Selendy & Gay PLLC
Jennifer M. Selendy
Philippe Z. Selendy
Joshua S. Margolin
Shelby P. Rokito
1290 Avenue of the Americas
New York, NY 10104
212-390-9000
jselendy@selendygay.com
pselendy@selendygay.com
jmargolin@selendygay.com
srokito@selendygay.com

Attorneys for Vote Solar

BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

In the Matter of the Application of Rocky Mountain Power to Establish Export Credits for Customer Generated Electricity	**Docket No. 17-035-61 Phase 2**

SUR-SURREBUTTAL TESTIMONY OF MICHAEL MILLIGAN, PH.D.

ON BEHALF OF

VOTE SOLAR

February 22, 2021

Table of Contents

I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Michael Milligan. My business address is 9584 W 89th Avenue, Westminster, Colorado 80021.

Q. On whose behalf are you submitting this sur-surrebuttal testimony?

A. I am submitting this Sur-surrebuttal Testimony on behalf of Vote Solar.

Q. By whom are you employed and in what capacity?

A. I am the principal consultant with Milligan Grid Solutions, Inc., an independent power system consulting firm.

Q. Please summarize your education and professional experience.

A. I have a Ph.D. in Economics from the University of Colorado and a B.A. from Albion College in Mathematics. My experience includes working in the power system industry for about seven years. Then I was Principal Researcher at the National Renewable Energy Laboratory for 25 years, where I authored/co-authored more than 225 technical reports, journal articles, and book chapters. I served on multiple technical committees at the Western Electricity Coordinating Council and the North American Electric Reliability Corporation ("NERC"), which is the official reliability regulator in the U.S., and I was a charter member of the IEEE Wind and Solar Coordinating Committee. For many years I served on the International Energy Agency Task 25 – Large-scale Wind Integration – research team where I led multiple international research papers on integrating wind into the power system. As an independent consultant, my clients have included NERC, the Electric Power Research Institute, the Southwest Power Pool, GridLab, and multiple trade

and educational/research organizations. Exhibit 1-MM to my Revised Affirmative Testimony, filed May 8, 2020, provides a statement of my qualifications and experience.

Q. Have you previously testified before the Utah Public Service Commission ("PSC" or "Commission")?

A. Yes. I submitted Affirmative, Rebuttal, and Surrebuttal Testimony in Phase 2 of this Docket.[1] I also testified at the hearing before the Commission on October 2, 2020.

II. PURPOSE OF TESTIMONY

Q. What is the purpose of your testimony in this proceeding?

A. I explain why the Commission improperly reduced the avoided capacity cost in cents/kWh from my prior testimony. I also address Rocky Mountain Power ("RMP")'s erroneous application of my proxy capacity contribution method which purports to account for utility-scale solar, and I recommend that the Commission reject RMP's calculations.

III. SUMMARY OF RECOMMENDATIONS

Q. Please provide a brief summary of your recommendations.

A. First, I recommend that the Commission recognize that the avoided capacity cost calculated in my Surrebuttal Testimony is based upon a carrying charge of 6.959%, not the 9.39% figure that was used only in my Affirmative Testimony. Performing the calculation using the approved carrying charge of 7.82% results in a one-year (2021) avoided capacity

[1] Vote Solar, *Revised Affirmative Testimony of Michael Milligan*, May 8, 2020 ("*Milligan Revised Affirmative*"); Vote Solar, *Rebuttal Testimony of Michael Milligan*, July 15, 2020 ("*Milligan Rebuttal*"); Vote Solar, *Surrebuttal Testimony of Michael Milligan*, Sept. 15, 2020 ("*Milligan Surrebuttal*").

cost of 2.966 cents/kWh. The one-year avoided capacity cost as calculated in my workpapers should not be adjusted downward to 2.310 cents/kWh, but upward from 2.771 cents/kWh to 2.966 cents/kWh.

Second, I address RMP's erroneous application of my proxy capacity contribution method which purports to account for utility-scale solar. RMP utilizes a variation of my method that has not been validated, and does not correct for the problem of resource ordering in avoided capacity calculations. I restate my prior testimony regarding the methodological problems associated with RMP's approach. I recommend that the Commission reject RMP's proposed method for calculating capacity contribution and affirm the decision in its October 30, 2020 Order to adopt the capacity contribution approach proposed in my testimony.

My lack of comments on any component of other parties' testimony or any order issued by the Commission should not be interpreted as acquiescence or agreement. I reserve the right to express additional opinions, to amend or supplement the opinions in this testimony, or to provide additional rationale for these opinions as additional documents are produced and new facts are introduced. I also reserve the right to express additional opinions in response to any opinions, testimony, or orders in this proceeding.

IV. Annual Carrying Cost of Capacity

Q. What capital carrying charge did you use in your calculation of avoided capacity cost?

A. In my avoided capacity cost calculation I utilized the annual cost of capacity based upon RMP witness Daniel MacNeil's Rebuttal Testimony. This value is $88/kW-yr in 2026 dollars or $78.61/kW-year in 2021 dollars.[2] The exhibit referenced in Mr. MacNeil's testimony confirms this value is predicated upon a carrying charge of 6.959%.[3]

Q. Why was the adjustment in the Commission's October 30, 2020 Order incorrect?

A. The Commission erroneously assumed that my avoided capacity cost was based on the initial 9.39% carrying charge used in my Affirmative Testimony, and therefore reduced Vote Solar's proposed one-year avoided capacity cost of 2.771 cents/kWh by the ratio of 7.82/9.39 to arrive at an avoided capacity cost of 2.310 cents/kWh.[4]

---

[2] RMP, *Rebuttal Testimony of Daniel J. MacNeil*, July 15, 2020 ("*MacNeil Rebuttal*"), line 766.

[3] *Id*., n. 25 (citing Docket 20-035-T04, Apr. 9, 2020, RMP Attachment 7 - Workpapers Avoided Cost Study Thermal, tab "Table 3 185 MW (NTN) 2026)", cell C74).

[4] Oct. 30, 2020 Order at 16. The method the Commission used to adjust the avoided capacity cost is also flawed because it fails to correctly take into account the adjustment for inflation.

Q. What is the proper carrying charge for calculating avoided generation capacity cost?

A. I agree with Vote Solar witness Dr. Spencer Yang that 7.82% is an appropriate carrying charge rate for avoided generation capacity cost.[5]

Q. If you were to use RMP's carrying charge of 7.82%, how would your avoided capacity cost change?

A. I based my avoided capacity cost calculation upon RMP's annualized capacity cost, which uses a 6.959% carrying charge.[6] Adjusting my calculation to account for the 7.82% annual carrying charge that the Commission adopted in its October 30, 2020 Order,[7] the resulting avoided capacity cost increases from my proposed one-year avoided cost of 2.771 cents/kWh to 2.966 cents/kWh.

V. Avoided Generation Capacity

Q. Please summarize your capacity contribution method for CG solar.

A. I calculate the capacity factor of CG solar for the top 10% of load hours.[8] This approximates the effective load carrying capability (ELCC) of the individual resource. This approximation method can be used for any resource. It differs from ELCC in that it avoids arbitrary changes in a resource's capacity contribution caused by resource ordering.

---

[5] Vote Solar, *Sur-Surrebuttal Testimony of Spencer S. Yang*, Feb. 22, 2021 ("*Yang Sur-Surrebuttal*"), lines 37-40, 151-54.

[6] *See* Vote Solar Workpaper 1 – MM (Feb. 22, 2021).

[7] Oct. 30, 2020 Order at 16.

[8] *Milligan Revised Affirmative*, lines 506-11.

Resource ordering refers to the fact that the ELCC of a resource depends upon the order in which it was put into the ELCC calculation relative to other resources. I discuss this issue in my Surrebuttal Testimony.[9]

Q. Do you recommend an approach that avoids the difficulties posed by the sensitivity to resource ordering in the calculation?

A. Yes. I recommend an approach where each resource can be added separately, one at a time, to the capacity proxy calculation. When this is done, the arbitrary nature of the ordering of resource additions is avoided and each resource is credited with capacity contribution that is independent of other new resources. This is the approach I used to calculate the capacity contribution of CG exports throughout this proceeding. My approach is transparent, unlike the weighted loss-of-load probability (LOLP) approach that RMP proposes. Furthermore, RMP's proposed LOLP method utilizes fragments of two different, non-contiguous years, further obfuscating the calculation and introducing LOLP weights that will most certainly not obtain in reality, thereby invalidating the calculations altogether.[10]

Q. What year should the analysis draw from?

A. RMP uses a backward-looking analysis that is, in part, based upon 2019 demand. However, this proceeding is focused on a rate for 2021, and has therefore utilized projected data for 2021 (or later). As such, I continue to recommend using the 2021 data. There is

[9] *Milligan Surrebuttal*, lines 420-69.

[10] *Milligan Revised Affirmative*, lines 423-25 ("PacifiCorp utilizied a LOLP model to calculate hourly LOLP value for its system by constructing a sample year with energy-not-served data (an output from an LOLP model), from June-September of 2030, and October-May from 2036").

no evidence that adding additional 2019 data to this proceeding will increase the accuracy of the results.

Q. Please summarize the method that RMP used to calculate avoided capacity for CG solar.

A. RMP's valuation of CG solar capacity was based upon the LOLP methodology set forth by PacifiCorp in its 2019 Integrated Resource Plan ("IRP"). LOLP measures the likelihood that electricity supply will not be sufficient to meet demand. It can be calculated for every hour of the year. The primary drivers of the LOLP values include (a) installed capacity, (b) resource outage rates, (c) hourly generation from renewable sources, and (d) level of demand.[11]

Q. Do you agree with the method that RMP used to calculate avoided capacity for CG solar?

A. No. RMP's approach has several flaws, which I describe below.

Q. Please summarize your testimony regarding the deficiencies of RMP's weighted LOLP approach.

A. As I explained in my Revised Affirmative Testimony, RMP's proposal, based upon PacifiCorp's LOLP-weighting approach, is deficient because "(1) it is based upon a method that has been shown to be less accurate than other simplified approximations to ELCC and (2) it is based solely on hourly LOLP values from two half-years that are

[11] *Milligan Surrebuttal*, lines 410-12.

unlikely to represent periods of long-term risk, which is what LOLP methods are intended to do."[12]

PacifiCorp's LOLP-weighting is also flawed because it applies a single set of weights from an artificially constructed, single year of data. In addition, there is an implicit assumption in this approach that all years, including 2019, 2020, and 2021, would have identical risk profiles throughout the year. As discussed in my Revised Affirmative Testimony, this is implausible especially because the artificially constructed year is based on the periods from June-September of 2030 and October-May of 2036.[13] These time periods are not even contiguous, and therefore the results are certainly incorrect.

Q. RMP argues that existing utility-scale solar should be added to the capacity model prior to evaluating CG exports.[14] Do you agree with this approach?

A. No. RMP argues that CG solar should receive a low capacity value because it should be the last solar resource added to the generation mix. Specifically, RMP argues that CG solar should be added to the calculation after the recently deployed level of utility-scale solar is already accounted for.[15] As explained in my Revised Affirmative and Rebuttal Testimony, it is well-established that the ELCC method used in PacifiCorp's 2019 IRP results in declining capacity contribution of solar as solar penetration increases.[16] ELCC measures a resource's contribution to long-term reliability*, as a function of a large*

---

[12] *Milligan Revised Affirmative*, lines 429-33.

[13] *Id*., at lines 423-25.

[14] RMP Response to Petitions for Review and/or Rehearing (Dec. 15, 2020), at 15-16.

[15] *MacNeil Rebuttal*, lines 726-32.

[16] *Milligan Rebuttal*, lines 738-49.

number of other factors and properties of other resources that are assumed to be fixed at the time the ELCC is calculated. This means that the ELCC for any given resource depends heavily upon the order in which it was added to the ELCC calculation. The ELCC for CG solar therefore depends on whether the CG resource is added to the calculation before or after the utility-scale solar in question. However, this ordering of resources is arbitrary and results in vastly different estimates of a given resource's capacity contribution.

Q. Please explain why CG solar would receive a lower capacity contribution if utility-scale solar were added to the resource mix first.

A. RMP's capacity calculations are based upon PacifiCorp's 2019 IRP. The 2019 IRP uses the ELCC method to calculate capacity contribution of various renewable resources. As explained above, ELCC declines as more resources are added to the calculation. This decline occurs because each new resource reduces the risk of having insufficient resources to meet demand. After adding a resource, the remaining risk is less than it was prior to adding the resource. This in turn diminishes the extent to which the next resource can reduce risk; accordingly, the next resource receives a lower capacity contribution. Thus, if utility-scale solar is added to the ELCC model first, CG solar will most likely receive a capacity value that is lower than what it would have received had CG solar been added to the calculation before utility-scale solar. This means that each resource's capacity contribution is highly dependent upon the order in which it was added to the calculation.

Q. Is there evidence in this proceeding that resource ordering influenced RMP's proposed capacity contribution for CG Solar?

A. Yes. My Surrebuttal Testimony contains a detailed discussion regarding the flaws of utilizing declining capacity contributions in rate development.[17] RMP's testimony expressly acknowledges the sensitivity of capacity contribution to resource ordering. As Mr. MacNeil points out in his Rebuttal Testimony, he calculated the capacity contribution of CG exports that ranged from 4.1% to 22% of rated capacity, depending upon the order in which CG exports were added to the calculation.[18] If CG solar is considered first, its value is 22% of rated capacity, and if it is considered after the operating and contracted utility-scale solar, the capacity contribution of CG solar is 4.1%.

Q. Has PacifiCorp recognized that the potential issues that resource ordering introduces?

A. Yes. In its development of the 2021 IRP, PacifiCorp recognized that the order in which resources are added to the mix can have a substantial impact on each resource's capacity contribution.[19] At a July 2020 public input meeting in preparation for the 2021 IRP, PacifiCorp proposed a method that acknowledges that the composition of the existing resource mix influences the capacity contribution of the resource in question. As I explained in my Surrebuttal Testimony, materials from the July 30-31, 2020 IRP

[17] *Milligan Surrebuttal*, lines 443-69.

[18] *MacNeil Rebuttal*, lines 722-32.

[19] 2021 IRP Public Input Meeting, July 30-31, 2020, https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/07-30-31-2020_PacifiCorp_2021_IRP_PIM.pdf at 42-43.

public input meeting show PacifiCorp attempting to rectify the arbitrary ordering of resources by proposing a method that evaluates the impact of a given resource type on capacity contribution. This is done by differentiating the "first-in" contribution, which is calculated by adding the solar to a portfolio consisting solely of capacity resources, and "last-in" contribution, which is based upon a resource mix that includes all other portfolio resources.[20] PacifiCorp ultimately proposes a "portfolio contribution" for solar energy, which accounts for both the first-in and last-in calculations.[21] As noted in my Surrebuttal Testimony, this portfolio contribution methodology is advantageous because it can avoid the problems associated with the different ordering of solar resources in the model by calculating the capacity contribution of all solar as a group.[22] PacifiCorp acknowledges in its presentation that the capacity contribution of a given resource differs significantly depending upon the order in which it was added to the calculation.[23] PacifiCorp specifically states that "[a]ttributing inter-related contributions to individual resource types is somewhat arbitrary, as the order of the analysis matters."[24] PacifiCorp further states that capacity contribution for solar was previously evaluated as a function of a single variable: solar capacity.[25] Instead, a "multi-variate solution" should be pursued so that solar capacity contribution is calculated "as a function of the characteristics of all other resources (i.e.

[20] *Id*. at 42.

[21] *Id.*

[22] *Milligan Surrebuttal*, lines 484-90.

[23] *Supra* note 19 at 42.

[24] *Id*.

[25] *Id*. at 47.

wind and storage)."[26]

Q. Please summarize the key points put forward by PacifiCorp in its July 2020 public input meeting.

A. PacifiCorp proposes that its prior approach of calculating the capacity contribution of solar energy solely as a function of its penetration rate is flawed, and that it should be replaced by a more robust method that can account for the issues associated with the arbitrary results of resource ordering. PacifiCorp's proposal in its 2020 public input meeting materials is largely consistent with my testimony.

Q. Is RMP's proposal for capacity contribution of CG solar in this proceeding consistent with the approach outlined in PacifiCorp's 2020 public input meeting?

A. No. RMP's evaluation of the capacity contribution of CG solar does not recognize the shortcomings associated with resource ordering.

Q. Are there other issues that arise from using an approach, such as ELCC, that is sensitive to the order in which resources are added to the calculation?

A. Yes. In my Surrebuttal Testimony I describe other methodological problems associated with the declining capacity valuation approach and I explain how it violates the principle of horizontal equity.[27] In a simplistic example I demonstrate that two otherwise identical solar plants that perform in precisely the same way would have different capacity values according to the approach for which RMP advocates. In this example, where Plant

[26] *Id*.

[27] *Milligan Surrebuttal*, lines 453-64.

A is added first, its capacity value would be 15% and Plant B's would be 2%. These plants are identical with respect to their power delivery and timing, and yet they have different capacity contributions. Thus, in deriving an avoided capacity cost for these two identical plants, we would find that they have different avoided capacity costs even though their performance is precisely the same. This example demonstrates the way in which the declining capacity approach that RMP advocates for in this proceeding violates the principle of horizontal equity. As I explained in my Surrebuttal Testimony, "[t]he rather arbitrary ordering of resources and resulting violation of the principle of horizontal equity imply that ELCC cannot effectively be translated into a market, nor can it be consistently used to determine avoided capacity payments. ELCC and equivalent conventional power ("ECP") are useful and important reliability metrics. However, some form of proxy should be used to craft a rate that compensates a resource for its capacity contribution."[28]

Q. If a declining capacity contribution is calculated for two identical CG resources using RMP's example of 22% and 4.1% based on resource order, what is the implication?

A. The price per avoided kW would be the same; however, using RMP's declining capacity contribution approach, the first of two identical CG resources would be credited at 22% of rated capacity and the second resource would be credited at 4.1%, using MacNeil's example.[29] The first resource would earn 5.4 (22/4.1) times as much as the second; yet each resource would be providing identical service.

[28] *Id*. at 464-69.

[29] *Supra* note 18.

Q. Did RMP apply your proxy method to evaluate the impact of resource ordering?

A. RMP provides a calculation that purportedly uses my capacity factor approach to calculate the avoided capacity of CG exports after accounting for currently installed utility scale solar.[30] However, RMP's method continues to suffer from the problems of resource ordering. The method RMP proposes the Commission adopt is an ad hoc method that has not been shown to be valid or reliable. And even if this method were to be successfully validated to match ELCC calculations, RMP's approach does not avoid the arbitrary result of incrementally adding resources to the calculation. Therefore, the Commission should reject RMP's calculations as it did in the October 30, 2020 Order.

VI. SUMMARY OF RECOMMENDATIONS

Q. Please summarize your recommendations.

A. I recommend that the Commission revise its calculation of avoided generation capacity cost to correct for the proper carrying charge, resulting in an increase from 2.310 cents/kWh to 2.966 cents/kWh. I further recommend that the Commission affirm its October 30, 2020 decision to adopt Vote Solar's approach for calculating avoided capacity contribution.

Q. **Does this conclude your Sur-Surrebuttal Testimony?**

A. Yes.

[30] RMP Response to Petitions for Review and/or Rehearing (Dec. 15, 2020), at 15-16.

CERTIFICATE OF SERVICE

I hereby certify that on this 22nd day of February, 2021 a true and correct copy of the foregoing was served by email upon the following:

DIVISION OF PUBLIC UTILITIES:

Chris Parker	chrisparker@utah.gov
William Powell	wpowell@utah.gov
Patricia Schmid	pschmid@agutah.gov
Justin Jetter	jjetter@agutah.gov
Erika Tedder	etedder@utah.gov
	dpudatarequest@utah.gov

OFFICE OF CONSUMER SERVICES:

Michele Beck	mbeck@utah.gov
Cheryl Murray	cmurray@utah.gov
Robert Moore	rmoore@agutah.gov
Steve Snarr	stevensnarr@agutah.gov
Bela Vastag	bvastag@utah.gov

SALT LAKE CITY CORPORATION:

Tyler Poulson	tyler.poulson@slcgov.com
Megan DePaulis	megan.depaulis@slcgov.com

UTAH SOLAR ENERGY ASSOCIATION:

Amanda Smith	asmith@hollandhart.com
Ryan Evans	revans@utsolar.org
Engels J. Tejada	ejtejada@hollandhart.com
Chelsea J. Davis	cjdavis@hollandhart.com

WESTERN RESOURCE ADVOCATES:

Nancy Kelly	nkelly@westernresources.org
Steven S. Michel	smichel@westernresources.org
Sophie Hayes	sophie.hayes@westernresources.org

UTAH CLEAN ENERGY:

Sarah Wright	sarah@utahcleanenergy.org
Kate Bowman	kate@utahcleanenergy.org
Hunter Holman	hunter@utahcleanenergy.org

VOTE SOLAR:

Sachu Constantine	sachu@votesolar.org
Claudine Custodio	claudine@votesolar.org
Ronny Sandoval	ronny@votesolar.org
Jennifer M. Selendy	jselendy@selendygay.com
Philippe Z. Selendy	pselendy@selendygay.com
Joshua Margolin	jmargolin@selendygay.com

AURIC SOLAR:

Elias Bishop	elias.bishop@auricsolar.com

ROCKY MOUNTAIN POWER:

Yvonne Hogle	yvonne.hogle@pacificorp.com
Jana Saba	jana.saba@pacificorp.com
Joelle Steward	joelle.steward@pacificorp.com
	datarequest@pacificorp.com
	utahdockets@pacificorp.com

VIVINT SOLAR, INC:

Stephan F. Mecham	sfmecham@gmail.com

/s/ *Joshua S. Margolin*