



2018

PADILLA REPORT

Costs and Cost Savings
for the RPS Program
(Public Utilities Code 913.3)



May 1, 2018

CALIFORNIA
PUBLIC
UTILITIES
COMMISSION







About this Report

The purpose of this annual Report is to comply with Public Utilities Code Section 913.3. Each May 1, the California Public Utilities Commission is required to report to the Legislature the aggregated costs and cost savings of renewable energy expenditures and contracts for the previous year.

Report Authors

Brandon Gerstle – Analyst

Amanda Singh – Analyst

Cheryl Cox – Analyst

Cheryl Lee – Supervisor, Renewable Procurement and Market Development Section
Judith Iklé – Program Manager, Procurement Strategy and Oversight, Energy Division



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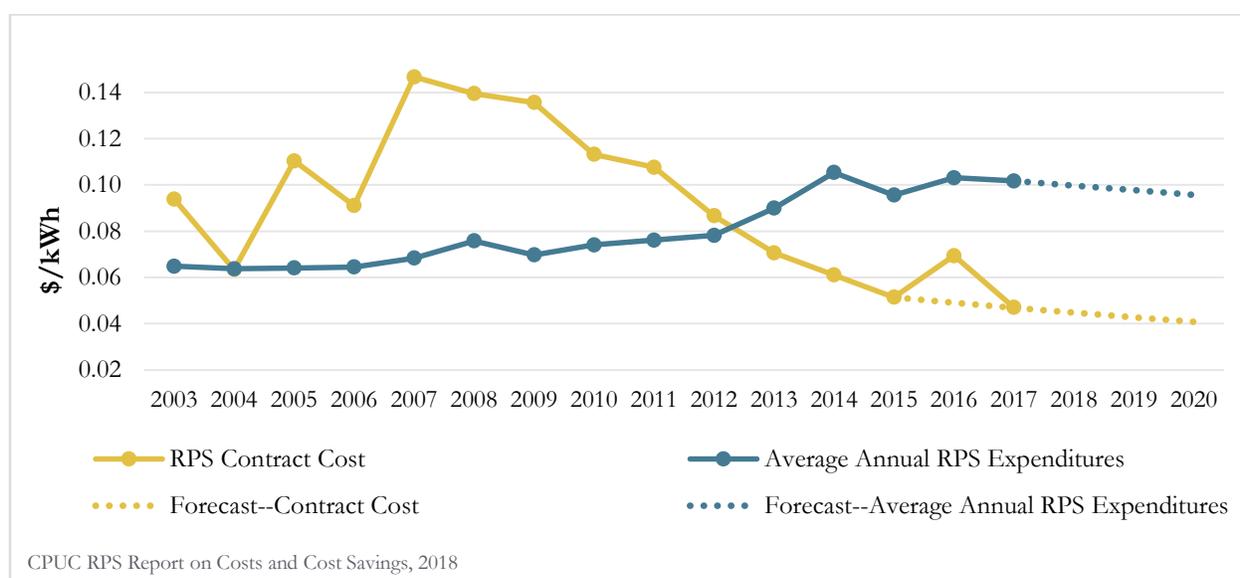
EXECUTIVE SUMMARY

In compliance with Public Utilities Code 913.3,¹ this report describes 2017 renewable procurement cost data for the Renewables Portfolio Standard (RPS) program. In 2017, the large investor-owned utilities (IOUs) and small and multi-jurisdictional investor-owned utilities (SMJUs) either met or exceeded their RPS procurement obligations while also increasing their procurement of renewables.² This increase in procurement of renewable resources is consistent with legislation, which has escalated RPS procurement goals.

The key conclusions from this report include the following:

- The large IOUs' total annual renewable procurement increased from 48,509 gigawatt hours (GWh) in 2016 to 52,469 GWh in 2017. The SMJUs' total annual renewable procurement increased from 341 GWh in 2016 to 372 GWh in 2017.
- The large IOUs' total annual RPS procurement expenditures increased from \$4.8 billion in 2016 to \$5.3 billion in 2017. For the SMJUs with 2017 procurement expenditure data,³ total annual RPS procurement expenditures decreased from \$8.4 million in 2016 to \$6.4 million in 2017.
- The large IOUs' 2017 RPS program expenditures indicated a cost savings compared to last year's benchmark and a slight cost premium compared to the new 2017 benchmarks.
- The large IOUs' average procurement expenditure for all RPS contracts online fell slightly from 10.2 cents per kilowatt-hour (¢/kWh) in 2016 to 10.1 ¢/kWh in 2017.
- As more projects come online, average RPS expenditures per kWh are forecasted to decrease further. Figure 1 below shows the forecasted impact of newer, low-cost projects bringing down the average annual RPS expenditures, as explained in detail in this report.

**Figure 1: RPS Program Expenditures and Contract Costs from 2003-2020
(Nominal Dollars)**



¹ The full text of California Public Utilities Code (*hereinafter* Pub. Util. Code) Section 913.3 can be found in Appendix D.

² This report does not address Publicly Owned Utilities (POUs), Community Choice Aggregators (CCAs), or Electric Service Providers (ESPs).

³ Liberty Utilities and Bear Valley Electric Service provided the Commission with 2017 procurement expenditure data. PacifiCorp informed the Commission that data for 2017 is unavailable until the company files its FERC "Form 1" in May 2018.

BACKGROUND

Senate Bill (SB) 836 (Padilla, 2011) requires the California Public Utilities Commission (Commission or CPUC) to report on the Renewables Portfolio Standard (RPS) program to the Legislature regarding “the costs of all electricity procurement contracts for eligible renewable energy resources, including unbundled renewable energy credits, and all costs for utility-owned generation approved by the Commission.”⁴

The 2017 procurement cost figures in this report were compiled from the large IOUs—Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E)—as well as the SMJUs—Liberty Utilities (Liberty), Bear Valley Electric Service (BVES), and PacifiCorp. The annual procurement costs for generation in this report may not correspond precisely with the utilities’ RPS compliance cost for the same year. Because the Renewable Energy Credits (RECs) associated with generation can be applied in later years for RPS program compliance purposes, the cost of procuring renewable energy might occur in one year and the RECs associated with generation may be applied in a later year.⁵

In 2015, Governor Edmund G. Brown Jr. signed SB 350 (de León, 2015) into law, which increased the proportion of required total retail electricity sales from renewable resources from 33% in 2020 to 50% by December 31, 2030.⁶ SB 350 also added RPS interim targets of 40% by December 31, 2024 and 45% by December 31, 2027.

Beyond the 50% RPS, SB 350 required the Commission to adopt an Integrated Resource Plan (IRP) process. The IRP’s goal is to optimize electricity procurement across resource types to meet California’s greenhouse gas (GHG) targets at the lowest costs while maintaining reliability. In February 2018, the Commission approved its first IRP Reference System Portfolio of energy resources to meet the 2030 GHG planning targets for the electric sector, which identified a need to procure renewable resources beyond the 50% RPS target as part of a cost-effective portfolio.⁷ Load serving entities (LSEs) are now developing integrated resource plans to demonstrate how they will meet GHG planning targets and other state goals, in a manner consistent with the Reference System Portfolio.

⁴ Pub. Util. Code Section 913.3(a). SB 697 (Hertzberg, 2015) changed the numbering of the Pub. Util. Code sections, and specifically changed Section 910 to Pub. Util. Code Section 913.3. None of the original reporting requirements that were required under Pub. Util. Code Section 910 were modified by SB 697. SB 1222 (Hertzberg, 2016) modified the reporting date for this report among other minor changes.

⁵ See Commission Decision (D.)12-06-038; D.17-06-026.

⁶ See the CPUC’s RPS website for more information about RPS program requirements and legislative history: <http://www.cpuc.ca.gov/renewables/>.

⁷ See Commission Decision (D.)18-02-018.

RENEWABLES PROGRAM COSTS

This section addresses the costs associated with renewable resource procurement in 2017, consistent with the requirements of Section 913.3(a)(1)-(2) and (b).

Section 913.3(a)(1)

For power purchase contracts, the commission shall release costs in an aggregated form categorized according to the year the procurement transaction was approved by the commission, the eligible renewable energy resource type, including bundled renewable energy credits, the average executed contract price, and average actual recorded costs for each kilowatt-hour of production. Within each renewable energy resource type, the commission shall provide aggregated costs for different project size thresholds.

Section 913.3(a)(2)

For each utility-owned renewable generation project, the commission shall release the costs forecast by the electrical corporation at the time of initial approval and the actual recorded costs for each kilowatt-hour of production during the preceding calendar year.

Section 913.3(b)

The commission shall report all electrical corporation revenue requirement increases associated with meeting the renewables portfolio standard, as defined in Section 399.12, including direct procurement costs for eligible renewable energy resources and renewable energy credits.

The 2017 costs and cost savings discussed in this section for California's large IOUs and SMJUs include:

1. RPS Procurement Expenditures
2. RPS Aggregated Contract Prices
3. Comparison of RPS Procurement Expenditures with IOU Revenue Requirements

I. RPS Procurement Expenditures

Large IOU Procurement Expenditures for 2017⁸

The CPUC compiled detailed information regarding the large IOUs' procured RPS generation in 2017. This summarized data can be found in Appendix B of this report. The data is expressed as weighted averages for RPS procurement expenditures in dollars per kilowatt-hour (\$/kWh) categorized by investor-owned utilities (IOU), technology, and size.⁹

Table B-1 provides all procurement expenditure information for every RPS eligible project,¹⁰ including contracts for the procurement of only renewable energy credit (REC-only) transactions and utility-owned generation (UOG) projects.¹¹ Table B-1 includes the actual price for production in 2017 of utility-owned generation, which include small hydroelectric and solar photovoltaic facilities. By contrast, Table B-2 presents procurement expenditure information for the large IOUs' bundled RPS energy projects only.¹²

Based on the compiled 2017 data, the weighted average RPS procurement expenditure was approximately 10.1 cents per kilowatt-hour (¢/kWh) across all RPS contracts, including REC-only contracts. This 2017 average is slightly lower than the 10.2 ¢/kWh in 2016.

Weighted Average Expenditures

Figure 2 below illustrates the weighted average RPS procurement expenditure for bundled renewable energy in \$/kWh for each of the large IOUs from 2003 through 2017. The changes in weighted average expenditures over time for each large IOU are similar, and the key factors driving the cost differences between the large IOUs are the resource mixes and contract vintages.

⁸ "Procurement Expenditures for 2017" includes costs for all procurement from online RPS eligible facilities that generated electricity in 2017. Additionally, "Procurement Expenditures for 2017" does not include costs from contracts that were approved by the CPUC in 2017 unless the contracted deliveries also began in 2017.

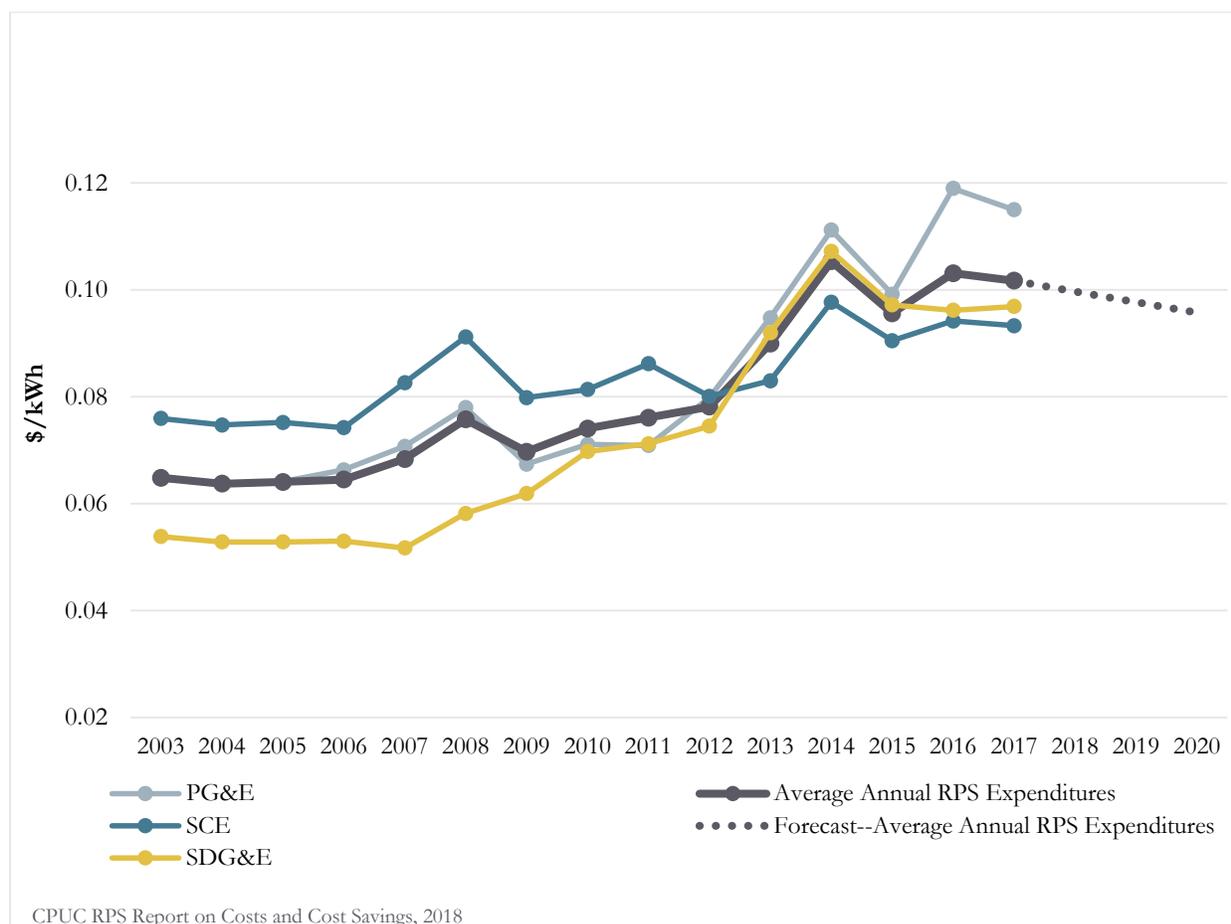
⁹ The cost of RPS procurement expenditures are weighted based on actual quantities of energy delivered.

¹⁰ Table B-1 can be found in the attached Appendix B. Pursuant to the confidentiality rules in Public Utilities Code § 913.3(d) and D.06-06-066, some of the costs in Appendix B have been redacted.

¹¹ At the inception of the three IOUs' solar photovoltaic programs (SPVP-UOG), the CPUC approved an average levelized cost of energy (LCOE) for each IOU. For PG&E's utility-owned generation (UOG) projects, the CPUC approved an average LCOE of \$0.25/kWh. (D.10-04-052 at 36.) For SCE's UOG projects, the CPUC approved an average LCOE of \$0.26/kWh. (D.09-06-049 at 31.) For SDG&E's UOG projects, the CPUC approved an average LCOE of \$0.24/kWh. (D.10-09-016 at 32.) See Appendix B for actual recorded costs. The UOG small hydroelectric facilities used for 2017 RPS generation began commercial operation primarily between 1900 and 1960.

¹² Contracts that only provide renewable energy credits (RECs) are not included in Table B-2.

Figure 2: Weighted Average RPS Procurement Expenditures of Bundled Renewable Energy from 2003-2020 (Nominal Dollars)



As shown in Figure 2 above, initial RPS expenditures were lower than current expenditures for the program. At the beginning of the RPS program in 2003, the large IOUs' RPS resources consisted primarily of heavily depreciated small hydroelectric facilities. Starting in 2010, new resources from contracts signed around 2007 finished construction, began coming online, and increased average expenditures. Historic contract price trends can be seen in Figure 3, which shows that executed contract prices peaked in 2007 and have been continuously falling for RPS-eligible resources. Because it takes several years from contract execution to delivering energy, there is a lag between when the declining contract prices will begin to result in declining expenditures.

Since 2007, annual contract prices for renewable energy have dropped an average of 9.5% per year, as shown in Figure 3. To approximate the impact of decreasing contract prices on future expenditures, Figure 2 includes a forecasted decline in average annual RPS expenditures at a rate of 2% per year between 2018 and 2020. The forecasted 2% drop in total RPS expenditures is significantly less than the historic 9.5% decrease in contract prices. This forecast was selected because the impact of falling contract prices is cumulatively realized in future years and each year's newly generating contracts represent a relatively small part of the IOUs' entire renewable portfolio.

Total Expenditures

In order to meet increasing annual RPS procurement targets, the large IOUs' total combined direct RPS procurement expenditures increased from \$4.8 billion in 2016 to \$5.3 billion in 2017. This increase correlates to the large IOUs' renewable procurement increasing from 48,509 GWh to 52,469 GWh, or 35% to 38% of total generation procurement, from 2016 to 2017.¹³

SMJU Procurement Expenditures for 2017

In 2017, Liberty and BVES spent approximately \$6.4 million on RPS procurement. PacifiCorp stated that it could not yet provide any expenditure data for 2017, but provided information for 2016 expenditures.¹⁴ In 2016, PacifiCorp spent a total of approximately \$12.3 million on RPS procurement. The SMJUs' RPS resources include biomass, geothermal, hydroelectric, solar photovoltaic, and wind.

Weighted Average Expenditures

In 2017, the weighted average RPS procurement expenditure for all BVES contracts was 0.9 ¢/kWh and 4.2 ¢/kWh for Liberty.¹⁵ In 2016, PacifiCorp's weighted average procurement expenditure for all RPS contracts was 7.6 ¢/kWh.

Total Expenditures

Using available 2017 data, Liberty and BVES had a total combined RPS procurement expenditure of \$6.4 million in 2017 compared to \$8.4 million in 2016. The SMJUs' total expenditures decreased in 2017, because Liberty started receiving roughly 86% of its RPS energy from a less expensive source. The SMJUs' total renewable procurement increased by approximately 30 GWh from 2016 to 2017 and their average RPS procurement percentage increased from 27% to 28%.¹⁶

¹³ CPUC, "California's Renewables Portfolio Standard Annual Report", at 12 (November 2017): http://cpuc.ca.gov/uploadedFiles/CPUC_Website/Content/Utilities_and_Industries/Energy/Reports_and_White_Papers/Nov%202017%20-%20RPS%20Annual%20Report.pdf.

¹⁴ PacifiCorp informed the CPUC that data for 2017 is unavailable until the company files its FERC "Form 1" in May 2018; therefore, its 2016 data has been used in this report.

¹⁵ BVES's 2017 procurement expenditure data includes just REC-only contracts; therefore, it is not comparable to the other utilities' 2017 expenditures as they procured significant quantities of contracts that include the cost of acquiring RECs, capacity, and energy.

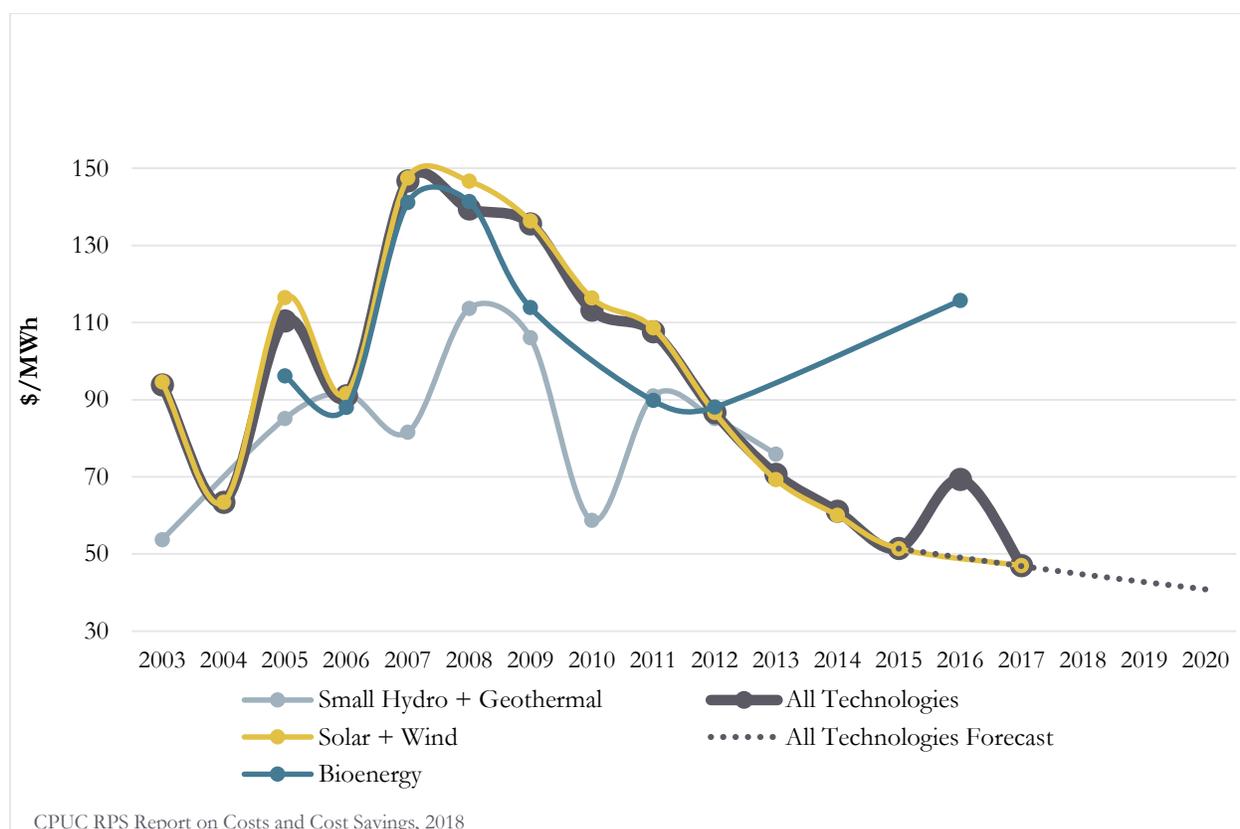
¹⁶ *Supra* note 14.

II. RPS Aggregated Contract Prices

Large IOU Contract Prices for 2017

The CPUC examined the large IOUs' aggregated RPS contract prices signed between 2003 and 2017 with nameplate capacities greater than 3 MW.¹⁷ Figure 3 below shows that contract prices between 2007 and 2015 consistently dropped for the aggregated all technologies group in nominal dollars.¹⁸ The annual contract price for all technologies decreased an average of 9.5% during that time. The downward trend in contract prices can be attributed to falling prices for wind and solar technologies, which together make up 87.1% of the large IOUs' collective RPS generating capacity.

Figure 3: Historical Trend of RPS Contract Costs by Technology from 2003-2020 (Nominal Dollars)



¹⁷ Contracts were analyzed using the CPUC's RPS Executed Projects Database, which contains self-reported information by the IOUs on their RPS contracts. The database, however, does not contain complete price information for every project. Contract prices are weighted averaged by contracted nameplate capacity. Additionally, small projects with nameplate capacities of 3 MW or less were excluded. Projects with a capacity of 3MW or less made up just 2.3% of all contracted RPS capacity, and removing these figures eliminated non-representative trends from the data. As a result of this size exclusion, feed-in-tariff projects were not considered in the analysis above. In California, feed-in-tariff programs provide projects with a capacity of 3 MW or less capacity a predetermined price (\$/MWh) to encourage market transformation for projects at these sizes.

¹⁸ In Figure 3, trend lines were used in years when no contracts were signed or confidentiality rules applied to contract prices. For the wind and solar category, there was just one solar signed contract in 2016; therefore, its contract price is confidential and the value for 2016 is a trend line between 2015 and 2017. For the small hydroelectric and geothermal category, a trend line was used in 2004 because no contracts were signed and in 2014 because of confidentiality rules. For the bioenergy category, a trend line was used in 2010, 2013, and 2014 because no contracts were signed and in 2015 because of confidentiality rules.

Average contract prices spiked in 2016 as a result of mandated high hazard zone (HHZ) biomass procurement. Consequently, the weighted average contract prices for all technologies increased from about \$50/MWh in 2015 to about \$70/MWh in 2016. HHZ biomass contracts were signed as a part of the state's response to Governor Brown's October 30, 2015, Emergency Proclamation and SB 859 (2016) to protect public safety and property from falling dead trees and wildfires.¹⁹ In 2016, six HHZ biomass contracts were signed with an average contract price of more than \$115/MWh and a combined capacity of 153.8 MW.

In 2017, one wind contract was executed with a price of 5.3 ¢/kWh and three solar contracts were executed with an average price of at 3.2 ¢/kWh.²⁰ These were the only projects signed in 2017 with a nameplate capacity greater than 3 MW; therefore, the average price of 4.7 ¢/kWh was the result for the all technologies group as well as the solar and wind categories. While the average price increased in 2016 due to mandated bioenergy procurement,²¹ future prices are expected to decline. To show an approximation of future prices, Figure 3 includes a forecast of the all technologies contract prices declining at a rate of 4.5% a year from the all technologies contract price in 2015. This is a conservative forecast, as it is less than half the rate of declining contract prices for all technologies between 2007 and 2015.²²

SMJU Contract Prices for 2017

In 2017, the CPUC did not approve three or more contracts for the SMJUs. Therefore, the Commission cannot report any of the cost information for these entities, due to confidentiality rules set out in CPUC Decision (D). 06-06-066.

¹⁹ Governor Edmund G. Brown Jr., *Proclamation of a State of Emergency* (October 30, 2015)

https://www.gov.ca.gov/wp-content/uploads/2017/09/10.30.15_Tree_Mortality_State_of_Emergency.pdf.

²⁰ The origination year category from the RPS Executed Projects Database was used to allocate contracts to corresponding years; however, some projects with 2016 origination years were allocated to 2017 as their confidential power purchase agreements (PPAs) were executed in 2017. Additionally, the one wind contract signed in 2017, Energía Sierra Juarez 2 US project, was a contract between SDG&E and an affiliate; therefore, its contract price is public.

²¹ In 2016, mandated bioenergy procurement caused significant upward pressure on contract prices in the all technologies category. However, the impact bioenergy procurement had on contract prices in 2016 is not representative, as the 153.8 MW of bioenergy procured was more than 500% ($153.8MW / 28.3MW$) greater than the historical average annual quantity of bioenergy procurement between 2003 and 2015 in the RPS program.

²² See also Lazard, *Levelized Cost of Energy Analysis – Version 11.0* (November 2017) at 4, 10 (The levelized price for solar dropped 11%-17% in the last three years to subsidized prices in 2017 of \$35-\$42/MWh and wind dropped 4.5%-16.0% in the last three years to subsidized prices in 2017 of \$14-\$52/MWh); Bloomberg New Energy Finance, *New Energy Outlook 2017* (June 2017) (By 2040, levelized price of solar to drop 66%, onshore wind to drop 47%, and offshore wind to drop 71%).

III. Comparison of RPS Procurement Expenditures to IOU Revenue Requirements

Large IOUs

Table 1 compares RPS procurement expenditures to revenue requirements for the large IOUs. The table shows the percentage of RPS procurement compared to total procurement for these IOUs' generation portfolios, as well as the RPS procurement as a portion of total revenue requirement. Additionally, Table 1 shows the large IOUs' RPS generation percentages for 2017.

Table 1 also shows that in 2017, RPS procurement expenditures were less than 20% of the IOUs' total revenue requirements. Compared to the total generation revenue requirements, the RPS expenditures make up a much smaller portion of the total revenue requirements, since total revenue requirements contain many large line items such as transmission expenditures, reliability costs, administrative, and capital expenses.

Table 1: Comparison of Large IOUs' RPS Procurement to Revenue Requirements in 2017^{23 24}

IOU	RPS Generation	RPS Procurement Expenditures (billions)	Total Generation Revenue Requirement (billions)	RPS Procurement Expenditures to Total Generation Revenue Requirement (%)	Total Revenue Requirement (billions)	RPS Procurement Expenditures to Total Revenue Requirement (%)
PG&E	33.7%	\$2.4	\$6.5	37%	\$14.2	16.9%
SCE	33.9%	\$2.2	\$5.6	39%	\$12.1	18.1%
SDG&E	46.3%	\$0.685	\$1.8	38%	\$4.3	16.0%

As the large IOUs are required to procure higher percentages of RPS-eligible energy, they are procuring less fossil fuel for their electric portfolios. Given that RPS energy is replacing fossil fuel energy, an increase in the revenue requirement due to RPS procurement, while difficult to calculate, can be approximated by comparing the average cost of RPS energy to fossil fuel energy. The large IOUs' average cost of renewable energy was 10.07 ¢/kWh and the average cost of fossil fuel energy was 9.56 ¢/kWh. Therefore, the RPS program on average likely contributed an additional half-cent to revenue requirements for each kilowatt-hour procured to obtain program benefits.²⁵ A more detailed comparison of 2017 RPS and Fossil Fuel procurement expenditures is provided on page 15 of this report.

²³ Revenue requirement numbers have been taken from the CPUC's "California Electric and Gas Utility Cost Report" Pursuant to Public Utilities Code Section 913, May 2018. Figures have been generated from CPUC GRC Phase 1 proceeding.

²⁴ RPS generation percentages are forecasts taken from CPUC Preliminary Compliance Report (2017) and procurement data collected from individual IOUs.

²⁵ The RPS cost premium compared to fossil fuel on a kilowatt-hour basis is represented by the following equation: $10.1 \text{ ¢/kWh (RPS)} - 9.6 \text{ ¢/kWh (Fossil Fuel)} = 0.50 \text{ ¢/kWh}$. The additional half-cent added to revenue requirements per kWh due to RPS procurement does not create a large impact on the average household bill. This is because generation costs comprise roughly half of the total bill, and RPS costs are roughly half of the total generation costs. See the CPUC's 2018 AB 67 Report at page 7 for more information on electric rates.

SMJUs

2017 revenue requirement information for Liberty, BVES, and PacifiCorp is currently confidential pursuant to Commission confidentiality rules.²⁶ Consequently, the CPUC is not able to perform an analysis on SMJU costs compared to their revenue requirements for 2017. However, Table 2 provides a summary of BVES's and Liberty's total 2017 RPS procurement expenditures and PacifiCorp's total 2016 RPS procurement expenditures.²⁷

Table 2: Comparison of SMJUs' RPS Total RPS Expenditures

	BVES (2017)	Liberty (2017)	PacifiCorp (2016)
Total	\$381,825	\$6,000,783	\$12,370,322

²⁶ See D.06-06-066 for confidentiality rules related to revenue requirements.

²⁷ *Supra*, note 15.

RENEWABLES PROGRAM COST SAVINGS

This section addresses the avoided costs associated with procuring renewable resources in 2017, consistent with the requirements of Section 913.3(c).

Section 913.3(c)

The commission shall report all cost savings experienced, or costs avoided, by electrical corporations as a result of meeting the renewables portfolio standard.

It is difficult to quantify the cost savings, or avoided costs, associated with the RPS program given this requires assessing whether the RPS program deferred construction of alternative generation facilities and the theoretical cost of those alternative resources. The Commission also cannot estimate the impacts that increased renewables and the resulting fuel diversity have had on the cost of natural gas in California. However, it is reasonable to assume that the RPS program has put downward pressure on natural gas prices. To assess the RPS program's cost savings, this report compares the utilities' 2017 RPS procurement costs to benchmark values produced by the market price referent (MPR) methodology and the utilities' 2017 fossil fuel procurement costs.

I. The Market Price Referent (MPR) Methodology

The MPR was developed for the Commission to determine whether a competitively bid RPS contract had above-market costs. The MPR models the cost to build and operate a baseload combined-cycle gas turbine (CCGT) power plant in a desired year, and the MPR model generates a benchmark price.²⁸ The model was adopted by the Commission as a proxy for the “levelized price of a utility’s long-term [power purchase agreement (PPA)] with a new natural-gas fueled generation facility in California.”²⁹ The Commission still finds the MPR is the best method for comparing and determining cost savings for the RPS program, because it is a publicly vetted proxy for the cost of a new power plant and it provides consistency with prior Padilla reports. However, since the last Commission-approved MPR model was updated in 2011 (2011 MPR), certain inputs no longer reflect current market conditions. Therefore, three inputs of the 2011 MPR model have been updated for this report (updated 2017 MPR). For the updated 2017 MPR, natural gas costs and the emission rate of carbon dioxide for each MWh of CCGT generation were taken from the 2017 Avoided Cost Calculator (ACC),³⁰ and GHG planning prices were taken from the IRP proceeding.³¹

Table 3: Comparison of MPR Benchmarks (¢/kWh)

Method	Proxy Costs
2011 MPR	10.7
Updated 2017 MPR	9.0

It should be noted that historically low natural gas commodity prices are driving down the values in the updated 2017 MPR model. Many factors have contributed to the decrease in natural gas prices, including reduced demand caused by renewable energy development.

Large IOU Cost Savings

The average 2017 RPS procurement expenditures for PG&E, SCE, and SDG&E were 11.0 ¢/kWh, 9.3 ¢/kWh, and 9.7 ¢/kWh, respectively.³² The average procurement expenditure for the large IOUs was 10.07 ¢/kWh.³³ Compared to the 2011 MPR proxy cost of 10.7 ¢/kWh, the large IOUs realized a cost savings of 0.6¢ for each kWh of RPS energy. Compared to the updated 2017 MPR proxy cost of 9.0 ¢/kWh, the large IOUs paid a premium of 1.7¢ for each kWh of RPS energy.

²⁸ See D.08-10-026.

²⁹ *Id.* at 1.

³⁰ The Avoided Cost Calculator can be found on the CPUC’s Cost Effectiveness website: <http://www.cpuc.ca.gov/General.aspx?id=5267>.

³¹ D.18-02-018 at 116. GHG planning prices for 2016 and 2017 were taken from the IRP’s RESOLVE model. IRP GHG planning prices were selected to update the MPR as that value will be used to assess RPS projects, whereas the Integrated Distributed Energy Resources (IDER) figures were developed for distributed energy resources. *See* D.17-08-022 at 1, 13.

³² Appendix B, Table B-1.

³³ *Id.*

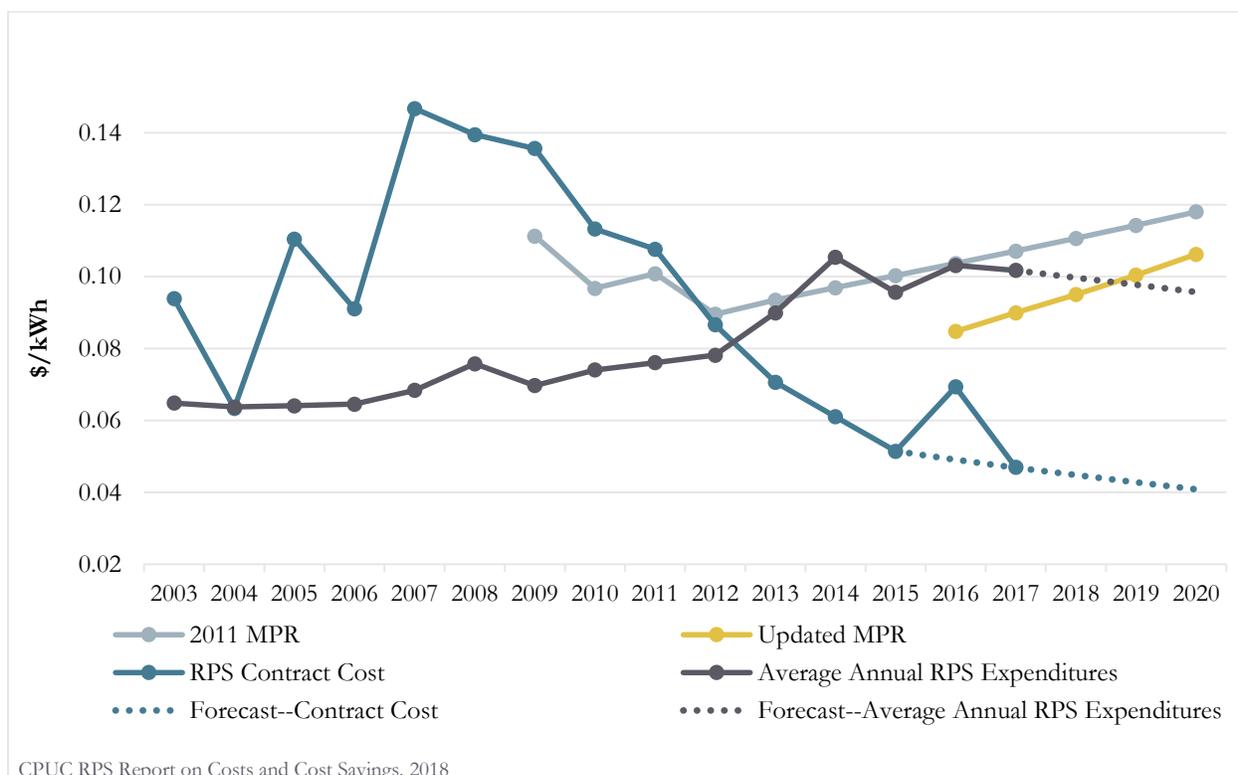
Based on total volumes of RPS generation procured and the different cost comparison metrics described above, the large IOUs realized the following cost savings (positive figures) or premiums (negative figures):

Table 4: Large IOUs' 2017 RPS Cost Savings: MPR Methodology (millions)³⁴

	Cost Savings Compared to 2011 MPR Proxy Expenditure	Cost Savings Compared to 2017 MPR Proxy Expenditure
PG&E	-\$56	-\$437
SCE	\$319	-\$76
SDG&E	\$72	-\$48

In 2017, the large IOUs' average annual RPS procurement expenditure was less than the benchmark created by the 2011 MPR and greater than the benchmark created by the updated 2017 MPR. However, the large IOUs' annual expenditures are not expected to remain above the updated benchmark, because total RPS procurement expenditures are projected to decline on a per kWh basis as new, low-cost RPS projects come online. Between 2016 and 2017, the large IOUs' average annual RPS procurement costs decreased slightly from 10.2 ¢/kWh in 2016 to 10.1 ¢/kWh in 2017. Conversely, MPR proxy prices will continue to go up over time as the models reflect increasing GHG planning prices.³⁵ As a result of the IOUs' decreased procurement costs and increasing GHG planning prices, RPS procurement expenditures are projected to move below the updated 2017 MPR in the near-term, as shown in Figure 4 below.

Figure 4: Historic Trends and Projections for RPS Program Costs (Nominal Dollars)



³⁴ Cost savings or premiums are calculated by multiplying an MPR proxy price by an IOU's total volume of RPS procurement in 2017, then subtracting that value from the IOU's 2017 RPS Procurement Expenditures (shown in Table 1).

³⁵ *Supra*, notes 32-33.

SMJUs Cost Savings

For the SMJUs, the average 2017 RPS procurement expenditure for BVES was 0.9 ¢/kWh and Liberty was 4.2 ¢/kWh, while the average 2016 RPS procurement expenditure for PacifiCorp was 7.6 ¢/kWh.³⁶ Based on total volumes of RPS generation procured and the different cost comparison metrics described above, the SMJUs realized the following cost savings (positive figures) or premiums (negative figures):

Table 5: SMJUs' 2017 RPS Cost Savings: MPR Methodology (millions)³⁷

	Cost Savings Compared to 2011 MPR Proxy Expenditure	Cost Savings Compared to 2017 MPR Proxy Expenditure
BVES (2017) ³⁸	NA	NA
Liberty (2017)	\$9.3	\$6.9
PacifiCorp (2016)	\$5.0	\$2.2

³⁶ *Supra*, note 15.

³⁷ Cost savings or premiums are calculated by multiplying an MPR proxy price with an SMJU's total volume of RPS procurement in 2017 then subtracting that value from the SMJU's 2017 RPS Procurement Expenditures (shown in Table 2).

³⁸ BVES's RPS projects consisted solely of REC-only products and is therefore not comparable to the MPR, as the MPR is a proxy cost for obtaining other energy and capacity benefits.

II. Fossil Fuel Procurement Methodology

In addition to the 2011 MPR and Updated 2017 MPR, the Commission considered the large IOUs' 2017 fossil fuel procurement costs as a cost comparison metric for the RPS program. The 2017 fossil fuel procurement data is an appropriate cost comparison metric because in the absence of RPS procurement, fossil fuel resources would be procured. Additionally, the fossil fuel procurement expenditures below confirm the reasonableness of the MPR models.

Large IOUs Cost Savings

In 2017, the large IOUs' average annual RPS procurement expenditure represented a half-cent per kilowatt-hour premium compared to their average fossil fuel expenditure.³⁹ More specifically, the premium for RPS energy compared to fossil fuel energy for PG&E, SCE, and SDG&E was 0.5 ¢/kWh, 0.1 ¢/kWh, and 1.1 ¢/kWh, respectively.

Table 6: Large IOUs' Average Fossil Fuel Procurement Expenditure (¢/kWh)

Method	PG&E	SCE	SDG&E	Average
2017 Fossil Fuel	10.4	9.3	8.6	9.6
2017 RPS	11.0	9.3	9.7	10.1

Based on total volumes of RPS generation procured and fossil fuel costs, the large IOUs' realized the following cost savings (positive figures) or premiums (negative figures):

Table 7: Large IOUs' 2017 RPS Cost Savings: Fossil Fuel Comparison (millions)⁴⁰

	Cost Savings Compared to 2017 Average Fossil Fuel Expenditure
PG&E	-\$119
SCE	-\$16
SDG&E	-\$76

SMJUs

The Commission does not have sufficient data to conduct a meaningful comparison of the SMJUs' RPS and fossil fuel procurement costs.

³⁹ *Supra*, note 27.

⁴⁰ Cost savings or premiums are calculated by multiplying each IOU's average 2017 fossil fuel expenditure (Table 6) by its total volume of RPS procurement in 2017 then subtracting that value from the IOUs' 2017 RPS procurement expenditure (Table 1).

APPENDICES

I. Appendix A: RPS Activities and Milestones

RPS Activities and Milestones in 2017	
January	<ul style="list-style-type: none"> PG&E contracted 1.4 MW of existing small hydro under the ReMAT Program
February	<ul style="list-style-type: none"> CPUC approves PG&E BioRAM contract with Burney (Res. E-4822) Large IOUs began monthly offerings of BioMAT contracts for forest biomass projects
March	<ul style="list-style-type: none"> PG&E contracted a 0.6 MW existing small hydro project under the ReMAT Program
April	<ul style="list-style-type: none"> CPUC approves PG&E BioRAM contract with Wheelabrator Shasta (Res. E-4834)
May	<ul style="list-style-type: none"> CPUC issued RPS Procurement Plan Assigned Commissioner/Administrative Law Judge Ruling providing guidance for 2017 RPS Procurement Plans and proposal for RAM procurement PG&E contracted a 3 MW solar PV project under the ReMAT Program
June	<ul style="list-style-type: none"> CPUC approves SCE RPS contract for 125 MW Maverick Solar project (Res. E-4851) CPUC holds Pre-Hearing Conference on Tree Mortality Non-bypassable Charge PG&E contracted a 0.85 MW municipal BioMAT project PG&E contracted a 0.3 MW existing small hydro project under the ReMAT Program
July	<ul style="list-style-type: none"> CPUC adopts D.17-06-026 implementing SB 350 (de León, 2015) IOUs, CCAs, and ESPs submitted their draft RPS Procurement Plans to the CPUC SCE contracted a 2 MW municipal BioMAT project PG&E contracted a 1 MW existing small hydro project under the ReMAT Program
August	<ul style="list-style-type: none"> IOUs, CCAs, and ESPs submitted their annual preliminary RPS Compliance Reports to Energy Division CPUC issued D.17-08-021 implementing AB 1979 (Bigelow, 2016) with revisions to ReMAT CPUC issued D.17-08-021 implementing AB 1923 (Wood, 2016) expanding eligibility for BioMAT participants SDG&E contracted a 3 MW project for municipal BioMAT
October	<ul style="list-style-type: none"> CPUC issued a Ruling to implement AB 1923's (Wood, 2016) provision to interconnect to existing transmission
November	<ul style="list-style-type: none"> CPUC issues Annual RPS Report to the Legislature: http://www.cpuc.ca.gov/RPS_Reports_Data/ SDG&E contracted a 105 MW RAM 7 Project
December	<ul style="list-style-type: none"> PG&E submits Advice Letter to use RAM to procure for its Solar PV Program CPUC approves 2017 RPS Procurement Plans with D.17-12-007 CPUC issued RPS Compliance Determinations for Compliance Period 1 (2011-2013)

II. Appendix B: RPS Procurement Expenditures per Senate Bill 836 (Public Utilities Code § 913.3)

Overview of Tables

Tables B-1 and B-2 show, for each large IOU, the weighted average time-of-delivery (TOD) adjusted RPS procurement expenditures for 2017. Per the confidentiality requirements in Public Utilities Code § 913.3, some of the data within this report is redacted in order to protect market sensitive information.

In addition:

- The “Average RPS Procurement Expenditures” represent the total weighted average payments made to renewable generators for 2017.
- Procurement expenditures represent weighted averages by capacity procured on a per kilowatt-hour basis. All figures are in 2017 dollars.⁴¹

⁴¹ PG&E modified their method for calculating UOG small hydro costs for this report by using actual energy generated (kWh) in the denominator as opposed to annual average generation figures that were used in past years. PG&E also included an allocation of common costs in the numerator resulting in a higher Average Cost per kWh (in past years PG&E did not include any common costs). PG&E believes this new method is a more accurate approach for calculating UOG costs in their portfolio. SCE provided UOG small hydro costs on a per project basis.

**Table B-1. Weighted Average RPS Procurement Expenditures
(All Projects – Including REC-only transactions) for 2017 (\$/kWh)**

	PG&E	SCE	SDG&E	Total
Biogas				
0-3 MW	0.1150	0.0868	0.1065	0.1046
+3-20 MW	0.1109	0.0713	0.0718	0.0975
Biogas Total	0.1116	0.0802	0.0858	0.0996
Biomass				
0-3 MW	Only 1 Contract			Only 1 Contract
+3-20 MW	0.1142	Only 1 Contract		0.1124
+20-50 MW	0.0983	Only 2 Contracts	Only 1 Contract	0.1008
+50-200 MW	Only 2 Contracts			Only 2 Contracts
Biomass Total	0.0944	0.1124	Only 1 Contract	0.0972
Geothermal				
+3-20 MW	Only 2 Contracts	0.0649		0.0756
+20-50 MW		0.0586		0.0586
+50-200 MW		0.0677		0.0677
+200 MW	Only 1 Contract	Only 2 Contract		0.0729
Geothermal Total	0.0801	0.0619		0.0692
Small Hydro				
0-3 MW	0.0734	0.0831	Only 1 Contract	0.0757
+3-20 MW	0.0608	0.0638		0.0619
+20-50 MW	0.0634			0.0634
Small Hydro Total	0.0643	0.0684	Only 1 Contract	0.0650
Solar Photovoltaic				
0-3 MW	0.1351	0.1329	0.1182	0.1327
+3-20 MW	0.1049	0.0805	0.0855	0.0897
+20-50 MW	0.1541	Only 1 Contract	Only 2 Contracts	0.1450
+50-200 MW	0.1327	0.0750	0.1203	0.1110
+200 MW	0.1531	0.1229		0.1369
Solar Photovoltaic Total	0.1400	0.1041	0.1188	0.1200
Solar Thermal				
+20-50 MW		0.1106		0.1106
+50-200 MW	0.1627	0.1474		0.1547
+200 MW	0.2040			0.2040
Solar Thermal Total	0.1923	0.1363		0.1750
Wind				
0-3 MW	0.0369	0.0772		0.0772
+3-20 MW	0.0668	0.0484	0.0750	0.0589
+20-50 MW	0.0875	0.0703	0.0589	0.0716
+50-200 MW	0.0784	0.1011	0.0657	0.0848
+200 MW		0.1046	0.1047	0.1047
Wind Total	0.0782	0.0974	0.0723	0.0859
UOG Small Hydro				
0-30 MW	0.1029	0.0527		0.0842
UOG Small Hydro Total	0.1029	0.0527		0.0842
UOG Solar Photovoltaic				
0-3 MW	0.4372	0.5543	0.5819	0.5455
+3-20 MW	0.1494	0.5643	0.2236	0.2206
UOG Solar Photovoltaic Total	0.1530	0.5604	0.2930	0.2560
Average of All Resources	0.1097	0.0933	0.0969	0.1007

**Table B-2. Weighted Average RPS Procurement Expenditures
(Bundled Energy Only) for 2017 (\$/kWh)**

	PG&E	SCE	SDG&E	Total
Biogas				
0-3 MW	0.1150	0.0868	0.1065	0.1046
+3-20 MW	0.1109	0.0713	0.0718	0.0975
Biogas Total	0.1116	0.0802	0.0858	0.0996
Biomass				
0-3 MW	Only 1 Contract			Only 1 Contract
+3-20 MW	0.1142	Only 1 Contract		0.1124
+20-50 MW	0.0983	Only 2 Contracts	Only 1 Contract	0.1008
+50-200 MW	Only 2 Contracts			Only 2 Contracts
Biomass Total	0.0944	0.1124	Only 1 Contract	0.0972
Geothermal				
+3-20 MW	Only 2 Contracts	0.0649		0.0756
+20-50 MW		0.0586		0.0586
+50-200 MW		0.0677		0.0677
+200 MW	Only 1 Contract	Only 2 Contracts		0.0729
Geothermal Total	0.0801	0.0619		0.0692
Small Hydro				
0-3 MW	0.0734	0.0831	Only 1 Contract	0.0757
+3-20 MW	0.0608	0.0638		0.0619
+20-50 MW	0.0634			0.0634
Small Hydro Total	0.0643	0.0684	Only 1 Contract	0.0650
Solar Photovoltaic				
0-3 MW	0.1351	0.1329	0.1182	0.1327
+3-20 MW	0.1049	0.0805	0.0855	0.0897
+20-50 MW	0.1541	Only 1 Contract	Only 2 Contracts	0.1450
+50-200 MW	0.1327	0.0750	0.1203	0.1110
+200 MW	0.1531	0.1229		0.1369
Solar Photovoltaic Total	0.1400	0.1041	0.1188	0.1200
Solar Thermal				
+20-50 MW		0.1106		0.1106
+50-200 MW	0.1627	0.1474		0.1547
+200 MW	0.2040			0.2040
Solar Thermal Total	0.1923	0.1363		0.1750
Wind				
0-3 MW	0.0369	0.0772		0.0772
+3-20 MW	0.0668	0.0484	0.0750	0.0589
+20-50 MW	0.0875	0.0703	0.0589	0.0716
+50-200 MW	0.0975	0.1012	0.0942	0.0988
+200 MW		Only 1 Contract	0.1029	Only 2 Contracts
Wind Total	0.0956	0.0944	0.0950	0.0949
UOG Small Hydro				
0-30 MW	0.1029	0.0527		0.0842
UOG Small Hydro Total	0.1029	0.0527		0.0842
UOG Solar Photovoltaic				
0-3 MW	0.4372	0.5543	0.5819	0.5455
+3-20 MW	0.1494	0.5643	0.2236	0.2206
UOG Solar Photovoltaic Total	0.1530	0.5604	0.2930	0.2560
Average of All Resources	0.1150	0.0922	0.0969	0.1042

III. Appendix C: Contract Price Data per Senate Bill 836 (Public Utilities Code § 913.3)

Overview of Contract Price Data

Table C-1 shows the weighted average time-of-delivery (TOD) adjusted contract price for all of the large IOUs' RPS contracts approved by the CPUC in 2017. Per the confidentiality requirements in Public Utilities Code § 913.3, some of the data within this appendix could be redacted:

- Contract prices were to be redacted if a) the power purchase agreement (PPA) is not already public on the CPUC's website per the CPUC's confidentiality rules, and b) there were fewer than three facilities in each category. If there was only one facility in a category and its PPA is publicly available on the CPUC's website, then the price information for that facility is reported. In addition, the following contracts are public and reported: all qualifying facility (QF) contracts that do not require CPUC approval, feed-in tariff contracts, contracts with municipal governments, affiliate entities, and utility-owned generation (UOG) costs.
- Weighted average contract prices represent contract prices weighted by capacity procured on a per kilowatt-hour basis. All figures are in 2017 dollars.
- All contract price figures have been adjusted by TOD factors since generators are paid based on the time that the facility delivers electricity, according to each IOU's TOD factors. For example, IOU TOD factors place a premium on generation that occurs during peak demand hours. Therefore, generators that provide electricity during peak hours when electricity is more valuable receive a higher payment for electricity during that time period based on the TOD adjustment.

Table C-1. Weighted Average TOD-Adjusted Price of All Renewable Energy Contracts Approved (All Projects – There were no REC-only transactions) for 2017 (\$/kWh)

	PG&E	SCE	SDG&E	Total
Biogas				
0-3 MW	0.1273	0.0892		0.1085
Biogas Total	0.1273	0.0892		0.1085
Digester Gas				
0-3 MW	0.1877		0.1272	0.1577
Digester Gas Total	0.1877		0.1272	0.1577
Small Hydro				
0-3 MW	0.0892			0.0892
Small Hydro Total	0.0892			0.0892
Solar Photovoltaic				
0-3 MW	0.0612	0.0472		0.0542
+3-20 MW	0.0325			0.0325
Solar Photovoltaic Total	0.0469	0.0472		0.0434
Wind				
50-200 MW			0.0553	0.0553
Wind Total			0.0553	0.0553
Average of All Resources	0.0558	0.0669	0.0591	0.0580

IV. Appendix D: Public Utilities Code § 913.3(a)–(d)

Text of Public Utilities Code § 913.3(a)–(d)

913.3. (a) Notwithstanding subdivision (g) of Section 454.5 and Section 583, no later than May 1 of each year, the commission shall release to the Legislature for the preceding calendar year the costs of all electricity procurement contracts for eligible renewable energy resources, including unbundled renewable energy credits, and all costs for utility-owned generation approved by the commission.

(1) For power purchase contracts, the commission shall release costs in an aggregated form categorized according to the year the procurement transaction was approved by the commission, the eligible renewable energy resource type, including bundled renewable energy credits, the average executed contract price, and average actual recorded costs for each kilowatt-hour of production. Within each renewable energy resource type, the commission shall provide aggregated costs for different project size thresholds.

(2) For each utility-owned renewable generation project, the commission shall release the costs forecast by the electrical corporation at the time of initial approval and the actual recorded costs for each kilowatt-hour of production during the preceding calendar year.

(b) The commission shall report all electrical corporation revenue requirement increases associated with meeting the renewables portfolio standard, as defined in Section 399.12, including direct procurement costs for eligible renewable energy resources and renewable energy credits.

(c) The commission shall report all cost savings experienced, or costs avoided, by electrical corporations as a result of meeting the renewables portfolio standard.

(d) This section does not require the release of the terms of any individual electricity procurement contracts for eligible renewable energy resources, including unbundled renewable energy credits, approved by the commission. The commission shall aggregate data to the extent required to ensure protection of the confidentiality of individual contract costs even if this aggregation requires grouping contracts of different energy resource type. The commission shall not be required to release the data in any year when there are fewer than three contracts approved.