Application No.:	16-10-012
Exhibit No.:	
Witness:	Nebiyu Yimer
ALJ:	MacDonald
Commissioner:	Randolph

In the Matter of the Application of DCR TRANSMISSION, LLC for a Certificate of Public Convenience and Necessity for the Ten West Link Project	Application 16-10-012

REBUTTAL TESTIMONY OF NEBIYU YIMER
ON BEHALF OF
THE CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION
(CORRECTED)

June 18, 2020

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A.16-10-012

I. INTRODUCTION

Q1. Have you previously provided testimony in this proceeding?

A1. Yes, on December 20, 2019, I provided opening testimony supporting the need for Delaney-Colorado River Transmission, LLC's (DCRT's) Ten West Link 500 kV transmission project (Proposed Project). My educational and professional background and job responsibilities are detailed in my opening testimony.

Q2. What is the purpose of your rebuttal testimony?

A2. The purpose of my rebuttal testimony is to respond to certain assertions made by the California Public Advocates Office (Cal Advocates) in its opening testimony. Specifically, I address the following issues:

(1) The reasonableness of the CAISO's assumptions in assessing the Proposed Project's economic benefits;

(2) The validity of Cal Advocates' assumptions in assessing the Proposed Project's economic benefits as an alternative to the CAISO's analyses; and

(3) The reliability benefits associated with the Proposed Project.

Q3: Please summarize your testimony.

A3: My rebuttal testimony describes the basis for the CAISO's benefits analysis in this proceeding. Specifically, I provide details regarding how the CAISO developed the underlying resource portfolio for its production cost modeling and capacity benefits analyses. Importantly, the CAISO developed the resource portfolio based on the most up-to-date version of the Commission's existing resource optimization tool (RESOLVE) that was available at the time the CAISO filed its opening testimony. The resource portfolio that the CAISO used for its benefits analysis is consistent with the 2017-2018 Preferred System Portfolio, with corrections the CAISO made to enable Arizona solar resources inside the CAISO balancing authority area. The 2017-2018 Preferred System Portfolio remains the base case for reliability and policy-driven analysis in the CAISO's transmission planning process per the Commission's recent Decision 20-03-028, as Mr. Millar's concurrently filed testimony details.

I also explain the CAISO's expectation that the Commission's 2019-2020 Reference System Portfolio, which is only a sensitivity portfolio for the purposes of the 2020-2021 TPP, would not materially change the economic value of the capacity benefits attributable to the Proposed Project.

My testimony also explains how the CAISO assessed the Proposed Project's capacity benefits. I show that the capacity value attributed to Arizona solar resources is conservative, given the Commission's instructions to load serving entities. I show that the CAISO used reasonable energy storage capacity costs to calculate the avoided costs of battery storage. In addition, I provide an alternative capacity benefit calculation based on a lower battery storage cost. Dr. Zhang's testimony uses this alternative capacity benefit calculation to show that the Proposed Project maintains a positive benefit-to-cost ratio even with the lower batter storage costs.

I also assess Cal Advocates' alternative to the CAISO's benefit analysis. I show that Cal Advocates' resource portfolio is arbitrary, and costly compared to the CAISO's RESOLVE-optimized portfolio. I also demonstrate that Cal Advocates' resource portfolio is consistent with neither the Commission's RESOLVE resource optimization nor any portfolios developed in the Commission's IRP. In addition, I show that Cal Advocates renewable resource allocations are both internally inconsistent and inconsistent with California Energy Commission mapping efforts. In summary, Cal Advocates alternative resource portfolio and its assumptions are invalid for transmission planning purposes.

Lastly, I provide details regarding the significant reliability benefits that the Proposed Project provides. Specifically, the Proposed Project mitigates the Path 46 Interconnection Reliability Operating Limit, which, if violated, could lead to widespread instability, uncontrolled separation, or cascading outages that adversely impact the reliability of the Bulk Electric System in certain contingency conditions.

II. THE CAISO'S BENEFITS ANALYSIS IS BOTH REASONABLE AND CONSERVATIVE.

Q4: Please explain how the CAISO developed the resource portfolio it used for assessing the Proposed Project's economic benefits.

A4: The CAISO used the latest version of the Commission's integrated resource planning (IRP) resource optimization model, *i.e.*, RESOLVE, to determine the amount of Arizona solar inside the CAISO balancing authority area (Arizona Solar) that can be economically selected to achieve emissions and resource adequacy targets. This involved enabling Arizona Solar as a candidate resource because it was incorrectly disabled in the model. The CAISO also removed the transmission cost adder for delivery to the California boarder associated with the Arizona Solar resource, which is inapplicable because the resource is inside the CAISO balancing authority area.[1]

The correction in RESOLVE resulted in more than 3,000 MW of Arizona Solar being selected, causing a reduction of $977 million in present value of the portfolio cost in 2016 dollars. In the case modeled with the Proposed Project, the CAISO allocated the economically-selected Arizona Solar to the Delaney, Hassayampa, and Hoodoo Wash substations based on commercial interest (*i.e.*, consistent with the distribution of proposed generation at those substations in the CAISO's interconnection queue). In the case modeled without the Proposed Project, the Delaney substation share of Arizona Solar was allocated to the Hassayampa and Hoodoo Wash substations based on commercial interest. This is necessary because Delaney substation will be outside the CAISO balancing authority area without the Proposed Project. The CAISO used the resulting RESOLVE portfolio to assess the Proposed Project's economic benefits.

Q5. Please respond to Cal Advocates' assertion that the CAISO's economic benefit analysis are outdated and would likely yield dramatically different results if the CAISO used the Commission's 2019-2020 Reference System Portfolio, which was issued after the CAISO filed its opening testimony.

[1] The CPUC made the same corrections to the RESOLVE model used in the 2019-2020 IRP.

A5. First, as explained in Mr. Millar's testimony, the 2017-2018 Preferred System Portfolio (2017-2018 PSP) remains the base case for reliability and policy-driven analysis. In Decision 20-03-028, the Commission requested that the CAISO use the 2017-2018 PSP as the reliability and policy-driven base case for the purposes of the CAISO 2020-2021 transmission planning process (TPP). In that same decision, the Commission requested that the CAISO use the 2019-2020 Reference System Plan (2019-2020 RSP) only as a policy-driven sensitivity in the CAISO 2020-21 TPP.[2] This means the transmission planning analysis presented in the CAISO's opening testimony, which is based on the 2017-2018 PSP, with corrections to include economically-selected Arizona Solar as described above, is still current, and Cal Advocates' claim that it is outdated has no merit.

Second, the CAISO notes that the 2019-2020 RSP itself would not be the same without the Proposed Project because the resource optimization uses transmission capacity estimates provided by the CAISO that were developed assuming the Proposed Project is in service. The CAISO models all CAISO-approved transmission projects in the studies it performs to develop its transmission capacity estimates. In calculating transmission capacity estimates provided for the Southern CA Desert & Southern NV transmission zone and sub-zones, CAISO assumed that the Proposed Project would be in service. The optimized resource buildout in the 2019-2020 RSP fully utilized this available FCDS transmission capability estimate for the Southern CA Desert & Southern NV transmission zone. Because transmission capacity estimates limit the amount of the economic FCDS and energy only resources that RESOLVE can select, the resulting RSP would likely have been significantly different and would have had higher overall resource costs had the transmission capacity estimates not included CAISO-approved projects that increase transmission capacity, including the Proposed Project.

Third, in opening testimony, the CAISO demonstrated the Proposed Project's economic benefits based on (1) capacity benefits arising from the increased amount of out-of-state

[2] *Decision 20-03-028, 2019-2020 Electric Resource Portfolios to Inform Integrated Resource Plans and Transmission Planning,* R.16-02-007, March 26, 2020, Ordering Paragraph No. 14, p. 108. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M331/K772/331772681.PDF

resources in the Southwest that the Proposed Project enables to count for resource adequacy and (2) production cost benefits that arise from the Proposed Project's ability to reduce the CAISO net ratepayer payments. The CAISO's deliverability assessment indicated that much of the capacity benefits of the Proposed Project arise from its ability to divert flows from the congested Sunrise/SWPL corridor. The production simulation results also demonstrated that the Proposed Project helps to mitigate congestion on Sunrise/SWPL corridor and the downstream system inside San Diego area.[3] Neither the CAISO nor Cal Advocates have performed studies using the 2019-2020 RSP, which is only a sensitivity case in the CAISO 2020-2021 TPP and only became available in March of 2020, after the CAISO filed opening testimony. In any event, the CAISO does not expect that using the 2019-2020 RSP portfolio is likely to yield dramatically different results in either the capacity or production benefits—as claimed by Cal Advocates—for the reasons explained in detail below.

Q6. Please provide the CAISO's assessment of the impact of the 2019-2020 RSP on the Proposed Project's benefits.

A6. The CAISO's analysis included 3,364 MW of Arizona Solar resources based on the RESOLVE-optimized portfolio. In opening testimony, the CAISO demonstrated that the Proposed Project would increase the resource adequacy-eligible quantity of these Arizona Solar resources by 969 MW—from 1,180 MW to 2,149 MW. The CAISO determined capacity benefits of the Proposed Project based on this increase in resource-adequacy eligible Arizona Solar resources.

The 2019-2020 RSP[4] includes 1,196 MW of economically-selected FCDS (*i.e.*, resource adequacy eligible) Arizona Solar resources in the SCADSNV-Riverside_Palm_Springs Transmission Sub-zone, and a total of 2,658 MW of FCDS solar and wind resources in the greater Southern CA Desert & Southern NV Transmission Zone. Because the transmission capacity estimates used in RESOLVE were developed assuming the

[3] *Testimony of Yi Zhang on Behalf of the California Independent System Operator Corporation*, A.16-10-012, December 20, 2019, Figure 1, p. 5. (CAISO – Zhang Opening Testimony)
[4] https://caenergy.databasin.org/documents/documents/b90faf47be4045a398171a5cfac51b87/

Proposed Project is in place, as noted in Q&A 5, the amount of economically selected FCDS capacity in Southern CA Desert & Southern NV Transmission Zone in the 2019 RSP would likely decrease by 969 MW without the Proposed Project. This means that additional, more expensive capacity resources—such as battery storage or less economic renewables—would be needed to meet the resource adequacy target without the Proposed Project. For this reason, the CAISO would not expect the new RSP to materially change the Proposed Project's capacity benefits (in MW).

In opening testimony, the CAISO used two alternative methodologies to calculate the economic value of the Proposed Project's capacity benefits. These two methods of calculating the capacity benefits were based on (1) the avoided cost of battery storage and (2) the locational renewables cost savings from RESOLVE. Because the later method involves running RESOLVE to produce a new resource portfolio with and without Arizona Solar enabled, the CAISO focuses on the former method to assess the impact of the 2019-2020 RSP on the economic value of the Proposed Project's capacity benefits.

Using the avoided cost of storage methodology, the economic value of the Proposed Project's capacity benefit depends on (1) the applicable effective load carrying capability (ELCC) of solar resources and (2) the cost of storage. As explained in detail in Q&A 10 of this testimony, the CAISO believes the ELCC values used in its opening testimony are conservative. The battery storage cost the CAISO used in its benefit analysis is also reasonable and not outdated as discussed in detail in the same Q&A 10. Based on these considerations, the CAISO would not expect the economic value of the capacity benefits attributable to the Proposed Project to materially change with the 2019-2020 RSP portfolio.

Dr. Zhang's rebuttal testimony, filed concurrently with this testimony, provides the CAISO's assessment of the impact of the new RSP on the Proposed Project's production cost benefits.

Q7. Do you agree with Cal Advocates' assertion that the difference between Arizona and California solar costs has narrowed significantly since the 2017-2018 RSP and that

the outdated assumption used in the CAISO's analysis overstates the Proposed Project's benefits significantly?

A7. No, I do not agree with the Cal Advocates' assertions. Cal Advocates' opening testimony incorrectly compares Arizona versus California solar resource costs.[5] Specifically, Cal Advocates testimony compares costs of Riverside East - Palm Springs *wind* resources with the cost of *solar* resources in Arizona. This is an incorrect, apples-to-oranges comparison that causes Cal Advocates' to significantly overstate the differences between the CAISO's solar resource cost assumptions, drawn from the 2017 IRP and the 2019 IRP. Cal Advocates' response to DCRT's Data Request No. 1 confirms this error.[6]

Table 1 below corrects Cal Advocates' error by properly comparing the actual difference between Arizona and California levelized cost of *solar* from the 2017 IRP to the 2019 IRP. Cal Advocates claimed that the CAISO's analysis had used Arizona levelized solar cost that were 35% lower than California resources. As Table 1 below shows, the actual levelized cost of energy differential is only 12%. In contrast, the 2019 IRP assumes that Arizona Solar resources have a levelized cost of energy that is 3.4% lower than California resources. Table 1 below shows both the levelized cost of energy and the capacity cost assumptions in the 2017 IRP and the 2019 IRP.

[5] *Opening Testimony for the Application of DCR Transmission, LLC for a Certificate of Public Convenience and Necessity for the Ten West Link Project*, A.16-10-012, May 13, 2020, Table 6, p. 2-26. (Cal Advocates Opening Testimony)

[6] Cal Advocates' response to DCRT's Data Request No. 1 at p. 2. *See* Attachment A. ("In collecting materials responsive to DCRT's request for Table 6, Mr. Wagle found that that the Capital Cost (2016 $/kW) and the Implied Levelized Cost of Energy (2016 $/MWh) from the 2017 IRP in the Riverside East - Palm Springs Solar resource were reported incorrectly in Table 6. While this error does not affect any of the conclusions in Public Advocates Office testimony, it will be brought to the Administrative Law Judge's attention")

Table 1: A comparison of Solar Resource Cost in California Riverside East versus Arizona in 2030

	2017 IRP[7]		2019 IRP[8]	
	Capital Cost (2016$/kW)	Levelized Cost of Energy (2016$/MWh)	Capital Cost (2016$/kW)	Levelized Cost of Energy (2016$/MWh)
Arizona Solar	$1,558	$51	$1,100	$29
Riverside East - Palm Springs Solar	$1,699	$58	$1,136	$30
Percentage difference Relative to Riverside East_Palm Springs	(8.3%)	(12.1%)	(3.2%)	(3.4%)

More importantly, the 2019 IRP reduction in the differential between Arizona and California solar resource costs is not consistent with the underlying source data for the solar photovoltaic (PV) costs. NREL's 2018 Annual Technology Baseline (ATB)—which is used as the primary basis for the IRP's renewable generation cost updates, including the cost updates for solar PV generation[9]—indicates differences between the cost of Arizona and southern California solar resources that are more consistent with the CAISO's assumptions and the 2017 IRP.

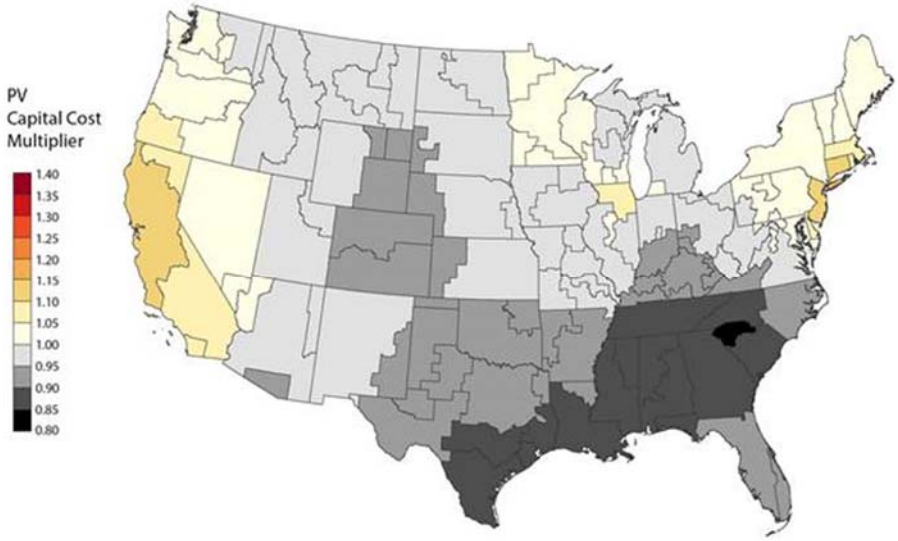
[7] *RESOLVE Documentation: CPUC 2017 IRP Inputs & Assumptions*, September 2017, pp. 36-37. https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/AttachmentB.RESOLVE_Inputs_Assumptions_2017-09-15.pdf

[8] *Inputs & Assumptions: 2019-2020 Integrated Resource Planning*, February 2020, pp. 45-47. ftp://ftp.cpuc.ca.gov/energy/modeling/Inputs%20%20Assumptions%202019-2020%20CPUC%20IRP%202020-02-27.pdf

[9] *Id*, p. 44 and p. 49. ftp://ftp.cpuc.ca.gov/energy/modeling/Inputs%20%20Assumptions%202019-2020%20CPUC%20IRP%202020-02-27.pdf

For solar PV generation, the 2018 ATB provides a regional "Cost Multiplier Map," reproduced below as Figure 1.[10] The map shows an approximately 10% capital cost differential between southern California and Arizona Solar. This 10% cost differential is much closer to the 9.0% differential assumed in the 2017 IRP and the CAISO's analysis. For comparison, the 2019 IRP assumes only a 3.2% cost differential between southern California and Arizona Solar costs.

Figure 1: Regional Capital Cost Multiplier Map for Solar PV[11]



To further validate the CAISO's solar resource cost assumptions, I reviewed the February 2020 U.S. Energy Information Administration (EIA) report titled "Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies" (EIA Report).[12] The EIA Report evaluates the capital cost and performance characteristics for 25 electric generator types and includes locational cost

[10] The CAISO included the updated 2019 version of the same map as Figure 1 in my opening testimony as additional evidence for the regional cost differences assumed in the testimony.
[11] https://atb.nrel.gov/electricity/2018/regional-capex.html
[12] This report was prepared by Sargent & Lundy and is available at: https://www.eia.gov/analysis/studies/powerplants/capitalcost/pdf/capital_cost_AEO2020.pdf

adjustments. According to the EIA Report the $/kW cost in 2019 dollars of a 150 MW Solar PV project for the two locations provided for southern California ranges from $1,400/kW in Bakersfield to $1429/kW in Los Angeles. The report indicates a similar project located in Phoenix—the only Arizona location included—will have a cost of $1,273/kW.[13] This data indicates southern California solar is 10% to 12% more expensive than Arizona Solar in terms of capacity costs, which is again consistent with the 2018 NREL ATB, the 2017 IRP and the assumptions used in the CAISO's benefits analysis for the Proposed Project.

Table 2 provides a summary of the cost differences between southern California and Arizona Solar based the various sources mentioned above. Table 2 suggests that the 2019 IRP assumption appears to be an outlier.

Table 2: Summary of Cost Variation of Southern California Solar Relative to Arizona Solar

	2017-2018 IRP[14] (Used in the CAISO's benefits analysis)	2019-2020 IRP (Basis for Cal Advocates assertions)[15]	2018/19 NREL ATB	2020 EIA Report[16]
CA vs. AZ Solar Costs (CA/AZ)	109%	103.3%	110.5%	110%-112%

The data does not support Cal Advocates' assertion that the difference in the cost of building solar resources in Arizona versus California has narrowed significantly since the 2017 IRP. Based on this data, I do not believe the assumptions the CAISO used in its analysis are outdated or significantly overstate the Proposed Project's benefits.

[13] Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies, https://www.eia.gov/analysis/studies/powerplants/capitalcost/pdf/capital_cost_AEO2020.pdf Table 1-24 at pdf p. 207.
[14] For project years 2018/2022.
[15] For project year 2020.
[16] For project year 2019.

It is also worth noting that despite the differences in the cost assumptions from the 2017 IRP, the 2019 IRP produced an RSP that includes 2,352 MW of economically-selected Arizona Solar, which favors approval of the Proposed Project.

Q8. Do you agree with Cal Advocates' argument that the CAISO should have included a transmission cost adder for Arizona Solar to develop the CAISO's production cost modeling case with the Proposed Project?

A8. No. Cal Advocates first agrees that my rationale for the changes in RESOLVE to remove the transmission cost adder and enable western Arizona Solar to become a candidate resource is reasonable.[17] Cal Advocates further indicates the change made by the CAISO is also consistent with the Commission's decision on 2019-2020 RSP, which eliminates the "previously-associated transmission wheeling cost" or "out of state renewable transmission costs" for those Arizona resources that are directly connected to existing CAISO transmission. However, Cal Advocates then claims my analysis erred by eliminating the transmission cost adder and developing the CAISO's PCM case with the Proposed Project, because, according to Cal Advocates, it adds resources at the Delaney Substation without incorporating the cost of the Proposed Project that is required to interconnect those resources.[18]

Cal Advocates' claim that the Proposed Project is required to interconnect the Arizona Solar resources is inaccurate. This is evident from my opening testimony, which states that the CAISO's analysis assumes that the Arizona Solar resources selected by RESOLVE can directly connect to the CAISO controlled grid with or without the Proposed Project.[19] My opening testimony further explained that the 3,262 MW of Arizona Solar capacity selected by RESOLVE, and the associated $977 million in resource cost savings, are *not* attributable to the Proposed Project because the resources can connect to the CAISO controlled grid without the Proposed Project.[20]

[17] Cal Advocates Opening Testimony, p. 2-35
[18] *Id*., p. 2-35 - 2-36
[19] *Testimony of Nebiyu Yimer on behalf of the California Independent System Operator Corporation*, A.16-10-012, December 20, 2019, p. 6. (CAISO – Yimer Opening Testimony)
[20] *Id*., p. 10

However, the CAISO studies did demonstrate that the Proposed Project will enable a significant amount of this economically-selected Arizona Solar resource to be deliverable, and to therefore count toward load serving entities' resource adequacy requirements.[21] The CAISO appropriately took this capacity benefit in to account in its updated economic analysis.

Cal Advocates' contention that the CAISO incorrectly used the same portfolio in its PCM cases with and without the Proposed Project has no basis in the coordinated resource and transmission planning processes. Cal Advocates' assertion that CAISO should have used one portfolio for the case without the Proposed Project and a different portfolio for the case with the Proposed Project undermines integrated resource planning. It implies that the CAISO cannot use Commission-developed IRP portfolios to evaluate a new economic project unless the Commission develops a new portfolio for the case by adding the cost of the candidate project in its resource optimization model to certain candidate resources.

In contrast, the CAISO's assessment of the Proposed Project is consistent with the coordinated resource and transmission planning process. In that process, the Commission first develops a resource portfolio using its resource optimization model (RESOLVE) and provides the portfolio to the CAISO. The CAISO then uses the Commission-developed portfolio in its transmission planning process, which includes evaluating candidate transmission projects. The CAISO's transmission planning project evaluation always involves modeling the prevailing portfolio with and without each candidate transmission project in power flow and/or PCM. This is how the CAISO evaluated all previously approved economic transmission projects and how it continues to evaluate all new candidate economic transmission projects. The CAISO used the same process to evaluate the Proposed Project using the corrected RESOLVE portfolio.[22]

[21] *Id*. at 12-13.

[22]To further elaborate the point using an example from the 2019-2020 TPP, the CAISO evaluated the reliability, local capacity and production benefits of increasing the rating of the Sylmar–Pardee 230 kV line, which is a tie-line between the CAISO and Los Angeles Department of Water and Power (LADWP). Consistent with the current

The CAISO's analysis does not ignore the cost of the Proposed Project, as Cal Advocates seems to suggest. The CAISO compared the cost of the Proposed Project to the benefits attributable to the investment; appropriately in calculating its benefit to cost ratio.

Q9. Please respond to Cal Advocates' assertion that the CAISO's approach to modeling Arizona Solar is incorrect.

A9. In the PCM case with the Proposed Project, the CAISO modeled the 3,364 MW of Arizona Solar at Delaney (60% or 2,018 MW), Hassayampa (20% or 673 MW) and Hoodoo Wash (20% or 673 MW) substations. In the PCM case without the Proposed Project, the CAISO distributed the resources at the Delaney substation in equal amounts at the Hassayampa and Hoodoo Wash substations. This resulted in the CAISO modeling 1,682 MW at each substation. Cal Advocates claims this assumption is incorrect and inflates the Proposed Project's value because there are other locations on the CAISO grid that would accommodate this amount of generation at a lower cost/higher value in the absence of the Proposed Project.

As explained in my opening testimony, the CAISO's assumptions are not arbitrary. The CAISO selected the 60%, 20% and 20% split among the three substations based on commercial interest, *i.e.*, the proportion of actual projects in the CAISO generation interconnection queue. Since the CAISO's approval of the Proposed Project, the Delaney substation and the proposed transmission line have attracted the largest amount of Arizona Solar (with battery storage) capacity wishing to connect to the CAISO grid. On top of the 4,164 MW of capacity that was in the queue at the time of filing its opening testimony, CAISO has received three additional solar/storage projects in its Cluster 13 interconnection process that wish to connect to the Proposed Project or Delaney Substation. These additional projects have a combined capacity of 2,906 MW, increasing the total solar capacity wishing to connect to the Proposed Project or Delaney Substation

process, the CAISO evaluated the project benefits by analyzing the system with and without the project using the same Base portfolio provided by the Commission. Neither the Commission nor the CAISO developed a new portfolio adding the cost of the project to any candidate resources in RESOLVE. The CAISO Board approved the project based on the results of the analysis. *See* http://www.caiso.com/Documents/ISOBoardApproved-2019-2020TransmissionPlan.pdf at pages 149-150

to 7,071 MW. The amount of solar (with storage) wishing to connect at Hassayampa and Hoodoo Wash increased by 830 MW and 365 MW, to 2,000 MW and 1,735 MW, respectively.

Cal Advocates correctly understands that the CAISO distributed Arizona Solar among the Delaney (60%), Hassayampa (20%) and Hoodoo Wash substations (20%) based on the commercial interest criterion. However, Cal Advocates argues that the CAISO's analysis must also take into account deliverability status and ignore any energy only projects in the queue. Cal Advocates argues that energy only projects should be ignored because they are "relatively unattractive from a procurement standpoint given lack of [resource adequacy] credit associated with them."[23]

This argument fails to recognize the fact that energy only projects in the CAISO interconnection queue, such as those connecting to Hoodoo Wash, have an opportunity to obtain deliverability in accordance with the CAISO Tariff.[24] Energy only projects have the opportunity to obtain deliverability through the annual Transmission Plan Deliverability allocation process in accordance with the Tariff when they achieve commercial operation or have executed or are actively negotiating a power purchase agreement. This is one reason why resource planning should not ignore energy only projects when applying the commercial interest criterion.

Furthermore, this argument is inconsistent with the Commission's IRP process and the CAISO's TPP. The 2017-2018 PSP (the CAISO's base portfolio for its analysis) and 2019-2020 RSP include a total of 4,662 MW and 3,319 MW of energy only renewable resources, respectively. The Commission does not ignore or discount the contribution of these energy only resources in meeting the renewable energy target because, as Cal Advocates argues, they are relatively unattractive from a procurement standpoint. Similarly, the CAISO does not ignore or discount these portfolio energy only resources in

[23] Cal Advocates Opening Testimony, p. 2-43
[24] CAISO Tariff Appendix DD, Section 8.9.2,http://www.caiso.com/Documents/AppendixDD-GeneratorInterconnection-DeliverabilityAllocationProcedures-asof-Feb20-2020.pdf.

its annual TPP production simulation studies that evaluate the economics of transmission projects.

The fact that no Arizona Solar is modeled at Delaney without the Proposed Project is not arbitrary. As explained in my opening testimony, without the Proposed Project, the Delaney substation will not have a direct connection to the CAISO transmission system and, as a result, it will not be available for projects wishing to connect directly to the CAISO balancing authority area. Further, projects that have requested to connect directly to the Proposed Project will not have a valid point of connection without the Proposed Project. If the Proposed Project is cancelled, all of these projects will have to withdraw their interconnection requests. If they still wish to connect directly to the CAISO grid, such projects will have to reapply with a different point of connection such as Hassayampa or Hoodoo Wash.

The CAISO notes that Cal Advocates' testimony, which is based on an analysis of the CAISO's production simulation results, seems to correctly imply that Delaney is a high value location for the Arizona Solar resources wishing to connect to the CAISO grid.[25] The amount of commercial interest that has developed since CAISO approval of the Proposed Project suggests most Arizona Solar developers also agree that Delaney is a high value point of connection to the CAISO grid. This appears to be more a reason for Cal Advocates to support rather than oppose approving the Proposed Project, which makes this high value point of connection, both from rate payers' and the developers' perspective alike, available for western Arizona Solar and hybrid resources that wish to connect to the CAISO balancing authority area.

Q10. Please address Cal Advocates' arguments that the CAISO's capacity benefit calculations are either invalid or exaggerate the capacity value provided by the Proposed Project.

[25] "When the Arizona Solar resource capacity is redistributed in the case with the Proposed Project, the generators at Delaney substation gain significantly more net revenues compared to the amounts the generators located at Hoodoo Wash and Hassayampa substations lose", Opening Testimony of Pushkar Wagle at p. 2-40.

A10. In its opening testimony, the CAISO used two methods to assess the capacity benefits associated with the Proposed Project. The first method is based on the avoided cost of energy storage, while the second is based on locational renewables cost savings. In opening testimony, Cal Advocates claim the CAISO significantly overestimates the capacity benefit attributed to the Proposed Project by (1) overestimating the capacity value or ELCC of solar resources[26] and (2) overestimating battery storage cost values by using the 2017 IRP rather than the 2019 IRP battery cost assumptions. Cal Advocates also claims the CAISO's renewable cost savings methodology for calculating the Proposed Project's capacity benefit is flawed because it assumed a high solar cost differential between Arizona and California solar resources. My response to Q&A 7 demonstrates that the CAISO's solar cost differential is appropriate and consistent with industry expectations.

As a preliminary note, the CAISO's first method of calculating capacity benefits, which uses avoided cost of energy storage, does not use a 14% ELCC to assess the capacity benefit associated with the Proposed Project.[27] As explained in my opening testimony, the CAISO discounted the Commission-adopted ELCC solar resources by two-thirds, one-half, and one-third to account for expected future declines in solar ELCC values. As a result, the CAISO's capacity benefit calculation assumes solar ELCCs of 4.7%, 7% and 9.3% in its three sensitivities, all of which led to overall benefit-to-cost ratios that exceed 1.0.

Furthermore, the Commission's current direction to load serving entities indicates that solar ELCCs well over 2% are appropriate for resource planning purposes. In Decision 20-03-028,[28] the Commission delegated to Commission staff the task of maintaining a

[26] Cal Advocates claims that the CAISO used a 14% ELCC capacity value for solar resources instead of the marginal 2% ELCC adopted in D.18-02-018, Attachment B.
[27] The Commission adopted a 14% ELCC value for solar resources for the peak month of September for use in the resource adequacy program in Decision 19-06-026. The Decision states "The adopted values shall be effective beginning with 2020 Resource Adequacy compliance year.", Decision 19-06-026, see Ordering Paragraph 19 https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M309/K463/309463502.PDF
[28] http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M331/K772/331772681.PDF

Resource Data Template to assist individual load serving entities in preparing their individual integrated resource plans. The Resource Data Template includes solar ELCC assumptions for load serving entities to use to estimate capacity contributions for their 2020 IRP filings.[29] The solar ELCC values from the Resource Data Template[30] for the peak month of September are shown in Table 3, below. As indicated in Table 3, the ELCC values range from 14% in 2020 to 9% in 2030 for the 46 MMT RSP Portfolio.

Table 3

**Solar ELCC Assumptions for September
46 MMT RSP Portfolio
2019 IRP Resource Data Template**

Year	Month	ELCC
2020	9	14%
2021	9	14%
2022	9	14%
2023	9	14%
2024	9	12%
2025	9	11%
2026	9	9%
2027	9	9%
2028	9	9%
2029	9	9%
2030	9	9%

Based on the Resource Data Template, the CAISO capacity benefit sensitivities using the 4.7% to 9.3% 2022 solar ELCC values are conservative. Therefore, the Commission should reject the Cal Advocates claim that the Commission should use a 2% marginal solar ELCC to assess the Proposed Project's capacity benefits.

The CAISO also notes that all the Arizona Solar resources are the first set of solar resources selected by RESOLVE in the 2017 IRP modeling. RESOLVE selected all

[29] 2020 load serving entity IRP filings are due to the Commission on September 1, 2020
[30] ftp://ftp.cpuc.ca.gov/energy/modeling/Resource%20Data%20Template.xlsx – See "ELCC" tab.

Arizona Solar resources by 2022.[31] RESOLVE did not select any solar resources in prior years. In addition, because Arizona Solar resources have the lowest resource cost per MWh of all candidate solar resources in the 2017 IRP,[32] one can assume that they are selected before all other solar resources of the same deliverability status in the resource optimization. If marginal ELCC means the ELCC of the last MW in the portfolio, then Arizona Solar will have a higher marginal ELCC than all the other incremental solar resources in the portfolio because they are likely the first incremental solar resources selected. In other words, because the Arizona resources are selected first, their ELCC will be greater than the last (*i.e.*, marginal) unit selected. Accordingly, the 969 MW of incremental Arizona Solar that becomes deliverable in 2022 as a result of the Proposed Project will have a higher marginal ELCC than any other solar selected in the portfolio.

Q11. Please respond to Cal Advocates' claim that the CAISO's capacity benefit analysis overestimates the economic value of the Proposed Project by overestimating the avoided cost of battery storage.

A11. Cal Advocates incorrectly claims that the CAISO's analysis assumes the avoided cost of battery storage based on the 2017 IRP values. This claim is incorrect because, as indicated in my opening testimony, the CAISO's source for battery storage cost information is Pacific Northwest National Laboratory's Energy Storage Technology and Cost Characterization Report, dated July 2019—not the 2017 IRP.[33] This claim is also misleading because it suggests the battery storage cost assumption the CAISO used is outdated compared to the 2019 IRP. To the contrary, the 2019 IRP relies on storage cost assumptions from Lazard's Levelized Cost of Storage 4.0 (published in 2018),

[31] CAISO – Yimer Opening Testimony, p. 8

[32] https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/AttachmentB.RESOLVE_Inputs_Assumptions_2017-09-15.pdf at pp 36-37

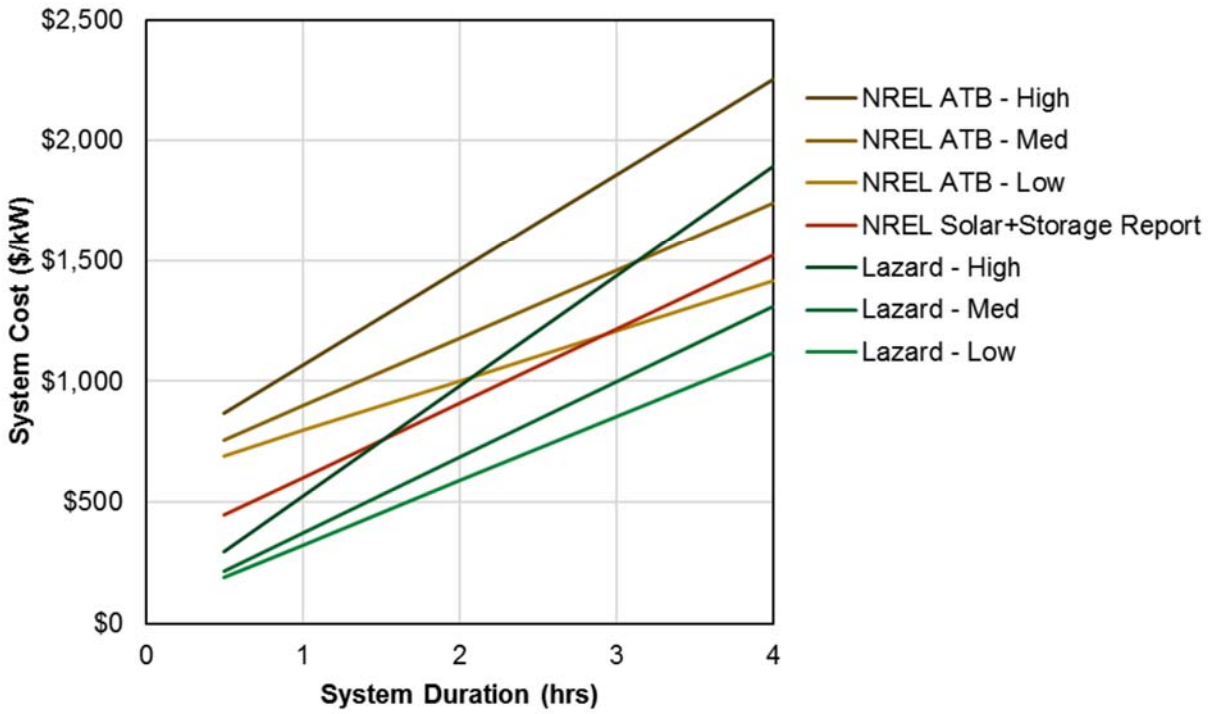
[33] Testimony of Nebiyu Yimer on behalf of the California Independent System Operator Corporation at page 14, see footnote 11.

supplemented by NREL's Solar and Storage Report (also published in 2018).[34] In reality, the CAISO's battery storage cost assumptions are based on more recently published data.

Nonetheless, there appears to be significant uncertainty in the current cost of battery storage. A recent WECC study performed by Energy and Environmental Economics found that lithium-ion battery system cost varies significantly by report.[35] The variation in utility-scale battery cost between NREL ATB and Lazard is shown in Figure 2. As the chart shows, the estimated cost of a 4-hour battery system varies from about $1,100/kW (Lazard – Low) to $2,250/kW (NREL ATB – High) in 2018 dollars. The $1661/kW the CAISO used in its analysis approximately represents the midpoint of the range. Similarly, there appears to be significant uncertainty regarding the future rate of decline in battery storage costs. Lazard's latest report (LCOS v5.0) found that year-over-year cost declines were less pronounced than those observed in its prior report (LCOS v4.0), particularly for wholesale systems.[36]

Figure 2: Utility-Scale Battery Cost Variation by Source

[34] ftp://ftp.cpuc.ca.gov/energy/modeling/Inputs%20%20Assumptions%202019-2020%20CPUC%20IRP%202020-02-27.pdf at page 60.
[35] https://www.wecc.org/Administrative/E3-WECC%20Resource%20Cost%20Update-201905%20RAC%20DS%20Presentation.pdf.
[36] https://www.lazard.com/media/451087/lazards-levelized-cost-of-storage-version-50-vf.pdf at p. 10.



Based these considerations, the Commission should reject Cal Advocates' claim that the CAISO's battery storage cost assumption is outdated. However, due to the uncertainty associated with the actual cost of battery storage, the CAISO believes an assessment of the Proposed Project's benefit-to-cost ratio (BCR) with the battery storage costs from the 2019 IRP is warranted as an additional data point. To provide this additional data point, in Table 4 below I provide capacity benefits of the Proposed Project based on the avoided cost of battery storage with the 2019 IRP storage cost assumption included. Dr. Zhang's concurrently filed rebuttal testimony calculates additional BCR results using the discounted ELCC values.

Table 4: Capacity Benefit of Ten West Link Based on Avoided Cost of Battery Storage

Lithium-Ion BESS (4-hr.)	Capital Cost		Levelized Cost	
	PNNL ($2018)	2019 IRP ($2016)	PNNL ($2018)	2019 IRP ($2016)
Unit Cost (2022)	$1661/kW	$1058/kW	$268/kW-Yr.	$166/kW-Yr.
Cost of 136 MW BESS	$225 million	$143 million	$36.3 million/Yr.	$22.6 million/Yr.
Capacity benefit after discounting ELCC by 1/3,1/2 and 2/3, respectively	$75M/$113M/ $150M per year	$48M/$72M/$95M per year	$12M/$18M/$24M per year	$7.5M/$11.3M/$15M per year

Q12. How would the CAISO's capacity benefit calculation change if hybrid solar/storage projects use the incremental 969 MW of deliverability provided by the Proposed Project?

A12. As indicated earlier in this testimony, the majority of Arizona projects in the CAISO generation queue are solar/battery hybrid projects. The capacity value of the 969 MW incremental deliverable capacity resulting from the Proposed Project will only increase if solar/battery hybrid resources located in Arizona are procured. According to the EIA Report,[37] Arizona solar/battery hybrid resources are about 9% less expensive than those in California. Table 5, below, compares the cost of a hybrid resource with 969 MW solar and 323 MW/4-hour battery in California (Bakersfield) vs. Arizona (Phoenix).

Table 5: Hybrid Solar/Battery Storage Resource Cost Comparison California vs. Arizona

	Cost (2019$)

[37] https://www.eia.gov/analysis/studies/powerplants/capitalcost/pdf/capital_cost_AEO2020.pdf, see table 1-25 at pdf p. 208

	California	Arizona	Difference
Hybrid resource with 150 MW Solar, 50 MW/4-hr Battery	$1,884/kW	$1,719/kW	$165/kW
Hybrid resource with 969 MW Solar, 323 MW/4-hr Battery	$1,825,596,000	$1,665,711,000	$159,885,000

The approximately $160 million cost difference can be considered as the capacity benefit of the Proposed Project based on the selected configuration of the hybrid resource assuming the hybrid resource in California will be deliverable. In this case, there is no need to discount the capacity benefit, as the CAISO did in its opening testimony, because the capacity benefit is calculated based on locational cost difference and, unlike solar resources, the capacity value of hybrid solar/storage resources are not likely to decline as much over time. Table 5 above demonstrates that the capacity benefit of the Proposed Project calculated based on hybrid solar/storage resources will be far greater than the $75-$150 million range that the CAISO used in its opening testimony.

III. CAL ADVOCATES' ALTERNATIVE TO THE CAISO'S BENEFITS ANALYSIS IS FLAWED.

Q13. Please briefly explain how Cal Advocates assessed the CAISO benefits analysis for the Proposed Project.

A13. To assess the CAISO's benefits analysis, Cal Advocates developed its own resource portfolio alternative (Cal Advocates Alternative Portfolio). Cal Advocates then used this portfolio as the base case in its own production cost modeling runs. Cal Advocates also developed its own flawed assumptions regarding modeling of Arizona Solar. I discuss the flaws in the Cal Advocates Alternative Portfolio and Cal Advocates modeling of Arizona Solar in this section.

Q14. Is the Cal Advocates Alternative Portfolio valid for transmission planning purposes?

A14. No. The Cal Advocates Alternative Portfolio is not a valid portfolio for transmission planning purposes because Cal Advocates arbitrarily selected the underlying resources. The Cal Advocates Alternative Portfolio was not produced using either the Commission's 2017 or 2019 IRP resource optimization model.

Q15. Explain why the Cal Advocates Alternative Portfolio is invalid in the context of the 2017 IRP resource optimization.

A15. The Cal Advocates Alternative Portfolio is arbitrarily selected and is not a result produced by the RESOLVE resource optimization model. Unlike the portfolio the CAISO used in its analysis, which is a result of optimization using the latest RESOLVE model available at the time, Cal Advocates' portfolio is not optimized using any version of this Commission-adopted resource optimization model. As a result, the Cal Advocates Alternative Portfolio is uneconomic from the outset, and thus invalid. Cal Advocates' portfolio involves a much higher resource cost than the RESOLVE optimized portfolio used by the CAISO.

The Cal Advocates Alternative Portfolio significantly alters the CAISO's economically optimized portfolio. As can be seen from Table 17 of Cal Advocates' opening testimony, the Cal Advocates increased Riverside East_Palm Springs Solar by 677 MW; Southern_Nevada_Solar by 139 MW; NW_Ext_Tx_Wind by 195 MW; and reduced Arizona_Solar by 1,012 MW compared to the CAISO's economically-optimized portfolio.

Using RESOLVE, the CAISO demonstrated that the resource portfolio that includes 3,262 MW of Arizona Solar results in a resource cost saving of $977 million in present value of revenue requirements (PVRR) or $58 million in terms of annual levelized cost (ALC), both in 2016 dollars, compared to the portfolio without Arizona Solar.[38] Because Cal Advocates modeled only 2,352 MW of Arizona Solar, a simple calculation indicates that the Cal Advocates Alternative Portfolio would be roughly $273 million (2016 dollars) more expensive in terms of PVRR and $16 million more expensive in terms of

[38] CAISO – Yimer Opening Testimony, p. 15.

ALC, compared to the CAISO's optimized portfolio. In its effort to reduce the benefits of the Proposed Project, Cal Advocates arbitrarily created a resource portfolio that increases the total resource costs compared to the RESOLVE-optimized portfolio.

Q16. Explain the flaws in Cal Advocates' assumptions regarding how to model Arizona Solar.

A16. Cal Advocates' allocation of Arizona Solar to the Delaney, Hassayampa, and Hoodoo Wash substations is problematic. Cal Advocates' Table 18 in its opening testimony, which is reproduced as Table 6 below, shows how it chose to allocate the 2,352 MW of Arizona Solar with and without the Proposed Project.

Table 6: Comparison of CAISO's and Cal Advocates' Modeling of Arizona Solar

Substation (Location)	CAISO	Cal Advocates	CAISO (See Note 1)	Cal Advocates
	without Proposed Project		*with Proposed Project*	
Delaney	-	-	2,018.4	969.0
Hassayampa	1,682.0	1,411.2	672.8	829.8
Hoodoo Wash	1,682.0	940.8	672.8	553.2
Total (MW)	**3,364.0**	**2,352.0**	**3,364.0**	**2,352.0**

Note 1: The column was mislabeled in Cal Advocates Table 18 as "Cal Advocates Baseline"

First, without the Proposed Project, Cal Advocates allocated 60% (1411 MW) of the Arizona Solar to Hassayampa and 40% (941 MW) to Hoodoo Wash. These are allocated in proportion to the amount of FCDS resources requesting to connect to the CAISO grid at these two substations as represented in the CAISO generation interconnection queue.[39] By the same logic, with the proposed Project, Cal Advocates should have modeled 69% of the resource at Delaney Substation, and only 19% and 12% at Hassayampa and Hoodoo Wash substations, respectively. Instead, with the Proposed Project, Cal Advocates modeled only 41% of the Arizona Solar resource at Delaney substation while almost doubling the amount at Hassayampa (35%) and Hoodoo Wash (24%) that should have been allocated based on FCDS. These materially inconsistent assumptions between

[39] Cal Advocates Opening Testimony, Table 12, p. 2-42.

the modeling with and without the Proposed Project is another reason that Cal Advocates' PCM analysis and results are invalid.

Second, Cal Advocates also incorrectly ignores energy only projects in applying the commercial interest criterion as explained in response to Q&A 9 above; despite the fact that a substantial amount of the Arizona Solar resources selected by the resource optimization are energy only.

Q17. Explain why the Cal Advocates Alternative Portfolio is invalid in the context of the 2019-2020 RSP and the mapping of Arizona Solar for the 2020-2021 TPP.

A17. First, Cal Advocates claims its alternative portfolio models Arizona Solar capacity consistent with the Commission's 2019-2020 RSP, which selected 2,353 MW of Arizona Solar resources by 2030. However, the consistency of Cal Advocates Alternative Portfolio with 2019-2020 RSP ends there. Table 7 compares the Cal Advocates Alternative Portfolio with the 2019-2020 RSP in Southern CA Desert & Southern NV (SCADSNV) Transmission Zone, which represents the part of the transmission system that is most impacted by the Proposed Project. The table shows that the Cal Advocates Alternative Portfolio is entirely inconsistent with 2019-2020 RSP in the SCADSNV transmission zone, other than the amount of Arizona Solar.

The Cal Advocates Alternative Portfolio selects arbitrary quantities of Riverside_Palm_Springs_Solar, Southern_Nevada_Solar, and New_Mexico_Wind. The Cal Advocates Alternative Portfolio selects these resources without optimization and the quantities are materially different from those in the 2019-2020 RSP. As indicated in Dr. Zhang's testimony, the 2019-2020 RSP also includes other resources that the Cal Advocates' Alternative Portfolio either reduces in quantity or entirely excludes. The CAISO expects this to materially affect the benefits with and without the Proposed Project. These resources include New_Mexico_Wind (606 MW) delivered at Palo Verde and Greater_Imperial_Solar (548 MW) and Baja_California_Wind (600 MW) delivered at Imperial Valley/Ocotillo.

Table 7: Comparison of Cal Advocates' Alternative Portfolio with the 2019-2020 RSP in the Southern CA Desert & Southern NV (SCADSNV) Transmission Zone

RESOLVE Resource	Tx Zone	2029/2030 Resource Capacity (MW)	
		Cal Advocates Alternative Portfolio	2019-2020 RSP
Greater_Imperial_Solar	SCADSNV-Greater_Imperial	--	548
Riverside_Palm_Springs_Solar	SCADSNV- Riverside_Palm_Springs	677	--
Southern_Nevada_Solar/ SCADSNV_Solar	SCADSNV-GLW_VEA/SCADSNV	1,541	1,192
Riverside_Palm_Springs_Wind	SCADSNV-Riverside_Palm_Springs	42	--
Arizona_Solar	SCADSNV-Riverside_Palm_Springs	2,352	2,352
Baja_California_Wind	SCADSNV-Greater_Imperial	--	600
New_Mexico_Wind	SCADSNV-Riverside_Palm_Springs	256	606
Greater_Imperial_Geothermal	SCADSNV-Greater_Imperial	1,276	--

The CAISO notes that the California Energy Commission (CEC) mapped the renewable resources in the 2019-2020 RSP to specific substations through a sequenced transfer of information between the Commission, CEC and the CAISO. Though the total Arizona Solar resource selected is consistent with the 2019-2020 RSP, the Cal Advocates Alternative Portfolio does not allocate the Arizona Solar resource to the Delaney, Hassayampa, and Hoodoo Wash substations consistent with the CEC's 2019-2020 RSP mapping.[40] Table 8 provides a comparison between the CEC bus bar mapping and the Arizona Solar resource allocation in the Cal Advocates Alternative Portfolio.

Table 8: Comparison of Cal Advocates' mapping of Arizona_Solar with the CEC mapping of the Resource for the CAISO 2020-2021 TPP

Substation	Cal Advocates' Mapping (MW)		CEC Resource Mapping for 2020-2021 TPP (MW)
	Without Proposed Project	With Proposed Project	
Delaney	-	969	870
Hassayampa	1,411	830	259
Hoodoo Wash	941	553	1,223

[40] California Energy Commission - Bus Bar Mapping for 2019-2020, https://caenergy.databasin.org/documents/documents/b4dd2901cfc24a15b95792a026a41cb9/.

Total	**2,352**	**2,352**	**2,352**

Contrary to the CEC mapping efforts, Cal Advocates increased the Hassayampa substation share of the Arizona Solar to 60% and reduced the Hoodoo Wash substation share to 40% in the Cal Advocates Alternative Portfolio. This allocation is entirely inconsistent with the CEC mapping of Arizona Solar, which allocates only 259 MW to Hassayampa Substation and 1,223 MW at Hoodoo Wash. Using the CEC mapping, the 870 MW allocated to the Delaney substation would need to be redistributed without the Proposed Project.

IV. CAL ADVOCATES INCORRECTLY ARGUES THAT THE COMMISSION SHOULD IGNORE THE PROPOSED PROJECT'S RELIABILITY BENEFITS.

Q18. Are there other factors besides the economic benefits of the Proposed Project that you believe the Commission should consider in this proceeding?

A18. Yes. Although the Ten West Link Project was approved as an economic project with benefits exceeding its costs, it also provides significant reliability benefits. The CAISO identified reliability benefits in its initial documentation to its Board of Governors in requesting approval of the Proposed Project. These reliability benefits are included in Mr. Millar's opening testimony.[41] Cal Advocates' direct testimony asserts that the Commission should focus only on the economic benefits of the Proposed Project. Mr. Millar's rebuttal testimony explains that the Commission should not limit its review to economic benefits, but should instead review the entire suite of benefits provided by the Proposed Project. In this testimony, I describe the significant reliability benefits that the Proposed Project provides.

.**Q19. Please describe the reliability concerns and the relevant North American Electric Reliability Corporation (NERC) reliability standards that the Proposed Project can address.**

[41] *Testimony of Neil Millar on Behalf of the California Independent System Operator Corporation*, A.16-10-012, December 19, 2019, Attachment A, pp. 264-265.

A19. The Proposed Project is a 500 kV line that parallels the existing Palo Verde–Colorado River 500 kV line—one of the critical 500 kV lines serving southern California. The Proposed Project mitigates the reliability impacts of the loss of the Palo Verde–Colorado River 500 kV line. One reliability issue that the Proposed Project mitigates is the existing Path 46 System Operating Limit; which qualifies as an Interconnection Reliability Operating Limit,[42] as further explained below.

NERC reliability standards[43] require the CAISO, as a registered Planning Authority, to have a documented methodology for use in developing System Operating Limits, including those that qualify as Interconnection Reliability Operating Limits. The reliability standards also require CAISO to establish System Operating Limits, including Interconnection Reliability Operating Limits, for its Planning Authority Area that are consistent with its System Operating Limit Methodology.[44] In accordance with these standards, the CAISO has developed a System Operating Limit Methodology for the Planning Horizon,[45] and using that methodology, established System Operating Limits including those that qualify as Interconnection Reliability Operating Limits.

The CAISO identified only two multiple contingencies across its entire system that cause a System Operating Limit to qualify as an Interconnection Reliability Operating Limit because the contingencies could lead to instability, uncontrolled separation, or Cascading outages that adversely impact the reliability of the Bulk Electric System. One of these multiple contingencies is the overlapping loss of Palo Verde–Colorado River and North Gila–Imperial Valley 500 kV transmission lines. These critical overlapping outages

[42] The Glossary of Terms Used in NERC Reliability Standards defines an IROL as a System Operating Limit that, if violated, could lead to instability, uncontrolled separation, or Cascading outages that adversely impact the reliability of the Bulk Electric System.
[43] NERC Reliability Standard FAC-010-3 available at: https://www.nerc.com/pa/Stand/Reliability%20Standards/FAC-010-3.pdf and NERC Reliability Standard FAC-014-2 available at https://www.nerc.com/files/FAC-014-2.pdf.
[44]The Glossary of Terms Used in NERC Reliability Standards defines an IROL T_v as the maximum time that an IROL can be violated before the risk to the interconnection or other Reliability Coordinator Area(s) becomes greater than acceptable. Each Interconnection Reliability Operating Limit's Tv shall be less than or equal to 30 minutes.
[45] http://www.caiso.com/Documents/FAC-10-3-FAC-14-2SystemOperatingLimitsMethodology-PlanningHorizon.pdf#search=sol%20methodology.

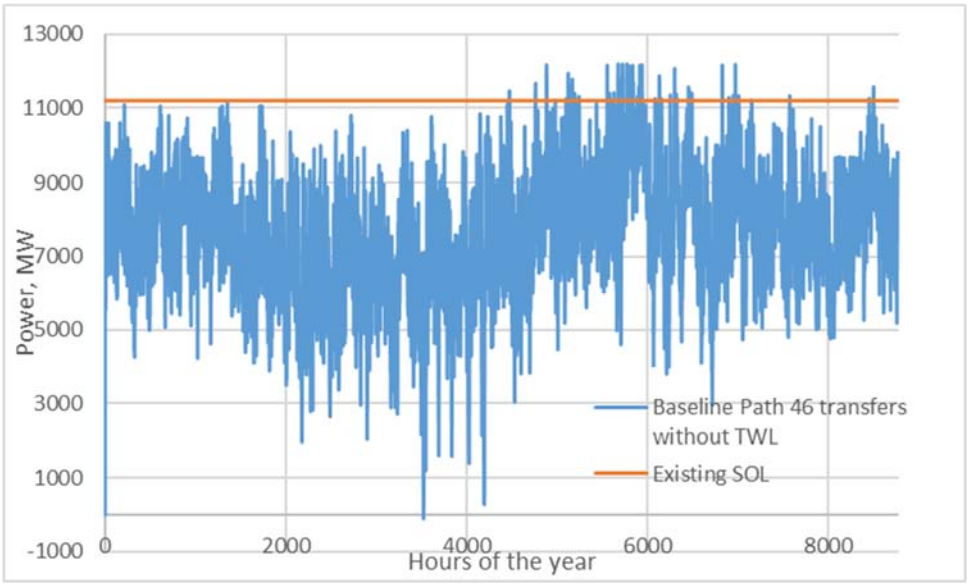
cause the existing Path 46 System Operating Limit (11,200 MW) to qualify as an Interconnection Reliability Operating Limit. If these contingencies occur while Path 46 is operating close to its System Operating Limit, the contingencies could lead to widespread instability, uncontrolled separation, or cascading outages that adversely impact the reliability of the Bulk Electric System unless transfers are reduced quickly enough[46] after the initial contingency. The CAISO first identified this Interconnection Reliability Operating Limit in the 2014-2015 Transmission Plan[47] and it was later updated with a Path 46 Interconnection Reliability Operating Limit Qualification Study in February 2020.

Figures 3 and 4 below provide projected transfers on Path 46 in 2029 based on Dr. Zhang's PCM results without the Proposed Project for the CAISO Baseline and Sensitivity cases.[48] The figures show there are a significant number of hours during which Path 46 is loaded close to or above its existing 11,200 MW System Operating Limit.[49] If the Proposed Project does not proceed, overlapping contingencies during these periods could lead to the widespread reliability impacts associated with the violation of an Interconnection Reliability Operating Limit.

For example, there are 81 hours and 217 hours in which Path 46 is loaded above 11,200 MW in the baseline and sensitivity cases, respectively. Similarly, there are 599 hours and 1,169 hours during which Path 46 is loaded above 10,000 MW in the baseline and sensitivity cases, respectively.

Figure 3: Projected Path 46 Transfers without Ten West Link in the Baseline Case

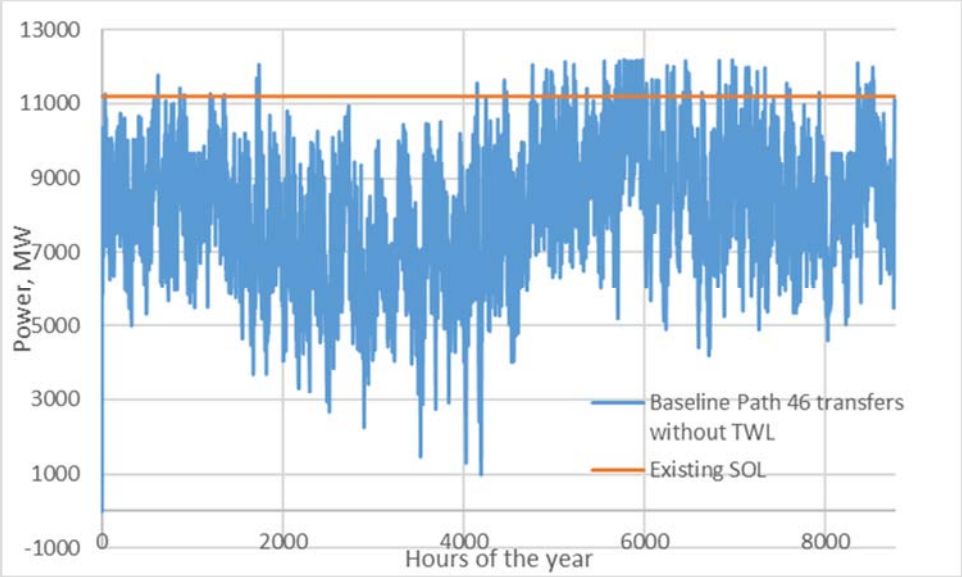
[46] Within the Interconnection Reliability Operating Limit Tv of 30 minutes.
[47] http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=55EBA03B-525E-438B-8D9A-C3C5B7B3DD3C, *See* for example pp. 94, 99 of the main report and pdf pages 417, 426 of Appendix C.
[48] *Response of the California Independent System Operator to Data Request Number Cal-Advocates-A1610012-CAISO-004 by the Public Advocates Office*, CAISO Response to Public Advocates Item No. at p. 3.
[49] Transfers on Path 46 exceed the existing SOL during some hours because the WECC approved future rating of 12,150 MW is modeled. The new rating will become effective when upgrades on the Lugo–Victorville 500 kV transmission line and certain series capacitors on SCE's and LADWP's Path 46 500 kV lines are in service.


13000
11000
9000
7000
5000
3000
1000
-1000
Power, MW
0
2000
4000
6000
8000
Hours of the year
Baseline Path 46 transfers without TWL
Existing SOL

1

2

Figure 4: Projected Path 46 Transfers without Ten West Link in the Sensitivity Case



As noted above, the Proposed Project creates a new 500 kV line that parallels the Palo Verde–Colorado River 500 kV line. As a result, it mitigates the reliability impacts of the loss of the Palo Verde–Colorado River 500 kV line, including the overlapping contingency with the Imperial Valley–North Gila 500 kV line, which could lead to the violation of the Path 46 Interconnection Reliability Operating Limit. As a result, the Proposed Project mitigates one of the Interconnection Reliability Operating Limits in the CAISO system that, if violated, could lead to widespread instability, uncontrolled separation, or cascading outages that adversely impact the reliability of the Bulk Electric System.

V. CONCLUSION

Q20. Please summarize your recommendations.

A20. For the reasons discussed above and in the concurrently filed testimony of Mr. Millar and Dr. Zhang, the Commission should approve DCRT's application for certificate of public convenience and necessity to construct the project.

Q21. Does this conclude your testimony?

A21. Yes, it does.

ATTACHMENT A