BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

In the Matter of the Approval of Rocky Mountain Power's Tariff P.S.C.U. No. 47, Re: Schedule 107 – Solar Incentive Program	Docket No 07-035-T14 REQUEST FOR COMMENTS

Comments of Utah Clean Energy
June 9, 2011

INTRODUCTION

Utah Clean Energy ("UCE") is a 501(c) (3) non-profit public interest organization working to advance energy efficiency and renewable energy in Utah. We have been engaged in Rocky Mountain Power's ("Company") Solar Incentive Pilot Program ("Program") Docket since before its inception, providing input and tracking progress throughout its duration. We appreciate the opportunity to provide input on whether and how the Program should be continued and expanded.

Utah Clean Energy has reviewed the Company's Annual Reports on the Solar Incentive Program, the Three-Year Assessment of the Solar Incentive Program, PacifiCorp's confidential attachments, and PacifiCorp's 2010 Integrated Resource Plan. After nearly five years of information and data, we submit that there is more than sufficient evidence to support the continuation and expansion of the Pilot Solar Incentive Program. Further, we believe the Program can be designed to meet the Commission's cost-effectiveness criteria. We provide program design recommendations for an expanded program.

BACKGROUND

In 2007, the Commission approved a tariff implementing a five-year pilot solar incentive program providing financial support for customers who purchase and install solar photovoltaic systems. The Program's purpose, when approved by the Commission, was to gather information on the viability of a distributed photovoltaic program by providing market-based data on the integration of distributed PV resources in the electric system, the ability of solar to meet peak demand, and customers' willingness to participate and make investments in solar technology.[1]

[1] Docket 07-035-T14, In the Matter of the Approval of Rocky Mountain Power's Tariff P.S.C.U. No. 47, Re: Schedule 107 – Solar Incentive Program. Public Service Commission Order Approving Tariff with Certain Conditions. Issued August 3, 2007. (hereinafter *07-035-T14 2007 Order)* at 2.

In approving the original five-year tariff in 2007, the Commission expressed its support for investigating the viability of distributed renewable resources in Utah because it concluded substantial environmental and public-interest benefits could cost-effectively be derived from such a program.[2] The Commission recognized that a distributed solar program may be viewed differently than a traditional DSM program in terms of costs and benefits and so directed the Company, the Division, and the DSM Advisory Group to determine appropriate cost-effectiveness criteria and guidelines for a distributed solar program.[3]

Pursuant to this direction to investigate appropriate cost-effectiveness criteria and guidelines for a distributed solar program, the DSM Advisory Group included in its Docket No. 09-035-27 Report[4] the following recommendation:

> Absent more appropriate economic tests, small-scale renewable resources may be evaluated on the same basis as energy efficiency and load management. The Commission may approve small-scale renewable resource projects that fail one or more of the economic tests but are determined to be in the public interest.[5]

The Commission concurred with this recommendation and added that if any of the economic tests fail, the Commission would consider arguments regarding whether the program is in the public interest for reasons other than economic efficiency.[6]

In Docket No. 09-2035-01, in its Acknowledgment of the 2008 PacifiCorp Integrated Resource Plan (IRP), the Commission directed the Company, in its 2010 IRP, to discuss methods for improving the evaluation of a solar rooftop customer buy-down program.[7] Therefore, in its 2010 IRP, PacifiCorp modeled a distributed solar incentive program in its System Optimizer model.[8] However, the modelers used the Total Resource Cost instead of the Utility Cost for the program, and therefore over-estimated the cost to the utility of the solar incentive program as a resource. Having discovered this error, however, PacifiCorp offered to run two sensitivity model runs, with utility cost inputs, to see if the model would select the distributed solar rebate program as a utility resource.[9]

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[2] *07-035-T14 2007 Order* at 6.
[3] *07-035-T14 2007 Order* at 7.
[4] Docket No. 09-035-27, In the matter of the Proposed Revisions to the Utah Demand Side Resource Program Performance Standards. Issued October 7, 2009. (hereinafter *09-035-27 Order)* at 3, 10-11. The Order in this docket established the Utility Cost Test as the threshold test for determining program prudence.
[5] *09-035-27 Order* at 4.
[6] *09-035-27 Order* at 15.
[7] Docket No. 09-2035-01, In the matter of the Acknowledgment of PacifiCorp's Integrated Resource Plan, *Report and Order*, 35 (issued April 1, 2010); *See also* PacifiCorp*, 2011 Integrated Resource Plan, Volume 1 (hereinafter PacifiCorp 2011 IRP, Volume 1)* at 168 (March 31, 2011); PacifiCorp, *2011 Integrated Resource Plan, Volume 2 (hereinafter PacifiCorp 2011 IRP, Volume 2)* at 27 (March 31, 2011). URL: *http://www.pacificorp.com/es/irp.html*.
[8] *PacifiCorp 2011 IRP, Volume 1* at 165 (Cases 30 and 30a), 168.
[9] *Id* at 243-44.

In early 2011, the Company ran two sensitivity scenarios using System Optimizer at two rebate levels, ($2/watt and a $1.50/watt, including a 14% administrative and marketing cost gross-up).[10] In its modeling assumptions, PacifiCorp imposed a limit on the amount of the distributed solar resource that the model could select: System Optimizer could select up to, but not more than 1.2 MW of distributed solar resources each year between 2011 and 2028 (for a possible cumulative total of 22 MW in 2028). System Optimizer selected all 1.2 MW that were available each year under both cost scenarios.[11]

On March 8, 2011, the Company filed its fourth Annual Report on the Solar Incentive Pilot Program. Utah Clean Energy has reviewed the 2010 Annual Report, and we provide comments on the Report, starting on page 21. The bulk of our comments are primarily intended to answer and inform the discussion of the Commission's question, issued on March 24, 2011, regarding "whether a continued or expanded solar PV program in Utah is appropriate and how that program might be structured."[12]

REASONS TO SUPPORT A CONTINUED AND EXPANDED SOLAR INCENTIVE PROGRAM

Utah Clean Energy asserts that a continued and expanded solar PV program is appropriate, and we provide our reasons below. We also provide some recommendations regarding how an expanded Program might be structured.

A. PACIFICORP'S INTEGRATED RESOURCE PLANNING MODELING INDICATES THAT A UTILITY SOLAR REBATE PROGRAM IS AN ECONOMIC RESOURCE

As explained above, in its IRP analysis, the Company ran two System Optimizer scenarios with different costs for solar PV rebate program,. In its modeling assumptions, PacifiCorp imposed a limit on the amount of the distributed solar resource that the model could select; the model could select up to, but not more than, 1.2 MW of distributed solar resources each year between 2011 and 2028 (for a possible cumulative total of 22 MW in 2028). Solar was found to be an economic resource and the System Optimizer model selected all 1.2 MW that was available each year under both cost scenarios.[13]

It appears that the 1.2 MW/year modeling restriction may be derived from the Cadmus Group's *Assessment of Long-term System-Wide Potential for Demand Side and Other Supplemental Resources for PacifiCorp,* a technical potential study. The Cadmus Group'sstudy shows that Utah has huge technical potential for distributed solar PV of 2,664.1 aMW by 2030[14] —equal to over 14,800 MW on a capacity basis. Cadmus reports the

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[10] *PacifiCorp 2011 IRP, Volume 1* at 168.
[11] *PacifiCorp 2011 IRP, Volume 1* at 234-244.
[12] Docket No. 07-035-T14, In the matter of the Approval of Rocky Mountain Power's Tariff P.S.C.U. No. 47, Re: Schedule 107—Solar Incentive Program, *Request for Comments*, 1. Issued March 24, 2011.
[13] *PacifiCorp 2011 IRP, Volume 1* at 243-244.
[14] The Cadmus Group, *Final Report Assessment of Long-Term, System-Wide Potential for Demand Side and Other Supplemental Resources Volume I,* March 31, 2011 (Prepared for PacifiCorp), available at:

achievable technical potential as a tiny fraction of the technical potential: 3.85 aMW by 2030, or slightly over 21 MW by capacity. Cadmus explains that the achievable potential is based on currently available incentives and other factors. However, since current incentives are determined, at least to some degree, by the Company, this assessment is somewhat circular. Utah Clean Energy believes that the achievable technical potential would be significantly higher than 21 MW by 2030 if the pilot program system size caps and total program cap were removed.

Furthermore, the fact that System Optimizer selected all the distributed PV that the model allowed at rebate levels of $1.50/watt and $2.00/watt strongly suggests that an expanded utility solar rebate program at the current incentive level of $1.55/watt is an economic resource for the utility and its rate payers.

B. THE SOLAR REBATE PROGRAM PASSES THE UTILITY COST TEST

In Docket 09-035-27 (discussed above and in footnote 5), the Commission determined that the Utility Cost Test should be the threshold test for demand side management program approval.[15] The Commission also found that the utility cost test provides the most equivalent comparison of costs between supply side and demand side resources.[16]

Utah Clean Energy used the Company's confidential spreadsheet and data inputs to run cost effectiveness analysis of the current program. The Company's Solar Incentive Program as currently implemented (with an incentive of $1550 per kW) passes the Utility Cost Test.

Additionally, Utah Clean Energy utilized the Company's confidential attachment to evaluate the cost effectiveness of the Program under different design scenarios. We analyzed changes to the Utility Cost Test, Utah Rate Impact test and Lifecycle Revenue Impacts with changes to three inputs: the incentive as a $/kW figure, administrative costs, and the inclusion or exclusion of the cost of generation meters.

The results show that the program in its current form, with an incentive of $1550 per kW, including meter costs and an administrative cost of 38 percent of the incentive and meter costs, has a net benefit of $29,156 and a cost benefit ratio for the Utility Cost Test of 1.13. When the current rebate level of $1550 is run with a 10% administrative fee and no generation meters, the program is even more cost effective with a net benefit of $97,389 and a cost benefit ratio for the utility cost test of 1.52.

The results of our analysis can be found in *Table 1 Cost Test Results for Alternative Program Designs*. Utah Clean Energy's calculations can be made available to parties that have signed

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http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/DSM_VolumeI_2011_Study.pdf.

[15] *09-035-27 Order* at 10-11 ("[T]he 2009 Report recommends the utility cost test as the threshold test for program approval…We concur with the recommendation to require the program to pass the utility cost test at a minimum.").

[16] *09-035-27 Order* at 9.

and submitted Confidential Information Certificate for this docket.Utah Clean Energy did not update the Total Resource Cost test to more accurately reflect current solar prices. While we acknowledge that the Program does not pass the Total Resource Cost (TRC) test, we believe that the Program is in the public interest. However, if consumers are willing to make investments in solar through a program that passes the Utility Cost Test (UCT), both the utility and ratepayers will benefit because the cost to the utility and ratepayers is lower than the utility's avoided costs.[17]

[17]*See* Rocky Mountain Power Utah Demand Side Management Advisory Group, *Utah Demand Side Management and Other Resources Benefit and Cost Analysis Guidelines and Recommendations* at 8 (2009 Report referenced in 09-035-27 Order issued on October 7, 2009). ("Passing the UC test indicates that the cost of the demand side resource that is recovered through rates is lower than a utility's avoided cost.").

Table 1 Cost Test Results for Alternative Program Designs

Program Design	Level-ized $/kWh	Costs	Benefits	Net Benefits	Benefit Cost Ratio
PacifiCorp Analysis 2010 Program Results ($2/watt incentive, meters and admin 38% of incentive and meter costs)					
Total Resource Cost Test (TRC) + Conservation Adder	0.5309	$1,174,898	$315,418	($859,480)	0.268
Total Resource Cost Test (TRC) no Adder	0.5309	$1,174,898	$286,744	($888,154)	0.244
Utility Cost Test (UCT)	0.1477	$326,906	$286,744	($40,162)	0.877
Utah Rate Impact Measure (URIM)		$573,537	$286,744	($286,793)	0.500
Participant (PCT)		$847,992	$246,631	($601,361)	0.291
LifeCycle Revenue Impacts ($/kWh)			$0.0000003739		
Analysis Below Conducted by Utah Clean Energy Using PacifiCorp's Confidential Attachment					
Incentive $2000, w/out meter cost, admin 15% of incentive					
Utility Cost Test (UCT)	0.12	$255,300	$286,744	$31,444	1.123
Utah Rate Impact Measure (URIM)		$501,931	$286,744	($215,187)	0.571
LifeCycle Revenue Impacts ($/kWh)			$0.0000002805		
Incentive $1550, includes meter cost, admin 38% of incentive and meter cost					
Utility Cost Test (UCT)	0.1164	$257,588	$286,744	$29,156	1.113
Utah Rate Impact Measure (URIM)		$504,219	$286,744	($217,475)	0.569
LifeCycle Revenue Impacts ($/kWh)			$0.0000002835		
Incentive $1550, w/out meter cost, admin 15% of incentive					
Utility Cost Test (UCT)	0.0970	$214,657	$286,744	$72,087	1.336
Utah Rate Impact Measure (URIM)		$461,288	$286,744	($174,544)	0.622
LifeCycle Revenue Impacts ($/kWh)			$0.0000002572		
Incentive $1550, w/out meter cost, admin 10% of incentive					
Utility Cost Test (UCT)	0.0855	$189,255	$286,744	$97,489	1.515
Utah Rate Impact Measure (URIM)		$435,886	$286,744	($149,142)	0.658
LifeCycle Revenue Impacts ($/kWh)			$0.0000002057		

Note: As discussed in Utah Clean Energy's comments on the 2010 Annual Report, the total system costs for PV systems installed through this program appear to be higher than costs reported elsewhere. However, we did not analyze total resource cost impacts using lower installation cost figures.

Meter costs. Utah Clean Energy asserts that there is sufficient evidence to eliminate the use of generation meters for small systems. Pages 24 and 25 of the Company's 2010 Annual Report show that PV systems performed better than the PV Watts model predicted; in fact, average output was 108% of the predicted value. Furthermore, the two PV systems compared on page 26 of the 2010 Annual Review showed that they had an even higher energy output in the summer months. If it is deemed that meters are needed for large commercial systems, these costs could be borne by the customer installing the system.

Administrative costs. In previous comments on the Program and in our comments on the 2010 Annual Review (below), we explain that the administrative costs for the pilot program are quite high. In 2010 they were about 38percent of the combined incentive costs and meter costs. We understand that these high costs are likely related to the inefficiencies of running a small pilot program. That said, we propose that an administrative cost of 10% is more appropriate for an expanded program. Utah Clean Energy's comments on the Company's 2009 Annual Report of the Program addressed the administrative cost issue:

> Other utility solar incentive programs across the country explicitly cap administrative costs at 5-10 percent of the total program costs; for example, the Colorado Solar Incentive Program caps administrative costs at 10 percent.[18] In addition to higher costs, the design of the program and the consistent issue of allocations going unfulfilled in the intended year appears to entail more administrative burdens, as noted in the report: "Annual program allocations pose an on-going administrative burden related to communications, chronological processing requirements, etc."[19] It is likely that a more expanded program, redesigned to be administratively straightforward and efficient, would benefit from economies of scale and would lower the administrative costs and burdens even as the program grew. Going forward, Utah Clean Energy would like to explore how this program might be revised to address some of these comparatively higher administrative costs and inefficiencies.[20]

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[18] Matthew Baker, Commissioner, Colorado Public Utilities Commission. Presentation: *Colorado's Renewable Portfolio Standard Making it a Success* at slide 7, EUCI RPS Planning & Implementation Conference, San Francisco, CA., August 15, 2008.

[19] Docket 08-035-78, In the Matter of the Approval of Rocky Mountain Power's Tariff P.S.C.U. No. 47, Re: Schedule 107 – Solar Incentive Program. Rocky Mountain Power, *Utah Solar Incentive Program 2009 Annual Report* (hereinafter *2009 Annual Report)* at 8.

[20] Docket 08-035-78, In the Matter of the Approval of Rocky Mountain Power's Tariff P.S.C.U. No. 47, Re: Schedule 107 – Solar Incentive Program, *Comments of Utah Clean Energy*, filed May 3, 2010 at 3-4.

The current administrative costs for the pilot solar incentive program (capped at 107 kW per year) are 38 percent of the incentive and meter costs.[21] Rocky Mountain Power's small pilot program suffers from a lack of economies of scale and high administrative costs that negatively impact the overall cost-effectiveness of the program.

An expanded program, redesigned to be administratively straightforward and efficient, would benefit from economies of scale that would lower administrative costs. As noted by the Office of the Governor in their comments, "The Office of Energy Development administers a tax credit program…for approximately 10 percent or less of the total incentive program budget."[22] Additionally, the former Utah State Energy Program administered a $3 million Utah Renewable Energy Rebate Program for five percent administrative costs.[23] While we recognize that these programs are distinct from the pilot Program, there is substantial reason to believe that the current program could be administered for far less than the current 38 percent.

C. Distributed Solar Energy Provides Valuable On-Site Energy to Customers During Peak Day-Time Hours

Solar energy produced during the daytime hours (especially during hot summer days) can reduce the need to purchase energy on the market during the day and/or reduce natural gas generation to meet daytime peak demand. As noted by the Company in its 2010 Annual Report, "solar PV systems do contribute a percentage of energy during the higher load and energy cost hours of summer days."[24] The Cadmus analysis in Appendix 2 confirms that "generation peaks tended to be higher than PV Watts during summer months."[25] Furthermore, the data collected with the 15-minute interval meters indicate that while the absolute peak production for the installed PV systems is between noon and 2 pm in August, the bulk of the total daily output falls between 9:30 am and 5:30 or 6:00 pmin the evening,[26] demonstrating with actual Utah data that PV offers a valuable summer energy resource. While we recognize that south-facing rooftop solar PV systems may be more limited in their ability to generate power during the super peak evening hours in the summer, solar remains a valuable energy resource during the times when energy is in high demand.

Additionally, different customer classes have different load profiles, and solar situated on commercial or light industrial facilities (which typically operate during daytime business hours) may help decrease those customers' contribution to daytime peak energy demand.

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[21], Docket 07-035-T14, Solar Photovoltaic Incentive Program (Schedule 107) Annual Report for Program Year 2010. Table 3. Levelized cost of Energy at 12.

[22] Docket No. 07-035-T14, Comments of the Office of the Governor, filed May 17, 2011.

[23] Docket No. 07-035-T14, Three Year Assessment of Solar Incentive Program, Comments from Utah State Energy Program, filed November 30, 2010.

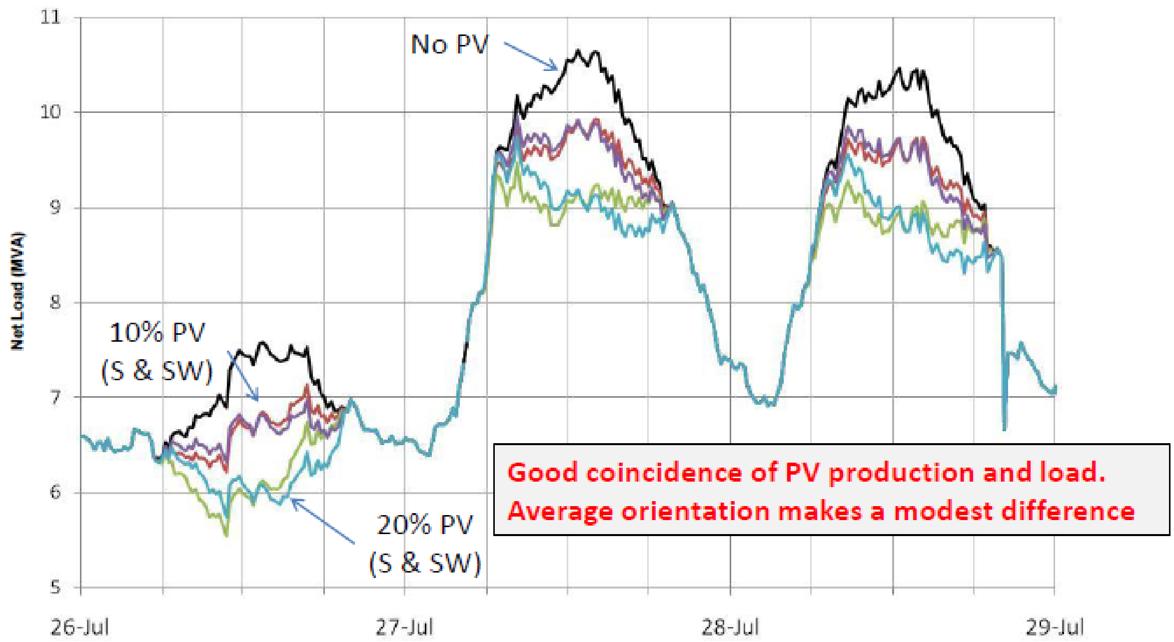
[24] Docket No. 07-035-T14, Solar Photovoltaic Incentive Program (Schedule 107) Annual Report for Program Year 2010, filed March 1, 2011 (hereinafter *2010 Annual Report*) at 13.

[25] *Id* at 25.

[26] *Id* at 14.

Figure 1. Results for Commercial Load (Exploration of PV and Energy Storage for Substation Upgrade Deferral in SLC, Utah)
Sandia National Laboratories, October 2010.

S=South; SW=Southwest



Sandia National Laboratories[27] conducted a study in collaboration with Rocky Mountain Power, Utah Clean Energy, and Salt Lake City as part of a technical assistance project for the U.S. Department of Energy Solar Energy Technologies Program. The findings from the study show that high penetrations of solar PV located in commercial/light-industrial districts can help decrease peak demand from those customers substantially (see Appendix B). As shown in Figure 1 *Results for Commercial Load (Exploration of PV and Energy Storage for Substation Upgrade Deferral in SLC, Utah*, the output of solar PV is closely aligned with the commercial/light industrial customer load profile.

The Sandia study findings also suggest that solar PV located in targeted areas may help defer substation upgrades and reduce the potential for overload, noting that the benefit of PV with respect to station upgrade deferral is a function of load & feeder characteristics.[28] An additional analysis conducted in New York similarly found that "distributed PV can deliver effective capacity at the feeder level when the feeder load is driven by industrial or commercial A/C, hence can reduce the wear and tear of the feeder's equipment – e.g., transformers -- as well as defer upgrades, particularly when the concerned distribution system

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[27] Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

[28] Abraham Ellis, Mark Ralph, Garth Corey, Dan Borneo, *Exploration of PV and Energy Storage for Substation Upgrade Deferral in SLC, Utah Second Progress Report*, Sandia National Laboratories, October 2010. See Appendix B.

experiences growth…[T]his distribution capacity value is highly dependent upon the feeder and location of the solar resource."[29]

According to the aforementioned New York analysis, distributed solar may also help mitigate the impacts of rolling blackouts caused by high demand and resulting stresses on the transmission and distribution system during summer heat waves:

> Quantitative evidence has...shown that the mean availability of solar generation during the largest heat wave-driven rolling blackouts in the US was nearly 90% ideal (Letendre et al. 2006). One of the most convincing examples, however, is the August 2003 Northeast blackout that lasted several days and cost nearly $8 billion region-wide (Perez et al., 2004). The blackout was indirectly caused by high demand, fueled by a regional heat wave. As little as 500 MW of distributed PV region-wide would have kept every single cascading failure from feeding into one another and precipitating the outage. The analysis of a similar subcontinental-scale blackout in the Western US a few years before that led to nearly identical conclusions (Perez et al., 1997).[30]

The benefits of solar during these high demand hours can be enhanced when distributed solar is coupled effectively with demand response mechanisms. According to a study commissioned by the National Renewable Energy Laboratory, which examined the value of integrating solar PV in demand response programs, solar PV generation has the potential to enhance the effectiveness of demand response programs and provide an added value to grid operators.[31] The study examined three utility case studies and showed that the grid operators in each case would benefit from an operational capacity increase using the same demand response pool with a dispersed PV resource on its grid.[32] Figure 2 demonstrates the symbiotic relationship between demand response programs and distributed solar generation in controlling and reducing peak demand (while may also help to reduce demand response program expenses[33]).

Given that distributed generation is designed and installed to meet some or all of a customer's annual electricity demand, it logically follows that distributed solar has similar characteristics to demand side resources because of its role in reducing customer load. This notion is supported by the Commission's Order on Docket 09-035-27, in which the

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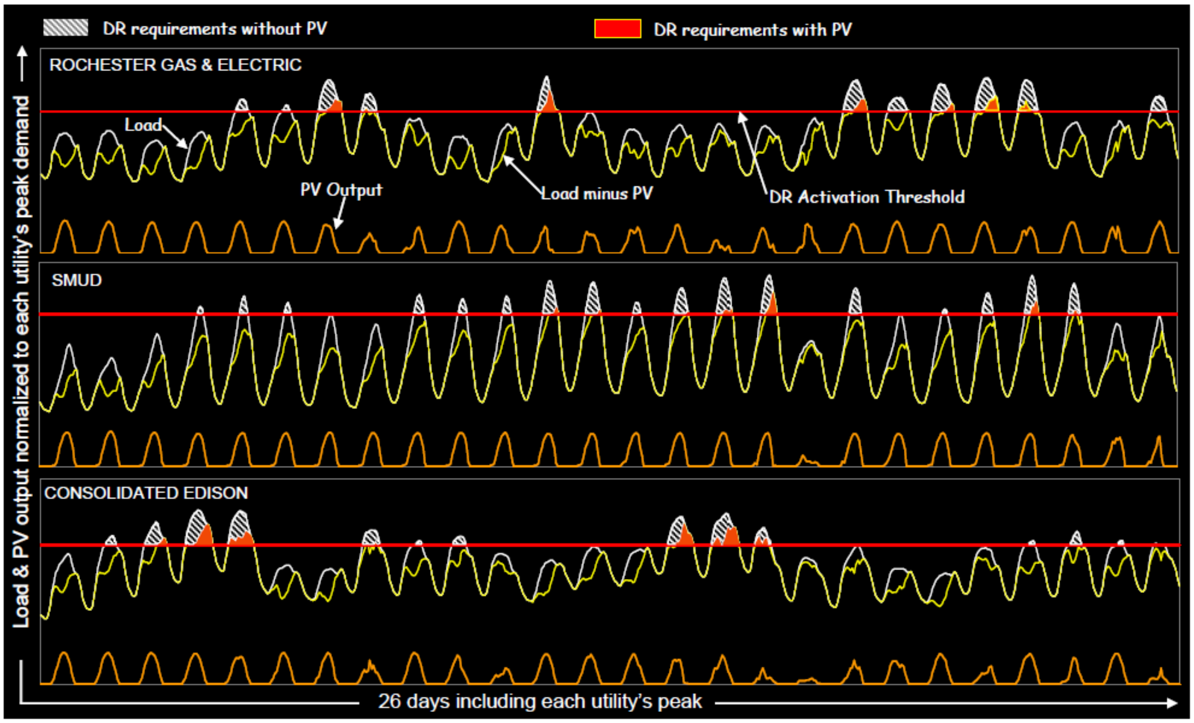
[29] Perez, Richard (University at Albany), Ken Zweibel (George Washington University), Thomas Hoff (Clean Power Research). *Solar Power Generation in the US: Too Expensive, or a Bargain?* 2011. (hereinafter *Perez et al, 2011*). URL: http://www.asrc.cestm.albany.edu/perez/2011/solval.pdf
[30] *Perez et al., 2011* at 4.
[31] Perez, R., *Integration of PV in Demand Response Programs*, NREL subcontract # AEK-5-55057-01 Final Report, Albany Nanotech, June 2006, *available at* http://www.asrc.cestm.albany.edu/perez/directory/LoadMatch.html.
[32] *Id*.
[33] *Perez et al., 2011 at 5.*

Commission determined that "small-scale renewable resources may be evaluated on the same basis as energy efficiency and load management."[34]

Figure 2. Illustrating demand response (DR) requirements with and without PV. All loads in excess of 80% of peak are to be met by DR or DR+PV. ***(Integration of PV in Demand Response Programs, Perez et. al. NREL subcontract # AEK-5-55057-01, 2006).***



D. Distributed Solar Provides Additional Benefits to the Grid

Figure 1. Illustrating DR requirements with and without PV. In this illustrative example, all loads in excess of 80% of peak are to be met by DR or DR+PV.

In addition to the benefits solar can provide during peak daytime hours, several studies indicate that distributed solar-generated electricity provides a range of benefits to the system in addition to those mentioned above, including: elimination of line losses, grid stabilization benefits, avoided emissions, protection against fuel cost volatility, hedging against economic risks associated with future environmental regulations, and energy security.[35] We discuss some of the additional benefits in section E and F below.

A thorough quantitative analysis of these benefits has not been conducted for Utah or the Company; however, the findings from other studies are applicable for other utilities and states. We have referenced these studies in our previous comments on this docket, and again provide a list of pertinent studies in Appendix A.

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[34] *09-035-27 Order* at 4.
[35] See Appendix A.

E. DISTRIBUTED SOLAR PROVIDES IMPORTANT BENEFITS TO CONSUMERS, THE ECONOMY, THE ENVIRONMENT, AND PUBLIC HEALTH

In its Order approving the Program, the Commission stated that it believed substantial benefits to the general public and the environment could cost effectively be derived from this program.[36] The Commission also recognized that distributed energy programs may be viewed differently than a traditional DSM program when determining cost and benefits: if economic cost-effectiveness tests should fail, the Commission shall consider arguments regarding whether the program is in the public interest for reasons other than economic efficiency. [37]

Utah Clean Energy submits that, in addition to providing the aforementioned energy-related benefits, distributed solar is otherwise in the public interest and provides broader benefits to the economy, the environment, public health, and society. These benefits are harder, though not impossible, to quantify, and are evidently not factored into the cost-benefit analyses for this Program.[38] Nevertheless, these benefits have value and should be considered in support of an expanded solar incentive program.

Economic Benefits. Distributed generation spurs new, especially local, job creation and stimulates local economic activity. The solar rebate program leverages private dollars and investment, while also supporting local jobs across the state. Furthermore, a more robust and mature solar market will maximize economies of scale, increase competition in the market, and help bring costs down further. A more robust solar market will extend the benefits of solar more broadly across the state.

A restrictively small solar incentive program creates significant bottlenecks in the solar industry and results in start-and-stop markets that struggle to mature and grow in a sustainable fashion. Surrounding states and other utilities have demonstrated the benefits of a more robust solar market, including decreased installation prices, improved quality assurance, and more competition.

In recent analysis for the state of New York, Richard Perez, et al. estimated that distributed solar in New York provided tax revenue enhancement benefits of nearly three cents per kWh, but that additional value from total economic growth would make that number higher.[39]

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[36] *07-035-T14 2007 Order* at 6.
[37] *09-035-27 Order* at 15.
[38] Utah Clean Energy has requested a more thorough explanation of these benefits and their underlying assumptions in prior comments on this docket (Ref: Utah Clean Energy Comments on Three-Year Assessment (filed November 30, 2011) and Utah Clean Energy Comments on 2009 Annual Report (filed May 3, 2010)).
[39] *Perez et al., 2011* at 8.

Environmental and Public Health Benefits. Solar PV electricity generation is a carbon free energy resource and therefore it helps mitigate the climate change impacts of our electricity system. While the economic risks associated with potential greenhouse gas regulation are evaluated in PacifiCorp's resource planning, the extensive costs to society from a changing climate are not factored into the analysis. Furthermore, on-site PV generation can help mitigate negative impacts from fossil-fueled generation on air quality and associated health impacts. "Each solar kWh displaces an otherwise dirty kWh and commensurately mitigates several of the following factors: greenhouse gases, SOx/NOx emissions, mining degradations, ground water contamination, toxic releases and wastes, etc., which are all present or postponed costs to society."[40]

While the majority of our local air quality issues stem from transportation, natural gas-fired power plants across the valley have an impact as well. Increased distributed renewable energy generation in the summer months has the potential to reduce the need to utilize more polluting, less efficient plants, such as the Gadsby plant, which is located in Salt Lake's heavily populated and polluted air shed. Oxides of Nitrogen emissions (NOx) (for example, from natural gas electricity generating plants[41]) when combined with sunlight in the hot summer months, contribute to ground level ozone. Ground level ozone is a respiratory irritant and studies show that exposure can lead to permanent lung damage and a depressed immune system.[42] Ground level ozone is a problem pollutant during the summer months along the Wasatch front.

In 2009, the National Academies produced a report that estimated the life cycle impacts of fossil-fueled electricity generation, namely coal and natural gas, which accounted for roughly 70% of the nation's electricity generation in 2005 (the year studied).[43] Costs (per kWh), on a national basis, were estimated for climate-related and non-climate related damages from both coal and natural gas. Non-climate damages associated with coal generation amounted to 3.2 cents per kWh (mostly from SOx emissions which are transformed into airborne particulate matter).[44] Climate-related costs depended on assigned costs per ton of coal and ranged from one to ten cents per kWh (corresponding with carbon costs of between $10 and $100 per ton of CO2 equivalent).[45] Non-climate damages from natural gas were estimated at 0.16 cents per kWh while climate-related costs ranged between .5 and five cents per kWh.

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[40] *Id.*

[41] U.S. Environmental Protection Agency Website. Air Emissions. Last updated 2007. URL: http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html

[42] *See* Utah Division of Air Quality website, http://www.cleanair.utah.gov/pollutants/ozone.htm; *see also* Western Resource Advocates, *Solar Solutions: Incorporating photovoltaics into public infrastructure*, 6-7 ((2011), available at: http://www.westernresourceadvocates.org/energy/solarsol/pvreport.pdf.

[43]The National Academies, *Hidden Costs of Energy: Unpriced consequences of energy production and use—Report in Brief*, 1, (2009), available at: http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/hidden_costs_of_energy_Final.pdf.

[44] *Id.* at 2.

[45] *Id.* at 3.

Perez, et al. evaluated the pollution mitigating benefits of distributed solar for New York and concluded that a coal generation footprint of over 45% has a corresponding cost of five to twelve cents per kWh.[46] In addition to reducing carbon emissions and other greenhouse gas, criteria, and other pollutants, distributed solar resources, along with other renewable resources, provide risk mitigating benefits relating to future carbon regulation.

The benefits of solar PV extend beyond mitigating greenhouse gases and poor air quality, with associated health issues. Solar PV requires minimal water use—primarily for washing panels—in contrast to fossil-fueled generation. Depending on the type of plant, natural gas power plants consume between 180 and 660 gallons of water per MWh.[47] Coal plants in the Southwest consumer around 540 gallons per MWh.[48] In the desert, water is an increasingly scarce resource and therefore distributed solar PV can create value because of the water use it avoids per MWh.

Fuel Price Risk Mitigation. Solar energy provides maximum output during the day in the summer months when demand on the electric system is high. While the output of PV systems may not exactly match the system super peak, solar provides valuable power that can mitigate fuel and energy price volatility in the summer months. Distributed renewable energy can therefore provide an important financial hedge to customers and the utility against the risks of carbon regulations and a reliance on fossil fuels, which have volatile and rising costs. According to Perez, et al., fuel price mitigation was valued for New York between three and five cents per kWh.

> Solar energy production does not depend on commodities whose prices fluctuate on short term scales and will likely escalate substantially over the long term. . . . [I]t is hard to imagine how the cost of the finite fuels underlying the current wholesale electrical generation will not be pressured up exponentially as the available pool of resources contracts and the demand from the new economies of the world accelerates. The cost of oil may be the most apparent, but all finite energy commodities, including coal, uranium and natural gas, tend to follow suit, as they are all subject to the same global energy demand contingencies. Even before the 2011 Middle East political disruptions, in a still sluggish economy, energy commodity prices had ramped up past their 2007 levels when the world economy was stronger (see fig. 3) [Figure 3 below].

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[46] Richard Perez, Ken Zweibel, and Tomas E. Hoff, *Solar Power Generation in the US: Too expensive, or a bargain?*, 7 (2011) ("Several exhaustive studies emanating from such diverse sources as the nuclear industry or the medical community . . . estimate the environmental/health cost of 1 kWh generated by coal at 9-25 cents, while a [non-shale] natural gas kWh has an environmental cost of 3-6 cents per kWh."), available at: http://www.asrc.cestm.albany.edu/perez/2011/solval.pdf.

[47] Western Resource Advocates, *Solar Solutions: Incorporating photovoltaics into public infrastructure*, 6 ((2011), available at: http://www.westernresourceadvocates.org/energy/solarsol/pvreport.pdf.

[48] *Id.*

Solar energy production represents a very low risk investment that will probably pan out well beyond a standard 30 year business cycle. In a study conducted for Austin Energy, Hoff et al. quantified the value of PV generation as a hedge against fluctuating natural gas prices. They showed that the hedge value of a low risk generator such as PV can be assessed from two key inputs: (1) the price of the displaced finite energy over the life of the PV system as reflected by futures contracts, and (2) a risk-free discount rate for each year of system operation. Focusing on the short term gas futures market (less than 5 years) of relevance to a utility company such as Austin Energy, and taking a stable outlook on gas prices beyond this horizon, they quantified the hedged value of PV at roughly 50% of current generation cost— i.e., 3-5 cents per kWh in the context of this article, assuming that wholesale energy cost is representative of generation cost.[49]

Figure 3. Finite energy commodity price trends 2007-2011 (Source: Richard Perez, Ken Zweibel, and Tomas E. Hoff, *Solar Power Generation in the US: Too expensive, or a bargain?* (2011)).

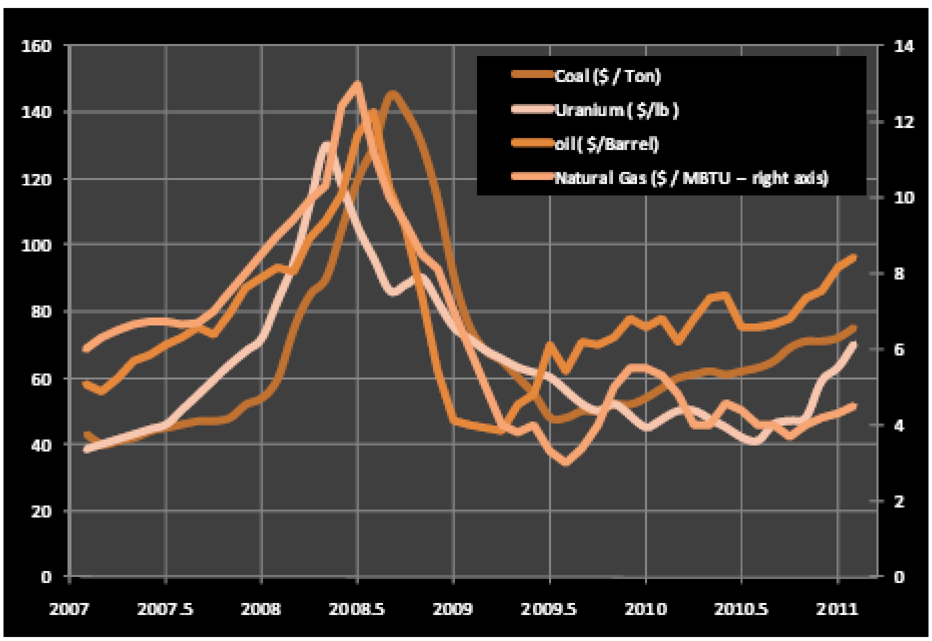

Figure 3: Finite energy commodity price trends 2007-2011

Perez et al. also estimated more long-term, societal benefits of distributed solar beyond the price mitigation hedge horizon relevant to a utility, worth between three and four cents per kWh:

[49] Richard Perez, Ken Zweibel, and Tomas E. Hoff, *Solar Power Generation in the US: Too expensive, or a bargain?*, 6 (2011) (citations, footnotes, and some internal references omitted), available at: http://www.asrc.cestm.albany.edu/perez/2011/solval.pdf.

> Beyond the commodity futures' 5-year fuel price mitigation hedge horizon of relevance to a utility company and worth 3-5 ¢/kWh (see above), a similar approach can be used to quantifying the long term finite fuel hedge value of solar generation, from a societal (i.e., taxpayer's) viewpoint in light of the physical realities [of finite fossil resources]. Prudently, and many would argue conservatively, assuming that long-term, finite, fuel-based generation costs will escalate to 150% in real terms by 2036, the 30-year insurance hedge of solar generation gauged against a low risk yearly discount rate equal the T-bill yield curve amounts to 4-7 cents per kWh. Further, arguing the use of a lower "societal" discount rate would place the hedge value of solar generation at 7-12 cents per kWh. Taking a middle ground of 6-9 cents per kWh, the long term societal value of solar generation can thus be estimated at 3-4 cents per kWh (i.e., the difference between the societal hedge and short-term utility hedge already counted above).[50]

Distributed solar provides numerous short and long term benefits to Utahans that should be considered in evaluating the public interests served by an expanded solar rebate program

F. AN EXPANDED SOLAR INCENTIVE WILL SUPPORT ECONOMIC DEVELOPMENT AND HELP INCREASE COST-COMPETITIVENESS OF UTAH'S SOLAR MARKET

Utah's distributed solar market remains extremely small, with well less than 0.1 percent of Rocky Mountain Power's customers having installed distributed energy projects. The availability of continued incentives will play an important role in driving solar costs down further, increasing competency and competitiveness in the market, spurring new economic development and jobs, and attracting new industries to Utah. Furthermore, a more robust market with lower solar PV prices will benefit all ratepayers through clean affordable energy choices.

At this point, many large solar companies (installers, manufacturers, dealers, etc.) consider Utah to be a "closed market" for solar; surrounding states, on the other hand, are attracting new jobs and economic development from these same companies because of the prime market conditions. Some comments submitted by SunEdison (a large solar company) portray the situation Utah faces with respect to our solar market:

> Most of the larger national companies view Utah as a "closed market," due to lack of policy drivers...If the state chooses to prioritize solar development, Utah can expect the statewide solar industry to quickly mature, and for national companies like SunEdison to bid on projects. This increased activity will undoubtedly change the cost of installing solar in Utah. In particular, the state can expect rapid

[50] Richard Perez, Ken Zweibel, and Tomas E. Hoff, *Solar Power Generation in the US: Too expensive, or a bargain?*, 8 (2011) (citations and internal references omitted), available at: http://www.asrc.cestm.albany.edu/perez/2011/solval.pdf.

> price declines on the commercial side, where the economies of scale offer a comparative price advantage…if the market were opened with appropriate solar policies, the experience from other states has shown that the solar industry can quickly drive down prices as competition increases.[51]

It is worth noting that the state solar rebate program funded through the American Reinvestment and Recovery Act (ARRA) formerly administered by the Utah State Energy Program (now located within the Office of Energy Development) was extremely popular and generated significant investments in solar and helped drive down the costs of solar; however, due to limited funds and high demand, this incentive is no longer available, as of several months ago.

SUMMARY OF REASONS TO SUPPORT CONTINUED AND EXPANDED SOLAR INCENTIVE PROGRAM

In summary, Utah Clean Energy recommends that the solar incentive program be continued and expanded for the following reasons:

1. PacifiCorp's Integrated Resource Planning modeling indicates that a utility solar rebate program is an economic resource.
2. The current Solar Rebate Program passes the Utility Cost Test and the program can be modified to be even more cost effective.
3. Distributed solar energy provides valuable on-site energy to customers and the utility during peak day-time hours.
4. Distributed solar provides additional benefits to the grid.
5. Distributed solar provides important benefits to consumers, the economy, the environment, and public health.
6. Distributed solar mitigates fuel price risk.
7. An expanded solar incentive will help drive down the costs of clean solar energy, support economic development and help increase the competitiveness of Utah's solar market.

RECOMMENDED PROGRAM STRUCTURE FOR EXPANDED SOLAR INCENTIVE PROGRAM

As discussed above, Utah Clean Energy submits that there is sufficient evidence to support a continued and expanded solar incentive program. In response to the Commission's request for input on how an expanded program might be structured, we provide the following recommendations.

[51] SunEdison Memo Re: *Cadmus memo on "Overview of PV Inputs and Data Sources."* Sent from Annie Carmichael, Manager of Interior West, Government Affairs, SunEdison to John Rush, PacifiCorp and Tina Jayaweera and Heidi Ochsner, The Cadmus Group. June 3, 2011 at 3.

1. **We support lowering the incentive from $2000 per kW to its current level of $1550 per kW.** The Program, as currently implemented, passes the Utility Cost Test at this level.

2. **The Program administrative costs should be much lower (in the range of 10% of the total annual incentive payments) as compared to the current program administrative costs of 38% of the Program incentive and meter costs.** Although the Program passed the Utility Cost Test in its current form (with high administrative costs), an expanded program will bring economies of scale and efficiencies that will enable the Company, or its designated Program administrator, to administer the program much more cost-effectively. A cap on the administrative costs will help maximize program operational efficiency.

3. **For systems larger than 25 kW, the incentive should be paid out on a performance basis over time.** To maximize system output and help ensure proper design, installation and O&M for systems over 25 kW, the incentive should be paid out on an equivalent performance basis (i.e. per kWh) over a period of around10 years (rather than allocating the entire incentive upfront). This has the additional benefit of spreading payments out over time such the utility and the ratepayers are not paying for all the energy in the first year for these large systems.

4. **Remove the generation meter requirement for small systems (less than 25 kW) and require that the customer cover the cost of meters for larger systems.** As discussed in the Utility Cost section above (Section B) and in Utah Clean Energy's review of 2010 Annual report, the 2010 Annual Program Report shows that installed systems are performing better than the PV Watts model predicted: average output was 108% of the predicted value. Furthermore, the two PV systems compared on page 26 of the 2010 Annual Review showed that they had a higher energy output in the summer months as compared to predicted output. If it is deemed that meters are needed for large commercial systems, these costs could be borne by the customer installing the system.

5. **Given that the Program passes the Utility Cost Test, remove individual system size caps for commercial systems and the annual program capacity cap.** The pilot program is extremely small and the system size cap of 15 kW for commercial systems eliminates the incentive for large commercial and industrial systems that bring economies of scale and significant power generation in the summer months to Rocky Mountain Power's system. Secondly, the 107 kW per year program caps fills up immediately. We propose that the residential small commercial program be capped at three to four MW per year and the large commercial (over 25 kW system size) be uncapped. As explained in recommendation number 4 above, we support the incentive payment of large projects over time thereby ensuring performance and reducing the upfront capital payments. We would support limiting the system size caps for residential customers to three to five kW to encourage energy efficiency investments first.

6. **Renewable Energy Credits (RECs) should be distributed to the Company proportionate to the percentage of system cost covered by the utility** as is the provision in the current program.[52]

7. **If there is a desire to utilize solar PV to help meet the super peak residential energy demand, the Company and Commission might consider** offering a tiered incentive for different system orientations, with higher incentives allocated to systems oriented west or southwest (which maximize solar production during the later part of the day, but reduce the overall annual output of the system). The current practice of allocating incentives based on the DC to AC conversion calculation results in a lower incentive for any systems not oriented due south; as such, a tiered incentive might need to be designed to offset this additional reduction in the incentive level. In addition to the tiered incentive, the Program could require residential participants that utilize compressor based cooling to enroll in the Cool Keeper program as condition of receiving the rebate. This recommendation reflects the above comments in section C pertaining to the symbiotic relationship between distributed solar and demand response programs.

8. **Program review.** Utah Clean Energy supports an annual review of the program, with more comprehensive three and five year reviews.

[52] 07-035-T14 2007 Order at 6.

9. **The Company must have regulatory assurance for full cost-recovery of all approved program costs.**

10. **Program modifications.** If future program modifications are necessary, we request a stakeholder process to review and provide input into the proposed changes and analysis.

CONCLUSION

As discussed throughout these comments, we submit that there is more than sufficient evidence to support the continuation and expansion of the Pilot Solar Incentive Program. IRP analysis indicates that a solar incentive program is a low-cost resource for the utility. The current program passes the utility cost. In addition utility cost-effectiveness, the program also provides other benefits, both energy- and non-energy related, including distribution benefits, environmental benefits, and risk mitigating benefits, and is in the public interest. We recommend designing an expanded program in line with the suggestions outlined above in order to continue the solar rebate program in a cost effective and administratively efficient manner.

Thank you for the opportunity to provide comments on this important matter.

COMMENTS ON SOLAR PHOTOVOLTAIC INCENTIVE PROGRAM (SCHEDULE 107)
ANNUAL REPORT FOR PROGRAM YEAR 2010

Utah Clean Energy has reviewed Rocky Mountain Power's Solar PV Incentive Program Annual Report for Program Year 2010, and we provide the following comments and recommendations for consideration:

1. The Company acknowledges that the Program continues to face administrative burdens, specifically: "Annual Program allocations pose an on-going administrative burden related to communications and chronological processing requirements" (2010 Annual Report, pg 8) and "lead times on waiting list projects and timing of cancelled projects pose challenges to fully allocating annual Program incentives" (2010 Annual Report, pg 8). We observe that this is a recurring issue for the Program every year. Given the small size of the pilot and the limited incentives available, the Program has inherent bottle-necks and inefficiencies that will persist until the Program expands appropriately to meet the growing demand for solar. Additionally, an expanded Program may need to be structured differently in order to accommodate greater demand and maximize the efficiencies of administering the Program.

2. The Company notes that "the highest system cost was $16.74 per Watt(ac), which included a battery backup. This project had to trench a distance and core drill through their foundation" (pg 6). We appreciate the Company pointing out the unique circumstances surrounding this installation, both of which are contributing to the very high cost of the system (which is much higher than the cost of an average grid-tied solar PV system installed in 2010). Arguably, many other systems that have received a Program incentive since 2007 have had similar elements (battery back-up, challenging installations locations, trenching, etc.) that have contributed to their extremely high prices, relative to the average installation (though, until now, these extenuating circumstances have not been noted in the annual reports). For example, the Company points out that "the highest system cost in 2010…[is] $27.90 per Watt(ac)" (pg 6).[53] While costs for these more complex systems are on the decline, they still remain extremely high relative to the average cost of solar in Utah and surrounding states. On the other hand, the Company notes "the lowest system cost was $3.63 per Watt(ac). The participant only paid for materials with the contractor donating the labor costs. The Company considers this installation an exception." (pg 6) Utah Clean Energy believes that both low and high outliers should be excluded when calculating the average system cost; additionally, grid-tied systems should be considered separately from grid-tied systems with battery back-up, given the cost difference between the two types of systems. Using the $/watt figures the Company provided in Table 5 and 7 of the Appendix, Utah Clean Energy calculated the average system cost excluding the high (above $10/watt) and

[53] Rocky Mountain Power's Annual Report reported installed costs of $27.90/watt, $19.47/watt, $18.66/watt, $15.48/watt, and $13.30/watt. All of these costs are exorbitantly higher than standard grid-tied solar PV installation costs, even in 2009. It is very likely these installations were more complex (trenching, battery back-up, etc.)

low (below $4/watt) outliers, and we came up with an average cost of $7.66/watt, or approximately $1.00 less per installed watt as compared to the Company reported average of $8.64 per watt. Clearly, the outliers impact the cost analyses for the Program and should be taken into consideration going forward.

Additionally, the Office of the Governor notes in their comments, submitted May 31, "the state data show the average installed cost per PV watt in Utah for residential and commercial systems without battery backup decreasing from an average of $9.55/DC watt in 2008 to $6.91/DC watt in 2010, a 27.6 percent decrease).

3. Three of the five commercial solar PV systems that received a utility incentive in 2010 are extremely high ($9.99, $10.36, and $12.94, as noted in Table7 in Appendix 1), especially when compared to the average commercial solar costs in other states with more robust solar markets. The report provides no explanation as to why these costs are so high, but it is plausible that these systems are more complex systems with battery back-up (as was the case with the aforementioned residential system). It is also plausible that Utah's small and underdeveloped solar installer market induces higher rates because of the lack of competition and/or economies of scale.

Though we recognize the intent of this Program is not to grow the solar market, it is worth noting that such a small program will inherently restrict the ability of Utah's solar market to flourish and achieve greater cost-competitiveness.

4. As Utah Clean Energy has noted in prior comments on the Pilot Solar Incentive Program, the administrative costs of the program remain high relative to the overall cost of the program (38% of the incentive and meter costs). We address this issue more thoroughly in our above comments on page 7.

5. The Company installed ten interval production meters, capable recording generation output on a 15-minute interval basis. The production curves from August 3, 2010 of monitored systems are shown in Figure 2 on page 14 of the 2010 Annual report and compared to the PV Watts predicted supply curve for the same day (see Figure 1 of the 2010 Annual Report on page 13). The company reports that the peak output was generally from noon to two o'clock in the afternoon. Utah Clean Energy agrees that the absolute peak output falls within this time period. Additionally, we'd like to point out that the actual metered output show that output picks up dramatically and at about 9:30 in the morning and remains relatively high until about five or five thirty in the evening and for some systems even later, illustrating with actual Utah-based data that PV offers valuable summer time energy resource.

6. The Company notes that they installed metering capable of measuring monthly generation on 30 of the 2010 installations and they plan to install additional interval generation meters at selected sites in 2011. The Company further notes that a comparison of the generation data and the PV Watts output was performed; this analysis showed a strong correlation between the systems monitored and the PV watts expected monthly output. The analysis found that "most overall metered or reported production was higher in aggregate than the PV watts estimate" (pg 25), "generation peaks tended to be higher than PV Watts during summer months" (pg. 25), and the "overall weighted average realization rate was computed to be 108%" (pg 24). The meters were valuable in showing that the generation output exceeded the output predicted by PV watts and that the generation peaks tended to be higher in the summer months when the electricity generated by the systems is most valuable. Utah Clean Energy recognizes the importance of collecting this data to achieve some of the original goals of the pilot program, and we appreciate The Cadmus Group and the Company's efforts to ascertain this information. If additional generation and interval meters are deemed valuable in 2011 for additional data collection, we recommend that sites be selected based on specific variables that impact the net energy usage and solar generation of the customer, including, but not limited to: the type of customer (residential or commercial), participation in demand side management programs (i.e. Cool Keeper), type of cooling (central A/C or Evaporative Cooling), solar panel orientation (south, west, southwest) and set-up (fixed vs. tracking). We believe this additional information would assist all parties in better understanding the value of different types of solar on different customer classes, along with any synergies with solar PV and available Demand Response Programs for the purpose of better managing super peak load.

7. In Utah Clean Energy's Comments on the 2009 Annual Report, we requested some additional details regarding the assumptions and calculations used to calculate the costs and benefits for *Table 3. Levelized Cost of Energy* (page 12) and *Table 4. Results for Standard Economic Tests*.[54] We appreciate the Company providing the confidential models used to develop the levelized cost of energy figures and the standard economic test results provided in Figures 3 and 4, for the 2007, 2008, 2009, and 2010 program years. Having reviewed these models, however, it remains unclear what benefits are considered, how the benefits are calculated, and what assumptions are used to assess these benefits. Utah Clean Energy respectfully requests a more thorough explanation of the benefits assumptions.

[54] Docket 07-035-T14, In the Matter of the Approval of Rocky Mountain Power's Tariff P.S.C.U. No. 47, Re: Schedule 107 – Solar Incentive Program, Utah Clean Energy Comments on 2009 Annual Report at 4-5.

This concludes our comments and suggestions for a continued and expanded solar rebate program and our comments on the 2010 Annual Report. Thank you for the opportunity to submit these comments and weigh in on this important matter.

Sincerely,

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Sarah Wright, Executive Director

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Sara Baldwin, Senior Policy & Regulatory Associate

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Appendix A – Solar PV Valuation Studies

- **Photovoltaics Value Analysis**. J.L. Contreras, L. Frantzis, S. Blazewicz, D. Pinault, and H. Sawyer, Navigant Consulting Inc. February 2008. Burlington, Massachusetts. URL: http://www.nrel.gov/docs/fy08osti/42303.pdf
- **The Value of Distributed Photovoltaics to Austin Energy and the City of Austin**. Study to Determine Value of Solar Electric Generation to Austin Energy. T. Hoff, R. Perez, G. Braun, M. Kuhn, B. Norris, **Clean Power Research, L.L.C.** March 2006. URL: http://www.austinenergy.com/about%20us/newsroom/reports/PV-ValueReport.pdf

- **Photovoltaic Capacity Valuations.** T. Hoff, R. Perez, JP. Ross, M. Taylor. Solar Electric Power Association. May 2008. URL: http://www.solarelectricpower.org/docs/PV%20CAPACITY%20REPORT.pdf

- **Distributed Renewable Energy Operating Impacts and Valuation**, R.W. Beck, Inc. for Arizona Public Service, 2009

- **Toward Reaching Consensus in the Determination of Photovoltaics Capacity Credit**, Perez et. al., 2008

- **CPUC Self-Generation Incentive Program Preliminary Cost-Effectiveness Evaluation Report**, Itron, Inc., 2006

- **Distributed Generation and Distribution Planning: An Economic Analysis for the Massachusetts DG Collaborative**, Navigant Consulting Inc., 2006

Appendix B – Submitted as PDF Attachment

Abraham Ellis, Mark Ralph, Garth Corey, Dan Borneo, *Exploration of PV and Energy Storage for Substation Upgrade Deferral in SLC, Utah Second Progress Report*, Sandia National Laboratories, October 2010.