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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** **Vivint Solar Exhibit I** **Phase 2**

DIRECT TESTIMONY OF CHRISTOPHER WORLEY
FOR VIVINT SOLAR, INC.

March 3, 2020

I. INTRODUCTION

Q. Please state your name, business address and position with Vivint Solar.

A. My name is Christopher Worley. My business address is 1800 W. Ashton Blvd, Lehi, Utah 84043. I am Director of Rate Design with Vivint Solar.

Q. Please describe your education and professional experience.

A. I have a bachelor's degree in English from the University of Colorado at Denver, and a master's degree and doctorate in Mineral and Energy Economics from the Colorado School of Mines. I have been employed by Vivint Solar since 2017. Before joining Vivint Solar, I was the Director of Policy and Research for the Colorado Energy Office, where I led legislative and regulatory efforts, including testifying before the Colorado Public Utilities Commission.

Q. Have you testified before the Utah Public Service Commission?

A. Yes, I testified in Phase 1 of this case.

II. SUMMARY AND RECOMMENDATIONS

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to provide the Commission:

- The policy context for their decision in this case,
- A list of key principles that should be considered when adjudicating this case, and
- Recommendations on the value of power exported from behind-the-meter distributed energy resources ("DER")

Q. What is your recommendation on the value of power exported from distributed energy resources?

A. DER provide many benefits to Rocky Mountain Power's ("RMP") grid, including avoiding short-term marginal costs (like avoiding wholesale power purchases) and long-term marginal costs (like investments in RMP's generation fleet and in transmission and distribution systems). Based on my conservative calculations, the solar export credit rate should be set to at least the current Schedule 136 Transition Program rate of 9.2 cents/kWh.

Table 1: Value of export credit factors

Factor	Value (cents/kWh)
Avoided energy (including system losses)	3.37
Avoided generation capacity	2.22
Avoided transmission capacity	1.90
Other factors (including avoided distribution capacity, hedging value, resilience, environmental benefits, others)	At least 1.71
Export credit floor	**At least 9.20**

Some of the benefits of DER can be easily quantified, but some values are more qualitative in nature. While I do not quantify all potential DER values in my analysis, the Commission should consider all factors when setting the export credit rate.

Q. Are you suggesting that the Commission include intangible values within utility rates?

A. No, I am recommending the Commission use judgement when weighing the value of some benefits that may be difficult to quantify. The lack of a methodology for quantifying a factor should not mean that factor has zero value. Ratemaking requires the Commission to adjudicate and weigh both quantitative and qualitative factors when setting just and reasonable rates. Other factors that have been assessed in value of solar studies around the country include:

- avoided distribution system capacity
- avoided fuel hedging costs
- avoided ancillary services costs, like voltage control and frequency response
- environmental benefits, including reduced CO2 emissions, reduced criteria air pollutants (SOx, NOx, PM), and reduced water use
- increased system reliability and resilience
- economic development benefits, including jobs and tax revenue

While I have not provided estimates of these values, the lack of a quantified estimate should not be seen as valuing those factors as zero. For example, the value DER of increasing the resilience of Utah's electrical grid is difficult to estimate, though most would agree the value is not zero. If other parties in this case have chosen to develop estimates, I recommend the Commission consider those estimates.

Q. Do you have other recommendations on how the export credit rate should be structured?

A. Yes. The export credit should be netted on an hourly basis and should be fixed for twenty years. The Commission should revise and update the export credit rate every three to five years, at which time new solar customers would have the updated export credit rate fixed for twenty years.

III. POLICY IMPLICATIONS

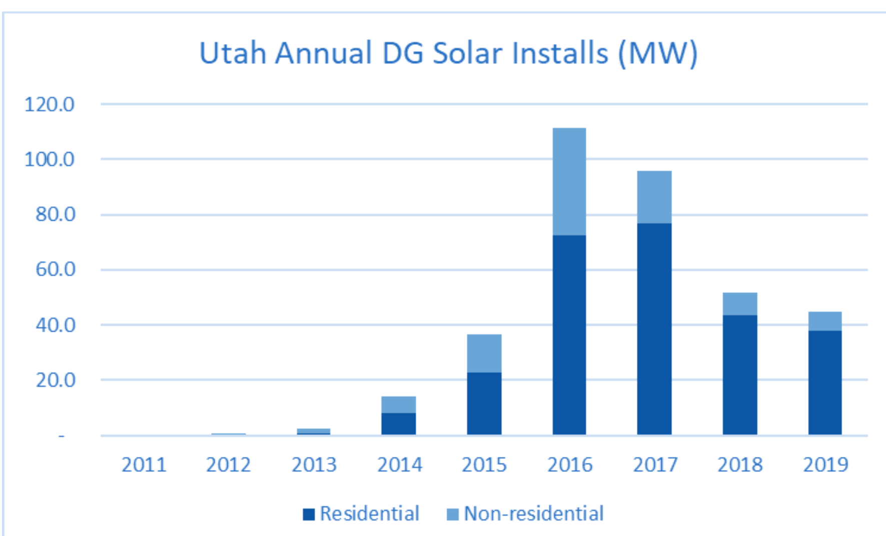
Q. What are the broad policy implications of the Commission's decision in this case?

A. Changes to the export credit rate impact the ability for Utah homeowners to invest in solar as a way to control their electricity bill. Furthermore, by changing the export credit rate, the Commission risks harming dozens (if not hundreds) of Utah businesses that serve different parts of the solar supply chain, including installation companies, distributors, and manufacturers of parts. The Commission's decision in 14-035-114 similarly had a large impact on solar installers and potential solar customers.

Q. How has the Transition Program impacted Utah's solar industry?

A. While I cannot speak for Utah's entire solar industry, I have heard anecdotally that many solar businesses have shut down or shut down their Utah operations as a result of the change to Schedule 136. And from a customer perspective, the number of Utahns investing in solar has dramatically declined since 2018 (see Figure 1).

Figure 1: Annual DG solar installs in Utah (data: Wood Mackenzie Power and Renewables)



Q. What impact has the change to the Transition Program had on Vivint Solar?

A. To our knowledge, no Vivint Solar employees were laid off as a result of the change to the Schedule 136 Transition Program. Vivint Solar is a national solar installer, while we are headquartered in Lehi, UT, we operate in 22 states and the District of Columbia. Given the reduced value of exports, the value proposition to investing in solar is reduced. As a result, Vivint Solar's sales volume in Utah has declined dramatically and employee resources have shifted to other states. While Vivint Solar may not have laid off employees, our employees are working in or supporting our work in other states. That said, it is unclear how many Utah-based sales or installation staff may have left the company to work in a different industry due to reduced work within Utah.

Q. How should the Commission balance the policy issues in this case?

A. The Commission should keep in mind the scale of this issue now and into the future. The change to the Schedule 136 Transition Program has slowed the installation of solar during a time of load growth and an increasing customer base for RMP. During 2018 and 2019, RMP has added an average of 20,000 new residential customers annually.[1] Given slowing solar installations and increasing customer demand, any concerns about "cost shifting" or lost revenue are decreasing in scale over time. The Commission should use the export credit rate to align customer incentives with grid incentives. Based on my initial calculations, a dramatic reduction in the export credit rate is not justified with respect to cost causation and cost allocation principles. And a drastic reduction in the export credit rate would be catastrophic for the Utah solar industry.

[1] UCE Information Request 5.2: New residential customers: 16,036 in 2017, 20,457 in 2018, 19,543 in 2019

IV. KEY PRINCIPLES

Q. How can the Commission balance the public policy implications of this case?

A. I recommend the Commission consider a set of key principles for their policy decision. These principles will assist the Commission in identifying policies that allow customers to invest in solar if they choose to do so, enable a viable market for solar installers in the state, and ensure fairness to all customers.

1. *Solar customers should receive fair compensation for the value provided to the grid.*
   Installation of behind-the-meter DER defers and avoids short-term and long-term marginal costs for utilities, thereby reducing costs for all customers. However, customers will not invest in solar unless they receive the benefit of bill savings.
2. *Solar policies should be certain and only change gradually.*
   Investing in solar requires certainty in the terms of investment. The possibility of changing terms adds risk to the investment and will reduce the number of customers that invest in solar.
3. *Solar policies should be understandable for customers.*
   Complicated policies introduce ambiguity and risk into the solar investment process. Wherever possible, the rules and procedures for investing in solar should be transparent.
4. *Solar policies should not treat retail customers like independent power producers.*
   Customers invest in behind-the-meter solar to control and reduce their energy bills. Independent power producers build generators to sell to power to utilities or into markets and earn a rate of return on their investment through the sale of a commodity.

The Commission's solar policies should treat solar customers and independent power producers as separate and distinct groups.

Following these principles will provide an opportunity for customers to invest in behind-the-meter solar if they choose to do so, and will enable a viable, competitive market for solar installers.

V. EXPORT CREDIT FACTORS

Q. What export credit values have you estimated?

A. I have calculated values for three factors: avoided energy, avoided generation capacity, and avoided transmission capacity.

Q. Are those the only factors the Commission should consider?

A. No. The Commission should include the value of all quantitative and qualitative factors when adjudicating this issue. Based on my calculations, the three factors I have estimated provide system value of 7.49 cents/kWh, however I am recommending the Commission set the export credit rate to at least 9.2 cents/kWh given the many other benefits solar provides to the grid. The Commission could use estimates of other factors that parties bring forth in this case, or the Commission could use judgement on qualitative factors when assessing the difference between 7.49 cents and 9.2 cents/kWh or some higher value.

A. AVOIDED ENERGY

Q. How does behind-the-meter solar avoid energy generation?

A. Behind-the-meter solar generates electricity during peak times. Some of that electricity is consumed on site, and some may be exported to the grid. But all of the electricity generated by the DER reduces the need for RMP to generate or to purchase energy.

Q. What is your recommendation for the value of avoided energy?

A. I recommend valuing avoided energy at 3.37 cents/kWh.

Q. How was that value calculated?

A. The value was calculated using average locational marginal price ("LMP") data from the CAISO Energy Imbalance Market. Specifically, I collected 15-minute data LMP data for a node in downtown Salt Lake City[2] for the years 2017 through 2019. The 15-minute data was averaged into hourly data and was then used to generate average prices for each hour of each month. More than 90% of solar production occurs between the hours of 9 AM and 7 PM, so the average value of avoided energy was created by averaging only those hours.

[2] Node WTEMPLE_NODED1

Table 2: Average locational marginal prices by month and by hour (2017-2019)

	9	10	11	12	13	14	15	16	17	18	19	Monthly average
Jan	35.31	31.04	27.04	25.57	23.67	23.11	25.03	30.59	42.97	54.68	50.70	33.61
Feb	38.57	33.28	28.07	25.57	24.01	23.36	23.08	29.19	44.31	70.09	83.30	38.44
Mar	28.71	22.25	18.73	14.01	12.81	12.05	12.47	14.68	20.03	32.63	53.27	21.97
Apr	20.23	16.25	12.33	10.33	9.38	10.59	10.11	13.13	17.48	24.29	43.02	17.01
May	15.58	14.53	13.24	11.68	11.07	13.54	13.61	16.43	18.23	21.54	36.58	16.91
Jun	16.48	16.22	17.11	18.46	18.94	22.20	23.59	27.04	35.69	37.92	70.24	27.63
Jul	25.92	26.27	28.43	30.33	32.31	37.72	40.94	44.68	43.02	46.84	62.03	38.04
Aug	27.34	27.70	29.33	31.49	34.20	38.55	44.01	52.31	58.21	66.59	93.45	45.74
Sep	27.19	24.82	24.22	26.54	27.59	31.03	33.04	37.87	47.19	62.11	104.07	40.51
Oct	32.65	27.56	25.29	24.90	25.68	27.77	29.30	31.60	36.23	66.68	118.21	40.53
Nov	36.78	33.23	31.71	30.21	30.20	31.66	34.35	45.89	63.03	90.38	61.89	44.48
Dec	38.69	35.09	33.52	30.25	28.96	28.98	31.54	39.56	56.27	58.91	53.82	39.60
Hourly Average	28.58	25.66	24.08	23.28	23.25	25.08	26.80	31.95	40.18	52.56	69.09	**33.68**

Q. Does your avoided energy value include the value of avoided line losses?

A. Yes. The CAISO EIM calculates locational and time-specific bid adders for LMP prices. Those "adders" are negative values for line losses, GHG value, and the lost value from transmission congestion. Instead of using the bid price (which includes the adders), I used the base LMP price data. Therefore, the base LMP price implicitly includes the value of avoided line losses.

B. AVOIDED GENERATION CAPACITY

Q. How do behind-the-meter DER avoid generation capacity?

A. To the extent that behind-the-meter DER generate electricity during peak times, those systems reduce on-site customer load, and when power is exported to the grid, that power will be consumed and reduce the load of neighboring homes and businesses. One customer installing a solar system on their roof reduces RMP's peak load now and for the lifetime of that system. Many customers installing solar reduces RMP's peak load forecast in their IRP, thereby reducing future resource needs. For these reasons, the export credit rate should include the value of avoiding new generation capacity.

Q. What value do you recommend for avoided generation capacity?

A. I recommend a credit of 2.22 cents/kWh.

Q. How did you calculate that value?

A. I estimated the cost of building a new natural gas peaking plant, and then determined the amount of new capacity that solar avoids. According to the 2019 update to Lazard's Levelized Cost of Energy report, the capital cost of new gas peaking plants is estimated to fall within the range of $700 and $950 $/kW.[3] I chose $825/kW, which is the average of that range, and multiplied by a carrying charge of 9.39%. The carrying charge was found in a marginal cost of service study that Pacificorp filed with the California Public Utilities Commission in 2018.[4] I then multiplied by the capacity contribution of solar (0.42) used by Pacificorp's in its 2019 Integrated Resource Plan. Finally, I divided by 1463, which is the expected annual hours for a 1 kW solar PV system installed in downtown Salt Lake City.[5] The result is $0.02224/kWh (or 2.22 cents/kWh).

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[3] Lazard's Levelized Cost of Energy Analsyis--Version 13.0 https://www.lazard.com/media/451086/lazards-levelized-cost-of-energy-version-130-vf.pdf

[4] https://www.pacificpower.net/content/dam/pcorp/documents/en/pacificpower/rates-regulation/california/filings/docket_a_18_04_002/4-12-18_application/14_Exhibit_PAC_1202_REDACTED.pdf

[5] PVWatts

Table 3: Calculation of avoided generation capacity

Step	Value
Capital cost ($/kW)	825
x 9.39% carrying charge	77.47
x 0.42 capacity contribution of solar	32.54
/ 1463 annual hours ($/kWh)	0.02224
/ 100 (cents/kWh)	2.22

C. AVOIDED TRANSMISSION CAPACITY

Q. How do behind-the-meter DER avoid investment in transmission capacity?

A. The extent to which behind-the-meter solar generates power at peak times, then DER are reducing the load on the transmission system and deferring or avoiding the need to build additional transmission capacity.

Q. What value do you recommend for avoided transmission capacity?

A. I recommend a credit of 1.90 cents/kWh.

Q. How did you calculate that value?

A. I used the National Economic Research Associates (NERA) method for calculating long-run marginal capacity costs, which has been used in marginal cost studies since the 1970s. I collected data from 2001 to 2018 on transmission investment and peak load from Pacificorp's FERC Form 1 filings, and ran a regression of transmission investments against its peak demand. In this method, the slope of the regression line is the marginal cost of transmission capacity in $/kW.

Table 4: Pacificorp transmission investment and peak load (2001-2018)

	Peak load (MW)	Transmission Investment ($, cumulative)
2001	7,899	7,029,271
2002	8,549	18,598,096
2003	8,922	39,011,131
2004	8,628	44,417,295
2005	8,937	65,581,713
2006	9,322	104,655,206
2007	9,775	185,972,954
2008	9,501	197,829,946
2009	9,420	227,634,195
2010	9,418	867,242,811
2011	9,431	872,033,442
2012	9,831	878,350,868
2013	10,507	1,212,984,783
2014	10,314	1,212,984,783
2015	10,621	1,542,137,107
2016	10,139	1,546,219,190
2017	10,334	1,568,698,178
2018	10,551	1,570,214,479

The regression resulted in marginal cost of transmission (i.e., the slope variable) of $705/kW, which is highly significant at the 0.01 level.

Table 3: Regression results

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-6.07E+09	1001613107	-6.06039	1.65282E-05
Slope	705.55118	104.436846	6.755769	4.61606E-06

As with the avoided generation capacity calculation, to estimate the capacity that can be avoided by solar, I multiplied by the carrying charge, the capacity contribution of solar, and the expected annual hours of solar production. The result is $0.0190/kWh (or 1.90 cents/kWh).

Table 4: Calculation of avoided transmission capacity

Step	Value
Marginal cost of transmission capacity ($/kW)	705
x 9.39% carrying charge	66.25
x 0.42 capacity contribution of solar	27.83
/ 1463 annual hours ($/kWh)	0.0190
/ 100 (cents/kWh)	1.90

D. OTHER FACTORS

Q. Are there other factors you have not included that the Commission should consider?

A. Yes, value of solar studies often include many other categories of value, such as:

- avoided distribution system capacity
- avoided fuel hedging costs
- avoided ancillary services costs, like voltage control and frequency response
- environmental benefits, including reduced CO2 emissions, reduced criteria air pollutants (SOx, NOx, PM), and reduced water use
- increased system reliability and resilience
- economic development benefits, including jobs and tax revenue

Some of these factors can be quantified and some are more qualitative in nature. Some factors are directly linked with RMP's cost of serving customers, and some factors have not been traditionally included in utility rates. While I am not providing estimates of these values at this time, I argue that the aggregate sum of these values is greater than 1.71 cents/kWh. Other parties in the case may choose to provide estimates for some or all these values, and I support Commission consideration of those estimates.

Q. Should the Commission assign a value in rates for qualitative factors or factors where quantitative estimates are controversial or under dispute?

A. The Commission could decline assigning a specific value to the cost of water use, the benefits of tax revenue, or any of the factors. The Commission has broad authority to set rates on quantitative and qualitative factors and should consider and include qualitative factors when setting the export credit rate.

VI. NETTING PERIOD

Q. How is solar energy production "netted" with on-site energy consumption under the Schedule 135 and 136 tariffs?

A. Schedule 135 customers have monthly netting[6] and Schedule 136 customers have 15-minute netting[7].

Q. What netting period do you recommend for the export credit rate?

A. I recommend the Commission adopt hourly netting for all customers on Schedule 136 and all successor tariffs.

Q. What is your rationale for hourly netting?

A. Netting on a sub-daily basis serves a function like time-of-use electricity rates. Under time-of-use rates, customers shift their energy consumption to times of the day when electricity

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[6] Schedule 135 https://www.rockymountainpower.net/content/dam/pcorp/documents/en/rockymountainpower/rates-regulation/utah/rates/135_Net_Metering_Service.pdf

[7] Schedule 136 page 2 https://www.rockymountainpower.net/content/dam/pcorp/documents/en/rockymountainpower/rates-regulation/utah/rates/136_Transition_Program_for_Customer_Generators.pdf

is cheaper. Sub-daily netting provides a monetary incentive for solar customers to shift energy consumption to periods when their solar photovoltaic system is producing. Residential customers cannot be reasonably expected to respond to changes in their solar system production on a 15-minute basis. Residential solar customers are not independent power producers. Independent power producers invest in solar and other generation technology to sell electricity to a utility or into a market and earn a rate of return on their investment. Residential customers invest in solar to reduce their energy bills, and they should not be expected to manage their net energy consumption on a 15-minute basis. If the Commission wishes to use a netting period less than monthly or daily, I recommend hourly netting as a reasonable period for customers to manage net energy consumption.

Q. Are there other reasons why hourly netting may be more appropriate for customers?

A. Rocky Mountain Power has a time-of-day rate[8] and two electric vehicle rate options[9] that have differentiated energy rates in hourly increments. For sake of consistency with other specialized tariffs, it would be reasonable appropriate for the solar export credit rate to have a similar rate structure.

VII. UPDATING THE EXPORT CREDIT RATE

Q. Should the Commission reassess and update the export credit rate?

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[8] https://www.rockymountainpower.net/savings-energy-choices/time-of-day.html

[9] https://www.rockymountainpower.net/savings-energy-choices/electric-vehicles/utah-ev-time-of-use-rate.html

A. Yes. I recommend the Commission revisit and reassess the value of solar exports every 3 to 5 years to account for changes in market conditions. However, when solar customers first interconnect, they should be locked in to the terms of the export credit rate for 20 years. A solar customer that interconnects and receives permission to operate on January 1, 2021 should receive a fixed export credit rate through December 31, 2040. The decision to install solar is an investment like any other and requires certainty in the terms of investment. Updating the export credit rate for all customers on a more frequent basis erodes the value proposition of solar by increasing the risk of investment. Instead, customers should receive the terms of the program when they first interconnect. If the export credit rate is updated at a later time, new solar customers receive the updated terms of the new export credit rate.

VIII. SUMMARY AND CONCLUSION

Q. To summarize, what are your recommendations for the Commission?

A. The Commission should set the export credit rate at a value no less than 9.2 cents/kWh and use hourly netting of customer energy. Current Schedule 136 customers and future solar customers should retain that export credit for twenty years. The Commission should review the export credit rate every three to five years and update if market conditions change. Successor export credit rates should guarantee a 20-year term for new solar customers.

Q. Does this complete your testimony?

A. Yes.

CERTIFICATE OF SERVICE

I hereby certify that on March 3, 2020, a true and correct copy of Vivint Solar's direct testimony of Christopher Worley in Phase 2 of Docket No. 17-035-61 was served by email on the following Parties:

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Dated this 3rd day of March, 2020

/s/ Stephen F. Mecham
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