Utah Solar Incentive Program

2009 Annual Report

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Executive Summary

In Docket No. 06-035-21, Rocky Mountain Power ("Company") outlined plans to introduce a Solar Photovoltaic program to gain market based information on the value of distributed solar resources to assist the Company in meeting peak demand requirements. On April 4, 2007, Rocky Mountain Power filed Tariff Advice No. 07-14 with the Public Service Commission of Utah ("Commission") requesting approval to implement a Solar Incentive Pilot program ("program"), which was approved by the Commission on August 3, 2007.[1] In their order approving the program, the Commission directed the Company to provide annual reports on the program containing information about completed projects, program expenditures and recommendations. This report is provided pursuant to that order and presents information on the program, which is administered through Schedule 107, for the 2009 program year.

Goals of the Program

The intent of this program is to gather market based information on the viability of a solar program in Utah funded by participating customers, tax incentives and Company incentives. The Project will provide technical information on the integration of distributed solar resources into the Rocky Mountain Power system and demonstrate the ability of solar power to meet growing peak demand. It will also gauge customers' willingness to participate in this program. In summary the goals of the program are to:

- Provide an assessment of the benefits of solar photovoltaic systems in Utah.
- Provide an assessment of the costs of solar photovoltaic systems in Utah.
- Gain experience on program administration logistics
- Acquire information on customer acceptance of solar photovoltaic systems in Utah.
- Provide experience in working collaboratively with the solar community.

[1] Refer to Docket No. 07-035-T14.

Key Dates, Data and Activities for 2009 Program

- Application acceptance date (the first day applications could be submitted) was January 5, 2009.
- Program installation completion date (the day projects had to be complete) for 2009 was January 31, 2010.
- Solar installations with a combined capacity of 7.015 kW for residential applications and 24.245 kW for non-residential applications were carried over from 2008 to the 2009 program.
- Including the carryover from 2008, the combined capacity available and allocated totaled 64.015 kW for residential and 74.245 kW for non-residential projects in 2009.
- The 2009 program also employed a waiting list. Applicants on this list could be eligible to receive 2009 incentives if an approved 2009 applicant withdrew or cancelled their project. Note that the current year waiting list does not function as a pre-reservation for the next program year allocation.
- Eleven customers notified the program administrator during 2009 they were not able to complete their projects and would re-apply later. When projects were dropped early in 2009, replacement projects from the waiting list were added. When projects dropped later in the year, replacement projects could not be completed in time. As a result of project cancellations, 18.640 kW for residential and 8.603 kW non-residential were carried over from 2009 to the 2010 program allocation.

Summary of 2009 Results

Information in the tables below summarizes expenditures by cost category, installed capacity by customer type and application data for the 2009 program. Additional information on individual 2009 projects is available in the Appendix.

Table 1. 2009 Program Installed Capacity and Expenditures

	kW	Incentives	Administration	Expenditures
Residential	45.375	$90,750		$90,750
Non-residential	65.642	$131,284		$131,284
Third party - total			$80,335	$80,335
Utility administration & evaluation			$14,055 [2]	$14,055
Total	111.017[3]	$222, 034	$94,390	$316,424

Table 2. 2009 Program Applications

Received	74
Approved and completed	33
Denied	2
Dropped/re-apply later	17
Moved to 2010	6
Added to 2009 waiting list	16

Key Findings from 2009

This section outlines key findings from the 2009 program and is designed to compare 2009 program activity and results in relation to stated program goals. These findings help inform the Company's recommendations for the next program year.

1. Installed System Costs - associated program goal: assessment of program costs
    a. Total reported customer costs were $1,038,086 for 111.017 kW(ac) of installed capacity that received incentives.

[2] Includes direct labor costs for program management, marketing and analysis. In 2009, the Company did not perform additional site inspections beyond those performed by the program administrator. As a result utility labor does not include any site inspection costs. Costs for net meters and associated metering department time is not allocated to the program or reflected in these costs. For the 33 project installations in 2009, 7 sites had generation meters installed at the cost of $1,800 per site, or $12,600 in total. Telecommunications charges to read the generation meters were $98. Net meters were installed at the remaining 26 project installations at a cost of $125 per site, or $3,250 in total. Metering costs of $15,948 were incurred by the metering department and not billed to this program. The cost of generation meters will be charged to the Program in 2010.

[3] Ten customers (nine residential and one non-residential) installed systems larger than the maximum size eligible for program incentives. Installed capacity beyond the Program is an additional 18.711 kW. Total installed capacity for systems receiving program incentives is 129.728 kW. Note that the company did not issue incentives for capacity installed beyond the program limits.

b. Total reported customer costs were $1,256,568 for 129.728 kW(ac) of installed capacity, which includes the additional 18.711 kW beyond the installed capacity listed in Table 1.

c. Average cost (based on total installed capacity that received incentives) was $9.35 /W(ac). Average cost for all installed capacity (including that beyond the capacity receiving incentives) was $9.69/W (ac).

d. Highest system cost was $27.90 /W(ac), which included a tracking system and battery back-up.

e. Lowest system cost was $3.23/W(ac). The customer already had existing racks and an inverter and procured labor on very favorable terms. The Company considers this installation an exception.

f. 2009 average system cost was approximately the same as 2008, which was $9.73 /W(ac).

g. The highest system cost in 2009 was 133% of highest system cost in 2008 at $20.83 /W(ac)

h. The lowest system cost in 2009 was 156% of lowest system cost in 2008 at $2.07/W(ac)[4].

i. Net meters required for 2009 program installations cost $125 per residential installation, or $3,250 in total for 26 installations that received only net meters. For net meters, the per-meter cost for 2009 was the same as 2008. Seven installations had generation meters installed at a cost of $1,800 per meter, or $12,600 in total for the seven installations. Net metering costs are not included in customer or utility costs shown in Table 1, but are provided in Table 3 which illustrates the levelized costs of energy.

2. Trade Allies – associated program goal: gain experience working with solar community

   a. Fifteen contractors performed the 2009 program installations, a decrease of three compared to 2008.

   b. Eight contractors performed one installation each.

[4] Lowest system cost in 2008 utilized a combination of donated materials and labor and should not be considered representative. See 2008 report for additional details. The 2009 lowest system cost is also not representative.

c. Four contractors performed two installations each.
d. Two contractors performed four installations.
e. One contractor performed nine installations.

3. Customers - associated program goal: customer acceptance of solar in Utah
    a. Participants were from eighteen unique cities, comparable to 2008 at nineteen.
    b. Participant count in the top three cities are: Salt Lake City (11), Park City (3), and Ivins (3). Salt Lake City and Ivins were in the top three in 2008.
    c. Customers were slow to return Attestation certificates for all projects, including those completed for prior years. See discussion in assessment of benefits section on the alternative approach employed in 2009 to gather system output data.
    d. Two customers submitted applications for completed projects which were denied.
    e. The most commonly cited reason for cancelled projects was changes in funding availability for solar equipment.

4. Marketing - associated program goals: program administration logistics & experience in working with solar community
    a. Similar to the prior program years, proactive trade allies are using personal selling to market the program to end use customers.
    b. Applications are being completed and submitted by the trade allies. This is being done as service for customers and is similar to prior program years.
    c. The program funded a sponsorship for the 2009 Utah Solar Tour. This Utah Solar Association and the sponsorship included a print ad in the tour magazine.

5. Equipment Availability - associated program goals: program administration logistics & experience in working with solar community
    a. Customers and trade allies did not report equipment shortages or schedule delays related to equipment availability in 2009.

6. Allocation of Program Incentives - associated program goals: program administration logistics

a. Even with a full year for approved projects to be constructed, changes in customer's available funding throughout the year precluded all of the available capacity and incentives from being fully utilized in the prescribed time frames.
b. Annual program allocations pose an on-going administrative burden related to communications, chronological processing requirements, etc.
c. The waiting list helped maximize yearly installation capacity and compensated for project cancellations, but lead times on waiting list projects and timing of canceled projects both pose challenges to fully allocating annual program incentives. Six projects that either started on the waiting list or had experienced construction delays and were not completed by January 31, 2010 were moved to the 2010 program.
d. The shortfall in allocated incentives for 2009 was largest in the residential customer group and increased when compared to 2008. The shortfall in allocated non-residential incentives declined when compared to the 2008.

7. Assessment of Benefits Goal

A key goal of the program is to assess the benefits of solar photovoltaic installations to Rocky Mountain Power's system, especially during periods of peak demand. Accurate measurements of the output of installed solar photovoltaic systems are an integral part of that effort. Prior program annual reports have outlined the challenges of having customers provide output data from their system inverters on a regular basis and submit that information to the Company via Attestation certificates. Also, in prior annual reports, the Company described an alternate approach to estimating solar photovoltaic system output on an hourly basis through the use of the National Renewable Energy Laboratory ("NREL") PV Watts calculator. Estimated output from each installation was calculated using the PV Watts calculator and a graphical representation of the contribution of the program installations to the Utah peak was provided.

On July 23, 2009, the Office of Consumer Services ("Office") provided comments on the Company's 2007 and 2008 annual reports which included the following recommendation:

> *"The Office understands that Attestation certificates are an important factor for Program evaluation and therefore believe the Company should be considering other avenues to obtain compliance in this area. Potential solutions might include withholding incentive payments until Attestation certificates are received or making only partial incentive payments until participants are in compliance with the requirements of the Program. The Office recommends that the Commission require the Company to assess the problem and consider alternative methods for increasing participant compliance in returning Attestation certificates."*[5]

In response to the Office's recommendation the Company offers the following:

The use of the Attestation certificates was originally proposed as a means to acquire solar photovoltaic system output data in a pilot program with the majority of the funds designated for customer incentives. This approach was suggested by a consultant to the program administrator who had experience in other markets. While this approach has had the advantage of reduced costs, it is reliant on customers taking regular action to record the output of their system. The variable customer response in providing this data over the last two years (2007 and 2008) led the Company to assess options for more reliable data with more granularity. The Company also notes that information collected through the Attestation certificates only provides system generation data that represents the system's output since the last reading and does not provide information on the system's ability to generate during peak periods of demand.

As suggested by the Office, the Company considered paying some or all of the incentive over time based on the return of the certificate(s), but recognized that a change in payments would complicate customer communications during the pilot period. If successful, this approach would still generate aggregate data with approximately monthly frequency. For these reasons, this option was not considered further and the production meter approach described below was implemented instead.

During the last half of 2009, the Company elected to install interval production meters at a selected number of sites to gather revenue grade output data. Installation of this meter

[5]Refer to page 2 of the Office's memorandum to the Commission dated July 23, 2009 in Docket No. 07-035-T14.

by the Company is a matter of installing it in the customer provided socket at the same time the net meter is installed at project completion. Many customers install a generation meter socket (in addition to the net meter socket) and a disconnect as part of their project and if a generation meter is not installed, the socket is bridged and sealed by the Company meter crew. In prior program years, in order to minimize costs, fewer customers installed this equipment, but during the latter half of 2009 the program administrator began requiring this equipment on all projects. The generation meters installed in these sockets can be read remotely and record 15 minute interval data on system output. Seven of these meters were installed at 2009 project participant sites, although they were installed late in the year after the projects were completed and therefore, full year data is not available. The costs associated with the meters and the meter reading for the 2009 program were included in the meter department budget. An initial comparison of the partial year data generation data and the PV Watts1 output for three sites, where meaningful data was available, was performed and is provided as Appendix 2. When statistically significant full year generation data is available, this analysis will be performed again and the results will be provided in the 2010 program annual report.

All 2010 program participants will be required to install generation meter sockets and the Company plans to install additional generation meters at selected sites. In 2010, the meter department will be asked to allocate the costs for additional meters to the program. Interval data from this pool of installed meters will be used to correlate/validate PV Watts data for systems. This data will be used to determine the value of distributed PV solar systems to Rocky Mountain Power's overall system. While the generation meter approach to gathering information on solar photovoltaic systems is more expensive than the Attestation certificate approach, the Company believes this approach is consistent with load research requirements and prudent in that it will provide more timely, accurate and granular data.

In summary, findings from the 2009 program indicate average costs per installed watt were comparable to 2008 program costs and are comparable to the original estimates of $10/watt. The

number of contractors has increased but a few contractors still account for most of the installations. Marketing continues to be done with contractors utilizing personal selling and including the program application process as part of their sales process. The annual program allocation process driven by limited funding poses administrative challenges. The assessment of benefits has improved with the installation of generation meters on a sample of projects and the correlation of that data (on a limited basis in the first year - 2009) with calculated PV Watts1 data.

Recommendations for the Program Year 2010

1. Carry over the "unused 2009 kW allocation" (18.640 kW for residential installations and 8.603 kW for non-residential applications) to the 2010 program. To ensure consistent marketing messages surrounding annual kW allocations, the addition will occur as part of the 2010 tracking by the program administrator and will not be included as a specific roll-over amount[6].
2. Continue on-going communication to solar trade ally community on importance of acquiring generation data from actual installations and that program requirements to support data acquisition, i.e, meter socket and disconnects are a necessary component to help the company assess program effectiveness.
3. Acquire and install additional generation meters to the extent of available budget. Record interval data from all installed meters and correlate with PV Watts data for the 2010 program report.
4. Move application acceptance date (the first day applications could be submitted) into February going forward to allow program administrator to focus on prior year close-out.
5. Move annual report due date to March 31 going forward to enable more orderly close-out and reconciliation of prior year projects.
6. As the Company will be installing generation interval meters on select solar photovoltaic installations to gather information on system generation performance, Rocky Mountain

[6] Since pilot program revenue requirements were established based on five full years of program operation, the re-allocation decision was made to compensate for the short falls in projects completion from 2007 that rolled into 2008 and short falls from 2008 that are carried over into 2009. The same approach is applied for the 2009 shortfall which is carried over to 2010. In other words, the intent is to deploy five years of funding to acquire the five year program targets even if each year is not exactly twenty percent of the total.

Power believes that gathering energy output information from the Attestation certificates is no longer necessary. System output information collected from the generation meters will be sufficient to determine the generation profile of solar photovoltaic systems in Utah.

Similar to prior program years and in support of the assessment of benefits goal, the Company has retained a third party consultant to estimate hourly output of the solar photovoltaic systems using the National Renewable Energy Laboratory (NREL) PV Watts calculator, which is available at http://rredc.nrel.gov/solar/codes_algs/PVWATTS/version1/. Information on the program installed systems provided in Appendix 1 is an input to this calculation. In addition, the levelized cost of energy and the results of the standard economic tests are provided. This is similar to the approach utilized for prior program years.

Table 3. Levelized cost of Energy[7]

Customer Cost (for capacity receiving incentives)	$1,038,086
Incentives	$222, 034
Administration	$94,390
Meters (Net meters, gen meters and telecommunications costs)	$15,948
Total Annual Generation (MWh)	206.8
Levelized Total Cost ($/MWh)	$493.71
Levelized Utility Cost ($/MWh)	$142.89
2008 IRP 49% Load Factor Decrement Levelized Cost ($/MWh)[8]	$101.86

[7] Levelized at 7.4% discount rate over 25 year estimated life.

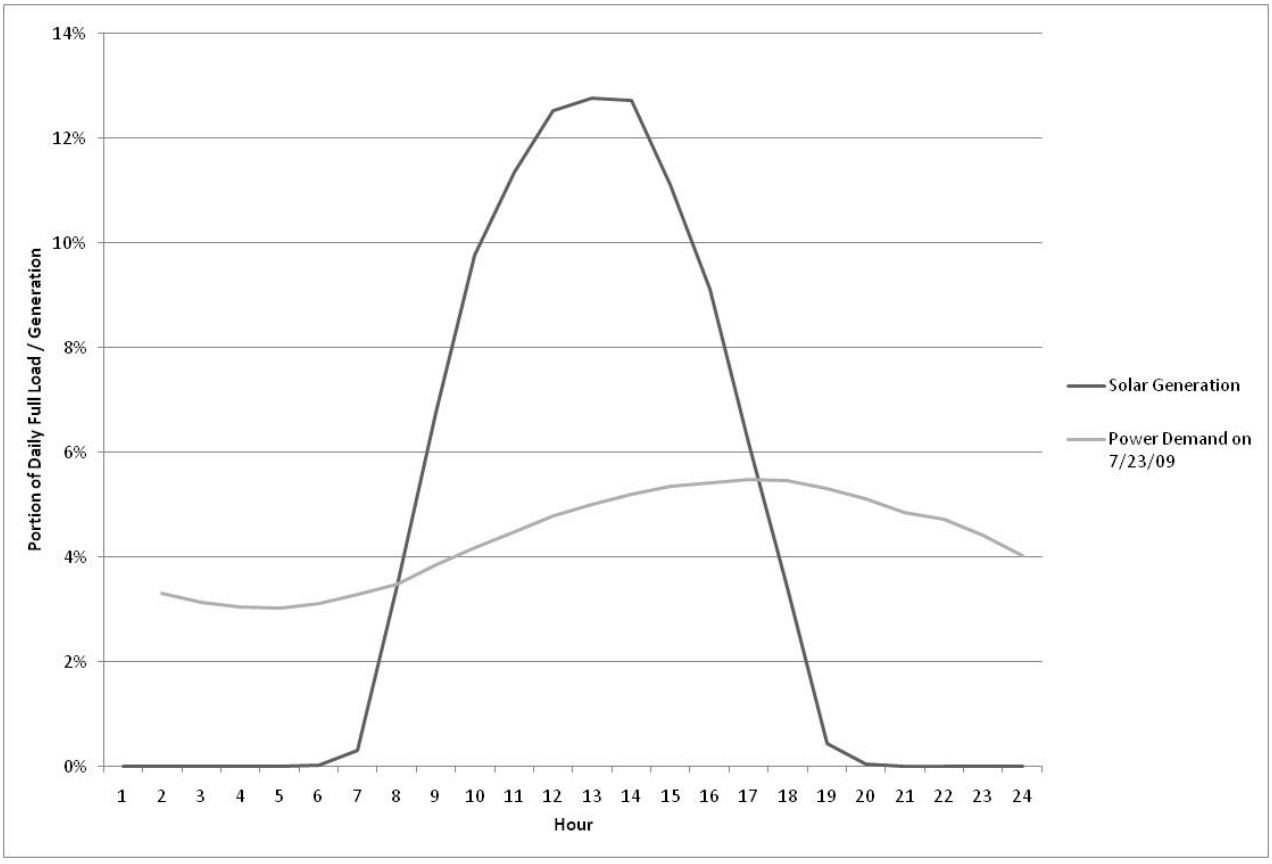
[8] Recognizing that solar output doesn't align with system coincident peaks and despite its high availability factor, solar has a limited capacity factor (reducing its resource value), the Company used an avoided cost of a flatter resource load shape, commercial lighting, in approximating the cost-effectiveness of the resource. Source was 2008 IRP decrement value for commercial lighting and assumes $45 CO2 tax.

Table 4. Results for Standard Economic Tests

All Systems				**AC: IRP 49% LF Decrement**	
	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	0.4937	$1,148,425	$309,334	($839,091)	0.269
Total Resource Cost Test (TRC) No Adder	0.4937	$1,148,425	$281,212	($867,212)	0.245
Utility Cost Test (UCT)	0.1429	$332,372	$281,212	($51,160)	0.846
Rate Impact Test (RIM)		$591,585	$281,212	($310,372)	0.475
Participant Cost Test (PCT)		$816,052	$259,212	($556,840)	0.318
Lifecycle Revenue Impacts ($/kWh)				$0.0000004046	

The ability of solar resources to meet peak demand in Utah is illustrated in the following figure. The shape of the generation output is derived from actual installation data modeled using the PV Watts Calculator from NREL. The load curve from July 23, 2009 (Utah peak demand in 2009) for Utah is shown in Figure 1 below and is compared to the assumed output (based on the PV Watts Calculator results) of the solar photovoltaic systems on that day.

Figure 1. Utah Peak Day Generation and Load Profile (July 23, 2009)



This analysis indicates the solar generation resources deliver peak output between 1-2 PM while Utah load peaks later in the day between 5-6 PM. Solar resources, while not coincident with system peaks do contribute a percentage of energy during the higher load and energy cost hours of summer days, as shown in Figure 1 above.. Hourly information used in providing this illustration, as well as for each hour of the year, is being stored electronically as supporting documentation for the 2009 program.

Appendix 1 - 2009 Program Project Detail

Table 5. 2009 Program Residential Participants

Project ID	City	Incentive	Total system - kW	System Kw eligible for incentive	Total System Cost ($)	$/watt - total cost	% of Sunshine	System Orientation	System Tilt Angle (Degree,°)	Module Manufacturer	Module Model	Module Quantity	Module CEC rated Watts Output	Inverter Manufacturer	Inverter Model	Inverter CEC Weighted Efficiency %
9010501	New Harmony	$ 1,686	0.843	0.843	23,519.23	27.90	100%	180	seasonal/ adjustable	Sharp	NT-175U1	6	151.8	Xantrex	XW6048-120/240	92.5%
9010502	Salt Lake City	$ 2,676	1.339	1.338	17,796.12	13.30	80%	180	28	REC Solar	REC215AE-US	10	178.0	Enphase	M190-72-240-SXX	94.0%
9010503	Vernal	$ 5,126	2.596	2.563	27,453.58	10.71	100%	180	26.4	Sharp	NT-175U1	18	149.9	Fronius	IG 5100	95.0%
9010504	Brighton	$ 4,058	2.029	2.029	17,461.46	8.61	100%	164	50	Evergreen Solar	ES-A-195-fa2	12	178.0	Power-One	PVI-3.6-OUTD-US (240 V)	95.5%
9010506	Salt Lake City	$ 6,000	3.591	3.000	33,840.50	11.28	90%	180	30	Suntech Power	STP175S-24/Ab-1 Black	24	157.5	Enphase	M190-72-240-SXX	95.5%
9010509	Holladay	$ 1,962	0.999	0.981	13,831.00	14.10	95%	180	45	Canadian Solar	CS6-200P	6	188.9	Outback Power	GVFX 3048	95.5%
9010510	Ivins	$ 5,500	2.7504	2.750	26,240.00	9.54	100%	180	30	Kyocera	KD205GX-LP	16	180.0	SMA	SB3000US (240)	95.5%
9010511	Dammeron Valley	$ 5,082	2.541	2.541	35,254.66	13.87	100%	180	23	Sharp	NT-175U1	18	151.8	Xantrex	XW4548120/ 240-60	93.0%
9010512	Eden	$ 2,146	1.073	1.073	11,175.00	10.41	100%	180	41	REC Solar	SCM225	6	196.5	Outback Power	GVFX3648/S	91.0%
9010513	Ivins	$ 5,046	2.523	2.523	23,999.70	9.51	100%	180	5-10	Sharp	NE-170U1	18	149.1	Fronius	IG3000	94.0%
9010516	Orem	$ 3,996	1.998	1.998	30,920.00	15.48	100%	195	41	REC Solar	SCM210	12	183.0	Outback Power	GFFX3648/D	91.0%
9010520	Salt Lake City	$ 5,426	2.713	2.713	22,050.00	8.13	100%	180	40	SunPower	SPR-225-BLK	14	209.5	SMA	SB 3000US (240)	95.0%
9010521	Salt Lake City	$ 4,266	2.180	2.133	30,000.00	14.06	95%	180	Variable	Sanyo	HIP-205NKHA5	12	185.9	Enphase	M210-84-240-s12	95.5%
9010522	Salt Lake City	$ 6,000	3.088	3.000	21,641.47	7.21	100%	180	23	Sanyo	HIP-190BA19	18	184.5	SMA	SB4000US (CL) (240V)	96.0%
9010525	South Jordan	$ 1,998	0.999	0.999	19,446.00	19.47	100%	180	45	REC Solar	SCM210	6	183.0	Xantrex	XW4024-120/240-60	91.0%
9010527	Salt Lake City	$ 2,076	1.202	1.038	10,561.70	10.18	95%	180	40	BP Solar	BP 175B	8	157.3	SMA	SB 3000US (240)	95.5%
9010528	Park City	$ 2,076	1.202	1.038	10,807.00	10.41	90%	180	40	BP Solar	BP175B	8	157.3	SMA	SB 3000US (240)	95.5%
9010529	Salt Lake City	$ 2,664	1.332	1.332	14,046.56	10.55	95%	188	59	Solar World	SW175 mono	9	156.6	Enphase	M175-24-208-S01	94.5%
9010532	Park City	$ 3,698	4.626	1.849	34,500.00	18.66	100%	SE/W	45	SunPower	SPR-225-BLK-U	24	188.9	SMA	SB 5000US	95.5%
9010533	Wanship	$ 4,672	2.336	2.336	17,000.00	7.28	98%	172	45	Canadian Solar	CS6P-190PE	15	184.5	Enphase	M190-72-240-SXX	96.0%
9010536	Castle Valley	$ 5,014	2.507	2.507	21,249.00	8.48	100%	180	39	REC Solar	SCM215	14	187.5	SMA	SB5000US	95.5%

Project ID	City	Incentive	Total system - kW	System Kw eligible for incentive	Total System Cost ($)	$/watt - total cost	% of Sunshine	System Orientation	System Tilt Angle (Degree,°)	Module Manufacturer	Module Model	Module Quantity	Module CEC rated Watts Output	Inverter Manufacturer	Inverter Model	Inverter CEC Weighted Efficiency %
9010538	Moab	$ 3,582	1.791	1.791	5,790.00	3.23	100%	180 S	25	REC Solar	SCM215	10	187.5	SMA	SB5000US	95.5%
9010539	Ivins	$ 6,000	3.478	3.000	25,900.00	8.63	100%	180	10	Mitsubishi	PV-UD185MF5	20	185.0	Xantrex	GT3.8-NA-240/208 UL - 05	94.0%
	Total:	$ 90,750	49.736		$ 494,482.98											

Table 6. 2009 Program Residential – Partial Participants

Project ID	Application Status Notes	App Submittal Date	City	Estimated Incentive	Estimated kW	% of Sunshine	System Orientation	System Tilt Angle (Degree,°)	Module Manufacturer	Module Model	Original App: Module Quantity	Original App. Watts Output	CEC Efficiency	Original App: Module	Original App: Inverter Model	Original App: Inverter CEC Weighted Efficiency %	Invoice: CORRECT CEC EFFICIENCY	Inverter Quantity
9010505	Application Withdrawn / Ineligible	1/5/09	Sandy	$5,165	2582.320	100%	195	32	Evergreen Solar	ES-190W	16	169.0	169.0	Xantrex	GT 3.3	95.5%	95.5%	1
9010507	As of 1/19, Application was Withdrawn. Unable to obtain approval from his HOA	1/5/09	Springdale	$8,210	4105.140	100%	180	37	Mitsubishi	PV-UD185MF5	26	166.2	166.2	Array	SB 700US (240V)	95.0%	95.0%	1
9010508	Application Withdrawn / Ineligible	1/5/09	Ogden	$2,399	1199.700	100%	180	41	REC Solar	SCM215	6	215.0	187.5	Outback Power	GVFX 3648/S	93.0%	93.0%	1
9010514	Application Withdrawn / Ineligible	1/5/09	Holladay	$5,100	2549.850		180	28	Evergreen Solar	ES-200	15	178.0	178.0	Xantrex	GT 3.3	95.5%	95.5%	1
9010515	Application Withdrawn / Ineligible	1/5/09	Draper	$1,758	878.850		180	28	BP Solar	175W	6	155.0	155.0	Enphase	M175-24-240-S	94.5%	94.5%	6
9010518	Application Withdrawn / Ineligible	1/5/09	Park City	$1,465	732.375	95%	210	40	Evergreen Solar	175W	5	155.0	155.0	Enphase	M175-24-240-S	94.5%	94.5%	5
9010519	Application Withdrawn / Ineligible	1/5/09	Tooele	$6,532	3266.100		180	20	Sanyo	HIP Double Solar	18	190.0	190.0	PV Powered	PVP 3500	95.5%	95.5%	
9010523	Application Withdrawn / Ineligible	1/5/09	Salt Lake City	$7,553	3776.357	95%	180	26	Sanyo	HIP-200-BA3	21	188.3	188.3	Xantrex	GT 4.0N	95.5%	95.5%	1
9010524	Application Withdrawn / Ineligible	1/5/09	Cottonwood Heights	$5,377	2688.480	100%	180	Variable	REC Solar	SCM210	15	186.7	186.7	Xantrex	GT 3.3	96.0%	96.0%	1

Project ID	Application Status Notes	App Submittal Date	City	Estimated Incentive	Estimated kW	% of Sunshine	System Orientation	System Tilt Angle (Degree,°)	Module Manufacturer	Module Model	Original App: Module Quantity	Original App. Watts Output	CEC Efficiency	Original App: Module	Original App: Inverter Model	Original App: Inverter CEC Weighted Efficiency %	Invoice: CORRECT CEC EFFICIENCY	Inverter Quantity
9010526	Application Withdrawn / Ineligible	1/5/09	Moab	$399	199.500		190	25	REC Solar	SCM210	10-12	210.0	183.0	Enphase	M200-32-240-S01	95.0%	95.0%	10-12
9010530	Application Withdrawn / Ineligible	1/5/09	Draper	$3,402	1701.000	100%	200	20	Solar World	SW175 mono	12	150.0	156.6	Enphase	M-175-240-S01	94.5%	94.5%	1
9010550	Application Withdrawn / Ineligible	1/5/09	Ivins		0.000													
9010537	Installation not complete yet; Awaiting more details	1/5/09	Park City			100%	176	22.5		Sanyo	18	188.7		SMA	SB 4000US	96.0%	96.0%	
9010540	Waiting List	1/5/09	Pleasant Grove				180	45	REC Solar	SCM225	16	225.0	196.5	Xantrex	XW6048 120/240-60	87.0%	92.5%	1
9010541	Waiting List	1/5/09	Park City		924.918		165	40	SunPower	SPR-210-BLK	5	193.7	188.9	SMA	SB 3000US (240)	95.5%	95.5%	1
9010542	Waiting List	1/5/09	Milford		3400.182		130	38.8	Sharp	ND-224U1F	18	197.8	197.6	PV Powered	PVP 3500	95.5%	95.5%	1
9010543	Waiting List	1/5/09	Sandy		2929.500		180	41	REC Solar	SCM210	15	210.0	183.0	Outback Power	GVFX 3648	93.0%	91.0%	1
9010544	Waiting List	1/5/08	Salt Lake City		1653.750		178	20	Solar World	SW175 mono	10	175.0	156.6	Enphase	M175-24-208-S01	94.5%	94.5%	10
9010545	Waiting List	1/5/09	Salt Lake City		1653.750		178	20	Solar World	SW175 mono	10	175.0	156.6	Enphase	M175-24-208-S01	94.5%	94.5%	10
9010546	Waiting List	1/5/09	Salt Lake City		2315.250		180	14	Solar World	SW175 mono	14	175.0	156.6	Enphase	M175-24-208-S01	94.5%	94.5%	14
9010547	Waiting List	1/5/09	Park City		4832.300		180	30	SunPower	SPR-230-WHT-U	22	230.0	209.5	SMA	SB 5000US	95.5%	95.5%	1
9010548	Waiting List	1/5/09	Morgan		3906.000		180	Variable	Solar World	SW175 mono	24	175.0	156.6	Outback Power	Flexware 1000	93.0%	93.0%	4
9010549	Waiting List	1/5/09	Eagle Mtn		5272.500		195	40	Evergreen Solar	ES-190SL	30	190.0	163.9	Xantrex	XW6048-120/240	92.5%	92.5%	1
9010551	Waiting List	1/6/09	Salt Lake City		1662.780		180	40	?	TDB125X125-72-P	12	149.8	149.8	PV Powered	PVP2000	92.5%	92.5%	1
9010552	Waiting List	1/7/09	Farmington		2604.000		180	30-35	Solar World	SW175 mono	16	175.0	156.6	Outback Power	GVFX3648	93.0%	91.0%	1
9010553	Waiting List	1/7/09	Pleasant Creek		969.000		180	30	BP Solar	BP585	12	85.0	85.0	Fronius	IG 3000	95.0%	94.0%	1

Project ID	Application Status Notes	App Submittal Date	City	Estimated Incentive	Estimated kW	% of Sunshine	System Orientation	System Tilt Angle (Degree,°)	Module Manufacturer	Module Model	Original App: Module Quantity	Original App. Watts Output	CEC Efficiency	Original App: Module	Original App: Inverter Model	Original App: Inverter CEC Weighted Efficiency %	Invoice: CORRECT CEC EFFICIENCY	Inverter Quantity
9010554	Waiting List	1/9/09	Odeon		1302.000		180	30	Solar World	SW175 mono	8	175.0	156.6	Outback Power	GVFX3648	93.0%	91.0%	1
9010555	Waiting List	1/30/09	Brighton		1680.000		190	30-35	Solar World	SW175 mono	10	175.0	156.6	SMA	SB4000US (240V)	96.0%	96.0%	1
9010556	Waiting List	2/18/09	Moab		1237.600		180	Variable	Sharp	NE-170U1	8	170.0	149.1	Outback Power	GFX3648	91.0%	91.0%	1

Table 7. 2009 Program Non-Residential Participants

Project ID	City	Incentive	Total system size (kW)	System kW eligible for incentive	Total System Cost ($)	$/watt - total $	% of Sunshine	System Orientation	System Tilt Angle (Degree,°)	Module Manufacturer	Module Model	Module Quantity	Module CEC Rated Watts Output	Inverter Manufaturer	Inverter Model	Inverter CEC Weighted Efficiency %
9010501	Clearfield	$ 16,272.00	8.136	8.136	$ 60,339.00	$7.42	100%	180	30	SolarWorld	SW185 mono/T	50	172.2	Fronius	IG Plus 11.4-3 Delta-208	95.0%
9010502	Centerville	$ 16,272.00	8.136	8.136	$ 60,339.00	$7.42	100%	180	30	SolarWorld	SW185 mono/T	50	172.2	Fronius	IG Plus 11.4-3 Delta-208	95.0%
9010503	Salt Lake City	$ 24,314.00	12.157	12.157	$ 91,228.00	$7.50	100%	180	26	REC ScanModule	REC215AE-US	68	187.2	Xantrex	GT5.0-NA-240/208 (208V)	95.5%
9010505	Park City	$ 2,712.00	1.377	1.356	$ 11,448.00	$8.44	100%	180	40	SunPower	SPR-210-BLK	8	188.9	SMA	SB 3000	95.5%
9010509	Green River	$ 6,768.00	3.384	3.384	$ 21,367.79	$6.31	100%	180	30	Kyocera		20	180.0	Fronius	IG 4001	94.0%
9010514	Salt Lake City	$ 4,816.00	2.408	2.408	$ 32,733.09	$13.59	100%	180	15	Suntech, REC, Solar World	STP175S-24/Ab-1 REC220AE-US SW175 MONO	5 5 5	156.0 191.7 156.6	Enphase	M190-72-208-Sxx	95.0%
9010519	Salt Lake City	$ 17,698.00	8.849	8.849	$ 76,345.00	$8.63	100%	180	28	Sunpower	SPR-230-WHT-U	44	209.5	Sunpower	SPR-4000m (240V)	96.0%
9010521	Magna	$ 17,876.00	8.938	8.938	$ 82,500.00	$9.23	100%	180	48	REC Solar	SCM216	48	196.5	Enphase	M200-32-208-S113	95.0%

Project ID	City	Incentive	Total system size (kW)	System kW eligible for incentive	Total System Cost ($)	$/watt - total $	% of Sunshine	System Orientation	System Tilt Angle (Degree,°)	Module Manufacturer	Module Model	Module Quantity	Module CEC Rated Watts Output	Inverter Manufacturer	Inverter Model	Inverter CEC Weighted Efficiency %
9010510	Moab	$ 10,804.00	5.402	5.402	$ 52,785.00	$9.77	100%	180	30	Sunpower	SPR-230-WHT-U	27	209.5	Sunpower	SPR-6000m (240V)	95.5%
9010522	Salt Lake City	$ 13,752.00	21.208	6.876	$273,000.00	$39.70	100%	180	15	Suntech	STP175S-24/Ab-1	132	156.0	SMA America	SB7000US (240V)	96.0%
	Total:	$ 131,284	79.99503		$762,084.88											

Table 8. 2009 Program Non-Residential – Partial Participants

COMMERCIAL: Project ID Pg 1.0	App Submittal Date	City	Estimated KW of system	Estimated incentive	Total System Cost ($)	System Orientation	System Tilt Angle (Degree,°)	Module Manufacturer	Module Model	Module Quantity	Module CEC Rated Watts Output
9010511	1/5/09	Salt Lake City	5.72	$11,438		180	41	REC Solar	SCM214	28	215.0
9010512	1/6/09	Salt Lake City	17.16	$34,314		180	41	REC Solar	SCM214	84	215.0
9010513	1/6/09	Richfield	17.16	$34,314		180	41	REC Solar	SCM214	84	215.0
9010515	2/27/09	Castle Valley	14.30	$28,600		180	39	REC Solar	SCM215	70	215.0
9010516	3/2/09	Tooele	47.27	$94,544			0	Solyndra Inc	SL-001-165U	300	165.0
9010517	8/28/09	Morgan	11.67	$23,338	$80,000.00	180	41	GSE Solar Power	PN 33060-0	60	112.0
9010518	9/10/09	Milford	3.40	$6,800	$31,000.00	180	38.3	Sharp	ND-224UiF	18	197.8

Appendix 2 - System Output Correlation for Selected Sites

THE CADMUS GROUP, INC.

Date: **February 26, 2010**

To: **Don Jones, Pacificorp**

From: **Jeff Cropp, Heidi Ochsner**

Re: **Methodology for Comparison of Estimated and Metered PV Data**

Cadmus analyzed metered data for a selection of photovoltaic (PV) installations incented by Pacificorp in 2009. Metered data for the PV systems was not available for all systems for the entire year, so the impact the systems have in reducing annual energy use and peak demand was estimated using the PV Watts Solar Calculator (PV Watts). PV Watts estimates energy production for each installed system based on the system's location, capacity, tilt, and orientation using solar irradiance data on an hourly basis from a typical meteorological year (TMY). Cadmus received 15-minute interval metered data for five of the installed sites and compared this data to the PV Watts data. This document outlines the methodology used to determine whether the estimated data was representative of actual system performance. The comparison involved three steps:

1. Identify the days within the metered dataset where the PV system was operational.
2. Convert the metered data and estimated data to common units and time interval.
3. Compare the estimated data to the metered data

Each step is discussed in more detail below.

Step 1: Identify Days Where the PV System was Operational

The PV Watts performance estimation assumes the system is operational during every hour of the year. Cadmus excluded days in which the PV system was not operational in order to perform a meaningful comparison. An operational day was defined as a day where the capacity factor (the system output divided by the system capacity)9 exceeded 0.02. Metered data for more than one operational day per customer was required in order to smooth out day-to-day differences in weather patterns. The analysis of metered projects is shown in Table 9.

[9] The daily capacity factor (CF) was calculated by taking the total kWh produced in one day divided by the system capacity (kW_{AC}) multiplied by 24 hours.

Table 9. Analysis of Metered Project Data

Customer	Number of Days with Metered Data	Number of Days Operational	Could Comparison Be Performed?
9010532 – res	52	26	Yes
9010539 – res	24	24	Yes
9010503 – nonres	16	16	Yes
9010522 – res	8	1	No
9010510 – nonres	16	1	No

Step 2: Convert to Common Units and Time Interval

The next step involved converting the metered data and estimated data to a common format where both datasets have the same units and time interval. Both sets of data were converted to a common format of daily interval kWh data. A daily interval was used in order to decrease variability due to weather or other factors such as morning or evening shading. The metered data Cadmus received was 15-minute interval kW data. The 15-minute interval kW data was multiplied by 0.25 to convert to kWh and then the total for each day was calculated.

$$kWh = kW_{15min} \times 15\ min \times \frac{1\ hour}{60\ min}$$

PV Watts reports estimated energy production in Watts at hourly intervals. Cadmus multiplied the hourly interval Watt data by 1,000 to convert to kW. Since the data was in hourly intervals, kWh is equivalent to kW. The total was then calculated for each day.

$$kWh = W_{hourly} \times \frac{1\ kWh}{1{,}000\ Wh}$$

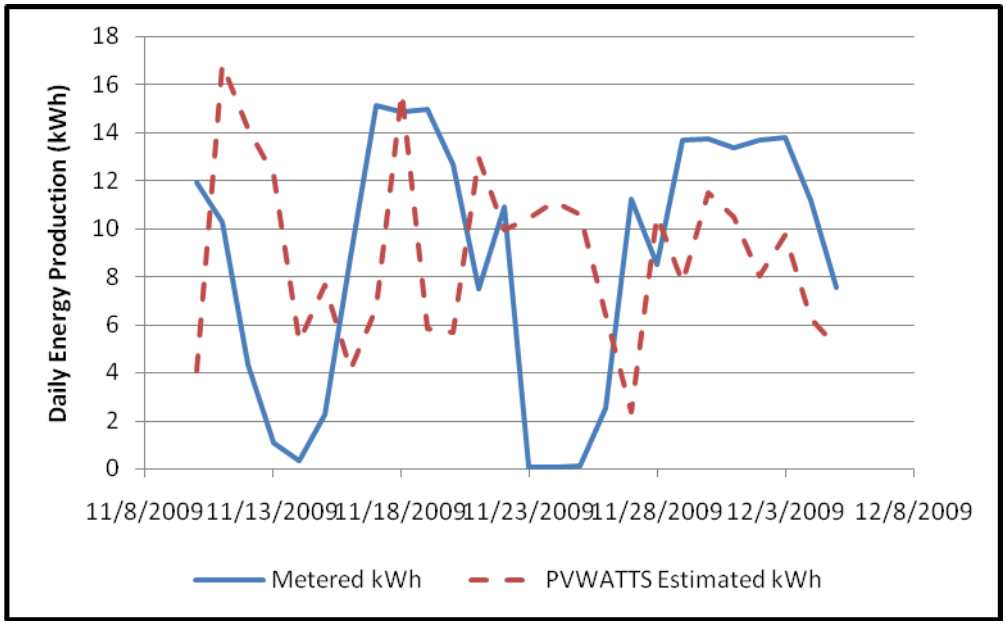
Step 3: Compare the Estimated Data to the Metered Data

The last step was to compare the estimated data generated using PV Watts to the metered data. This was done for three customers with sufficient data to analyze. Two different methods were used to compare the data. The first was to plot the daily kWh data side-by-side so it could be visually compared. The second method was to calculate the percent difference between the averaged daily energy production for the metered and estimated data.

Plot Daily Energy Production

The daily energy production from the metered data and estimated data for the same days of the year was plotted side-by-side for visual comparison. Figure 1 shows an example of this comparison, using the 26 days of viable data for 9010532. .

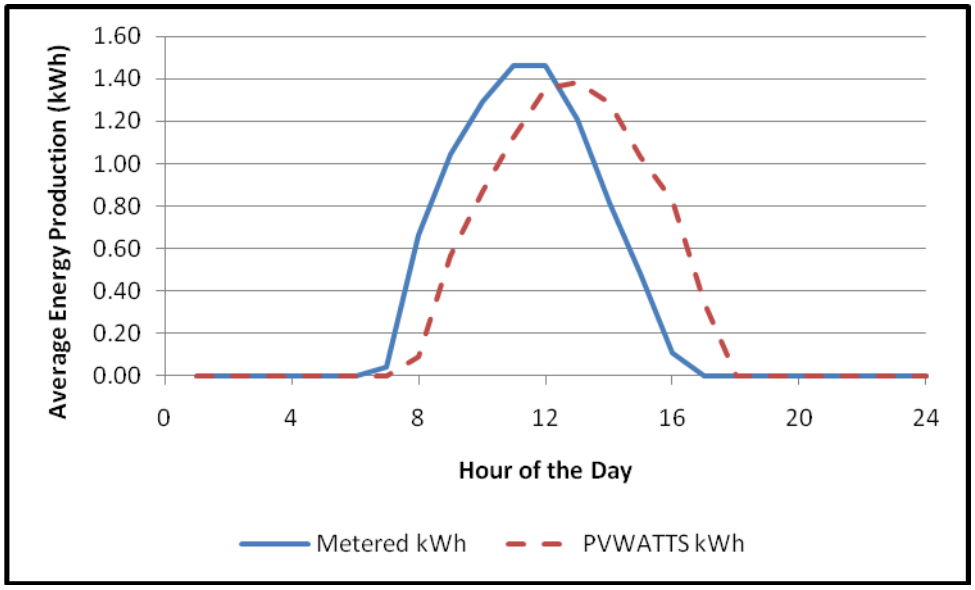
Figure 2: Comparison of Daily Metered Data and Estimated Data for 9010532



The plot indicates significant variability in both the metered data and the estimated data from day to day. This is likely due to weather differences on a daily basis. As noted previously, the PV Watts Solar Calculator uses TMY data, and any variation between the TMY and the actual weather in 2009 is reflected in the plot. Day to day variability is acceptable for modeling purposes so long as the average day during the analysis period is similar between both sets.

Using the calculation in Step 2, the hourly energy production was determined for the metered and PV Watts data on each project. These values were averaged by hour for each day in the metering period in order to eliminate daily variability. Figure 2 shows the difference between the metered and estimated data once averaged by the hour of the day. The main difference between the two datasets is that the peak occurs slightly earlier in the day for the metered data than for the estimated data.

Figure 3: Comparison of Hourly Averaged Metered Data and Estimated Data for 9010532



Calculate the Percent Difference Between the Datasets

The last comparison involved calculating the total energy production for the days with non-zero metered data and the average daily energy production for each of the three customers. The difference between the estimated and metered data was then determined. The results are shown in Table below.

Table 10. Comparison of Daily Average Metered and Estimated Data

Customer	Metered Energy Production (kWh)		PVWATTS Estimated Energy Production (kWh)		Difference (%)
	Total	Daily Avg	Total	Daily Avg	
9010532	224	9	231	9	3%
9010539	178	7	183	8	3%
9010503	458	29	449	28	-2%

The table shows that the percent difference between the estimated data and the actual data was less than five percent for all three sites. This gives us confidence that using the PV Watts Solar Calculator represents appropriate methodology for estimating site performance, so long as the PV system is operational. PV systems occasionally need repairs and so there could be days or weeks during the year where PV Watts will overestimate production from the system. But on an annual average and across a large sample size, the difference between the estimated performance and actual performance is expected to be minimal.

The only remaining issue involves the difference in daily peak generation time, and the implications for comparing solar generation peak data to system wide data on the peak demand day. Cadmus notes the metered data only includes information from November and December 2009, which may or may not yield a different solar generation profile from PV Watts than will be

achieved during summer peak demand periods. Metered data for summer 2010 can be used to resolve whether a discrepancy exists.