecast jobs from new renewable generation that will be needed to meet the target of 50% renewable energy by 2030, using a low and high scenario for energy demand.

Our jobs projections are limited to the jobs created by the construction of renewable energy facilities. They exclude jobs created from renewable self-generation, which does not contribute to the RPS directly, but reduces the energy sales on which RPS targets are based, as well as jobs from energy efficiency investments, which also reduce electricity sales. We also do not report the jobs in operations and maintenance of new renewable power plants, which are smaller in number than the construction jobs and are unlikely to change significantly with a transition from conventional to renewable sources. Nor do we calculate the jobs required for new transmission infrastructure or increased energy storage, both of which will likely be needed to meet a 50% RPS. These estimated jobs assume no major changes to the California Independent System Operator (CAISO) or RPS-eligible energy sources.

POLICY BRIEF

While we present two reasonable scenarios for ease of exposition, our tool can be used to estimate job creation from other scenarios with different assumptions about the amount of new generation needed, the mix of renewable technologies, and mix of in-state vs. out-of-state capacity.

FINDINGS

Table 1 presents data on the new renewable energy capacity that has been built in California since the passage of the RPS in 2002. California has increased in-state renewable generation by about 16,000 gigawatt hours (GWh), from 29,000 GWh in 2003 to 45,000 GWh in 2014.¹ To generate this energy, California has

increased its capacity of in-state renewable generation, developing almost 7,077 megawatts (MW) of in-state renewables and importing power from 2,622 MW of new wind and solar photovoltaic facilities built in other states. In addition, about 180 MW of renewable energy production came back online during that time period.²

To meet a 50% RPS in 2030, California will need to increase generation from renewable sources. Table 1 shows two scenarios of energy demand and the associated need for new renewable capacity: a low scenario of 270,000 GWh and a corresponding 30,600 MW of new capacity, and a high scenario of 316,000 GWh, produced by 37,400 MW of new capacity (from a 2014 baseline).

Table 1. Renewable Energy Development Scenarios - California-based Renewable Energy Capacity (in MW) to meet California Renewables Portfolio Standard

Renewable Energy	2003-2014 (New in-state MW capacity built)	2015-2030 (New in-state MW capacity required for 50% RPS)	
	Baseline	50% RPS - Low Scenario	50% RPS - High Scenario
Photovoltaic (PV)	2,799	15,684	19,066
Rooftop	-	1,529	1,796
Community Scale (1-20MW)	127	4,956	5,975
Utility (>20MW)	2,672	9,199	11,295
Concentrated Solar Power	857	2,659	3,273
Land-Based Wind Power	3,335	6,294	8,038
Geothermal	50	2,481	2,923
Small Hydro	5	1,277	1,501
Biomass (+Biogas)	31	2,243	2,640
Total Renewable MW	7,077	30,638	37,441

Notes: (1) Low scenario is CEC “Unmodified” forecast from E3 with total estimated consumption in 2030 = 270,000 GWh. This excludes self generation estimated at 10,500 GWh (2) High scenario is “Modified” to include transportation electrification including high speed rail, with total estimated consumption in 2030=316,000 GWh. This includes moderate energy efficiency estimated at 24,000 annual GWh and excludes self generation estimated at 23,000 GWh

Sources: (1) California Energy Commission (2013, November 19). California Energy Demand 2014-2024 Final Forecast, Mid-Case Final Baseline Demand Forecast Forms (Statewide Mid). (2) Energy and Environmental Economics, Inc. (2014, January). Investigating a Higher Renewables Portfolio Standard in California. (3) National Renewable Energy Laboratory. California 2030 Low Carbon Grid Study: Phase 1 Work Papers. p.17; and California 2030 Low Carbon Grid Study: Phase 1 Work Papers, Supplement 1.

The low scenario is based on the Energy + Environmental Economics (E3) 2014 Report *Investigating a Higher Renewables Portfolio Standard in California*. We chose E3’s “diverse” scenario, which reflects a diverse mix of technologies and very low imports of renewable energy from outside the state. The high scenario used in this report modifies the low scenario to incorporate a higher 2030 forecast of energy demand as modified by the *Low Carbon Grid Study*, which may occur with more aggressive transportation electrification.³

Table 2 presents our job estimates from 2003-2014 and our forecasts for 2015-2030 under the low and high energy demand scenarios. We use the Jobs and Economic Development Impact (JEDI) model developed by the National Renewable Energy Laboratory for our jobs estimates. JEDI uses standard economic impact assessment methods and applies them to renewable and conventional energy production.

We estimate that between 2003-2014 about 52,000 (including both blue collar and related white collar) direct jobs were created due to the construction of renewable energy plants, measured in person job years (one full-time job with 2,080 hours for one person for one year).⁴ We estimate that this renewable energy development stimulated about 130,000 total job years, including the indirect jobs created due to purchase of in-state inputs, like construction materials, and the induced jobs, created from spending the additional household income resulting from this investment. This total job estimate is gross, rather than net, i.e. it does not subtract out any jobs in non-renewable energy generation that would have been created if the RPS had not existed.

We estimate that for the period 2015-2030, increasing California’s renewable portfolio standard to 50% by 2030 would create about an additional 354,000 (low scenario) to 429,000 (high scenario) direct jobs from the construction of new renewable generation. Including

Table 2. Job Impacts of Renewable Energy Construction (in Job Years)

	2003-2014		2015-2030 (50% RPS)			
	Baseline		Low scenario		High scenario	
Renewable Energy	Direct	Total (Direct, Indirect, Induced)	Direct	Total (Direct, Indirect, Induced)	Direct	Total (Direct, Indirect, Induced)
Photovoltaic	40,827	93,527	292,436	702,990	355,109	853,540
Rooftop	-	-	35,172	85,086	41,314	99,944
Community Scale PV (1-20MW)	2,406	5,876	93,863	229,211	113,162	276,339
Utility PV (>20MW)	38,421	87,651	163,401	388,693	200,633	477,257
Concentrated Solar Power	7,860	20,056	24,387	62,226	30,018	76,595
Land-Based Wind Power	2,443	15,476	5,684	29,019	7,258	37,060
Geothermal	432	1,244	21,449	61,737	25,270	72,735
Small Hydro	6	54	1,622	13,780	1,906	16,197
Biomass (+Biogas)	116	135	8,266	9,218	9,729	10,851
Job Years	51,684	130,492	353,844	878,970	429,290	1,066,978

Notes: (1) “Low” total estimated consumption in 2030 = 270,000 GWh. This excludes self generation estimated at 10,500 GWh (2) “High” total estimated consumption in 2030 = 316,000 GWh. This accounts for moderate energy efficiency estimated at 24,000 annual GWh and excludes self generation estimated at 23,000 GWh; (3) Reported in job years (1 job year = 2080 man hours); (3) From 2003-2014 79% of renewable development was in-state; (4) Diverse RPS scenario assumes 92% in-state; (5) Community Solar scenario assumes 97% in-state

multipliers for indirect and induced jobs, additional renewable energy development in California would create a total of 879,000 to 1,067,000 job years by 2030. Again, these are job years, not permanent jobs, and if they were spread out evenly during this period there would be about 23,600 to 28,600 direct full-time jobs per year and about 58,600 to 71,100 total full-time jobs per year from 2015-2030. The figures are also gross, rather than net, job forecasts, and they reflect only the investment in new renewable energy generation capacity, not related investments in grid infrastructure or storage.

Table 3 illustrates how replacing in-state capacity with out-of-state capacity would affect jobs. The E3 study and the scenarios we use are based on the current definition of eligible renewable resources which implies a continuation of the dominance of in-state renewable energy capacity. If this changes, it will impact job creation in California. We estimate that for every MW produced out-of-state instead of in-state, on average 11.5 direct jobs and 28.7 total jobs (including indirect and induced) jobs would be lost. This varies by the in-state technology that is replaced, as shown in the table. Any estimate of job loss or gain using this tool should be based on net imports (i.e. exports minus imports), since an increase in exports of California generation would compensate for job loss resulting from an increase in imports.

METHODOLOGY

To determine the distribution and renewable generation capacity needed to generate the predicted GWh needed to meet the 2030 50% RPS, we relied on E3's Report *Investigating a Higher Renewables Portfolio Standard in California* and its assumptions.⁵ The E3 study assumes that a 50% RPS is defined in the same way as California's current 33% RPS. The RPS requires generation from eligible renewable resources to be equal to or exceed 50% of retail sales.

The low scenario used in this paper is based on E3's Diverse Scenario, which meets a 50% RPS in 2030 by relying on a diverse portfolio of large, utility-scale resources, including some solar thermal with energy storage and some out-of-state wind. E3's other scenarios were based on higher solar PV development—both large-scale and small-scale, which require more total capacity to be built, and would consequently lead to more job creation, albeit at higher cost.

Table 3. Jobs per MW (in job years)

Renewable Energy	Direct Jobs	Total Jobs (Direct, Indirect, Induced)
Photovoltaic	18.6	44.8
Rooftop	23.0	55.6
Community Scale PV (1-20MW)	18.9	46.3
Utility PV (>20MW)	14.4	32.8
Concentrated Solar Power	9.2	23.4
Land-Based Wind Power	0.9	4.6
Geothermal	8.6	24.9
Small Hydro	1.3	10.8
Biomass (+Biogas)	3.7	4.1
Average	11.5	28.7

The high scenario increases E3's energy load forecast to reflect greater electricity demand due to aggressive transportation electrification, which some analysts assert is necessary to meet 2030 carbon reduction targets. The E3's load forecast is based on California Energy Commission's (CEC) *California Energy Demand 2012 - 2022 Final Forecast*. We modified this load demand for 2030, using the alterations made by the *Low Carbon Grid Study*⁶ to the CEC's *California Energy Demand Forecast, 2014-2024 Mid-Demand Case*.⁷ These alterations included more aggressive adoption of electric vehicles, projected high speed rail service, and a mid range of energy efficiency for California utilities (both public and investor-owned). This resulted in a load scenario of 316,000 GWh. We adjusted E3's 2030 load forecast (of 270,000 GWh) and incremental capacity projection by the same percent increase.⁸ For the baseline estimates, we calculated the RPS-eligible renewable generation built between 2003 and 2014.^{9,10}

Finally to estimate the employment impacts from these renewable investments, we used the JEDI models developed by the National Renewable Energy Laboratory. The parameters were set to California, and in most cases, JEDI's default values were used.¹¹

The employment estimates are all affected by the scale of the project. To estimate jobs in the future, we used average project size in each renewable technology from the past.

We compare the employment impact results against empirical studies, such as our 2014 report, *Environmental and Economic Benefits of Building Solar in California: Quality Careers—Cleaner Lives*, and find that JEDI may overestimate direct jobs per MW, particularly for solar where we have industry data. Thus the JEDI model is likely more accurate for comparisons between alternative scenarios and technology mixes than for absolute job numbers. However, it remains the only comprehensive source of job estimates for all relevant energy technologies, so the numbers presented here are the best available.

ENDNOTES

- 1 California Energy Commission. Energy Almanac. *Electric Generation Capacity & Energy*. Data based on CEC-1304 QFER Database as of June 24, 2015. Retrieved from: http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html
- 2 California Public Utilities Commission. *RPS Monthly Project Status Table (May 2015)*. Retrieved from: <http://www.cpuc.ca.gov/PUC/energy/Renewables/index.htm>
- 3 National Renewable Energy Laboratory. *California 2030 Low Carbon Grid Study: Phase 1 Work Papers, Supplement 1*. Retrieved from: <http://lowcarbongrid2030.org/wp-content/uploads/2014/10/LCGS-Workpapers-Supplement-1-Load-Forecast-Spreadsheet.xlsx>
- 4 In construction, individual workers often do not work a whole year on one project, nor do they necessarily work year-round. So one job-year may be shared by more than one worker. Consequently, the headcount of individuals working on these projects will add up to more individuals than job-years.
- 5 Energy and Environmental Economics, Inc. (2014, January). *Investigating a Higher Renewables Portfolio Standard in California*. Retrieved from: https://ethree.com/documents/E3_Final_RPS_Report_2014_01_06_with_appendices.pdf p. 80-91.
- 6 National Renewable Energy Laboratory. *California 2030 Low Carbon Grid Study: Phase 1 Work Papers*. Retrieved from: <http://lowcarbongrid2030.org/wp-content/uploads/2014/10/LCGS-Workpapers.pdf> p.16; and *California 2030 Low Carbon Grid Study: Phase 1 Work Papers, Supplement 1*. Retrieved from: <http://lowcarbongrid2030.org/wp-content/uploads/2014/10/LCGS-Workpapers-Supplement-1-Load-Forecast-Spreadsheet.xlsx>
- 7 California Energy Commission (2014, December). *California Energy Demand Updated Forecast, 2015-2025 (Staff Draft Report)*. Retrieved from: <http://www.energy.ca.gov/2014publications/CEC-200-2014-009/CEC-200-2014-009-SD.pdf>; and California Energy Commission (2013, November 19). *California Energy Demand 2014-2024 Final Forecast, Mid-Case Final Baseline Demand Forecast Forms (Statewide Mid)*. Retrieved from: http://www.energy.ca.gov/2013_energy/policy/documents/demand-forecast/mid_case/STATEWIDE_Mid.xls
- 8 An increase in energy demand does not necessarily result in a proportional increase in generation capacity. Whether additional capacity is needed depends on the shape of the load, energy storage, imports, and other variables.
- 9 RPS capacity installed since 2003 by year (based on RPS contract database). California Public Utilities Commission (2015). *Renewables Portfolio Standard Quarterly Report: 1st Quarter 2015*. Retrieved from: <http://cpuc.ca.gov/NR/rdonlyres/8EB096A9-8000-4A1D-9623-DB3EB9F1BFB5/0/2015Q1RPSReport.pdf> p. 5.
- 10 California Energy Commission. *Database of California Power Plants*. Retrieved from: www.energyalmanac.ca.gov/power-plants/Power_Plants.xls; and *Status of All Projects*. Retrieved from: http://www.energy.ca.gov/sitingcases/all_projects.html (Both accessed August 7, 2015)
- 11 The following versions of these models were used:
 - JEDI Geothermal Model rel. GT11.03.14
 - JEDI MHydro Model rel.MH10.06.14 (for small hydro)
 - JEDI Project PV Model rel PV3.24.14 (separated by size and type of solar project)
 - JEDI CSP Trough Model rel. CSP3.24.14 (for all Solar thermal)
 - JEDI Biopower Model rel. B3.17.15 (for biogas and biomass)
 - JEDI Land based Wind Model rel. W07.08.15

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