

**PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA**

**ENERGY DIVISION**

**RESOLUTION E-4801  
September 29, 2016**

**R E S O L U T I O N**

Resolution E-4801. Adopts updates to the Avoided Cost Calculator for use in demand-side distributed energy resources cost-effectiveness analyses.

**PROPOSED OUTCOME:**

- Adopts certain data input updates, minor modeling adjustments and a version control process for the Avoided Cost Calculator for use in distributed energy resource cost-effectiveness analyses.

**SAFETY CONSIDERATIONS:**

- Based on the information before us the Resolution does not appear to result in any adverse safety impacts.

**ESTIMATED COST:**

- No incremental cost. Funds necessary for updates to the Avoided Cost Calculator were authorized in Decision (D.)16-06-007.

Authorized by D. 16-06-007, issued on June 15, 2016.

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**SUMMARY**

In accordance with D. 16-06-007 Ordering Paragraph (OP) 2, this Staff Proposed Resolution adopts updates to the Avoided Cost Calculator (ACC) submitted on August 1, 2016 for use in demand-side cost-effectiveness analysis of distributed energy resources (DER).

## **BACKGROUND**

The Avoided Cost Model was adopted in D.05-04-024 and was originally used to measure Energy Efficiency (EE) cost-effectiveness.<sup>1</sup> The assumptions used in the ACC and the ACC methodology require periodic updates in order to stay current with market conditions, prices, and trends. Thus semi-regular improvements to the ACC modeling software and data input updates were adopted in D.06-06-063, D.09-09-047, and D.12-05-015.

The most recent set of updates proposed for the ACC was initiated by an October 9, 2015 Administrative Law Judge (ALJ) Ruling in the Integrated Distributed Energy Resources (IDER) proceeding.<sup>2</sup> This Ruling described a Commission staff's proposal for updating the Commission's cost-effectiveness framework and established a Cost-Effectiveness Working Group (CEWG) to address three objectives for updating the Commission's current cost-effectiveness framework: 1) establishing a system for avoided cost calculator version control; 2) developing a process for avoided cost calculator data updates; and 3) developing recommendations related to four elements: a) resource balance year; b) avoided cost estimation; c) costs and benefits definitions; and d) whether to develop a social cost test.

In compliance with the October 9, 2015 Ruling, the CEWG filed a Status Report on February 2, 2016 "describing the activities of the working group and the progress of the working group in attaining each of the three objectives." While the CEWG continued to meet to reach further consensus on issues, it recommended three groups of actions the Commission should address within the next three months to ensure timely adoption of the ACC updates: 1) updating the avoided cost calculator; 2) providing guidance in applicable proceedings; and

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<sup>1</sup> The Commission issued R.04-04-025 to develop avoided costs in a "consistent and coordinated manner across Commission proceedings. D.05-04-024 adopted the report, *Methodology and Forecast of Long-Term Avoided Cost(s) for the Evaluation of California Energy Efficiency Programs* and associated spreadsheet models developed by the firm E3 to use in determining cost effectiveness of energy efficiency programs.

<sup>2</sup> R.14-10-003.

3) providing guidance regarding the consensus proposals identified in the report.<sup>3</sup>

Upon review of the Status Report, the ALJ issued a Ruling directing comments to be filed on the Status Report and asking parties to respond to specific questions regarding the recommendations. Parties filed comments and reply comments to the Ruling on March 14, 2016 and March 21, 2016.

The Commission contracted with Energy and Environmental Economics, Inc. (E3) to conduct the update of the ACC. E3 proposed a set of data input updates and minor enhancements to the ACC that were informed by the CEWG Status Report, party comments, and in consultation with Commission staff. Commission staff shared a Draft Report with the Working Group and posted it to the CPUC's Public Documents Area website (<http://www.energydataweb.com/cpuc/search.aspx>) on June 1, 2016. The California Large Energy Consumers Association (CLECA) and San Diego Gas & Electric/Southern California Gas Company submitted comments to the Draft Report. E3 submitted its Final Report, *Avoided Costs 2016 Interim Update* ("Final Report"), with Energy Division on August 1, 2016. A link to the Final Report is attached to this Resolution as Appendix A.

Decision (D.)16-06-007 adopted updates to portions of the Commission's current cost-effectiveness framework for DERs. OP 2 of D.16-06-007 allows the CPUC Energy Division to draft Resolutions recommending data updates, minor corrections, and amendments to inputs to the Avoided Cost Calculator no later than May 1<sup>st</sup> each year.<sup>4</sup> D.16-06-007 acknowledges that this May 1<sup>st</sup> deadline presents timing complications for the 2016 ACC update, and thus allows Energy Division to issue a draft resolution updating the ACC after the adoption of the Decision.

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<sup>3</sup> On February 29, 2016, an ALJ Ruling authorized the Working Group to continue to meet in order to complete its tasks. The Ruling directed that the Working Group, "should cooperatively develop a final consensus report to be filed no later than May 31, 2016."

<sup>4</sup> D.16-06-007, OP 2.

In accordance with OP 2 of D.16-06-007, this Resolution proposes the adoption of the changes to the ACC as proposed by E3 in its Final Report.

According to D.16-06-007, Conclusion of Law 2, all DER proceedings should be required to use the ACC adopted in Integrated Distributed Energy Resources (IDER) Rulemaking (R.) 14-10-003.

## **DISCUSSION**

The Commission reviewed the ACC updates in the E3 Final Report and finds the proposed ACC updates are within the scope ordered by D.16-06-007. The ACC updates were necessary in order to more accurately reflect market conditions, trends and prices. We have determined that it is reasonable to adopt the changes proposed to the ACC.

The Final Report proposes eight (8) methodology enhancements to the ACC, five (5) data source updates, and an additional two (2) proposed ancillary amendments that do not result in changes to the ACC itself. This section of the Resolution addresses each of these proposals with a brief description of the context, definitions, and justification for the change.

The eight Proposed Methodology Enhancements and five Data Source Updates are listed below in the same order that they appear in the introduction to the Final Report, with corresponding page numbers included in the footnotes of this Resolution.

### **Proposed Methodology Enhancements to the Avoided Cost Calculator**

- 1. Replace CAISO system load-based allocation of capacity value with unserved energy probabilities based on E3 RECAP model.<sup>5</sup>**

D.16-06-007, OP 4 adopted the RECAP model as the method for hourly time-allocation of avoided generation capacity costs to be used across all Commission proceedings. RECAP is an hourly expected generation availability tool that incorporates decades of historical load and generation data combined with expected new generation. RECAP is then layered against historical weather data

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<sup>5</sup> For additional explanation see p. 24-25 in the Final Report.

to produce a matrix of hour-by-hour, system wide probability values labeled here as expected unserved energy (EUE). Where previously RECAP simply accounted for the probability of a loss of load, the addition of EUE values to RECAP provide insight into the severity and consequences of a loss of load. This results in a more robust means of calculating capacity value. Higher EUE probabilities equate directly to higher capacity needs, which match up in direct proportion to the capacity value of the system. The RECAP model and resulting EUE probabilities for 2020 and beyond show that as renewable penetrations increase (e.g., solar photovoltaic generation), capacity value needs shift from afternoons to evenings (after sunset) and to more weekends during the late summer.

- 2. Replace 2010 MRTU hourly energy price shapes with 2015 data and update the hourly price shapes to reflect changes in market prices expected to occur due to increased renewable generation as California continues to move toward the 50% RPS goal.<sup>6</sup>**

The Market Redesign and Technology Upgrade (MRTU) is definitional shorthand used to describe a suite of certain short-term grid needs and markets managed by the CAISO. Specifically these markets include four types of ancillary services: regulation up, regulation down, spinning reserves, and non-spinning reserves. Distributed energy resources, namely behind-the-meter load reductions via energy efficiency and distributed generation exports, e.g., rooftop solar, are expected to accelerate in California in the foreseeable future. The need to procure regulation services, i.e., regulation up and down, is generally independent of load; however, spinning and non-spinning reserves are directly linked to load. As a result, load reductions will result in a reduction in the procurement of spinning and non-spinning reserves. The ACC will now capture this reduced reserve procurement need and use more current price shapes for its calculations. In addition, the hourly shaping of energy prices is updated using 2015 market data and the RPS Calculator.

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<sup>6</sup> Ibid at p. 25-26

**3. Replace use of private long-run gas forecasts (as no longer procured by the Commission) with a modified market price referent (MPR) methodology.<sup>7</sup>**

This ACC methodology update is made in order to more accurately incorporate recent gas delivery prices as well as expected long-term gas delivery price trends available in the public domain. The modified MPR methodology uses the most recent publicly available price and trend forecasts for Pacific Gas and Electric Company (PG&E) Citygate and the SoCal Border from the Integrated Energy Policy Report (IEPR) as well as expected price quotes from Henry Hub from the Energy Information Administration Annual Energy Outlook (EIA AEO).

**4. Move the resource balance year to 2015.<sup>8</sup>**

The resource balance year is the year that the Avoided Cost Model assumes new capacity is needed to maintain planning reserve margins to reliably meet load. This ACC update directly follows D.16-06-007, OP 7. It effectively sets the resource balance year to zero (0), meaning that the value of avoided generation capacity will always be based off of long-term avoided capacity costs. For comparison purposes, E3 also calculated a resource balance year using the IEPR 2015 mid-load forecast consistent with the methodology used in previous models.

**5. Include the carbon price and variable O&M in the dispatch logic for calculating the residual net cost of generation capacity.<sup>9</sup>**

Within the portion of the ACC that determines the long-run value of capacity, the avoided cost model performs an hourly dispatch of a new CT to determine energy market net revenues. The CT's net margin is based on net revenue maximization logic by assuming that a given CT unit dispatches at full capacity in each hour that the real-time price exceeds operating cost (the sum of fuel costs, variable O&M, and carbon costs). E3 notes that this methodology update was

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<sup>7</sup> Ibid at p. 5-8

<sup>8</sup> Ibid at p. 17-18

<sup>9</sup> Ibid at p. 19-20

made in order to account for specific CT CO<sub>2</sub> emissions and variable O&M costs that are recovered through the energy market.

**6. Update the T&D allocation factors to better reflect actual peak demand patterns on distribution facilities.<sup>10</sup>**

As noted in the Final Report, “T&D costs are unique in that both the value and hourly allocation are location specific.”<sup>11</sup> The ACC avoided T&D costs methodology is updated to include more granular temporal and geo-spatial distribution facility data, paired against corresponding temperature records and matching area-wide expected retail solar PV generation growth. When tested against actual recent distribution level load trends, the resulting regression model proved to simulate distribution loads with about 90% accuracy.

**7. Forecast annual energy prices that include CO<sub>2</sub> costs (consistent with the Cap and Trade market), and decompose those prices into energy and environment components.<sup>12</sup>**

The cost of CO<sub>2</sub> has been updated to use the 2015 IEPR Mid-Case forecast values, including the Mid-Case price forecast extending to 2030. As noted in the Final Report, “In the prior avoided cost model [ACC] the avoided cost of energy was forecast without the cost of CO<sub>2</sub>. The CO<sub>2</sub> costs were therefore an additional cost item and added to the total avoided cost forecast. In this update, the cost of CO<sub>2</sub> is included in the cost of energy because of the established Cap and Trade market [that encapsulates and reveals the avoided CO<sub>2</sub> market costs)].”<sup>13</sup>

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<sup>10</sup> Ibid at p. 26-33

<sup>11</sup> Ibid at p. 26

<sup>12</sup> Ibid at p. 33-36

<sup>13</sup> Ibid at p. 34

- 8. Include adjustments to the hourly energy price profile using the CPUC Renewable Portfolio Standard (RPS) Calculator to account for projected increases in renewable generation.<sup>14</sup>**

The RPS Calculator implied heat rate changes by month/hour are incorporated into the price shape for years 2016 through 2020, and adjustments after 2020 are held at the 2020 levels.

### **Proposed Data Source Updates**

The Final Report recommends five data source updates in order to more accurately reflect market conditions, trends and prices.

- 1. Update the cost and operating characteristics of a simple cycle gas turbine (CT) and a combined cycle gas turbine (CCGT) unit with the latest available data from the CEC Estimated Cost of New Renewable and Fossil Generation in California report.<sup>15</sup>**

This update will bring the ACC up-to-date with the current costs and operating characteristics of CT and CCGT units in California. The avoided costs of these units are critical elements in demand-side cost-effectiveness analysis.

- 2. Update the ancillary service value to reflect the latest data available from 2015 markets.<sup>16</sup>**

The IDER Cost-Effectiveness Working Group Report highlights the need for ancillary service values to be updated on a frequent basis. The three Investor Owned Utilities (IOUs) typically perform these updates annually.<sup>17</sup>

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<sup>14</sup> Ibid at p. 90-92

<sup>15</sup> URL: <http://www.energy.ca.gov/2014publications/CEC-200-2014-003/CEC-200-2014-003-SF.pdf>.

<sup>16</sup> At pp. 9. URL: <http://caiso.com/Documents/2015AnnualReportonMarketIssuesandPerformance.pdf>.

<sup>17</sup> IDER CEWG Status Report, February 2, 2016, p. B-1.



**3. Update T&D capacity costs from the most recent respective utility General Rate Case (GRC) filings.<sup>18</sup>**

The 2016 Demand Response Cost-Effectiveness Protocols, last updated in Resolution E-4788, utilize T&D capacity costs from the most recent utility GRC filings. This update is required to provide consistency across all demand-side cost-effectiveness analyses.

**4. Replace Synapse forecast of CO<sub>2</sub> price forecast using the latest available data with 2015 IEPR mid-case forecast values.<sup>19</sup>**

This update is necessary in order to maintain consistency with the CEC's statewide demand forecast.

**5. Update the marginal RPS cost (used to calculate the RPS premium) using the latest available data with values from the latest RPS Calculator spreadsheet model (version 6.2).**

A suggestion was made in the CEWG Status Report that a data source be incorporated that both updated costs and the declining renewable energy and capacity values that impact the premium associated with marginal development of renewables.<sup>20</sup> The RPS Calculator is one such data source.

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<sup>18</sup> PG&E 2014 General Rate Case, pp. A2-A3. URL: <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M099/K767/99767963.PDF>.

SCE 2015 General Rate Case, pp. 6. URL: <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M155/K034/155034804.PDF>.

SDG&E 2015 General Rate Case, Attachment A. URL: [https://www.sdge.com/sites/default/files/regulatory/Saxe%20Clean%20w\\_Attachments.pdf](https://www.sdge.com/sites/default/files/regulatory/Saxe%20Clean%20w_Attachments.pdf).

<sup>19</sup> URL: [http://www.energy.ca.gov/2015\\_energypolicy/](http://www.energy.ca.gov/2015_energypolicy/).

<sup>20</sup> IDER CEWG Status Report, February 2, 2016, p. B-1.

## **Proposed Ancillary Changes**

### **1. Updated naming convention**

In accordance with D.16-06-007<sup>21</sup>, future updates to the ACC modeling software package shall be referenced using a specific naming convention, which shall include the calendar year of the update and version number. The version number shall reset to “1” in each new calendar year. For instance, the ACC software package with the proposed changes for adoption by this resolution has been named, “ACC\_2016\_v1.” This naming convention will simplify version control of ACC updates.

### **2. Calculator user manual**

The ACC is a complex, Excel-based spreadsheet model for use in demand-side cost-effectiveness proceedings at the Commission. As part of the Commission’s mission to approach utility and energy policy decision-making in an open and transparent manner and to utilize broad and diverse stakeholder input, Energy Division tasked E3 with developing a user manual to accompany the ACC to allow stakeholders to easily and fully understand how to interact with the model, including making input changes and accessing and interpreting results. The User Guide is included in E3’s Final Report (Appendix A), starting on page 81.

In its comments on the Draft Resolution, PG&E recommends that an additional Proposed Ancillary Change be added to the Draft Resolution for updating the discount rate. The Final Report of the IDER Cost-Effectiveness Working Group includes in Recommendation 1 that all cost-effectiveness analysis should use the latest approved after-tax Weighted Average Cost of Capital (WACC) for each utility and further notes that individual resource proceedings cannot change the discount rate in their cost-effectiveness analysis for some or all programs, as has happened in the past.

We agree with PG&E’s recommendation to include “Updating the discount rate,” as an additional Proposed Ancillary Change. This will clarify the discount

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<sup>21</sup> D.16-06-007, OP 1.

rate methodology by using each utility's respective WACC for all IDER programs cost-effectiveness analysis. This adds transparency for the benefit of utilities and DER program and market participants.

### **3. Updating the discount rate**

Affirming the list of ACC inputs adopted in OP 3 of D.16-06-007<sup>22</sup>, all cost-effectiveness analysis shall use the latest approved after-tax Weighted Average Cost of Capital (WACC) for each utility as the discount rate.

### **SAFETY CONSIDERATIONS**

Based on the information before us the Resolution does not appear to result in any adverse safety impacts.

### **COMMENTS**

Public Utilities Code section 311(g)(1) provides that this resolution must be served on all parties and subject to at least 30 days public review and comment prior to a vote of the Commission. Section 311(g)(2) provides that this 30-day period may be reduced or waived upon the stipulation of all parties in the proceeding.

The 30-day comment period for the draft of this resolution was neither waived nor reduced. Accordingly, this draft resolution was mailed to parties for comments, and will be placed on the Commission's agenda no earlier than 30 days from today.

Pacific Gas and Electric Company submitted comments on September 19, 2016.

### **FINDINGS**

1. The updates to the Avoided Cost Calculator as described by E3 in its Final Report are reasonable for use in DER cost-effectiveness. It is

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<sup>22</sup> D.16-06-007, OP 3.

reasonable that the addition of Expected Unserved Energy values to RECAP provide insight into the severity and consequences of a loss of load.

2. It is reasonable to replace 2010 MRTU hourly energy price shapes with 2015 data and update the hourly price shapes to reflect changes in market prices expected to occur due to increased renewable generation.
3. It is reasonable that the Avoided Cost Calculator more accurately reflect recent gas delivery prices as well as expected long-term gas delivery price trends available in the public domain.
4. It is reasonable that the Avoided Cost Calculator update directly follows D.16-06-007, OP 7 by effectively setting the resource balance year to zero (0).
5. It is reasonable to include the carbon price and variable operations and maintenance in the dispatch logic for calculating the residual net cost of generation capacity.
6. It is reasonable to update the transmission and distribution allocation factors to better reflect actual peak demand patterns on distribution facilities.
7. It is reasonable to forecast annual energy prices that include carbon dioxide costs to make them consistent with the Cap and Trade market, and decompose those prices into energy and environment components.
8. It is reasonable to include adjustments to the hourly energy price profile using the Commission's Renewable Portfolio Standard Calculator to account for projected increases in renewable generation.
9. It is reasonable to update the cost and operating characteristics of a simple cycle gas turbine and a combined cycle gas turbine unit with the latest available data from the California Energy Commission Estimated Cost of New Renewable and Fossil Generation in California report.
10. It is reasonable to update the ancillary service value to reflect the latest data available from 2015 markets.
11. It is reasonable to update transmission and distribution capacity costs from the most recent respective utility General Rate Case filings.
12. It is reasonable to replace the Synapse carbon dioxide price forecast using the latest available data with 2015 Integrated Energy Policy Report mid-case forecast values.

13. It is reasonable to update the marginal Renewable Portfolio Standard cost using the latest available data with values from the latest Renewable Portfolio Standard Calculator spreadsheet model (version 6.2).
14. The updated naming convention for the Avoided Cost Calculator is reasonable.
15. It is reasonable that all cost-effectiveness analysis should use the latest approved after-tax Weighted Average Cost of Capital (WACC) for each utility as the discount rate.

**THEREFORE IT IS ORDERED THAT:**

1. The updates to the Avoided Cost Calculator found reasonable in this resolution are adopted for use in demand-side distributed energy resource cost-effectiveness analyses.

This Resolution is effective today.

I certify that the foregoing resolution was duly introduced, passed and adopted at a conference of the Public Utilities Commission of the State of California held on September 29, 2016, the following Commissioners voting favorably thereon:

/s/TIMOTHY J. SULLIVAN  
TIMOTHY J. SULLIVAN  
Executive Director

MICHAEL PICKER  
President  
MICHEL PETER FLORIO  
CATHERINE J.K.SANDOVAL  
LIANE M. RANDOLPH  
Commissioners

Commissioner Carla J. Peterman, being necessarily absent, did not participate.

## **Appendix A**

### **E3 Final Report: Avoided Costs 2016 Interim Update**

Available online:

Public copies of the 2016 Avoided Cost Calculator, the 2016 Avoided Cost Calculator User Manual, and the Avoided Costs 2016 Interim Update (“E3 Final Report”) are all available for download on this site:

<http://www.cpuc.ca.gov/General.aspx?id=10710>

The documents are located under “Recent News and Quick Links” towards the bottom of the site.