

DRAFT

PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

ENERGY DIVISION

Agenda ID: 18386
RESOLUTION E-5077
June 11, 2020

R E S O L U T I O N

Resolution E-5077. 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.20-04-010 issued on April 16, 2020.

SUMMARY

D.20-04-010 authorized Energy Division to issue a resolution providing the final updated 2020 Avoided Cost Calculator (ACC), consistent with the policies adopted in the decision. The ACC is used in cost effectiveness analysis of distributed energy resource (DER) programs and policies. The Decision adopted major and minor changes to the ACC.

This Draft Resolution provides the final 2020 ACC and related documentation, consistent with policies adopted in D.20-04-010. This Draft Resolution describes the methodological updates to the 2020 ACC, including details of increased alignment with the IRP and DRP proceedings, major changes to the electric avoided cost calculator, major changes to the natural gas avoided cost calculator, and several minor changes.

BACKGROUND

The Avoided Cost Calculator (ACC), first adopted in D.05-04-024¹, was originally used to measure Energy Efficiency (EE) cost-effectiveness. The assumptions, data, and models used in the ACC require periodic updates 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 several Energy Efficiency proceedings by D.06-06-063, D.09-09-047, and D.12-05-015.

D.09-08-026 modified and adopted the ACC for use by customer generation (then called distributed generation) programs.

D.10-12-024 modified and adopted the ACC for use by demand response programs, and adopted Demand Response Cost-Effectiveness Protocols, which detailed those ACC modifications. The Demand Response Cost-Effectiveness Protocols were subsequently updated in D.15-11-042, including updates to the ACC.

In 2014, the IDER proceeding² opened with a focus on 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, and define a process to regularly update the ACC.

¹ 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.

² R.14-10-003

D.16-06-007 authorized annual updates to the ACC, consisting of minor changes, corrections and data updates, via Resolution drafted by Energy Division staff.

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 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.19-05-019 revised D.16-06-007, authorizing biennial processes for making both major and minor changes to the ACC. This decision modified the schedule set out in D.16-06-007, by authorizing Resolution adopting minor changes to the ACC to be released for public comment no later than May 1st of every odd-numbered year,³ as well as establishing a process for making major changes (in addition to minor changes and updates) during even-numbered years.

That process began with a workshop on August 30, 2019, to discuss proposals for both major and minor changes to the 2020 ACC. Parties filed testimony on October 7, 2019, which included proposals for major and minor changes to the Avoided Cost Calculator. On October 21, 2019, parties filed rebuttal testimony. The assigned Administrative Law Judge presided over an evidentiary hearing on November 18, 2019. On November 20, 2019, the Administrative Law Judge issued a ruling, inviting parties to file comments on the Energy Division Staff Proposal for 2020 Avoided Cost Calculator Update (Staff Proposal)⁴ along with opening briefs and reply comments with reply briefs.

On April 16, 2020, D.20-04-010 (the Decision) adopted a modified Staff Proposal, as summarized in Attachment A⁵ of the Decision. The Decision authorizes Energy Division to issue a draft resolution providing the final ACC within 30 days of the Decision issuance. The Decision approved major changes to both the electric and natural gas calculators to create greater alignment between the ACC, the Integrated Resource Planning (IRP) Rulemaking (R.) 16-02-007, and the Distributed Resource Planning R.14-08-013. Additionally, the Decision approved

³ [D.19-05-019](#), p. 8.

⁴ Energy Division Staff Proposal for 2020 Avoided Cost Calculator Update, Draft.
<http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M319/K898/319898332.PDF>

⁵ Energy Division Staff Proposal for 2020 Avoided Cost Calculator Update, Final.
<http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M334/K786/334786698.pdf>

the addition of a new avoided cost for high global warming potential (GWP) gases. The Decision also authorized the Director of Energy Division to host workshops or webinars to: (a) provide calculations for the Net Cost of New Entry for battery storage, (b) review the post-2030 greenhouse gas values, (c) educate parties and stakeholders on the greenhouse gas emissions avoided costs, (d) discuss the final values for the unspecified distribution avoided costs, (e) provide parties with the details of the method to derive avoided transmission costs, and (f) review details of the avoided cost of high global warming potential gases.

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

In accordance with OP 1 of the Decision this Resolution adopts the changes to the ACC. According to D.16-06-007, Conclusion of Law 2, all DER proceedings are required to use the ACC adopted in the IDER Rulemaking (R.) 14-10-003 when performing cost-effectiveness analysis of DER programs. Hence, any direction or guidance provided by the Decision in concert with this Resolution supersedes any contradictory provisions of previously discussed Decisions, Resolutions, or other documents adopted by the Commission, such as the Demand Response Cost-Effectiveness Protocols.

DISCUSSION

We have reviewed the Avoided Cost Calculator (ACC) updates made by staff's consultant E3 and find that the proposed ACC updates are within the scope ordered by D.16-06-007, D.19-05-019, and D.20-04-010. The ACC updates are found to be necessary to more accurately reflect Commission policies and priorities related to resource planning, as well as to better reflect market conditions, trends and prices. We have determined that it is reasonable to adopt these changes.

Greater Alignment with the IRP and DRP Proceeding

The 2020 ACC update brings greater alignment between the IDER and the IRP and DRP proceedings, as detailed in this section. Data from IRP was used to update energy, ancillary services, and greenhouse gas avoided costs. Data from DRP was used to update transmission and distribution avoided costs.

As a matter of policy, the Decision stated that the ACC will reflect the IRP proceeding's modeling inputs and outputs.⁶ The IRP proceeding uses RESOLVE capacity expansion and SERVUM production cost modeling to determine the least-cost resource portfolios for meeting electricity sector GHG emissions targets.

The ACC uses RESOLVE model inputs for financial assumptions, natural gas prices and energy storage technology costs. RESOLVE model results are used to estimate the GHG adder and forecast cap and trade values. The adopted values are used in SERVUM production cost modeling to estimate the hourly avoided energy and ancillary services costs and marginal GHG emissions used in the ACC.

Additionally, the "No New DER" scenario, developed in the RESOLVE model and based on the Reference System Portfolio adopted in the IRP proceeding, will be the basis for most of the avoided cost inputs. The "No New DER" scenario is a counterfactual load forecast that includes no new distributed energy resources installed after 2018. It represents what the forecasted load would be if no new distributed energy resources were to be installed.

The IRP Reference System Portfolio includes forecasts for energy efficiency, demand response, and behind-the-meter solar and energy storage. The portion of these DERs attributed to utility-sponsored programs is removed from the load forecast to create the No New DER scenario. Thus, in the No New DER scenario all energy efficiency, behind-the-meter solar and storage, and other demand-side resources would remain at the 2018 level and demand response resources are assumed to be zero.⁷ A table showing the exact amounts of DERs removed to create the No New DER scenario is included in the ACC documentation referenced in Appendix A.

The Decision also called for greater alignment with the Distributed Resources Planning (DRP) proceeding, R.14-08-013. In D.20-03-005, the DRP proceeding developed methods for modeling transmission and distribution avoided costs for consideration in the ACC.⁸ D.20-03-005 adopted a staff proposal entitled *Staff Proposal on Avoided Cost and Locational Granularity of Transmission and Distribution Deferral Values*. (Staff White Paper). The ACC will reflect the Staff White Paper's

⁶ [D.20-04-010](#), p. 2

⁷ Staff Proposal, p.9.

⁸ [D.20-03-005](#).

proposed framework for using unspecified distribution costs as the basis for the avoided cost of distribution. The ACC will also continue to use the current method of estimating the avoided cost of transmission, as recommended in the Staff White Paper. The current method uses marginal transmission values filed by the utilities in their general rates cases. However, currently only PG&E includes a marginal transmission value. Hence, the method used by PG&E to develop this value has been extended to SCE and SDG&E, and marginal transmission capacity costs for those two utilities have been derived based on utility-specific data.

Major Changes to the Electric Avoided Cost Calculator

Avoided Cost	Current Method	New Method	Data Source
Generation Capacity	Combustion Turbine Cost of New Entry	Battery Storage Cost of New Entry	RESOLVE input assumptions
Energy	Energy futures and gas turbine modeling	RESOLVE and SERVVM modeling	SERVVM outputs
Ancillary Services	percentage of energy	RESOLVE and SERVVM modeling	SERVVM outputs
GHG Value	Based on RESOLVE GHG shadow price and cap & trade	Based on RESOLVE GHG shadow price and cap & trade	RESOLVE outputs, cap & trade prices
GHG emissions	Implied market heat rate short-run marginal emissions	SERVVM short-run marginal emissions and RESOLVE long-run grid emissions intensity	RESOLVE and SERVVM outputs, cap & trade prices, annual electric sector GHG goals
Renewable Portfolio Standard	Incorporated into avoided GHG in 2019	NA	NA
Transmission	GRC marginal cost filings	From DRP guidance	GRC filings and historical utility cost and financial data
Distribution	GRC marginal cost filings	From DRP guidance	GNA data
High GWP gases	NA	Methane & refrigerant leakage modeling	CARB data

The table states the previous method (as reflected in the 2019 ACC), new method (as is included in the 2020 ACC), and data source for each avoided cost. The

Decision added the avoided cost of high GWP gases, and separated transmission and distribution avoided costs. Note that the table also includes, for historical reference, a previously used avoided cost, the avoided cost of meeting Renewable Portfolio Standard (RPS) goals, which was absorbed into the avoided GHG cost as of the 2019 ACC update.

This section addresses major changes to each of the avoided costs listed in the table. Additional technical details of each change can be found in the ACC documentation linked in Appendix A.

Generation Capacity Avoided Cost. Previously, the ACC estimated the avoided cost of generation capacity using a natural gas combustion turbine as a proxy. The annual capacity values were allocated to each hour of the year, for 30 years, using E3's RECAP model. The results of the RESOLVE model show that a battery storage resource better represents the marginal capacity unit. To create greater alignment with IRP, the generation capacity value will now use a new 4-hour battery storage resource as a proxy. The Avoided Cost Calculator uses RESOLVE model input assumptions for the fixed costs of a new 4-hour storage battery and calculates the annual levelized fixed cost of a battery over its expected useful life. The revenue that batteries earn from the energy and ancillary markets will be based on SERVVM production cost modeling, and subtracted from the leveled fixed costs to calculate a Net Cost of New Entry in \$/kW-yr.

Energy Avoided Cost. Previously, the avoided cost of energy was forecasted using energy futures and gas turbine modeling. The average energy cost in the short run was based on the last 22 trading day average on-peak and off-peak market prices forecasts for NP-15 and SP-15. For the long run, energy costs were forecasted using last available futures market price and long-run energy market price. The avoided cost of energy will now be determined by hourly values from the SERVVM model, based on the No New DER case. Because SERVVM models the dispatch of all generators, it produces more accurate values for future energy prices than the previous methodology.

Ancillary Services Avoided Cost. Previously, the avoided cost of ancillary services was forecasted as a percentage of wholesale energy costs. Estimates of hourly avoided ancillary services costs, will come from SERVVM production cost modeling. The SERVVM modeling uses data from the No New DER case to forecast ancillary service prices. Because the SERVVM model simulates the dispatch of electric resources, it is a more accurate indicator of actual ancillary services prices than the previous method.

Greenhouse Gas Avoided Cost. The avoided cost of GHG is an estimate of the cost ratepayers will incur to achieve the electric sector's share of California's GHG goals. This avoided cost estimates the total cost that will be incurred, including both cap and trade allowance prices and the additional electric sector supply costs for delivered renewable energy needed to meet the GHG goals.

Previously, greenhouse gas impacts were based only on hourly marginal emissions and calculated using an implied heat rate incorporating market price forecasts for electricity and natural gas. This approach does not reflect the GHG intensity of the electric grid, which must decline each year, as determined in the IRP proceeding, to reach the GHG goals.

When energy usage decreases due to DERs such as energy efficiency, or increases due to electrification programs, this has the short-run impact of changing a utility's cap and trade obligation. The short-run impact is calculated in the various resource cost-effectiveness tools by multiplying the hourly marginal electric grid emissions (in tonnes/kWh) by the change in load in kWh. However, in the long-run, changes in load will result in changes in a utility's planning and procurement of renewable energy, as the utility must rebalance their supply portfolio to achieve their GHG goals.

The 2020 ACC uses a combination of hourly marginal emissions and resource portfolio rebalancing to more accurately project hourly GHG emissions over time. Hourly marginal emissions will be estimated for each year from SERVM production simulation modeling. Portfolio rebalancing to achieve the annual target for average GHG intensity of the electric grid will be estimated for each year from RESOLVE modeling.

The GHG costs avoided by demand-side actions will be calculated in two steps, based on the annual energy sector GHG intensity target. In the first step, hourly marginal emissions up to the annual grid intensity target will be valued at the cap and trade allowance price. In the second step the supply portfolio rebalancing necessary to achieve annual grid intensity target will be valued at the energy sector GHG value.

The energy sector GHG avoided cost reflects the marginal cost of GHG abatement based on the additional supply costs needed to meet the GHG goals. The GHG avoided cost is based on GHG shadow prices modeled in RESOLVE

for the Reference System Portfolio. The GHG adder is the difference between the GHG avoided cost and the cap and trade allowance price forecast. The 2020 ACC includes separate categories for the cap and trade allowance price and the GHG adder, the sum of which equal the GHG avoided cost.

The GHG shadow prices are very low in early years and very high in later years. The GHG shadow price curve has been modified to a straight line to ensure steady deployment of distributed energy resources. This approach also reflects that making cost-effective GHG reductions in early years is preferable to making them in later years.

In developing the GHG adder used in the 2020 ACC, Staff considered the RESOLVE model's 2020-2030 GHG shadow price values, as well as post-2030 values, as per the Decision. Staff determined that the GHG adder proposed in the Staff Proposal represents the best estimation of the marginal GHG avoided cost. The ACC documentation provides more information on the various GHG adders that were considered.

Distribution Avoided Costs. Previously, the ACC used the marginal transmission and distribution capacity costs from utilities' General Rate Case Phase Two proceedings for the avoided cost of distribution and transmission, as a combined value. The Decision adopted a methodology which calculates transmission and distribution avoided costs separately, and includes only unspecified costs, following the specific guidance in the Staff White Paper, as per D.20-03-005. Unspecified distribution deferral avoided costs (transmission deferral avoided costs are discussed below) reflect the cost of distribution capacity projects that are likely to be needed in the future but are not specifically identified in current utility distribution planning. Unspecified distribution deferral avoided costs will be calculated using a system-average approach. The ACC will use a counterfactual forecast to determine the impact of distributed energy resources on load. The ACC will extrapolate the avoided cost estimates from the Distribution Deferral Opportunity Report and the Grid Needs Assessment, as filed in the DRP proceeding.⁹

Transmission Avoided Costs. As mentioned above, the ACC previously calculated transmission and distribution jointly using values from utility General Rate Case Phase 2 Proceedings. The Decision acknowledged that DERs avoid

⁹ [D.20-03-005](#), p.8.

transmission costs but stated that, as D.20-03-005 determined, the record of the DRP proceeding provided no specific method for determining unspecified transmission costs, other than recommending continued use of the existing method.¹⁰

Therefore, the Decision directed that the ACC continue to use marginal cost of transmissions values from the General Rate Case Phase 2 proceedings. As PG&E is the only utility to file transmission-level costs in their general rate case, transmission values for San Diego Gas & Electric and Southern California Edison will be modeled using PG&E's method and data specific to each utility. The ACC documentation provides the details of these calculations.

High Global Warming Potential Gases Avoided Costs

Previously, the ACC did not include avoided costs associated with high global warming potential (GWP) gases. The ACC will include a new avoided cost associated with leakage of refrigerants and methane, which are high GWP gases. Considering the avoided cost of high GWP gases is essential, due to the increased statewide focus on programs designed to replace natural gas appliances with electric appliances.

The new avoided cost includes three components, or "use cases." Two use cases will apply to methane reductions in the electric and gas sectors, respectively. The third use case will apply to refrigerant leakage emissions and will be used for programs that change the amount or type of appliances that use refrigerants.

The impacts of methane leakage will be estimated by increasing avoided GHG emissions for all DERs, using an upstream in-state methane leakage adder. This new avoided cost also includes an additional behind-the-meter adder, which will increase the avoided GHG emissions only for those programs which eliminate natural gas appliances from residential buildings. The upstream in-state methane leakage adder has been determined to be 5.57%, and the behind-the-meter adder is 3.78%, based on data from the California Air Resources Board (CARB). These adders take into account both the 100-year global warming potential of methane, which has 25 times the global warming impact of CO₂, and different molar mass of CO₂ and methane.

¹⁰ [D.20-04-010](#), p.58

All methane and refrigerant leakage data are inferred from CARB's databases, and the leakage rates and adders were reviewed by CARB staff.

Major Changes to the Natural Gas Avoided Cost Calculator

This resolution makes the following Major Changes to the natural gas ACC:

- 1) Simplify methodology for developing natural gas price forecast
- 2) Utilize same IRP-based GHG adder as the electric sector

Previously, natural gas prices were forecasted using NYMEX natural gas futures prices for the most recent 22 days, long-term natural gas forecast using the revised 2019 Integrated Energy Policy Report Mid-Demand case. The method for calculating natural gas price forecasts has been simplified. The ACC natural gas price forecasts will be developed using forward prices for five years, then transition to the California Energy Commission IEPR mid gas price forecast, which is currently used in the IRP proceeding over a three-year transition phase.

The Commission will utilize the same IRP-based GHG adder for the natural gas sector as for the electric sector. Additionally, the natural gas ACC will use the cap-and-trade value so that the total per ton value of GHG reductions is that same as that used for electricity. Previously, the Natural Gas Greenhouse Gas Adder relied on the Interim GHG adder from 2017.

Minor Changes to the Avoided Cost Calculators

The following minor changes will be made to the ACCs:

- 1) Expand the outputs used for demand response
- 2) Remove separate outputs related Permanent Load Shifting
- 3) Include historical year(s) in the ACCs
- 4) Correct minor errors in the 2019 Natural Gas ACC

Following the version-control nomenclature ordered in D. 19-05-019, this new Avoided Cost Calculator is ACC_2020_v1a, which will replace the previous version, ACC_2019_v1h.

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.

FINDINGS

1. D.20-04-010 directs Commission staff to update the Avoided Cost Calculator within 30 days of its issuance on April 16, 2020.
2. D.20-04-010 OP 7 directs Commission staff to make major changes to the Avoided Cost Calculator, as specified in that Decision.
3. D.19-05-019 OP 11 directs Commission staff to make corrections, data updates, and minor changes.
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 2020 Avoided Cost Calculator, specifically referred to as ACC_2020_v1a.
5. It is reasonable for ACC_2020_v1a to adjust the generation capacity value to reflect the Net Cost of New Entry of new battery storage.
6. It is reasonable for ACC_2020_v1a to adopt the No New DER Scenario as the counterfactual and use the resulting data to model hourly avoided costs.
7. It is reasonable for ACC_2020_v1a to estimate the hourly avoided energy and ancillary services costs using production cost modeling.
8. It is reasonable for ACC_2020_v1a to adopt the system-average approach for modeling unspecified distribution avoided costs.
9. It is reasonable for ACC_2020_v1a to adjust the current approach for calculating transmission avoided costs to include costs for SCE and SDG&E based on the PG&E's GRC method.
10. It is reasonable for ACC_2020_v1a to adjust the straight-line GHG adder to utilize post-2030 values.
11. It is reasonable for ACC_2020_v1a to adopt the short-and-long term greenhouse gas modeling approach described herein.
12. It is reasonable for ACC_2020_v1a to adopt the simplified methodology for developing natural gas price forecasts described herein.

13. It is reasonable for ACC_2020_v1a to utilize the IRP-based GHG adder used for the electric sector for the natural gas sector.
14. It is reasonable for ACC_2020_v1a to make all corrections described in this resolution.

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 of 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 June 11, 2020; the following Commissioners voting favorably thereon:

ALICE STEBBINS
Executive Director

Appendix A

Avoided Cost Calculator 2020 Update documents available online:

2020 Avoided Cost Calculator ACC_2020_v1a (available in both xlsb and xlsx formats), the 2020 Natural Gas Avoided Cost Calculator, the Avoided Cost Calculator 2020 Documentation, and related data files are all available for download on this site:

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

As a backup, these documents are also temporarily available here:

<https://www.ethree.com/cpuc-acc-downloads-page/>