



Sidney Dietz
Director
Regulatory Relations

Pacific Gas and Electric Company
77 Beale St., Mail Code B13U
P.O. Box 770000
San Francisco, CA 94177

Fax: 415-973-3582

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Energy Division
Attention: Tariff Unit
California Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102

Subject: Comments of Pacific Gas and Electric Company, San Diego Gas and Electric Company, and Southern California Edison Company on Draft Resolution E-5150 (Avoided Cost Calculator 2021)

Dear Energy Division Tariff Unit:

Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric Company (SDG&E), and Southern California Edison Company (SCE), collectively the Joint Utilities, appreciate the opportunity to comment on Draft Resolution E-5150 (the Draft Resolution) updating the Avoided Cost Calculator for 2021.

Joint Utilities' Comment:

I. Introduction

The Joint Utilities support the 2021 updates and changes to the Avoided Cost Calculator (ACC) proposed in Draft Resolution E-5150 (Draft Resolution). As noted in D.20-04-010, “[t]he [ACC] is updated annually to improve the accuracy of how benefits of distributed energy resources are calculated.” The updates proposed in the Draft Resolution are consistent with the minor update scope set forth in D.16-06-007 and D.19-05-019, appropriately refresh the ACC to reflect the most recent data developed in the Integrated Resources Planning (IRP) proceeding, and correctly reflect the most recent estimates of forecast avoided generation costs.¹

II. The 2021 Updates to the ACC are Procedurally Appropriate

The 2021 updates and changes to the ACC are procedurally “minor.” As described in the Draft Resolution, the final list of minor changes to the 2021 ACC focuses on incorporating new **data** from IRP modeling, fixing **minor errors** found in the 2020 ACC, and updating all the traditional sources of ACC **data**.² These are all identified as

¹ D.20-04-010 at p. 5.

² Draft Resolution at p. 3, emphasis added.

“minor” changes that are in scope for the biennial ACC Minor Update, which D.19-05-019 specifies should include “data and input updates as indicated in D.16-06-007 [and] changes to the [ACC] modeling method that most parties can reasonably agree are minor in scope and impact.” D.19-05-019 goes on to distinguish between “major” and “minor” updates and explains that:

“D.16-06-007 defines the term, “major changes,” as changes to the list of data inputs, addition or deletion of categories or types of avoided costs, or modifications of the methods or models used in the calculator; **all other changes are minor.**”³

This explanation and the scope of the 2021 updates and changes are also consistent with the 2019 Minor Update approved in Resolution E-5014. For example, the 2019 Minor Update refreshed inputs to the ACC based on recent Integrated Energy Policy Report (IEPR) forecasts, recent gas futures/electricity forwards, and recorded 2018 data⁴—these same elements are being updated by the current Draft Resolution using data vetted in the IRP proceeding, as discussed below. In addition, the 2019 Minor Update corrected errors in the GHG calculation when negative energy prices resulted in positive GHG emissions, among other spreadsheet corrections.⁵ Finally, consistent with the requirements set forth in D.19-05-019, these changes have been fully and transparently reviewed with parties through a December 9, 2020 workshop, a solicitation for proposals for other minor updates, and a March 11, 2021 notice to the appropriate service lists. Stakeholders have thus been aware of the scope and data sources for the minor update for over six months and have had an opportunity to comment on their reasonableness. The updates proposed in the Draft Resolution are procedurally appropriate, consistent with D.16-06-007 and D.19-05-016 definitions of “minor updates” and the 2019 Minor Update, and have been fully and transparently vetted with stakeholders.⁶

³ D.19-05-019 at Finding of Fact 49. D.19-05-019 also expanded the definition of minor changes to include “changes to modeling methods that most parties can reasonably agree are minor in scope and impact and would represent an improvement to the status quo.” See D.19-05-019 at OP 11.

⁴ Resolution E-5014 at pp. 5-7.

⁵ *Ibid.*, pp. 7-8.

⁶ See D.19-05-019 at p. 49, which requires to hold a workshop prior to the issuance of the draft ACC resolution to discuss the proposed changes and include party feedback in the resolution discussion.

III. The 2021 Updates to the ACC Appropriately Align the ACC with the Most Recently Available IRP Modeling

The 2021 updates and changes also ensure the most current information from the IRP is reflected in the ACC.⁷ D.20-04-010 adopted major changes to better align the ACC with the IRP proceeding (Rulemaking (R.)16-02-007, and its successor R.20-05-003)⁸ so there could be a common resource valuation method for both supply- and demand-side resources. Importantly, D.20-04-010 required energy supply prices, generation capacity costs, and grid emissions from the IRP models be used in the ACC.⁹ Indeed, as Energy Division Staff noted in its Proposal for 2020 Avoided Cost Calculator Update, which was ultimately approved in D.20-04-010,

“The Commission has clearly expressed its intent that all electricity resource procurement be guided by the IRP process. Following this direction Staff proposes that in line with that effort, we align the data, models, and methods used for IDER cost-effectiveness with the data, models, and methods used in the IRP.”¹⁰

Accordingly, the Commission adopted the use of the RESOLVE model outputs from the “No New Distributed Energy Resources (DER)” Scenario (a sensitivity analysis based on the updated Reference System Plan (RSP)) and Strategic Energy Risk Valuation Model (SERVM) production cost modeling of that portfolio as the basis for the generation-related avoided cost inputs to the ACC.¹¹

The 2021 updates and changes appropriately update the ACC to reflect the most recent data developed in the IRP. In D.21-02-008 issued in the IRP proceeding, the Commission approved an updated electricity resource portfolio, (Updated RSP) to transfer to California Independent System Operator (CAISO) for its biennial 2021-2022 Transmission Planning Process (TPP). This Updated RSP did not alter the adopted GHG target for LSE planning established in D.20-03-028, but it did incorporate “minor

⁷ See D.16-06-007 at p. 6, which explains that a prescriptive process to routinely update the data for the ACC on an annual basis is needed to “ensure that the most current information is in the calculator so that the calculator is ready when it is needed to be used for approval of resources.”

⁸ D.20-04-010, OP 2

⁹ The Joint IOUs note there was very little concern or opposition to aligning the ACC with the IRP’s modeling inputs and outputs. See D.20-04-010, pp. 25-26.

¹⁰ D.20-04-010 Appendix A at p. 4.

¹¹ D.20-04-010, OP 2. See also D.20-04-010 Appendix A (Final Energy Division Staff Proposal for 2020 Avoided Cost Calculator Update) page 5, which specifies that “[t]he IRP will provide values for developing GHG and system capacity avoided costs, and the resource portfolio that will be used to develop energy and ancillary service avoided costs.”

updates to include more updated information,”¹² such as an updated load forecast using the 2019 IEPR, an updated gas price forecast, and additional minor RESOLVE updates and corrections.¹³ The data and model improvements reflected in the Updated RSP were reviewed by stakeholders in the IRP proceeding at a December 9, 2020 workshop prior its formal approval in D.21-02-008 and are documented in the February 2021 Modeling Assumptions for the 2021-2022 Transmission Planning Process. It is therefore reasonable and appropriate to refresh the No New DER scenario using the Updated RSP approved in D.21-02-008 and to use the refreshed No New DER scenario in SERVM for purposes of updating the generation-related avoided costs in the 2021 ACC.

As a more general matter, the IRP proceeding is intended to be the “umbrella” proceeding for both supply- and demand-side resources and is thus the primary forum for development and refinement of the Commission’s resource planning models.¹⁴ The Commission chartered a staff-led Modeling Advisory Group in the IRP to collaboratively and iteratively update those models throughout the IRP cycle to ensure they are reasonable and reflect the most recently available market and policy data.¹⁵ Indeed, the Commission found in D.18-02-018 that “Commission staff **can and should continuously improve modeling and analysis techniques to represent the optimal electric resource portfolio** and appropriate GHG emissions targets for the electric sector.”¹⁶ Commission staff fulfilled that charge—as explained in the 2021 ACC Documentation:

“[O]ver the last year, the IRP proceeding performed analysis with updated inputs and assumptions, including updated resource cost and build inputs and results from the Final 2019 CEC IEPR issued after the 2019 RSP was finalized. The 2021 ACC uses the most recent available inputs and outputs from RESOLVE scenarios developed in 2019-2020 IRP Proceeding with these updates.”¹⁷

By linking the ACC with the IRP and requiring that “the ACC... reflect the [IRP] proceeding’s modeling inputs and outputs,” the Commission is leveraging the ongoing work performed and vetted in the IRP - including work that may have been finalized

¹² TPP final decision fact sheet, p. 2.

ftp://ftp.cpuc.ca.gov/energy/modeling/Fact%20Sheet_Decision%20Transferring%20IRP%20Portfolios_02112021.pdf

¹³ See page 2 of the Descriptions of the Proposed Portfolios for the 2021-2022 TPP, prepared by the CPUC Energy Division on October 23, 2020, and included as Attachment B to the October 20, 2020 Administrative Law Judge Ruling in R.20-05-003.

¹⁴ R.20-05-003, Order Instituting Rulemaking to Continue Electric Integrated Resource Planning and Related Procurement Processes, at pp. 5-6

¹⁵ See D.18-02-018 Attachment B, “Guide to Production Cost Modeling in the Integrated Resource Plan Proceeding.”

¹⁶ D.18-02-018 at Finding of Fact 3, **emphasis added**.

¹⁷ 2021 ACC Documentation at p. 11.

after the Updated RSP was approved by the CPUC - to ensure demand-side resources are evaluated using up-to-date information.¹⁸

Finally, the generation-related data inputs being updated in the 2021 ACC using updated IRP values are the same inputs that have always been updated annually. As shown in Attachment 2 of D.16-06-007—which lists the inputs that were deemed to be in scope for the annual data update—forecast energy, ancillary service, generation capacity, GHG, and natural gas prices have always been updated annually. Prior to 2020, these inputs were updated using market publications, reports, and/or historical data. The Commission's direction to use the IRP modeling inputs and outputs as the source for those updates guarantees the updates are developed and vetted through a Commission-led process and are consistent with supply-side planning criteria. It is reasonable and consistent with historical precedent and D.20-04-010 to update the generation-related avoided costs annually through this Minor Update process using the latest IRP modeling data.

IV. The 2021 Updates to the ACC are reasonable and correctly capture changes reflected in recent IRP modeling

With the policy shift towards alignment of the ACC with IRP, it is important that data inputs, assumptions, and methods flow logically between all of the IRP modeling tools and the final ACC. In other words, changes in the IRP to RESOLVE portfolio modeling inputs and assumptions naturally—and by definition—must flow into SERVM production cost modeling, and outputs of both of these IRP models must ultimately inform the forecast energy, GHG, ancillary services, and generation capacity costs in the ACC. Incorporating the most recently available and vetted information from the IRP into the 2021 ACC update results in ACC values that are reasonable, consistent with energy market and policy trends, and ultimately work together to achieve greater alignment of supply and demand side resource valuation.

As described above and in the 2021 ACC documentation and the Draft Resolution, the RESOLVE modeling incorporated in the 2021 ACC relied and improved upon the updated RSP.¹⁹ This updated information results in a lower overall portfolio cost relative to modeling performed in 2019 and reflected in the 2020 RSP and 2020 ACC. Table 1 below compares total resource costs for the portfolios modeled in 2019/2020 and the updated results from 2021.²⁰

¹⁸ D.20-04-010 at p. 2.

¹⁹ See 2021 ACC Documentation, p. 30. See also Draft Resolution, p. 4. See also RESOLVE summary of model changes, noticed to the IDER service list on 5/19/2021 and housed on E3's website here: <https://willdan.app.box.com/v/2021CPUCAvoidedCosts/folder/137688918075>

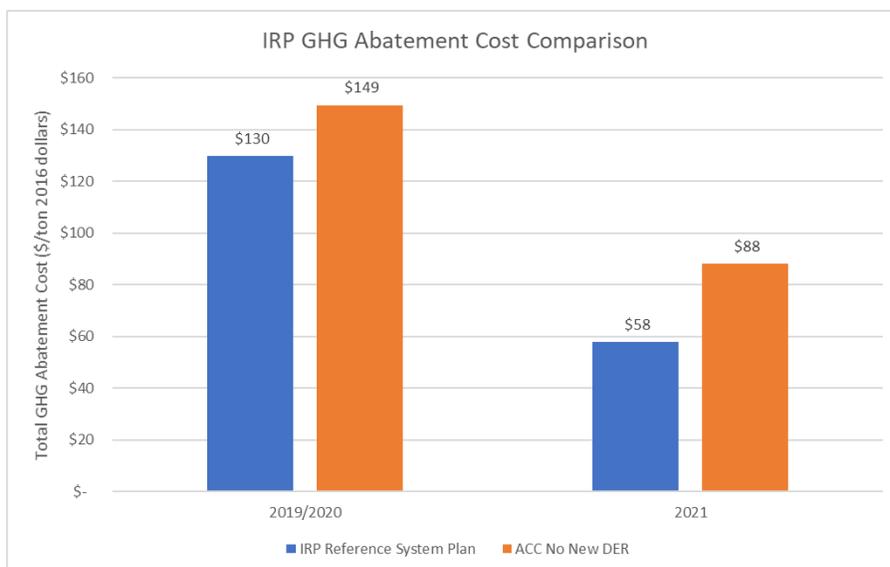
²⁰ See Draft Resolution, p. 4

Table 1: RESOLVE Total Resource Cost Comparison (\$Million in 2030)

RESOLVE Year	IRP Reference System Plan	ACC No New DER
2019/2020	\$ 45,680	\$ 45,086
2021	\$ 40,103	\$ 42,155

With updated and lower resource costs, it follows that the implied price of GHG emissions reduction would also decrease. The RESOLVE model calculates this implied price, also known as a "shadow price", and transparently produces this as an output for use in the ACC. Figure 1 below shows these GHG abatement costs from the 2019/2020 RSP, the Updated RSP, the 2020 No New DER for ACC and the 2021 No New DER for ACC.

Figure 1: RESOLVE Total GHG Abatement Costs



These results indicate a logical flow of input data to ACC output. As updates are made in the IRP with respect to load, costs, and modeling assumptions that result in a lower overall system cost, the implied value of GHG reduction should decline in the ACC. Were this not the case, and the ACC continued to utilize 2019 vintage data and modeling assumptions, the implied value of GHG reduction from DERs would be almost 3 times greater than the implied cost of GHG reduction from the Updated RSP. This illustrates the core purpose of closer alignment between the ACC and IRP: new information that informs the future outlook of California's grid should be incorporated in

all resource planning proceedings to ensure California is following the least-cost pathway to achieving its climate goals.²¹

Updates to RESOLVE inputs and assumptions, and resulting outputs, require corresponding updates to downstream reliability modeling in SERVM to calculate updated hourly energy and ancillary services prices, which then triggers updates to the implied market heat rates that rely on the SERVM outputs. The Draft Resolution states that as part of this process to reflect the refreshed No New DER scenario in SERVM, Commission staff also performed benchmarking analyses and enhanced the SERVM modeling, including updates to include the most recently available IEPR forecast and updates to dispatch assumptions to better match CAISO historical prices. The refinement of the scarcity adjustment algorithm reflected in the 2021 update was also made as a result of these benchmarking exercises.²² Specifically, the IRP staff incorporated changes in the SERVM modeling to more accurately reflect historical market price shapes.

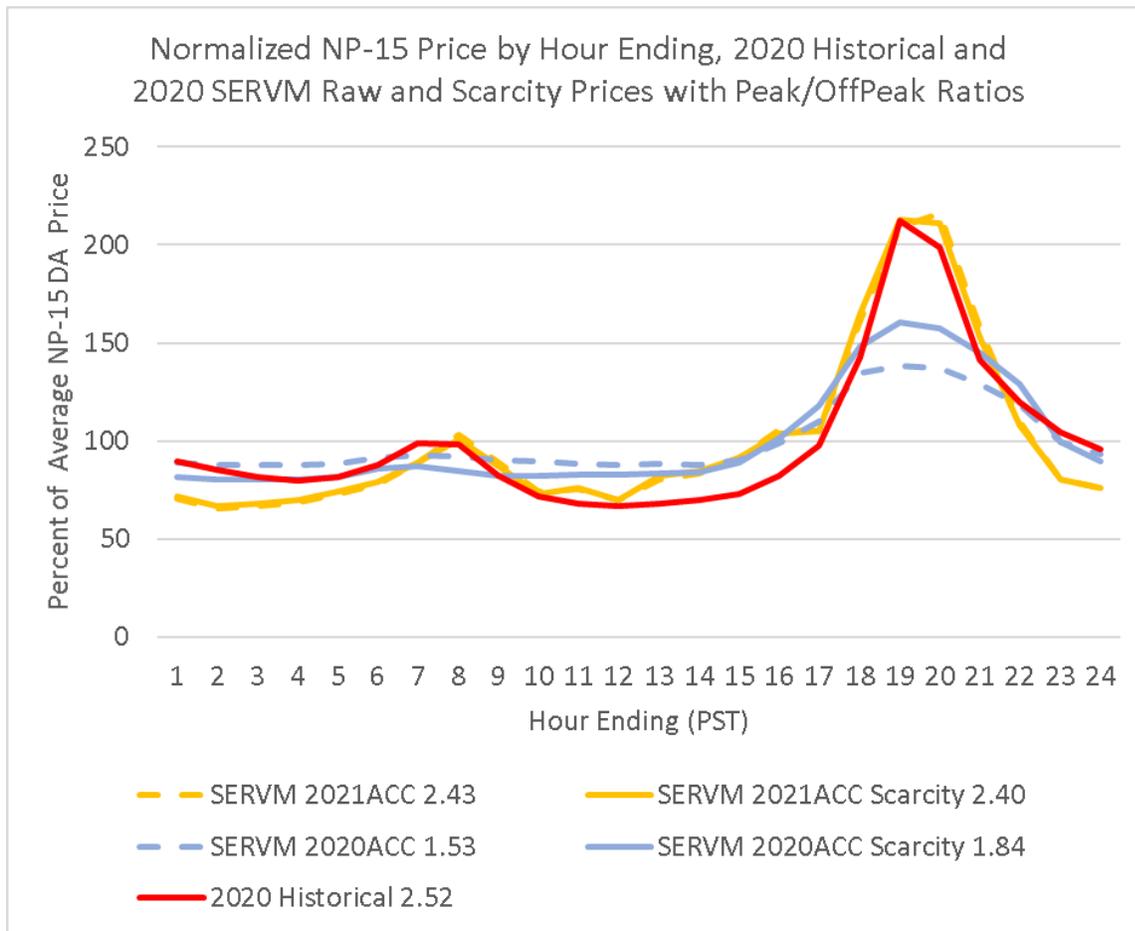
Figure 2 below compares normalized historical Day-Ahead NP-15 prices from 2020 to unadjusted²³ and scarcity-adjusted 2020 SERVM prices from the 2020 and 2021 ACC vintages. The SERVM prices used in the 2020 ACC model clearly were too flat even after applying scarcity adjustments, with peak to off-peak ratios dramatically lower than actually occurred in 2020 – in fact, they completely fail to emulate the CAISO's famous duck curve. In contrast, SERVM prices used in the 2021 ACC model, while still slightly flatter than historical 2020 prices, fit the historical shape remarkably well, especially during the peak.

²¹ See D.19-05-019

²² As described in Resolution E-5077, SERVM modeling alone does not accurately capture energy price volatility seen in the day-ahead and real time CAISO markets. In order to correct for this, the 2020 ACC applied a "scarcity pricing" adjustment on top of the raw SERVM results to account for non-ideal market conditions that scales up the top 5% of hours in a year.

²³ The SERVM outputs used in the 2020 ACC model have a lower bound of -\$300/MWh, which skews the annual averages. The SERVM outputs used in the 2021 ACC model, and both 2020 and 2021 scarcity-adjusted prices have a lower bound of \$0/MWh or greater. To provide a more consistent comparison, the "unadjusted" SERVM prices from the 2020 ACC in Figures 2-4 are therefore modified to use a lower bound of \$0/MWh.

Figure 2: 2020 Historical and SERVM Energy Prices in NP-15



Looking into the future, Figures 3 and 4 below compare unadjusted SERVM energy prices against scarcity-adjusted energy prices for 2030 from the 2020 and 2021 ACC:

Figure 3: SERVM Average Energy Prices from the 2020 ACC

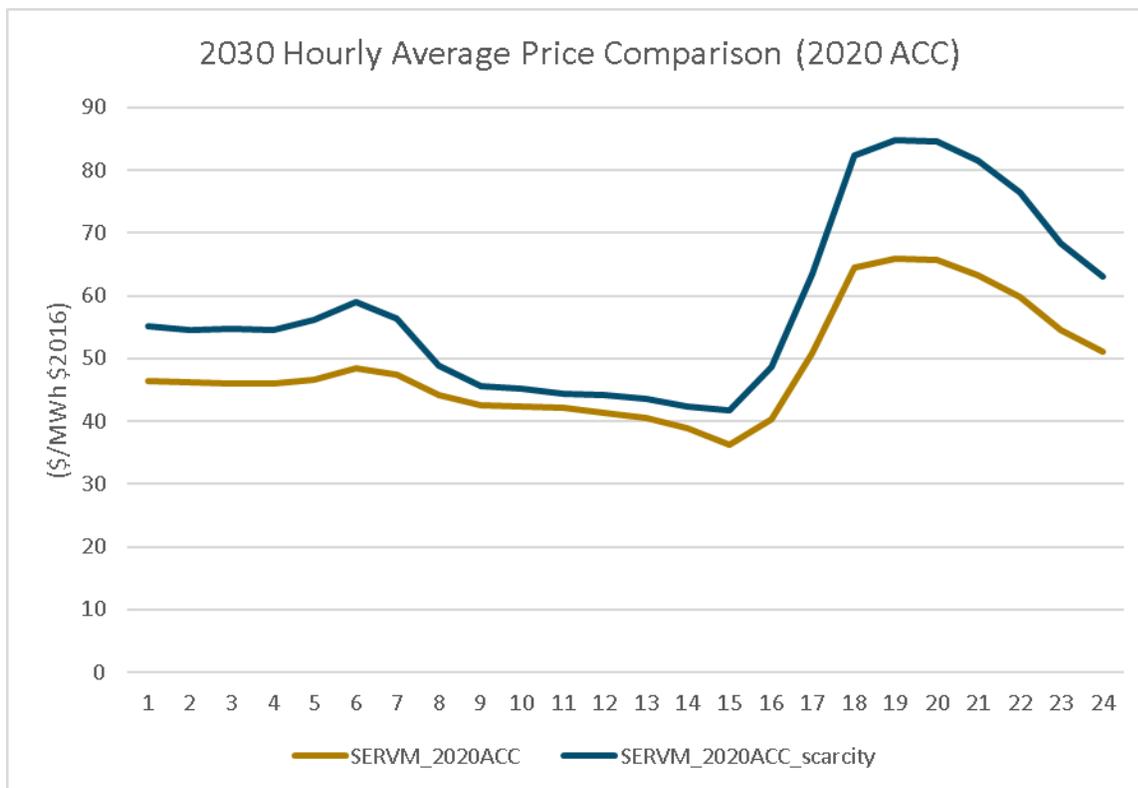
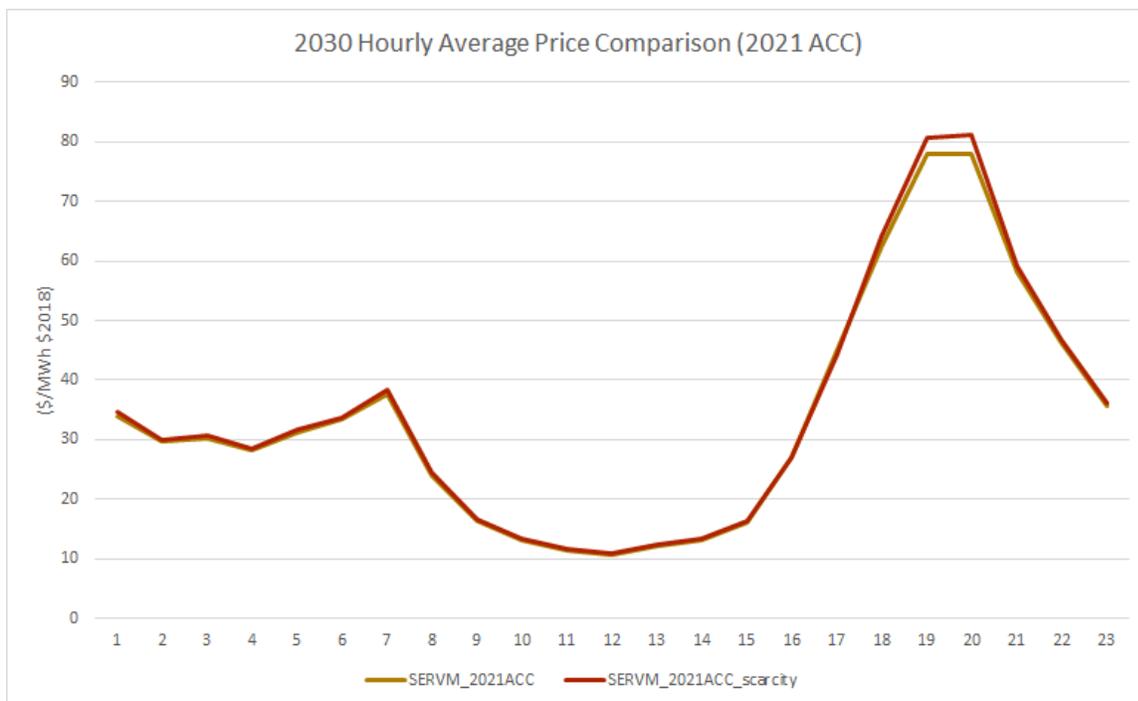


Figure 4: SERVM Average Energy Prices from the 2021 ACC



There were some significant modeling issues with the raw SERVM prices in the 2020 ACC, as demonstrated in the chart above. As noted in the 2021 ACC documentation, the 2020 scarcity pricing adjustment tended to push up an unrealistically large number of hours in each year²⁴, resulting in a price shapes (and also implied heat rates) that were relatively flat and showed little variability between peak and off-peak hours, which consequently lowered the relative value of flexible demand-side resources such as energy storage. The raw and scarcity-adjusted SERVM prices for the 2021 model are both notably improved because of the IRP benchmarking exercises, and the change to the scarcity adjustment algorithm is a minor update because it adjusts relatively few high-priced hours in the forecast. Both the SERVM and scarcity pricing refinements were specifically flagged in the December 9, 2020 workshop as an area for improvement in this Minor Update, and explicitly described in the March 11, 2021 email to stakeholders on proposed updates.²⁵ Refinements to SERVM modeling were also reviewed in the December 9, 2020 IRP Model Improvement and GHG Ground-truthing Modeling Advisory Group Webinar, and ultimately approved as part of the base scenario update for the TPP.²⁶ The intention to refine SERVM modeling and the scarcity adjustment algorithm has been well-documented, the change has been vetted with stakeholders in the IRP process and benchmarked against historical market prices, is limited in impact, and is thus well within the scope of the Minor Update.²⁷

Finally, as a result of updated energy and ancillary services prices, the generation capacity costs in the 2021 ACC are also greatly improved. This is a result of two updates that impact the net cost of new entry (CONE) of a 4-hour battery: (1) updates to storage costs; and (2) updates to energy and ancillary services prices from SERVM. In the 2020 and 2021 ACC models, the marginal resource is 4-hour battery energy storage.²⁸ The 2020 ACC resulted in net CONE unreasonably skyrocketing in the post-2040 timeframe. The 2021 ACC net CONE is lower in the earlier years as storage is forecast to earn more revenue from the energy and ancillary services markets (consistent with the more-accurate energy price shapes), while a further enhancement

²⁴ See 2021 ACC Documentation, p. 21

²⁵ See "Integrated Distributed Energy Resources (IDER) Workshop Final", slides 11-13 at: [https://ethreesf-](https://ethreesf-my.sharepoint.com/personal/gabe_mantegna_ethree_com/_layouts/15/onedrive.aspx?id=%2Fpersonal%2Fgabe%5Fmantegna%5Fethree%5Fcom%2FDocuments%2FCPUC%20ACC%20Documents%2F2020%20ACC%20Research%20Update&originalPath=aHR0cHM6Ly9ldGhyZWVzZi1teS5zaGFyZXBvaW50LmNvbS86ZjovZy9wZXJzb25hcC9nYWJlX21hbnRlZ25hX2V0aHJlZV9jb20vRW1qRmdraWV5UUUpOdmllZTlBV1VRTUFCUS1CbVN0emlpeV85eHpacWotOVBNUT9yZGltZT1sQXRTbU5zZTJVZw)

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²⁶ See Modeling and Advisory Group Webinar 6, "IRP Model Improvement and GHG Ground-truthing", 12/9/2020, slides 12-13 at: <https://www.cpuc.ca.gov/General.aspx?id=6442459770>

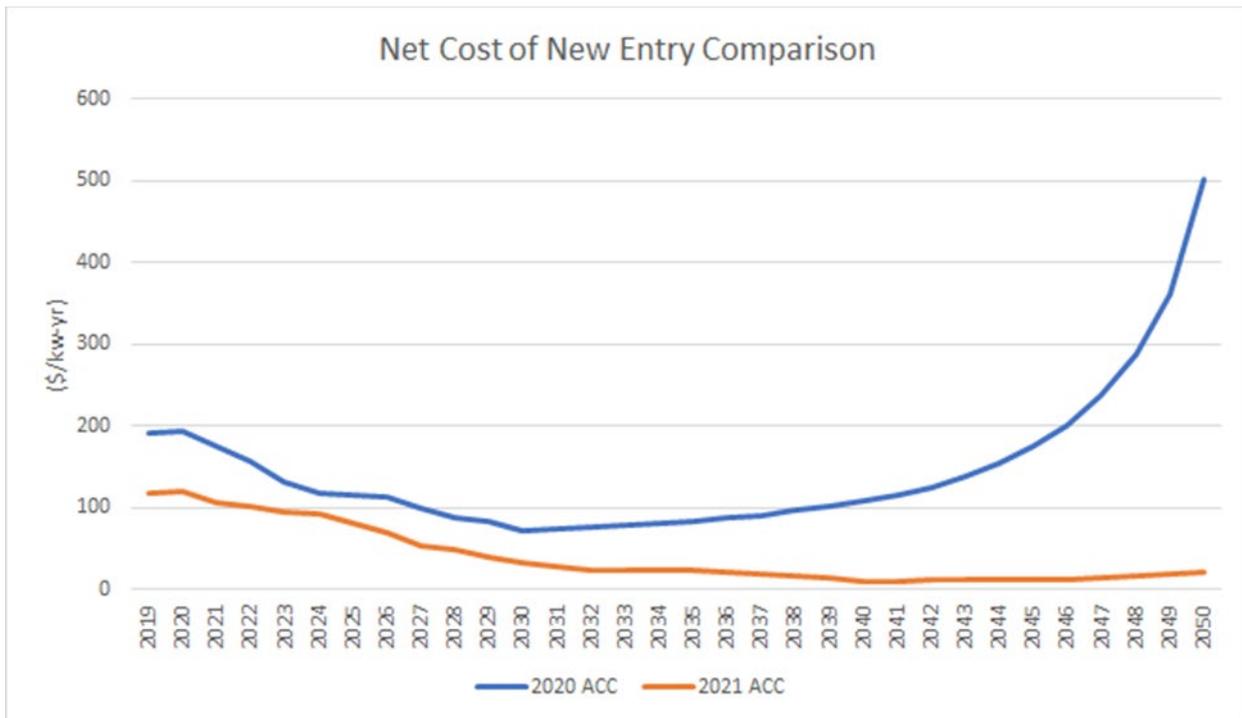
²⁷ See

ftp://ftp.cpuc.ca.gov/energy/modeling/IRP%20Model%20Improvement%20and%20GHG%20Groundtruthing_updated.pdf

²⁸ Draft Resolution E-5150, p. 4

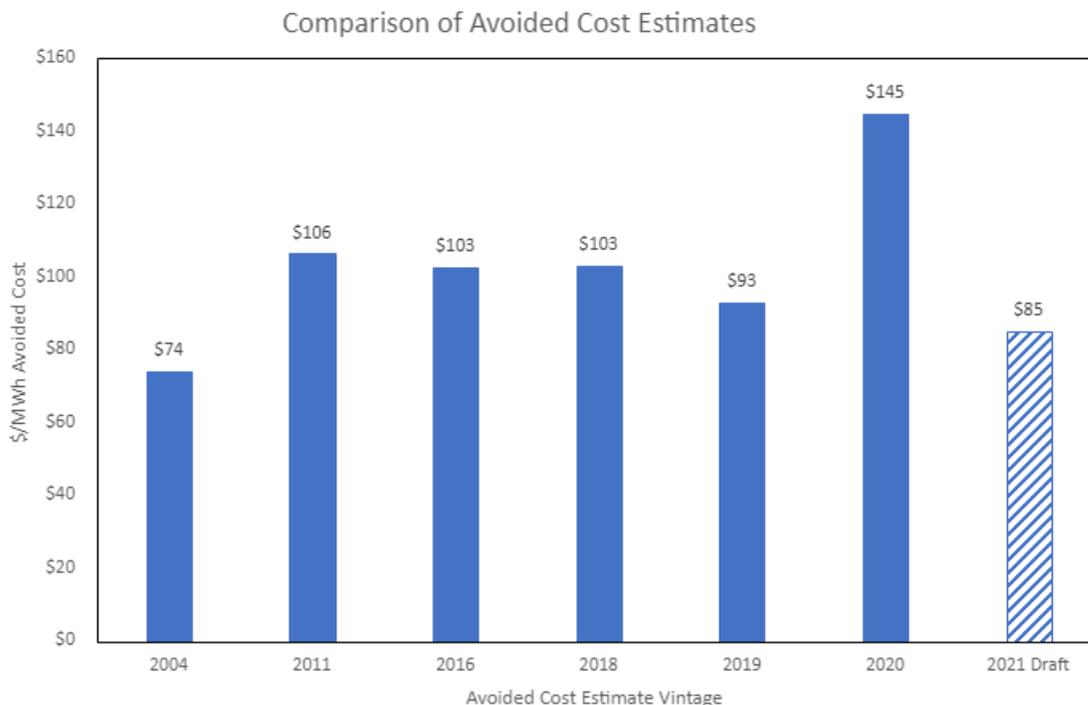
to the Effective Load Carrying Capacity (ELCC) approach improves the long-run outlook of generation capacity avoided costs.

Figure 5: 2020 and 2021 ACC Net Cost of New Entry for Battery Storage



The net result of these changes is the 2021 ACC produces results that are more intuitive with the general trend of the CAISO energy system. As shown in the chart below, full avoided costs in the ACC have been trending downward, which makes sense given the general trend in lower-cost renewable energy and batteries.

Figure 6: Average 20-year Levelized* Full Avoided Cost Value Stack, PG&E CZ4



**Note: 2011 vintage is a 30-year levelized, as this vintage only had 15 and 30-year levelization options*

The 2020 ACC is a noticeable departure from this general trend, but the 2020 ACC also incorporated the first major change to the modeling methodology since the tool was developed. This further illustrates why it is reasonable to not only incorporate more recent historical data, but to continue to review and refine inputs from the IRP to ensure alignment between supply and demand side resource valuation.

V. Conclusion

In summary, the 2021 updates are in scope for a minor ACC update year because they are limited to data input updates, including updates in the IRP process which refined previous results and were thoroughly vetted in stakeholders in that umbrella proceeding, and correction of prior minor errors. In the context of an increasingly renewable grid, reliant on large-scale buildout of GHG free resources and energy storage, the resulting avoided costs improve upon the Commission-approved ACC policy guidance adopted in 2020.

