BEFORE THE PUBLIC UTILITY COMMISSION
OF OREGON

UM 1673

In the Matter of OREGON PUBLIC UTILITY COMMISSION Draft Report to the Legislative Assembly, "Investigation into the Effectiveness of Solar Programs in Oregon", Prepared by Public Utility Commission or Oregon, May 8, 2014.	Comments of Renewable Northwest

I. INTRODUCTION

Renewable Northwest appreciates the opportunity to comment on the first draft of the Oregon Public Utility Commission's ("the Commission") report to the legislature under HB 2893 on the evaluation of solar programs. Renewable Northwest will restrict its comments in this submission to the following sections of the Commission's draft report: *Section V—Resource Value of Solar*; *Section VI—Evaluation of Solar Programs*; *Section VII—Other Policy Issues*; and the *Appendices*.

Renewable Northwest will address general comments on the draft report in Section II, followed by more detailed comments on the methodology, specifically capacity value (Section III), avoided transmission and distribution costs (Section IV), and avoided emissions costs (Section V), before concluding in Section VI. These comments should be considered in addition to the Joint Comments filed concurrently that Renewable Northwest was a party to.

As Renewable Northwest noted in comments dated December 18, 2013, determination of the true solar resource value is essential for a strong rational foundation from which good solar policy in Oregon can be developed. Analyses of the costs and benefit of solar are notoriously complicated and controversial, and in acknowledgement of that Renewable Northwest appreciates the efforts of the Commission and Staff in producing this draft report.

Renewable Northwest recommends the Commission consider using the methodologies discussed in these comments in its final report to the legislature. These methods would allow the avoided transmission and distribution costs, as well as the avoided emissions costs, to be quantified. Furthermore, these methods would lead to a more accurate calculation of the solar capacity value, which is an essential component of the cost-benefit analysis. Finally, Renewable Northwest suggests that the Commission keep separate the discussions of incentives (such as grants and tax credits) and rate structures (such as net metering) when determining the resource value.

Renewable Northwest appreciates the assistance of Tom Beach and his staff at Crossborder Energy in preparing these comments.

II. GENERAL COMMENTS

"Hard" versus "Soft" Benefits

The Commission's draft report begins its discussion of the solar resource value in *Section V* by classifying the benefits as either "hard" benefits that are readily calculated and accrue directly to ratepayers, or as "soft" benefits that may be harder to calculate or that may not directly benefit ratepayers. The implication of this division is that the Commission should focus on consideration of "hard" benefits, as **Table 5.1** in the draft report categorizes the "soft" benefits as "NA" for Oregon. Furthermore, the "hard" benefits listed in the draft report are limited to those that the utilities now include in their periodic solar value reports.

An examination of the Rocky Mountain Institute's 2013 meta-study of solar resource evaluations, "A Review of Solar PV Benefit & Cost Studies"[1]—reference 16 of the Commission's draft report—reveals that most of the solar value studies completed in other states over the last several years have included and quantified a number of the benefits that the draft report considers to be "soft." These include, most importantly, avoided T&D capacity costs and avoided emission costs, explored by Renewable Northwest in Section III. These benefits are real and quantifiable and will accrue directly to utility ratepayers over the life of a solar facility. Renewable Northwest recommends the Commission consider some of the methods of quantifying these "soft" costs that are explained in Sections IV and V of these comments.

[1] A Review of Solar PV Benefit & Cost Studies" RMI, September 2013.

Cross-subsidization

Section V of the Commission's draft report begins by defining the "resource value of solar" as the "benefits that ratepayers and taxpayers receive from distributed solar generation". A more thorough explanation would describe the solar resource value as the balance between the costs and the benefits of distributed generation. This slightly more detailed definition ensures that the "recovery of fixed utility costs" (explored by the Commission in *Section VII—Solar Policy Issues* of their draft report) are considered holistically as part of a cost benefit analysis. Considering the issue of fixed cost recovery in the balance between the costs and the benefits of distributed solar generation also leads to a position where the phenomenon of cross-subsidization between participating and non-participating customers cannot be asserted.

On page 38 of the draft report, under "Recovery of Fixed Utility Costs" the Commission reports the assertion of Portland General Electric (PGE) and PacifiCorp that it is necessary to set a fixed charge for "net-metering participants to recover distribution costs ". As noted, such an assertion is only possible by artificially divorcing the discussion of cross-subsidization from the cost-benefit analysis. Renewable Northwest recommends that fixed cost recovery only be considered in terms of the balance between costs and benefits; considered in isolation it is just an artifact of the utilities rate structure, and does not reflect a true cross-subsidy.

Distinguishing Incentives from Policies

The purpose of programs that provide direct solar incentives—such as the Residential Energy Tax Credit ("RETC") and Energy Trust of Oregon ("ETO") rebates—are market transformation. As the cost of solar continues to fall, the technology will become economic in Oregon without these state incentives, as has begun to happen in California[2]. As a result, a key comparison for legislators should be the costs and benefits of solar resources for Oregon without factoring in the state incentives. This comparison is necessary in order to evaluate the costs and benefits of policies such as net metering that will remain even when state incentives have ceased.

In the Regulatory Assistance Project's 2013 report, "Designing Distributed Generation Tariffs Well", one of the key recommendations for regulators is to "[k]eep the discussion of incentives separate from rate design":[3]

> In seeking to identify a rate design that provides fair compensation across the board, regulators should keep separate any discussion of specific incentives to support a specific technology. Rate design should be about fair compensation for value of services provided and fair allocation of the costs to reliably operate the system. If policy makers feel for any reason that additional incentives are warranted, those incentives should be added in a transparent manner that does not distort or obscure the assessment of fair compensation.

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[2] The Solar Energy Industries Association (SEIA) reported in 2013 that California was the first major solar market to begin the transition away from state level incentives. www.seia.org/research-resources/solar-market-insight-report-2013-year-review

[3] Regulatory Assistance Project, Designing Distributed Generation Tariffs Well, 2013 www.raponline.org/document/download/id/6898 p6

However, Table A.2.4 in the draft report clearly try to take account of the incentives involved when attempting to determine the balance between the costs and benefits for the net metering and volumetric incentive rate (VIR) programs and the impact on ratepayers. Discussions of incentives are timely and necessary; however, Renewable Northwest recommends that they should not be conflated with issues of rate design.

III. SOLAR CAPACITY VALUE

Increased Granularity Necessary

PacifiCorp and PGE calculate the value of solar using their standard avoided cost energy prices, which are only time-differentiated into annual on-peak and off-peak prices. This limited differentiation assumes that the avoided energy cost in each hour of an on- or off-peak period is the same as the average avoided energy cost across all hours of the period. However, there can be significant hourly variations in the marginal cost of energy, particularly within the off-peak hours. For example, the avoided energy costs during daytime off-peak hours (such as during the day on Sunday, when there is significant solar production) are higher than during other off-peak hours at night (when solar is not operating, such as late on Monday night). In addition, the use of annual on- and off-peak prices may fail to reflect the significant seasonal variations in solar production. The energy value of solar resources should be calculated on an hourly basis, either using hourly energy market prices (if those are available), hourly system lambda values[4], or hourly marginal energy costs from production cost models. There are well developed and widely-used tools to estimate solar PV output on an hourly basis in Oregon—for example, the National Renewable Energy Laboratory's (NREL) PVWATTS calculator, or Clean Power Research's Solar Anywhere dataset based on satellite measurements of solar insolation. PVWATTS is used later to calculate the solar capacity value using the average capacity factor method.

Using hourly price data from the California-Oregon Border ("COB") market hub, it was calculated that the utilities' 6-to-1 weighting of HLH (heavy load hours) and LLH (light load hours) prices understates the energy value of a solar output profile in Oregon by about 4%. This underestimate occurs mostly because the LLH price for solar is understated by 10%, because it does not consider that the only LLH hours in which solar produces are the higher-valued daylight hours on Sunday. To the extent that it is possible, Renewable Northwest recommends that the Commission consider taking into account the existence hourly variations in marginal energy costs and how these can impact avoided cost energy prices when calculating the value of solar.

<u>Standard Ways of Calculating Capacity Value</u>

There are two types of methodologies in widespread use across the United States to establish the firm or "accredited" capacity (aka capacity value or capacity credit) of

[4] The system lambda value is the cost of providing one MWh of energy at the reference electrical bus (such as a specific substation), used in calculating the energy component of location marginal prices in some balancing authorities.

renewable energy facilities that use wind or solar resources. The North American Electric Reliability Corporation's (NERC) Integration of Variable Generation Task Force (IVGTF) discussed these two methods in its April 2009 report *Accommodating High Levels of Variable Generation*.[5] In these comments, Renewable Northwest will focus on explaining some specific concerns with PacifiCorp's methods for calculating capacity value, while making some important observations about PGE.

The first commonly used approach is the Effective Load Carrying Capacity ("ELCC") method, used by PGE in their solar capacity value calculations. Renewable Northwest observes that as PGE increasingly moves towards becoming a summer peaking utility, the increased coincidence between peak loads and peak solar generation need to be taken into account.

Rather than using ELCC, many control area operators in the United States instead use the simpler "capacity factor" method.[6] This approach sets the capacity value of the renewable resource based on its demonstrated capacity factor during certain critical hours of peak demand. For example, if a 100 MW solar facility operates at a 50% capacity factor during the designated critical peak hours, the capacity value of that unit would be 50 MW. Most control areas use the average capacity factor during the peak hours—in other words, the output that is exceeded in roughly 50% of hours.

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[5] NERC, "Accommodating High Levels of Variable Generation", April 2009 www.nerc.com/files/IVGTF_Report_041609.pdf.

[6] Ibid. Figure 3.3 on page 40 shows the details of the capacity factor methods used by a number of the major independent system operators in the United States.

Table 5.1 of the draft report assigns a capacity value, or "Avoided Generation", of 2.0 cents per kWh for Oregon. This value seems to rely upon the utilities' filed avoided cost prices to calculate the capacity value of solar resources, which Renewable Northwest argues have been calculated incorrectly. Filed avoided cost prices in Oregon calculate capacity credits (which are added to on-peak energy prices) on a $ per MWh basis. To earn the full capacity value of the avoided resource, the QF must operate at a 90% capacity factor. PacifiCorp's "90% exceedance method" discounts the capacity value of Oregon's solar resources based on methods that are not consistent with industry standards, resulting in significant underestimates of the capacity value of solar.

PacifiCorp—The 90% Exceedance Method

PacifiCorp assumes that the capacity value of solar is just 13.6% of a solar facility's nameplate.[7] This assumption is derived from a calculation in PacifiCorp's IRP, where the utility used a "90% exceedance" method which looked at the solar output that is exceeded in 90% of the top 100 summer (June-September) peak load hours from 2007-2010 at five locations in its six-state service territory. As discussed above, this level of exceedance is very conservative, and far in excess of the 50%-level used by

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[7] PacifiCorp and The Cadmus Group, "Revised Overview of PV Inputs, Data Sources, and Potential Study Results", September 2013, p 15 www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2013IRP/PAC_2013IRP_Memo_PVInputs_09282012.pdf

most utilities to calculate average capacity factor.[8] Because PacifiCorp lacked actual solar output data, the utility used NREL's PVWATTS calculator to obtain simulated solar output for the five locations.[9]

<u>The Average Capacity Factor Method</u>

Table 1 shows the capacity value of solar for PGE and PacifiCorp over the top 100 summer peak hours, using recorded loads from 2006–2012 and PVWATTS data, and assuming the use of the average capacity factor (i.e. roughly 50% exceedance) as discussed above. Table 1 shows that solar has capacity values of 36% and 50% of nameplate in the PGE and PacifiCorp service territories, based on the average solar capacity factor over each utility's top 100 summer load hours.

Year	Portland General Electric	PacifiCorp
2006	36%	51%
2007	31%	51%
2008	40%	53%
2009	35%	46%
2010	38%	55%
2011	35%	45%
2012	38%	52%
2009–2012	**36%**	**50%**

Table 1—Solar Capacity Value

Based on average capacity factor for Top 100 summer load hours, as % of AC nameplate

[8] The only control area that uses an exceedance percentage higher than 50% is California, which looks at the solar output that is exceeded in 70% of peak hours. Most control areas also sample a broader set of hours than the top 100 summer peak hours that PacifiCorp uses; for example, the PJM method samples about 350 summer peak hours.
[9] PacifiCorp 2013 IRP, Appendix O, pp 363–364.

The solar capacity values for PGE and PacifiCorp shown in Table 1 are significantly higher than those used by the utilities in their solar value reports. **Table 2** calculates PacifiCorp's solar value using the IRP method, the capacity value analysis presented in Table 1 based on solar output over PacifiCorp's top 100 load hours, and a solar capacity factor of 17.3%. The results are 20-year levelized solar values of 5.5 cents per kWh for energy and 4.0 cents per kWh for capacity. Renewable Northwest recommends the Commission consider the merit of these methods and using them to fill in the empty boxes for Oregon in Tables 5.2 A2.2 of the draft report.

Year	IRP Energy (c/kWh)		IRP Capacity	ELCC	Solar Output		Solar Capacity Value		TOTAL Energy & Capacity
	All	Solar	$/kW-yr		cf %	kWh/kW	$/kW-yr	c/kWh	c/kWh
2014	3.75	3.90	0	50%	17.3%	1,515	0.00	-	
2015	3.83	3.98	0	50%	17.3%	1,515	0.00	-	
2016	3.72		116.78	50%	17.3%	1,515	58.39	3.85	
2017	3.79		119.02	50%	17.3%	1,515	59.51	3.93	
2018	4.42		121.29	50%	17.3%	1,515	60.65	4.00	
2019	4.62		123.46	50%	17.3%	1,515	61.73	4.07	
2020	4.37		125.54	50%	17.3%	1,515	62.77	4.14	
2021	4.95		127.81	50%	17.3%	1,515	63.91	4.22	
2022	5.56		130.12	50%	17.3%	1,515	65.06	4.29	
2023	5.85		132.47	50%	17.3%	1,515	66.24	4.37	
2024	5.57		134.85	50%	17.3%	1,515	67.43	4.45	
2025	5.75		137.28	50%	17.3%	1,515	68.64	4.53	
2026	5.83		139.74	50%	17.3%	1,515	69.87	4.61	
2027	6.17		142.41	50%	17.3%	1,515	71.21	4.70	
2028	6.29		145.12	50%	17.3%	1,515	72.56	4.79	
2029	6.53		147.87	50%	17.3%	1,515	73.94	4.88	
2030	6.77		150.67	50%	17.3%	1,515	75.34	4.97	
2031	7.03		153.69	50%	17.3%	1,515	76.85	5.07	
2032	7.29		156.62	50%	17.3%	1,515	78.31	5.17	
2033	7.57		159.61	50%	17.3%	1,515	79.81	5.27	
Levelized at 7.1%	5.05							3.62	
w/9.18% Line Losses	5.5							4.0	**9.5**
Escalation	3.76%								

Table 2—Energy and capacity Value of Solar for PacifiCorp

IV. AVOIDED TRANSMISSION AND DISTRIBUTION

Renewable Northwest noted that Table 5.1 of the draft report lists no avoided transmission and distribution ("T&D") costs from solar in Oregon, even though the same table reveals that studies in other states have found that solar can provide significant cost savings by avoided or deferring the need for future T&D infrastructure. This particular aspect of the solar resource is complex and often contentious, as revealed by the range of values calculated in other states in Table 5.3 of the draft report. However, they are many reasons for pursuing the calculation of the avoided T&D costs in Oregon.

The case for avoided T&D capacity costs is particularly compelling for net metered systems, the majority of whose output serves the on-site load without ever using the grid, with the remainder serving neighboring local loads on the distribution system. During the hours of peak demand, the output of small, distributed solar systems are likely to consumed entirely on the distribution system to which they interconnect until solar penetrations reaches much higher levels. As a result, distributed solar will reduce peak loadings on the transmission system, will make more capacity available on the transmission system to serve load growth, and will allow the utility to avoid building new transmission capacity. This applies both to behind-the-meter, net metered systems and to small wholesale solar systems interconnected at the distribution level whose output is entirely sold under a feed-in tariff.

Transmission

Studies in other states using power flow analyses have demonstrated that distributed PV systems reduce demand on the upstream transmission system, freeing existing transmission capacity to meet load growth or to serve other transmission customers. Impact evaluation reports of the California Solar Initiative ("CSI"), prepared by energy analysts Itron for the California Public Utilities Commission, have shown that CSI systems reduce peak transmission system loadings, make additional capacity available on the transmission system, and thus avoid transmission expansion costs.[10] Clearly, small-scale solar resources have the ability to avoid transmission capacity costs.

Distribution

The ability of small solar systems to avoid distribution capacity costs is more complex than for transmission systems. Distribution circuits peak at a variety of times, depending on the mix of customers which a circuit serves. As a result, the ability of solar capacity to avoid distribution upgrade costs can be different for a circuit serving commercial customers peaking in mid-afternoon—coincident with peak solar output—compared to a residential circuit that peaks at dusk, when solar production is almost zero. Techniques are beginning to be developed to quantify the ability of distributed solar to reduce distribution system loadings, such as the

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[10] Itron, *2009 CSI Impact Evaluation Report*, at page ES-17
http://www.cpuc.ca.gov/PUC/energy/Solar/evaluation.htm
Itron, "CPUC Self-Generation Incentive Program – Sixth Year Impact Evaluation Report", August 30, 2007, pp 5-29 to 5-
33.www.cpuc.ca.gov/PUC/energy/DistGen/sgip/sgipreports.htm.

distribution peak capacity allocation factor ("PCAF") method developed by Energy and Environmental Economics (E3) in California[11]. The PCAF methodology involves comparing the output profile of the distributed solar unit to the local area load and determining the level of statistical coincidence, which is then used to calculate the percentage of PV capacity that counts towards avoided distribution costs. The PCAF method was also used by Crossborder Energy to correlate the peak loadings on Public Service Company of Colorado's 58 substations to solar output in Colorado.

As an example of this method, Figure 2 shows the distribution of peak loads at these distribution substations as a function of the hour of the day plotted alongside a typical PV output profile for Boulder. The substation peaks tend to occur later in the day, with the peak in the allocation around 7 p.m., due to substations that largely serve residential load. Crossborder Energy's Colorado study applied this allocation to the typical hourly PV output profile for Boulder to determine that rooftop solar can avoid about 23% of the Public Service Company of Colorado's marginal capacity-related distribution costs.

[11] California Public Utilities Commission, Renewable DG Technical Potential Workshop, January 31, 2013. Slide 58. www.cpuc.ca.gov/NR/rdonlyres/5F2B76C0-043D-46CA-8C41-1F67E3116999/0/Jan31_CPUC_RenewableDGTechnicalPotentialWorkshopSlides.pdf

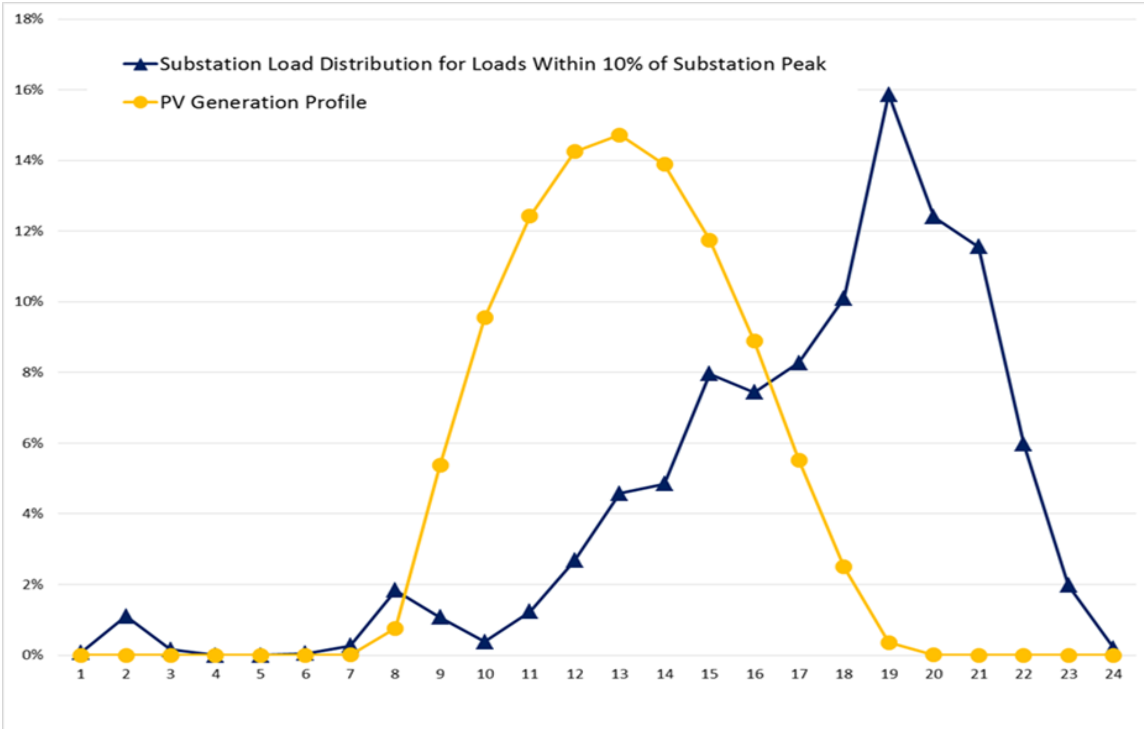

Figure 1—Correlation of Solar Output to Distribution Substation Peaks for Public Service Company of Colorado[12]

In applying this to Oregon, the best measures of avoided T&D capacity value of solar resources are utility marginal T&D costs, adjusted to reflect solar's contribution to reducing the peak demands that cause T&D costs to be incurred. For example, in its last General Rate Case, PacifiCorp calculated its marginal, demand-related transmission and distribution costs to be $165 per kW-year for transmission and about $100 per kW-year for small residential and commercial customers.[13] Table 3 uses this data to calculate the value of solar in avoiding demand-related T&D costs for PacifiCorp.

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12 Source: Crossborder Energy

13 Docket UE 263, Exhibit PAC 1107 (Testimony of C. Craig Paice), at Tables 6 and 7 (Tabs 2.6 and 2.7). $100 per kW-year is the marginal demand-related distribution cost for serving residential customers; the marginal distribution cost for small commercial loads is $112 per kW-year.

Category	**Marginal Cost** *($/kW-year)*	**Solar Percent Contribution to Peak**	**Annual Solar Output** *(kWh/kW-AC)*	**Solar Avoided T&D Costs** *(cents/kWh)*
	a	B	c	100 x (a x b) / c
Transmission	$165	50%	1,515	5.5
Distribution	$100	23%*	1,515	1.5

Table 3—Avoided Demand-Related T&D Costs for PacifiCorp

** Exemplary value from Crossborder's Public Service Company of Colorado study.*

Renewable Northwest recommends the Commission consider using such approaches for quantifying the avoided transmission and distribution costs in its final report to the legislature.

V. AVOIDED EMISSIONS

The Commission's solar resource value calculation should estimate the value of solar generation as a future resource for Oregon. The utilities' current solar value calculations do not include the expected future costs of carbon, even though the utilities include carbon costs in their current resource plans. Based upon these resource plans, utilities are making future resource choices that have "hard" cost impacts on ratepayers as those resources are built and placed into rate base. Customer adoption of solar energy to serve on-site loads clearly will displace—on the margin—the fossil generation that the utility would have used to serve that load, and thus will avoid the long-term cost of carbon emissions associated with that generation that are inevitable.

In the Commission's Order No. 12-396 in UM 1559, it was concluded that carbon costs are one of the "legitimate components of the resource value of [solar PV] systems." Clearly—as acknowledged on page 9 of the draft report—there is uncertainty about the future cost of carbon, but this can be handled, as it is in utility IRPs, through the use of various scenarios.

Table 4 shows calculations that were undertaken to determine the 20-year (2014-2033) levelized costs of carbon for various recent carbon cost assumptions from the U.S. federal government and the utility IRPs. These results are expressed in cents per kWh using the utilities' assumed heat rates for their avoidable CCCTs.[14] Table 4 shows that the federal government's social cost of carbon (SCC) projection—on which it is basing administrative actions to reduce carbon pollution—is at the high end of the range of carbon costs assumed by the utilities in their recent IRPs.

Entity	Scenario	Levelized Carbon
EPA	Social Cost of Carbon	2.2
PacifiCorp	Base	0.3
	High	0.9
	Hard Cap / Base Gas	1.5
	Hard Cap / High Gas	1.8
PGE	Reference	0.3
	Low Carbon	0.2
	Synapse Low	0.5
	Synapse High	1.2
	Trigger Point	2.7

Table 4—Carbon Costs: 20-year levelized (2014-2033) cents per kWh

[14] Pacific Power, Order Schedule 37, Gas Market Indexed Avoided Cost Prices, p6 ww.pacificorp.com/content/dam/pacific_power/doc/About_Us/Rates_Regulation/Oregon/Approved_Tariffs/Rate_Schedules/Avoided_Cost_Purchase_From_Qualifying_Facilities_of_10_000_KW_or_Less.pdf

Renewable Northwest recommends that the Commission consider using the federal SCC as one of the input values when attempting to calculate the value of avoided carbon dioxide emissions in the final report to the legislative assembly.

VI. CONCLUSIONS

Renewable Northwest is very grateful for the opportunity to comment on the Commission's draft report to the legislature on the Investigation into the Effectiveness of Solar Programs in Oregon, and appreciates all the time and effort that Staff and Commissioners have devoted to UM 1673.

Renewable Northwest recommends the Commission consider using the methodologies described in these comments to calculate the so-called "soft" benefits of avoided T&D costs and avoided emissions. It is also suggested that the existence and direction of cross-subsidization should be determined based on the results of a holistic cost-benefit analysis, rather than just asserting the proposition *a priori*. Furthermore, Renewable Northwest recommends that the Commission note the problems associated with the utilities' methods of calculating the capacity value of the solar resource and consider including the methods elucidated in these comments in the final report to the legislature.

Renewable Northwest looks forward to providing oral comments on June 10, 2014, and working toward a robust solar resource value that will provide a strong rational foundation for legislators, regulators and other stakeholders to develop good solar policy in Oregon.

RESPECTFULLY SUBMITTED this 23rd day of May, 2014.

RENEWABLE NORTHWEST

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I HEREBY CERTIFY that I served the foregoing COMMENTS OF RENEWABLE NORTHWEST upon the following parties on the service list for UM 1673, via electronic mail, on May 23, 2014:

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