

PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

ENERGY DIVISION

**RESOLUTION E-5014
August 1, 2019**

R E S O L U T I O N

Resolution E-5014. 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 and minor modeling adjustments 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 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 and D.19-05-019 issued on May 16, 2019.

SUMMARY

In accordance with D.16-06-007 Ordering Paragraph (OP) 2, this Staff Proposed Resolution adopts the annual update of the Avoided Cost Calculator (ACC) for use in demand-side cost-effectiveness analysis of distributed energy resources (DERs). This annual update, as per D.16-06-007, is scheduled for May 1 of each

year. However, with the permission of the Executive Director¹, the deadline was extended to July 1, 2019.

BACKGROUND

The Avoided Cost Calculator, first adopted in D.05-04-024², was originally used to measure Energy Efficiency (EE) cost-effectiveness. The assumptions, data, and models used in the Avoided Cost Calculator require periodic updates to stay current with market conditions, prices, and trends. Thus, semi-regular improvements to the Avoided Cost Calculator modeling software and data input updates were adopted in several Energy Efficiency proceedings by D.06-06-063, D.09-09-047, and D.12-05-015. D.10-12-024 modified and adopted the Avoided Cost Calculator for use by demand response programs, and also adopted Demand Response Cost-effectiveness Protocols, which detailed those Avoided Cost Calculator modifications. The Demand Response Cost-effectiveness Protocols were subsequently updated in D.15-11-042, including updates to the Avoided Cost Calculator. D.09-08-026 modified and adopted the Avoided Cost Calculator for use by customer generation (then called distributed generation) programs.

In 2014, the IDER proceeding³ opened with the goal of developing policy to facilitate the use of DERs. Among its goals was to establish a unified cost-effectiveness framework that would apply to all DER programs, technologies and proceedings. The IDER proceeding established a four-phase plan to accomplish this, the first phase of which was to establish one Avoided Cost Calculator for use in all DER-related proceedings, which would be regularly updated.

D.16-06-007, OP 2 states:

The Commission's Energy Division, no later than May 1st each year, shall draft a Resolution recommending data updates and minor corrections to the avoided

¹ Letter from Alice Stebbins, CPUC Executive Director, to Energy Division Director Edward Randolph, dated April 12, 2019 and sent by email to the service list of R.14-10-003 on April 15, 2019 extended the deadline to July 1, 2019.

² 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.

³ R.14-10-003

costs calculator and, when appropriate the inputs, as described in this decision. Energy Division may issue a draft Resolution updating the Avoided Cost Calculator for 2016 after this Decision is adopted.

D.17-08-022 modified Ordering Paragraph 2 of Decision 16-06-007 allowing for a one-year waiver of the Commission's Energy Division's requirement to update the Avoided Cost Calculator. Hence, D.16-06-007, OP 2 was modified to:

The Commission's Energy Division, no later than May 1st each year beginning in 2018, shall draft a resolution recommending data updates and minor corrections to the avoided cost calculator, and when appropriate, the inputs as described in this decision. Energy Division may issue a draft resolution updating the Avoided Cost Calculator for 2016 after this decision is adopted.

On May 16, 2019, the Commission adopted D.19-05-019, which authorized processes for making both major and minor changes to the Avoided Cost Calculator. Minor changes can be included in the Resolution drafted by Energy Division that also proposes the corrections and data updates authorized by D.16-06-007. D.19-05-019 adopts PG&E's recommendation that minor changes be defined as "changes to modeling methodology that most parties can reasonably agree are minor in scope and impact and would represent an improvement to the status quo." The Decision also modifies the schedule set out in D.16-06-007, by authorizing the Resolution to be released for public comment no later than May 1st of every odd-numbered year,⁴ and instructs Energy Division staff to hold an annual workshop to discuss all proposed changes to the Avoided Cost Calculator, as well as adopting a process for making major changes (in addition to minor changes and updates) during even-numbered years.

Staff's consultant, Energy and Environmental Economics, Inc. (E3) performed the update of the Avoided Cost Calculator under direction from Commission staff. E3 has issued a draft Avoided Cost Calculator spreadsheet and documentation that details the proposed set of changes to the Avoided Cost Calculator. Commission staff has posted these files to the CPUC's Public Documents Area website, as described in Appendix A.

In accordance with OP 2 of D.16-06-007 and OP 11 of D.19-05-019 this Resolution adopts the changes to the Avoided Cost Calculator as set forth in Appendix A.

⁴ D.19-05-019, p. 8.

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

DISCUSSION

We have reviewed the Avoided Cost Calculator updates made by staff's consultant E3 and find that the proposed Avoided Cost Calculator updates are within the scope ordered by D.16-06-007 and D.19-05-019. The Avoided Cost Calculator updates are found to be necessary to more accurately reflect market conditions, trends and prices. We have determined that it is reasonable to adopt these changes.

The proposed updates to the Avoided Cost Calculator include eleven data updates, four corrections and one minor change. The details of these updates are listed below.

Background on "Minor Change" to the Avoided Cost Calculator

This Resolution makes one "minor change" to the Avoided Cost Calculator, by adjusting the heat rate threshold used to estimate hourly marginal greenhouse gas (GHG) emissions. The hourly marginal GHG emissions are determined by first estimating the marginal "heat rate". Heat rate is defined as the amount of natural gas (in BTU/kWh units) required to produce a kWh of electricity. The marginal heat rate is then multiplied by a standard conversion factor of 0.0585 tons/MMBTU⁵ to estimate the tons of GHG emissions per kWh in each hour. Electricity and natural gas prices are used to calculate an "implied marginal heat rate" in each hour.

In the past, the Avoided Cost Calculator assumed that the marginal unit of generation was always a natural gas turbine, and that the marginal heat rate was bounded by a low-efficiency and high-efficiency heat rate threshold (corresponding to the actual heat rates of the least-efficient and most-efficient natural gas turbine). If the implied marginal heat rate in a particular hour was found to be less than the high-efficiency threshold, the marginal heat rate for the purpose of estimating marginal emissions was adjusted upward to the high-efficiency threshold level. For example, if the implied marginal heat rate was 5,000 BTU/kWh, which is lower than the high-efficiency threshold of 6,900

⁵ 0.0585 tons/MMBTU = 0.000000585 tons/BTU. Derived from the value 117 lbs/MMBTU defined by the U.S. Energy Information Agency at <https://www.eia.gov/tools/faqs/faq.php?id=73&t=11>. The avoided cost calculator presents this value in tons/MMBTU, but the heat rates noted below are in BTU/kWh.

BTU/kWh, the heat rate used to determine GHG emissions was adjusted to 6,900 BTU/kWh to reflect the fact that no marginal unit of generation based on a natural gas turbine could actually be more efficient than 6,900 BTU/kWh, and that therefore an implied marginal heat rate of 5,000 BTU/kWh must reflect an estimation error. However, the increased penetration of renewables means that there are other possible interpretations of a low implied marginal heat rate. It is possible that both a natural gas turbine and a renewable unit could be on the margin during part of an hour, or in different parts of the state.

Therefore, the updates include elimination of the high-efficiency threshold when the implied marginal heat rate is lower than 6,900 BTU/kWh. However, the Avoided Cost Calculator retains the practice of assigning a marginal heat rate of zero when the estimated implied marginal heat rate is less than zero, as well as retaining a maximum marginal heat rate threshold, determined by the lowest efficiency natural gas turbine.

The maximum marginal heat rate threshold will remain at 12,500 BTU/kWh, so that even when the implied marginal heat rate is estimated to be higher, the maximum marginal heat rate of 12,500 BTU/kWh will be used to determine the GHG emissions on the margin. This change is considered minor as it does not alter the list of included inputs, avoided costs, or methodology. All parties agreed during a workshop held on April 29, 2019 at the CPUC that this change was minor and that it more accurately reflects marginal GHG emission levels. Parties at the workshop also agreed to allow staff's consultant E3 to do some research and then provide a recommendation as to whether the low-efficiency threshold (i.e., maximum heat rate) should remain at 12,500 BTU/kWh. Research conducted by staff's consultant E3, detailed in the Avoided Cost Calculator documentation, does indicate that this threshold value is reasonable and should be retained.

Following the version-control nomenclature ordered in D. 19-05-019, this new Avoided Cost Calculator is ACC_2019_v1b, which will replace the previous version, ACC_2018_v1h.

The next section of this Resolution addresses each of these proposed changes with a brief description. Details of each change can be found in the Avoided Cost Calculator documentation linked in Appendix A.

Data Updates in ACC_2019_v1b

1. Update natural gas prices, using the following data sources:
 - NYMEX natural gas futures prices from the most recent 22 trading days.
 - Long-term natural gas forecast using revised 2019 IEPR Mid-Demand case, and the U.S Energy Information Administration's 2019 Annual Energy Outlook Report.
 - SoCal, PG&E backbone system (PG&E BB) and PG&E local transmission system (PG&E LT) natural gas transportation rates from 2019 tariff sheets (effective April 1, 2019).
 - Municipal surcharge rate for SoCal Gas.
2. Update electricity forward prices using on-peak and off-peak forwards for NP-15 and SP-15 using most recent 22 trading days.
3. Update ancillary service costs to 0.9% for annual energy from CAISO 2018 Annual Report on Market Issues and Performance, excluding regulation services.⁶
4. Update Hourly Market Price Shapes, using the following data sources:
 - Day ahead and real time prices for 2018 for NP-15 and SP-15.
 - Daily 2018 natural gas spot prices from PG&E Citygate and SoCal Border Hubs (used to derive implied heat rates).
 - Average 2018 CO₂ trading price from March 2019 IEPR.⁷
5. Update CO₂ market price forecast from Revised 2019 IEPR Mid-Demand forecast.
6. GHG adder values from D.18-02-018 adjusted to nominal dollars then reduced by the CO₂ market price forecast from the 2019 IEPR.⁸
7. Update transmission and distribution (T&D) marginal costs (\$/kW-yr values) from the following sources:

⁶ CAISO 2018 Annual Report on Market Issues and Performance, p.141-142

⁷ 2019 IEPR Preliminary Carbon Allowance Price Scenarios

⁸ Reduced by the IEPR CO₂ market price forecast to avoid double counting the cap and trade allowance costs. Natural gas avoided costs continue to use the interim GHG adder from 2017.

- PG&E: Settlement agreement in the utility's 2017 Phase II General Rate Case (GRC) proceeding.
 - SCE: Estimates by SCE's regression analysis of cumulative distribution capacity-related investments and cumulative peak loads, consistent with avoided distribution capacity costs that have been used for SCE in prior avoided cost updates.
 - SDG&E: Testimony filed by the utility in its 2016 GRC. Testimony was used rather than a Decision because the 2016 Decision did not specifically address T&D marginal costs.
8. Update T&D hourly allocation factors based on 2018 recorded weather by climate zone, and 2018 weekend and holiday schedules.⁹
 9. Update generation capacity hourly allocation factors using 2018 recorded weather.
 10. Financing costs for new generation updated to reflect the CEC's 2019 *Estimated Cost of New Utility-Scale Generation in California: 2018 Update Report*.¹⁰
 11. Update natural gas avoided costs and market prices for electricity avoided costs using the following sources:
 - California electric generation gas price forecast from the updated "MPR Gas Forecast 2019".
 - Gas transportation rates sourced directly from current utility tariffs.
 - Inflation rate and nominal discount rate to reflect values used in the electricity ACC model.

Corrections in ACC_2019_v1b

1. Inconsistent calculation references to Northern California vs. Southern California price and temperature adjustments and heat rate multipliers were resolved on the "Market Dynamics" tab.

⁹ The regression equations used to estimate these allocation factors were also corrected to include an improved forecast of distributed PV by climate zone. See Avoided Cost 2019 Documentation, Section 4.5.1 for more information.

¹⁰ New natural gas generation costs and performance remain based on the 2017 IRP assumptions, which reflects no change from the 2018 avoided cost calculator.

2. The model was updated to account for hours with negative energy prices but positive GHG emissions (this was a calculation error that will no longer occur).
3. The regression equations used to estimate T&D allocation factors were corrected to include an improved forecast of distributed PV by climate zone. (See Section 4.5.1 of the Avoided Cost Calculator documentation linked in Appendix A for additional detail.)
4. The spreadsheet format was corrected as follows:
 - Added “EE Outputs” tab, with a flow chart describing how to pull hourly annual avoided costs and format them for the Energy Efficiency Cost Effectiveness Tool.
 - Correct years for demand response outputs, consistent with the inputs required for the Demand Response Reporting Tool, in the “DR Outputs” tab.
 - Demand response outputs for five years, rather than three years, in the “DR Outputs” tab, consistent with current DR reporting requirements.
 - Irrelevant information, such as the PLS tab, has been deleted.

Minor Changes in ACC_2019_v1b

1. Adjust heat rate threshold used to estimate hourly marginal GHG emissions by eliminating the high-efficiency threshold when the implied marginal heat rate is positive but less than 6,900 BTU/kWh, to reflect the increased penetration of renewables. Continue to assign a heat rate of zero when the estimated heat rate is less than zero, as well as retain a maximum heat rate threshold. (See Section 4.6.1 of the Avoided Cost Calculator documentation linked in Appendix A for additional detail.)

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. Draft Resolution E-5014 was issued on June 28, 2019.

Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and Solar Energy Industries Association (SEIA) filed comments on Draft Resolution E-5014 on July 18, 2019.

PG&E recommended three modifications to Draft Resolution E-5014:

- Allow negative hourly energy values,
- Use longer-term weather forecasting techniques for the allocation of transmission and distribution avoided costs, and
- Post “2019 Electricity market Forwards” spreadsheet to the CPUC website.

We reject PG&E’s proposal to allow negative hourly energy values. PG&E mischaracterizes the 2018 calculator, by stating that it allowed negative energy prices. These negative number were a result of an error in the calculator. The correction was discussed and agreed to by all parties in the April 29, 2019 workshop.

We acknowledge PG&E’s recommendation to include longer-term weather forecasting techniques for the allocation of transmission and distribution avoided costs. While we decline to implement this proposed change through resolution, we recommend that the issue be taken up in the scheduled August 30, 2019 workshop, at which time possible major changes to the Avoided Cost Calculator will be discussed.

We accept PG&E’s proposal to post “2019 Electricity Market Forwards” to the CPUC website and will do so immediately.

SCE recommended five modifications to Draft Resolution E-5014:

- Remove “extreme days” where natural gas prices exceed \$15 from the model,
- Make financing cost for new generation consistent with the IRP proceeding,
- Exclude the grid-related portion of distribution costs to forecast distribution avoided costs,
- Use the 2019 IEPR forecast for natural gas avoided costs rather than the MPR forecast, and

- Normalize capacity allocation factors and incorporate climate change projections.

SCE's proposal for removal of days with very high natural gas prices is already consistent with the 2019 Avoided Cost Calculator. The highest natural gas price included in the model is \$14.86, making the proposal to remove values over \$15 unnecessary.

Financing cost assumptions have been sourced from the CEC cost of new generation reports. In this update, the financing numbers were updated to use values from the CEC's latest 2019 report. While we do see merit in being more consistent with the IRP efforts, the 2019 IRP work has not even reached the public review stage. We therefore reject SCE's recommendation to change data sources for the financing costs at this time.

We reject SCE's proposals to exclude the grid-related portion of distribution capacity costs and use the 2019 IEPR forecast for natural gas avoided costs. We recommend that SCE discuss the issues at the August 2019 workshop for consideration in the 2020 avoided cost calculator update. Separating distribution capacity costs into peak and grid-related portions and switching from the MPR forecast to the IEPR forecast for natural gas avoided costs would represent major changes, and therefore should not be undertaken without stakeholder discussion.

We acknowledge the value of incorporating more advanced forecasting techniques for capacity allocation factors and T&D hourly allocation factors. PG&E addressed a similar topic in their comments, and we recommend this issue for discussion during the August 2019 workshop.

SEIA recommended one modification to Draft Resolution E-5014.

- Use mid-range values from General Rate Case party proposals for the marginal distribution capacity costs in instances where there are no clearly adopted marginal cost values.

This issue was discussed at the April 29, 2019 workshop. We agree that using utility testimony to determine the marginal transmission and distribution capacity costs in instances where there are not clearly adopted marginal cost values may fail to incorporate valid stakeholder input. However, parties were unable to reach a consensus on an alternate technique. Additionally, averaging values presented in stakeholder testimony lacks precision and is not necessarily more accurate than utility predictions. In addition, it is likely that an entirely new

method of calculating avoided transmission and distribution capacity costs will soon be adopted, based on the work currently underway in the Distributed Resource Planning proceeding (R.14-08-013), making this issue obsolete.

FINDINGS

1. D.16-06-007 OP 2, directs Commission staff to annually update the Avoided Cost Calculator by May 1.
2. D.19-05-019 OP 11 directs Commission staff to make corrections, data updates, and minor changes.
3. By letter dated April 12, 2019, the CPUC Executive Director extended the deadline for the 2019 update to July 1, 2019.
4. The updates to the Avoided Cost Calculator as described by staff's consultant E3 in its Avoided Cost Calculator spreadsheet and documentation are reasonable for use in DER cost-effectiveness. It is reasonable to adopt this 2019 Avoided Cost Calculator, specifically referred to as ACC_2019_v1b.
5. It is reasonable for ACC_2019_v1b to use updated natural gas prices using the data sources listed above.
6. It is reasonable for ACC_2019_v1b to use updated electricity forward prices using on-peak and off-peak forwards for NP-15 and SP-15 using most recent 22 trading days.
7. It is reasonable for ACC_2019_v1b to update ancillary service costs to 0.9% based on the CAISO 2018 Annual Report on Market Issues and Performance.
8. It is reasonable for ACC_2019_v1b to use updated Hourly Market Price Shapes using the data sources listed above.
9. It is reasonable for ACC_2019_v1b to update the CO₂ market price forecast using the data source listed above.
10. It is reasonable for ACC_2019_v1b to update the GHG adder values using the data sources listed above.

11. It is reasonable for ACC_2019_v1b to update T&D hourly allocation factors and marginal cost, using the data sources listed above.
12. It is reasonable for ACC_2019_v1b to update generation capacity hourly allocation factors using 2018 recorded weather.
13. It is reasonable for ACC_2019_v1b to update financing costs for new generation using the sources listed above.
14. It is reasonable for ACC_2019_v1b to update natural gas avoided costs and market prices for electricity using the sources listed above.
15. It is reasonable that certain files be updated and made publicly available on the CPUC's website.
16. It is reasonable for ACC_2019_v1b to make all corrections described in this resolution.
17. It is reasonable to adjust the heat rates used to estimate hourly marginal GHG emissions by eliminating the high-efficiency threshold when the implied marginal heat rate is positive but less than 6,900 BTU/kWh.
18. It is reasonable to continue to assign a heat rate of zero when the estimated heat rate is less than zero, as well as retain a maximum heat rate threshold of 12,500 BTU/kWh, for the purpose of estimating GHG emissions.

THEREFORE IT IS ORDERED THAT:

1. The updates to the Avoided Cost Calculator as specified herein and further enumerated in documents made available through Appendix A 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 August 1, 2019; the following Commissioners voting favorably thereon:

/s/Alice Stebbins

ALICE STEBBINS
Executive Director

MICHAEL PICKER
President

LIANE M. RANDOLPH
MARTHA GUZMAN ACEVES
CLIFFORD RECHTSCHAFFEN
GENEVIEVE SHIROMA
Commissioners

Appendix A

Avoided Cost Calculator 2019 Update documents available online:

2019 Avoided Cost Calculator ACC_2019_v1b (available in both xlsb and xlsx formats), the Avoided Costs 2019 Documentation, and related files are all available for download on this site:

<http://www.cpuc.ca.gov/General.aspx?id=5267> (scroll down to Avoided Cost Calculator section)