

# Solar Photovoltaic Volumetric Incentive Program

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*2015 Report to the Legislative Assembly*

Prepared by:

Oregon Public Utility Commission

January 1, 2015

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# Executive Summary

The 2009 Legislature enacted House Bill 3039 (HB 3039) to direct the Oregon Public Utility Commission (Commission) to establish a pilot program to demonstrate the use and effectiveness of “volumetric incentive rates” and payments for electricity delivered from solar photovoltaic (PV) energy systems within Portland General Electric (PGE), PacifiCorp, and Idaho Power service territories.

Volumetric incentive rates (VIR) are production-based incentives in which participants receive payments based on the actual output generated from the solar PV systems. HB 3039 capped the total nameplate capacity of all systems installed under the pilot at 25 megawatts (MW) and limited eligibility to systems under 500 kilowatts. HB 2893, enacted in 2013, raised the cap to 27.5 MW. Pilot program participants cannot take advantage of any state tax credit or Energy Trust of Oregon incentives.

Under the pilot program, participating customers sign a 15-year agreement with their utility and are paid the approved incentive rate at the time of enrollment for all power produced during that period. After 15 years, the utility may pay its prevailing avoided cost price for power produced.

HB 3690, enacted in 2010, allocated 75 percent of program capacity to small and medium size systems (under 100 kilowatts) and the rest for systems between 100 kilowatts and 500 kilowatts.

The Commission must submit a report to the Legislature every two years. In the report, the Commission shall:

- Evaluate the relative effectiveness of volumetric incentive rates versus the existing regime of state tax credits and Energy Trust incentives in promoting the development of solar PV systems and in reducing system costs.
- Estimate the cost of the pilot program on utility customers.
- Estimate the resource value of solar energy.

## **Pilot Program Design and Results to Date**

The Commission adopted rules to implement a pilot program starting July 1, 2010. Since that time, the Commission has monitored the program results and refined the program design when needed.

The Commission has allocated the 27.5 MW total program capacity to the three electric companies based on retail sales in Oregon: PGE 16.3 MW; PacifiCorp 10.8 MW, and Idaho Power 0.45 MW.

The Commission established eight capacity allocation windows over the four-year pilot period for small-scale systems (under 10 kilowatts) and medium-scale systems (between 10 kilowatts and 100 kilowatts). The capacity for large-scale systems (between 100 kilowatts and 500 kilowatts) was allocated once a year over the four-year period. HB 2893 provided for an additional capacity enrollment window to allocate all remaining capacity.

Initially, for owners of small- and medium-size systems, program capacity was awarded on a first-come/first-served basis. Later, the Commission used competitive bidding for medium-size systems to set rates and determine the systems awarded the VIR rates.

The initial rates for small- and medium-size systems were set by the Commission and thereafter adjusted based on program participation and the speed of uptake of the eligible capacity (known as the “automatic rate adjustment mechanism” (ARM)).

Over time, the VIR rates exhibited a clear downward trend:

- Rates for small-scale systems in Zone 1 (Portland) steadily declined from \$0.65 per kilowatt-hour (kWh) in July 2010 to \$0.39 per kWh in April 2014. Small system rates in other geographic Zones decreased in a similar fashion.
- Rates for all medium-scale systems dropped from a high of \$.55 per kWh in July 2010 to just \$.16 per kWh in April 2014.
- The Commission has used competitive bidding to set the rates for large- scale systems. The highest winning bid for PGE dropped from nearly \$0.40 per kWh in the first enrollment window to just over \$0.17 per kWh in the 2013.

As of July 2014, the pilot program had resulted in over 23 MW of installed solar capacity in Oregon. Participants installed 13.5 MW of solar capacity in PGE’s service territory; 9.2 MW in PacifiCorp’s service territory; and 0.4 MW in Idaho Power’s service territory. The pilot program is on target to achieve the goal of 27.5 MW by the end of 2015.

## **Estimated Rate Impacts**

The estimated rate impact is highest in the early years of the pilot due to start-up costs in establishing the program processes and procedures. Rate impact declines over time, resulting in an average of about 0.25 percent of revenue requirements.<sup>1</sup> The estimated average annual rate impact from the entire 15-year pilot program is 0.28 percent of revenue requirement for PGE customers; 0.22 percent of revenue requirement for PacifiCorp customers; and 1.3 percent of revenue requirement for Idaho Power customers.

## **Comparative Effectiveness of Alternative Incentive Options**

The pilot program and its production based incentives have not adversely affected the use of state tax credits and Energy Trust incentives in promoting the development of Solar PV systems in Oregon. Since July 2010, over 40 MW of solar capacity has been installed in Oregon with the help of state tax credits and Energy Trust incentives. Both the pilot program and the state tax credit/incentive program have promoted the development of Solar PV systems in Oregon. Different individuals are likely to find one or the other of the incentive programs to be more advantageous to their decision to install a solar PV system.

## **Effects on System Cost**

The cost of systems installed under all Oregon solar incentive programs declined steadily over the last several years primarily due to the decline in solar panel costs. The Commission found no fundamental difference in system cost trends between programs, with one exception: the reverse auction mechanism for large systems under the VIR pilot has consistently provided the lowest energy and installation costs among the programs.

## **Resource Value of Solar**

At the conclusion of the 15-year VIR contract, the customer-generator may continue to sell power to the utility at a rate determined by the resource value of solar. There are many potential benefits that could be incorporated into the determination of the resource value. However, to date, the Commission has chosen to calculate this value based on benefits that are observable and measurable.

After conducting an investigation into this subject through Docket UM 1559, the Commission determined that the resource value of solar at present should reflect the avoided cost of energy generation and transmission. Other additional benefits may be incorporated into this value as more solar is installed onto the electric grid in the future.

The current utility estimates of the resource value of solar range from 5.5 to 6.7 cents per kWh. The Commission will be conducting a comprehensive study of this subject in the future.

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<sup>1</sup> Approximately \$0.25 on an average retail customer's monthly bill

## Background

The 2009 Oregon Assembly directed the Public Utility Commission to establish a Volumetric Incentive Rate (VIR) Pilot Program in the service territories of Portland General Electric Company (PGE), PacifiCorp, and Idaho Power Company (Idaho Power). The purpose of the pilot is to demonstrate the use and effectiveness of paying a fixed price, in cents per kWh, for solar electricity produced by retail customers.<sup>2</sup> The fixed price (incentive rate) established by the Commission is set to recover the system's total installation cost over time and attract customer and solar developer interest. Systems less than 500 kilowatts are eligible for the program. Participants in this pilot are not eligible for state tax credits or Energy Trust rebates.

The Legislature originally set a cap of 25 MW of installed capacity for the program.<sup>3</sup> In 2013, it raised the cap to 27.5 MW.<sup>4</sup>

Seventy five percent of the program capacity is allocated to "residential qualifying systems and small commercial qualifying systems." A "residential qualifying system" has a nameplate capacity of 10 kilowatts or less. A "small commercial" system has a nameplate capacity between 10 kilowatts and 100 kilowatts. The remaining program is allocated to systems between 100 kilowatts and 500 kilowatts.

Under the VIR Pilot Program, the customer executes a 15-year agreement with their utility and is paid the approved incentive rate for each kWh of solar power they generate. However, each customer will receive the rate in effect at the time they execute their contract for the duration of the contract. After 15 years, the utility may pay its prevailing avoided cost price for solar power generated by the customer.

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<sup>2</sup> ORS 757.365(1).

<sup>3</sup> Former ORS 757.365(1).

<sup>4</sup> ORS 757.265.(1)

## Program Design and Results

The Commission adopted rules to implement the VIR Pilot Program starting July 1, 2010. Since that time, the Commission has monitored the program and refined the program design when needed.

The Commission allocated the original 25 MW total program capacity to the three electric companies based on retail sales in Oregon: PGE 14.9 MW; PacifiCorp 9.8 MW; and Idaho Power 0.4 MW. HB 2893 authorized an additional 2.5 MW of capacity bringing the company totals to: PGE 16.3 MW; PacifiCorp 10.8 MW; and Idaho Power 0.45 MW.

Eight capacity allocation windows were established over the four-year pilot period to enroll small-scale systems (under 10 kilowatts) and medium-scale systems (between 10 kilowatts and 100 kilowatts). The capacity for large-scale systems (between 100 kilowatts and 500 kilowatts) was allocated once a year over the four-year period. HB 2893 provided for an additional enrollment window in starting May 1, 2015,<sup>5</sup> to allocate all remaining capacity.

Initially, capacity was allocated to small and medium sized systems on a first-come, first-served basis. Currently, capacity is allocated to small systems by lottery and to medium systems by competitive bid. After setting initial rates for small- and medium-sized systems, the Commission adjusted the rates based on program participation and the speed of uptake of the eligible capacity (an automatic rate adjustment mechanism (ARM)).

Table 1 below shows the rates for small-scale, medium-scale, and large-scale systems for each year during the course of the pilot. The data in Table 1 highlight two important trends:

- Rates for small-scale systems have steadily declined throughout the program. As an example, rates in Zone 1 (Portland) fell from \$0.65 per kWh in July 2010 to \$0.39 per kWh in April 2014. Small system rates for other zones have similarly declined over time.
- Rates for medium-scale systems in all zones have reflected a similar pattern, falling from a high of \$0.55 per kWh in July, 2010, to the current rate of \$0.16 per kWh.

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<sup>5</sup> Order No. 14-025 in UM 1452, p. 2.

**Table 1 - History of VIR Rate**  
*Small systems (<10kW) -- \$/kWh*

<b>Enrollment Period</b>	<b>Zone 1</b>	<b>Zone 2</b>	<b>Zone 3</b>	<b>Zone 4</b>
Jul 2010	\$0.65	\$0.60	\$0.60	\$0.55
Oct 2010	\$0.585	\$0.54	\$0.54	\$0.495
Apr 2011	\$0.468	\$0.432	\$0.432	\$0.396
Oct 2011	\$0.374	\$0.346	\$0.346	\$0.317
Apr 2012	\$0.411	\$0.346	\$0.346	\$0.317
Oct 2012	\$0.411	\$0.346	\$0.346	\$0.317
Apr 2013	\$0.390	\$0.311	\$0.311	\$0.285
Oct 2013	\$0.390	\$0.280	\$0.280	\$0.256
Apr 2014	\$0.390	\$0.252	\$0.252	\$0.230

*Medium systems (>10kw and <100kW)*

<b>Enrollment Period</b>	<b>Zone 1</b>	<b>Zone 2</b>	<b>Zone 3</b>	<b>Zone 4</b>
Jul 2010	\$0.55	\$0.55	\$0.55	\$0.55
Oct 2010	\$0.495	\$0.495	\$0.495	\$0.495
Apr 2011	\$0.396	\$0.396	\$0.396	\$0.396
Oct 2011	\$0.317	\$0.317	\$0.317	\$0.317
Apr 2012	\$0.285	\$0.25	\$0.25	\$0.25
Oct 2012	\$0.285	\$0.25	\$0.25	\$0.25
Apr 2013	\$0.230	\$0.181	\$0.181	\$0.181
Oct 2013	\$0.175	\$0.16	\$0.16	\$0.16
Apr 2014	\$0.175	\$0.16	\$0.16	\$0.16

*Large systems - 100kW to 500kW (cents per kWh)*

	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>
<b>PGE</b>	39	22.5	21	17
<b>PacifiCorp</b>	24	23	17	11

The Commission used competitive bidding to set the rates for large-scale systems. The highest winning bid for PGE dropped from nearly \$0.40 per kWh in the first enrollment window in 2010 to \$0.175 per kWh in the last 2013 enrollment window. The winning bid for large-scale systems for PacifiCorp dropped from 24 cents/kWh in 2010 to 11 cents/kWh in the last enrollment window in 2013.



As of July 2014, the VIR Pilot Program had resulted in over 23 MW of installed solar capacity in Oregon (out of 27.5 MW mandated by the legislature). Participants installed 13.5 MW of solar capacity in PGE's service territory; 9.2 MW in PacifiCorp's service territory; and 0.4 MW in Idaho Power's service territory. The Pilot Program is on target to achieve the goal of 27.5 MW of installed capacity with most of the additional capacity already assigned to projects in progress.

# Estimated Rate Impacts

Each year the electric companies file with the Commission a report estimating the yearly rate impacts of the pilot program. Pilot program costs include both the cost of the incentive payments and the utility cost to administer the program.

To estimate the rate impacts of the pilot program, the electric companies and Commission assume the following:

- Full capacity is reached for reservations in each allocation window;
- Immediate installation of all winning projects after the enrollment window is complete;
- Immediate incorporation of all costs into electricity rates. The estimates do not consider regulatory lag or deferred accounting treatment;
- The utility benefit of not having to purchase power on the open market in an amount equivalent to the output from participating solar systems; and
- For the small and medium-sized projects the VIR is reduced by the retail rate, or bill savings the customer receives, due to the net-metering structure of the program. Without this reduction in the VIR the electric companies, and its customers, would be effectively paying the retail rate plus the VIR per kWh.

Below are the overall rate impacts estimated by each utility. See Appendix II for more detail from the associated compliance reports submitted by the utilities.

UTILITY	PGE	PAC	IPCO
% of Revenue Requirement	0.28%	0.22%	1.30% <sup>6</sup>

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<sup>6</sup> Idaho's rate impact based on a 1.5 percent revenue rider and not on actual costs

# Comparative Effectiveness of Alternative Incentive Options

Electric utility customers who plan to install solar generation currently have two Oregon incentive programs to choose from – the “rebate/tax-credit” program offered through the Energy Trust of Oregon (ETO) and the Oregon Department of Energy (ODOE), and the VIR offered through the utilities. Both programs offer cash incentives to the program participant, but the two programs vary greatly in the way these incentives are determined and paid out.

The primary difference between the two incentive programs is in the way the cash incentives are paid out. The rebate/tax-credit program incentive is paid out in two ways. First, the ETO offers a cash rebate based on the size of the system installed (that is, on a “per-kilowatt” basis). Second, participants in the program are eligible for a state income-tax credit (also based on system size) for the tax year that the system is installed. Because the incentive amount is based on how large the solar system is, it is referred to as a “capacity” payment.

In contrast, under the pilot VIR program a participant receives an incentive based on the amount of energy generated (that is, on a “per kilowatt-hour” basis). The incentive is paid monthly at a rate determined when the project is accepted into the program. Since the incentive amount depends on actual energy generation, this type of incentive is referred to as a “production” payment. Participants in VIR pilot program are not eligible for state renewable tax credits.

The relative risks of the two different types of incentives vary. Because recipients of volumetric incentive rates only get paid when their systems operate, they bear the risks associated with reduced generation due to system damage and degradation in the panel efficiency, among other factors. In addition, owners may not be able to take advantage of the payments for a sufficiently long period to justify the investment. Further, the solar pilot program participant must bear the full upfront cost of the system (minus the federal tax credit), and incur greater carrying costs or realize greater opportunity costs, depending on the individual’s financing arrangements, as compared to a lump sum upfront payment.

Some customers will prefer the up-front payments of the Energy Trust incentive coupled with state tax credits. Others will prefer the volumetric incentive rates and payments offered in the pilot program. Obviously, the higher the VIR rates, the more customers that will favor the VIR approach. Still, even at high VIR rate levels, some individuals would still prefer incentives to reduce the upfront cost of a system.

The comprehensive report on solar incentives presented by the Commission to the legislature in July 2014,<sup>7</sup> contained a comparative analysis of the VIR and ETO rebate/tax

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<sup>7</sup> “Investigation into the Effectiveness of Solar Programs in Oregon”, Oregon Public Utility Commission report to the Legislature, July 1, 2014.

credit incentive programs. In that study, the two programs were compared on a number of attributes and their relative efficiencies were discussed. In this section, the two most prominent performance comparisons are highlighted – those based on demand (number of projects and capacity) and cost.

## Number and Capacity of Installed Projects

As can be seen in Table 2, the pilot program and its production-based incentives have not affected the use of state tax credits and Energy Trust incentives in promoting the development of Solar PV systems in Oregon. Since July 2010 (post VIR), over 40 MW of solar capacity have been installed in Oregon with the help of state tax credits and Energy Trust incentives. From Table 2, it can be seen that this is more than double the amount of capacity installed under these programs in the three years prior to the establishment of the VIR program.

**Table 2 – Solar Projects Completed Under ETO Rebate/ Tax Credit Programs<sup>8</sup>**

Year	No. Projects	Capacity (kW)
PRE VIR		
2007	220	1,069
2008	256	3,959
2009	482	5,900
POST VIR		
2010	1205	9,732
2011	1331	11,114
2012	1244	19,186

By comparison, for each of the eight allocation windows held for the VIR Pilot Program, all available capacity was reserved and to date, all of the allocated capacity is either installed or expected to be installed by the end of the Pilot Program.

Both the pilot program and the state tax credit/incentive program have promoted the development of Solar PV systems in Oregon. Different individuals are likely to find one or the other incentive programs to be more advantageous to their decision to install a solar PV system.

For another view, Table 3 compares the number of projects and installed capacity under the legacy programs for 2009 (before the VIR was offered) and 2013 (the fourth year of the VIR Pilot Program).

<sup>8</sup> *Ibid.*, Appendix 1

**Table 3 - Number of Projects and Installed Capacity by Program**

Program	Number of Projects (2009)	Number of Projects (2013)	Capacity (kW) (2009)	Capacity (kW) (2013)
ETO plus Tax Credit (Residential)	507	838	1595	4323
ETO plus Tax Credit (Commercial)	159	42	3499	1479
VIR Pilot (Small)	-	342	-	2589
VIR Pilot ( Med & Large)	-	17	-	2143

Despite the alternative incentive offered to customers through the VIR Pilot Program, there has been no slowing in the demand for residential solar programs assisted by the legacy programs. As can be seen in Table 3, demand for residential installations with the ETO/tax incentive program continued to increase during the years of the VIR.

Table 3 also reflects a drop in demand for business incentives through the legacy programs in 2013 compared to 2009. This drop is directly due to the severe decrease in funding for the Business Energy Tax Credit (BETC) program during this time period.<sup>9</sup>

In conclusion, the VIR Pilot Program has had no dampening effect on the demand for solar through the ETO rebate/tax incentive program.

### Comparison of Installation Cost

The following table compares the average installation cost of solar generating equipment as reported by the installers for the legacy and VIR pilot programs.

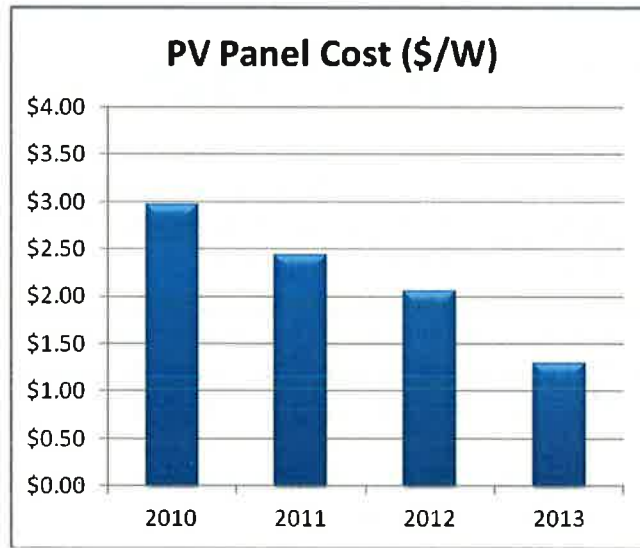
**Table 4 - Cost of Solar Installation by Program**

Program	Cost in 2010 (\$/Watt)	Cost in 2013 (\$/Watt)	Decrease %
ETO plus Tax Credit (Residential)	\$6.88	\$4.62	32
ETO plus Tax Credit (Commercial)	\$6.74	\$5.23	22
VIR Pilot (Small)	\$6.48	\$4.57	29
VIR Pilot (Large)	\$3.71	\$2.31	38

<sup>9</sup> The BETC program expired in 2012 for projects not under construction by April 2011.

Figures 1 and 2 show, by year, the average of panel costs and non-equipment costs for systems installed for the VIR Pilot Program. On average, panel costs have dropped from \$3.00 per watt in 2010 to \$1.25 per watt in 2013. Non-equipment costs have come down but not as fast. On average, non-equipment costs dropped from about \$3.50 per watt in 2010 to a little more than \$2.50 per watt in 2013.

**Figure 1: Cost of PV Panels Used in the VIR Pilot**



**Figure 2: Trend in Solar Installation Non-Equipment Costs**

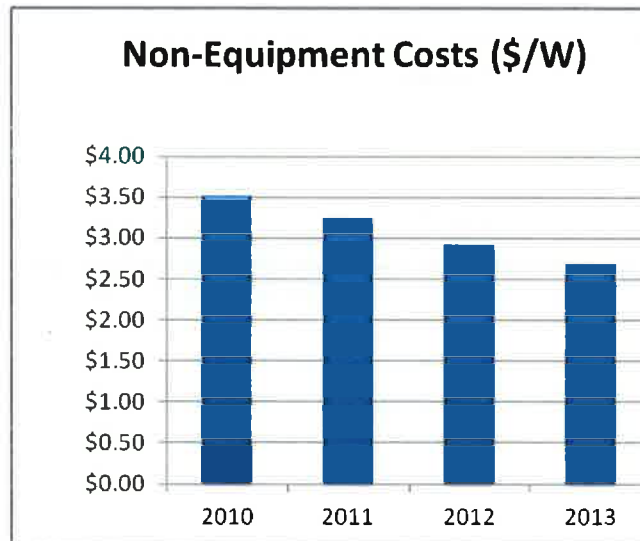


Table 4 (along with Figures 1 and 2) shows that the installed cost of solar equipment decreased substantially over the VIR program window. This dramatic cost drop was observed in both the legacy solar incentive programs and the VIR Pilot Program.

The costs of systems installed under all programs have declined steadily primarily due to the industry-wide decline in solar panel costs. As explored in detail in the July solar incentive report, the Commission found no fundamental difference in system cost trends between programs.

There is no evidence that the design of any of the incentive program had any effect on installation costs (with the exception noted below). Since the decreases in costs are relatively comparable for the two programs, we conclude that the cost decreases were not due to program design but rather to general market forces.

However, the very low price reached under the VIR Pilot Program for large systems is likely the result of the use of a “reverse auction” mechanism used to determine winning bids. In theory, the market competition of the reverse auction method is expected to bring the lowest expected price to the purchaser. From the pilot program experience, this appears to be true.

## Resource Value of Solar Energy

Under the VIR Pilot Program, Oregon's utilities must report the solar resource value every two years. Resource value is defined in ORS 757.360(5), as:

- a) The avoided cost of energy, including the avoided fuel price volatility, minus the cost of firming and shaping the electricity generated from the facility; and
- b) Avoided distribution and transmission cost.

In general terms, the resource value of solar refers to the sum of benefits that accrue to the utility system due to solar generation. The Commission distinguishes "resource value" from a broader definition of value that might include society-wide benefits such as improved environmental quality or net increase in employment. These societal and environmental benefits, though perhaps important, are beyond the scope of normal utility regulation and have not been investigated by the Commission.

Some recognized and quantifiable benefits of solar generation include:

- The value of the energy that the utility would otherwise generate or purchase;
- Avoided or deferred cost of new generating capacity;
- Savings in transmission line losses;
- Value in preventing or recovering from grid reliability issues;
- Improved power quality;
- Avoided or deferred transmission and distribution investments;
- Risk and price hedge against future gas price volatility; and
- Reduced cost of complying with current or anticipated environmental regulations.

In order to address stakeholder concerns over the solar resource values reported early in the VIR Pilot Program, the Commission opened an investigation<sup>10</sup> into the appropriate method of calculating resource value. At the conclusion of that investigation, the Commission determined that although precise calculation of the solar resource value was still an issue among parties, the resource value was not greater than the incentive rates; a finding that was not disputed.<sup>11</sup>

As a result of the investigation into solar resource value, the Commission directed utilities to estimate the benefits of avoided energy, avoided investments in capacity, and avoided transmission line losses. The Commission chose to not require calculations of avoided

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<sup>10</sup> Oregon Public Utility Commission Docket No. UM 1559.

<sup>11</sup> Order No. 12-396; *In the Matter of the Public Utility Commission of Oregon Investigation into the Appropriate Calculation of Resource Value for Solar Photovoltaic Systems*, Docket No. UM 1559.



transmission and distribution investments, firming and shaping costs, fuel price hedging, or carbon costs, stating that a certain threshold level of solar penetration in Oregon is needed before these additional costs and benefits become measurable and need to be considered.

Utilities were required to estimate the value of avoided energy benefits using three methods:

- i. The “Standard” method used to set the Avoided Cost Price under the Public Utility Regulatory Policy Act (PURPA),
- ii. A “Renewable” method, also used to set the Avoided Cost under PURPA, and
- iii. An “IRP” method, which uses computer models to compare the utility’s total cost to serve its loads with and without the solar generation. The Commission also directed utilities to calculate the capacity contribution of solar using the “Effective Load Carrying Capacity” or “ELCC” method, a computer based method recommended by ODOE and Commission staff.<sup>12</sup>

The table below shows the resource values reported by utilities as of July 2014.

**Table 6: Solar Resource Value cents/kWh Reported by Oregon IOUs<sup>13</sup>**

<b>Solar Value (Cents/kWh) Reported by Utilities under OAR 860-084-0370</b>			
<b>Calculation Method</b>	<b>PGE</b>	<b>Idaho</b>	<b>PAC</b>
Standard	6.7	6.5	6.3
Renewable	6.7	N/A *	5.9
IRP	5.5	5.0	5.5

*\*Idaho Power does not provide a Renewable Method calculation since they are not required to do so by the Oregon PUC.*

### “Value of Solar” Studies

A number of studies have been conducted recently to estimate the value of solar. In most of these studies, the value of solar calculation includes some or all of the recognized societal and environmental benefits of solar power. These studies were recently reviewed and summarized in a 2013 Rocky Mountain Institute (RMI) report.<sup>14</sup>

Table 7 below summarizes the results of the studies reported by RMI:

<sup>12</sup> In our review of solar value studies outside Oregon, we found several that also used the ELCC method for this purpose.

<sup>13</sup> Values for all utilities were adjusted to 2014 dollars using the Oregon Consumer Price Index reported by the Oregon Office of Economic Analysis.

<sup>14</sup> “A Review of Solar PV Benefit & Cost Studies” RMI, September 2013.

**Table 7: Summary of Nationwide Avoided Cost Study Results (cents per kWh)**

Study	BENEFITS/COSTS						
	Energy	Transmission	Generation	T&D	Grid	Fuel	Other
AZ (1)	2.7		0.72	0.14			
AZ (2)	7.9 – 11.1		0 – 1.85	0.82			
AZ (3)	6.4 – 7.5		6.7 – 7.6	2.4	1.5		0.1
Austin (1)	6		1.7	1			2
Austin (2)	7.8	0.7	1.5	0.11			2.2
CA (1)	6	0.2	4.5	2	0.5		2
CA (2)	6	1	4	2	0.5		2
MN	6.7		2.4	1.1			3.1
NREL	3.2 – 2.7		1.1 – 10		1.5	0.9	0.4 – 6.2
NJ	6.1		1.6 – 2.2	1 -8		2.5	2.3 – 5.5
TX	10.6		1.6 – 1.9	0.5		2.6	
CO	3.6 – 7.6	0.5 – 0.8	1.15	0.1		0.7	0.5
RMI	2.5 - 12	0 – 4.5	0 - 13	0 - 11	1.8	0 - 4.5	0.5 – 5.5

As seen in the table, the benefit estimates vary widely. Estimates of the total benefits of solar generation range from 4 cents per kilowatt-hour to 25 cents per kilowatt-hour. It must also be noted that some categories of benefit (such as avoided line losses) are utility-dependent, and as such there is no generic value that can be assumed for these benefits.

The wide range in solar benefits is also driven by assumptions, methodologies, and decisions about which costs and benefits to quantify. For example, some studies reported levelized cost and benefit over 20 years; others used a 25- or 30-year life. Different studies used different approaches to estimating avoided costs of energy, capacity, and transmission and distribution costs. Some states placed a dollar value on environmental and societal benefits; others did not. No two studies placed values on the same set of benefits.

The Commission will continue to monitor other study efforts in this area and will be conducting a comprehensive assessment of the value of solar in the future.

# Appendix I

## Comparison of Energy and Incentive Cost

Table I.1 below compares the levelized cost of solar energy<sup>15</sup> over a 20-year period of the VIR Pilot Program with a similar cost calculation for the legacy solar incentive programs. The table also shows the cost of these programs to ratepayers and taxpayers. All cost values shown are averages.

**Table I.1 - Average Levelized Cost<sup>16</sup> of Energy and Average Levelized Cost to Ratepayers and Taxpayers under Oregon programs**

Program	Levelized Cost of Energy	Levelized Incentive Cost to Ratepayers	Levelized Incentive Cost to Taxpayers	Incentive Percentage of Cost
ETO plus Tax Credit (Residential)	43	6.4	9	35%
ETO plus Tax Credit (Commercial)	33	6.4	14.6	63%
VIR Pilot (Small)	39	21	0	53%
VIR Pilot (Large)	20	16.5	0	82%

The costs of energy from these programs are ultimately a function of the size and vintage of the projects supported by the program. By far the primary cost driver is the cost of the solar panels themselves, followed by the cost of the electrical inverter. Labor, permitting, and other so-called “soft costs” make up roughly one quarter to one third<sup>17</sup> of the total system cost, depending on system size.

<sup>15</sup> “Levelized cost” for solar projects is calculated by spreading the installation cost of the project equally over all energy generated during the lifetime of the project, on a discounted present value basis. The result is the average cost per kilowatt-hour.

<sup>16</sup> All costs expressed in cents per kilowatt-hour (c/kWh).

<sup>17</sup> “Investigation into the Effectiveness of Solar Programs in Oregon”, PUC report to the Oregon Assembly, July 1, 2014, p. 35

Table I.1 shows that the average cost of energy per kilowatt hour declines with a larger system size, demonstrating an economy of scale. The cost of energy for commercial systems under both incentive programs is lower than that for residential projects.

One reason for this is that solar panels can be cheaper on a per unit basis when bought in larger quantities. In addition, the incremental labor cost to install a large solar project vs. a residential size system is relatively small; once the installation crew and equipment is onsite, the cost to install additional panels is minimized.

The way the programs are funded dictates the split in costs between ratepayers and taxpayers. The legacy program incentives are funded from two sources: 1) a direct rebate from the Energy Trust of Oregon funded from the three percent public purpose charge applied to every ratepayer's bill; and 2) tax credits offered by the state.

In comparison, the solar VIR Pilot Program incentive is completely funded by utility ratepayers. The VIR Pilot Program is, in effect, a set of power contracts between the customers and the utility in which the utility pays the customer directly for their solar generation. The funds for these contracts are collected from ratepayers through normal utility ratemaking. No taxpayer money is used to fund the program.

# Appendix II

## Rate Impact Reports

**Table II.1 – Idaho Power Estimate of Revenue Impact from the Solar VIR  
(filed with the Oregon PUC on 10/29/2014 as Report RE 94(1))**

Idaho Power Company  
Calculation of Revenue Impact  
State of Oregon  
Schedule 93: Solar Photovoltaic Pilot Program Rider  
April 1, 2015 - March 31, 2016

Summary of Revenue Impact  
Current Billed Revenue to Proposed Billed Revenue

Line No	Tariff Description	Rate Sch. No.	Average Number of Customers (1)	Normalized Energy (kWh) (1)	Billed Revenue Excluding Schedule 93	Schedule 93 Revenue	Total Billed Revenue	Percent Change Billed to Billed Revenue
<u>Uniform Tariff Rates:</u>								
1	Residential Service	1	13,735	190,842,496	\$18,876,880	\$266,268	\$20,143,148	1.32%
2	Small General Service	7	2,472	18,644,047	\$2,036,641	\$27,573	\$2,064,214	1.34%
3	Large General Service	9	951	137,523,215	\$11,090,515	\$146,200	\$11,236,715	1.30%
4	Dusk to Dawn Lighting	15	0	457,839	\$116,563	\$1,651	\$118,215	1.40%
5	Large Power Service	19	6	258,462,678	\$16,714,018	\$215,454	\$16,929,472	1.27%
6	Agricultural Irrigation Service	24	1,697	45,581,275	\$4,663,450	\$61,806	\$4,725,256	1.31%
7	Unmetered General Service	40	2	8,791	\$876	\$12	\$888	1.30%
8	Street Lighting	41	24	888,721	\$147,546	\$2,086	\$149,633	1.38%
9	Traffic Control Lighting	42	7	21,017	\$2,068	\$28	\$2,096	1.34%
10	Total Uniform Tariffs		18,894	653,468,079	\$54,648,558	\$721,060	\$55,369,618	1.30%
12	Total Oregon Retail Sales		18,894	653,468,079	\$54,648,558	\$721,060	\$55,369,618	1.30%

**Table II.2 – Pacific Power Estimate of Revenue Impact from the Solar VIR  
(filed with the Oregon PUC on 11/3/2014 as Report RE 95(1))**

Pacific Power  
State of Oregon  
Estimated Rate Impact of OSIP Cost Recovery  
November 1, 2014

	Total Retail	Residential	Sm/Med General Svc	Large General Svc	Irrigation
2015	0.4%	0.3%	0.4%	0.5%	0.3%
2016	0.4%	0.3%	0.4%	0.5%	0.3%
2017	0.3%	0.3%	0.4%	0.4%	0.3%
2018	0.3%	0.3%	0.3%	0.4%	0.3%
2019	0.3%	0.3%	0.3%	0.4%	0.3%
2020	0.3%	0.3%	0.3%	0.4%	0.3%
2021	0.3%	0.3%	0.3%	0.4%	0.3%
2022	0.3%	0.3%	0.3%	0.4%	0.3%
2023	0.3%	0.2%	0.3%	0.4%	0.2%
2024	0.3%	0.2%	0.3%	0.3%	0.2%
2025	0.2%	0.2%	0.3%	0.3%	0.2%
2026	0.2%	0.2%	0.2%	0.3%	0.2%
2027	0.2%	0.1%	0.2%	0.2%	0.1%
2028	0.1%	0.1%	0.1%	0.1%	0.1%
2029	0.1%	0.0%	0.1%	0.1%	0.0%
2030	0.0%	0.0%	0.0%	0.0%	0.0%

Note: Assumes 3% annual revenue growth.

**Table II.3 – Portland General Electric Estimate of Revenue Impact from the Solar VIR  
(filed with the Oregon PUC on 10/31/2014 as Report RE 97(1))**

The following table shows PGE's estimated average rate impact across all program years for each customer class in its 2012 OAR 860-084-0380(2) filing and its current 2014 filing.

**Rate Impact Estimates of Solar Photovoltaic Pilot Programs**

<b>Filing Year</b>	<b>Residential</b>	<b>Small and Medium</b>	<b>Large</b>	<b>Total</b>
2012	0.32%	0.29%	0.32%	0.26%
2014	0.33%	0.29%	0.33%	0.28%