# BEFORE THE PUBLIC UTILITY COMMISSION

# OF THE STATE OF OREGON

## RESPONSE TESTIMONY OF DAVID W. BROWN

ON BEHALF OF

## OBSIDIAN RENEWABLES, LLC

ON SOLAR CAPACITY

JULY 24, 2015

**Q. PLEASE STATE YOUR NAME, AND CURRENT EMPLOYMENT POSITION OR TITLE.**

A. My name is David W. Brown. I am the Owner of Obsidian Renewables LLC ("Obsidian"). My testimony is based on my personal knowledge gained through my experience as a developer of solar and other generating facilities. I have degrees and considerable experience in finance and law and I have considerable professional experience with taxes and structuring complex transactions. I am active in the Oregon legislature on energy matters and I have testified before this Commission on renewable energy matters in this and other proceedings.

**Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

**A.** The purpose of this testimony is to address the capacity payment for solar QF projects. My testimony will be divided into two parts. First, I will discuss why the original staff proposal for calculating capacity payments adopted by the Commission in Order 14-058 results in a computational error when applied to renewable solar QF projects. The computational error creates a "double discount" for such projects and results in a solar capacity payment amount that is disproportionately low. Staff has subsequently modified its own proposal to eliminate this error, and the Commission's order should be clarified to adopt Staff's revised methodology.

Second, I will discuss why the Effective Load Carrying Capability ("ELCC") method is appropriate for calculating the amount of capacity that a solar project contributes to a utility's system. The utilities already use the ELCC methodology in their IRPs—which methodology is widely accepted as the industry standard—and yet the utilities have refused to accept their own ELCC figures as the basis for calculating the solar capacity payment rate. The Commission should order that solar capacity payment rate be calculated using the ELCC valuations taken from the utilities' most recent IRPs.

## I. THE CAPACITY CONTRIBUTION PAYMENT METHODOLOGY CONTAINS A DOUBLE DISCOUNT FOR RENEWABLE SOLAR QF PROJECTS

**Q. WHAT IS A CAPACITY CONTRIBUTION PAYMENT?**

**A.** A capacity contribution payment is a payment made by a purchasing utility to a wholesale generator to compensate it for the amount of capacity that the generator contributes to the utility's system. The rationale for such capacity contribution payment is that the utility has reliability standards that require it acquire and maintain a certain level of generating capacity. To the extent that a wholesale generator contributes capacity that the utility would otherwise have to construct or acquire, then the utility and its ratepayers receive a benefit. The generator is therefore entitled to compensation for the benefit that it has provided.

**Q. IN THE PURPA CONTEXT, DOES THIS RESULT IN A 'SUBSIDY' FOR QF PROJECTS?**

**A.** Absolutely not. The Federal Energy Regulatory Commission has been very clear in stating that PURPA requires utilities purchasing energy from QF projects must also compensate such QF projects for the value of the capacity that they contribute. This is not a hand-out for QF projects, this is a mandate of federal law that recognizes a tangible benefit provided by the QF project to the utility's ratepayers.

**Q. DON'T THE AVOIDED COST RATES ALREADY COMPENSATE QF PROJECTS FOR CAPACITY?**

**A.** Sometimes yes and sometime no. It depends on the type of resource and the basis of the avoided cost rate. For all QF projects, when the purchasing utility is resource sufficient and the avoided cost rate is based on forecasted short-term market rates, no compensation is provided for capacity. While a capacity payment should be made in such circumstances, that is not the purpose of my testimony in this matter.

When the purchasing utility is resource deficient, the avoided cost rate is based on the avoided proxy project. In the case of regular avoided cost, the proxy project is a

baseload natural gas generating facility. The QF project is to be compensated for capacity to the same extent that the proxy project would contribute capacity to the utility's system, adjusted for any incremental differences in the relative capacity contribution. After the capacity contribution of a QF project is determined (expressed as a percentage), it should receive the capacity dollars reflected by the ratio of QF capacity over proxy capacity times capacity value.

To illustrate with a simple example: If the capacity contribution of a ground-mount, tracking solar farm on the sunny side of Oregon is determined to be 40 percent, and the capacity contribution of the natural gas proxy is determined to be 80 percent, then the solar farm should receive roughly half of the total capacity dollars paid or attributed to the proxy. If the solar farm capacity contribution is 20 percent and the proxy capacity contribution is 80 percent, then the solar farm should receive 25 percent of the capacity dollars. In other words, the capacity contribution payment received by the solar QF project should be roughly proportionate with the capacity contribution of the proxy taking into account any incremental increase or decrease in capacity contribution.

**Q. WHAT DOES ORDER 14-058 SAY ABOUT CAPACITY CONTRIBUTION PAYMENTS?**

A. I believe that Order 14-058 intends to adopt this principle of rough proportionality between different resource types. In Order 14-058, the Commission held that "[w]e agree on the need to adjust for capacity contribution of each resource type and adopt Staffs proposed method for calculating capacity adjustments, as set forth in Staff/102-103, using input estimates derived from the utility's acknowledged IRP." In other words, the Commission agreed that it would be appropriate for purchasing utilities to compensate QFs for capacity consistent with the methodology described by Commission Staff.

**Q. DOES STAFF'S ORIGINAL PROPOSED METHOD FOR CALCULATING CAPACITY PAYMENTS, AS ADOPTED BY THE COMMISSION IN ORDER 14-058, WORK FOR SOLAR QF PROJECTS?**

**A.** No. When applied to solar QF projects, Staff's original proposed methodology for calculating the capacity contribution payments results in a *double* discount of the payment amount. There is no disagreement that the total annual capacity contribution payments made to a solar QF project should reflect a discount as compared to a natural gas baseload proxy project because the solar project will have less effective capacity during peak load hours. Using our second example above, if the solar farm has an effective capacity contribution of 20 percent and the natural gas plant has an effective capacity contribution of 80 percent, the solar capacity payment should be discounted by 75 percent. In other words (and these are important words), the total capacity dollars received by the solar farm should be only 25 percent of the total capacity value of the natural gas proxy.

The problem with the methodology originally proposed by Staff is that it would start with the 20 percent number to calculate a capacity payment rate, but then effectively discount this rate again by applying it only to the hours of full capacity production. If you are paid 20 percent of the value of capacity on 20 percent of the high load hours then you end up with only 20 percent of 20 percent, or only 4 percent of the total capacity dollars. I believe, and Staff has since confirmed, that this double discount was not intentional and was simply an inadvertent math error. That is why Obsidian requested clarification. There is certainly nothing in the rest of Staff's testimony or Order 14-058 that reflects an intent to apply such a double discount to capacity contribution payments made to renewable solar QF projects.

**Q. DID OBSIDIAN TIMELY SEEK CLARIFICATION OF THE DOUBLE DISCOUNT ISSUE IN PHASE I OF UM 1610?**

**A.** Yes. On April 24, 2014, Obsidian timely filed for clarification of that portion of Order 14-058 that applies to capacity payments to renewable solar QF projects.

**Q. DID THE COMMISSION STAFF AGREE THAT THE APPLICATION OF ITS CAPACITY PAYMENT METHODOLOGY TO RENEWABLE SOLAR QF PROJECTS REQUIRED CLARIFICATION?**

A. Yes. On May 9, 2014, Staff filed a response to Obsidian's motion for clarification in which it agreed with Obsidian that the proposed methodology would result in an unintentional double discount of the capacity contribution payment for renewable solar QF projects and therefore should be clarified. "Staff agrees with Obsidian . . . that there appears to be a second and unintended discounting of the avoided capacity value in the design of the volumetric avoided cost prices." Staff's response further states that "Staff recommends that the Commission allow parties to address this limited question regarding the design of the volumetric avoided cost prices in the investigations currently open to address the utilities' recent filings to comply with Order No. 14-058."

**Q. DID THE PURCHASING UTILITIES OPPOSE OBSIDIAN'S MOTION FOR CLARIFICATION?**

**A.** No. None of the purchasing utilities opposed Obsidian's Motion for Clarification. That is to say, none of the purchasing utilities disputed Obsidian's and Staff's conclusion that the original proposed methodology included an unintended double discount and should be clarified.

**Q. WHAT WAS THE RULING ON OBSIDIAN'S MOTION FOR CLARIFICATION?**

A. On June 10, 2014, the administrative law judge ("ALJ") issued a Ruling that resolves a number of procedural issues including Obsidian's motion for clarification. The ALJ found that "Staff agreed with the concerns raised by Obsidian . . . regarding the application of Staff's methodology to renewable solar QF resources . . .." The ALJ notes

that Staff recommended further input from interested parties in order to clarify the issue raised by Obsidian. In light of this, the ALJ's Ruling states that Obsidian's "request for clarification of Staff's methodology for adjusting rates to reflect a solar QF's capacity contribution is granted. The parties should address the methodology applicable to renewable solar QF resources . . . in the investigations currently taking place for Pacific Power's and Idaho Power's compliance filings in this docket."

**Q. WHAT IS THE CURRENT STATUS OF THE RENEWABLE SOLAR QF CAPACITY PAYMENT ISSUE RAISED BY OBSIDIAN?**

A. Although it as been more than a year since Obsidian' Motion for Clarification was granted, the issue still has not been clarified. This should be an uncontroversial issue that is easy to resolve. Staff submitted an initial proposal for calculating capacity contribution payments, which was adopted by the Commission. Staff later discovered that its initial proposal contained an error, and has put forth a replacement proposal that eliminates that error. On March 26, 2015, however, the ALJs for this case issued a ruling calling for additional testimony on the solar capacity contribution issue in Phase II of this docket. The issue could have been easily resolved many months ago—and still can be— simply by adopting Staff's revised methodology.

**Q. HAVE YOU REVIEWED THE TESTIMONY FILED BY OTHER PARTIES ON THIS ISSUE?**

**A.** Yes. I have reviewed the opening testimony on this issue provided on May 22, 2015, by other parties including the Commission Staff, the Oregon Department of Energy ("ODOE"), PacifiCorp, Portland General Electric ("PGE") and Idaho Power.

**Q. DO ANY PARTIES RAISE ANY NEW POINTS OR ISSUES IN THIS ROUND OF TESTIMONY THAT HAVE NOT ALREADY BEEN RAISED?**

**A.** No. As far as I can tell, the parties providing opening testimony on this issue in Phase II have done little more than repeat the testimony previously provided on this issue. Staff

and ODOE still agree that the original methodology contains an unintentional double discount that should be clarified. The purchasing utilities, on the other hand, predictably argue for the lowest possible capacity payment amount without regard to Staff's assessment of its own position.

**Q. AFTER REVIEWING THE OTHER PARTIES' TESTIMONY, DO YOU STILL BELIEVE THAT THERE IS A "DOUBLE DISCOUNT" ISSUE WITH STAFF'S ORIGINAL CAPACITY PAYMENT PROPOSAL?**

**A.** Yes. My analysis concluding that Staff's original methodology included an unintentional double discount when applied to renewable solar QF projects remains unchanged. In fact, my conclusions are once again confirmed by the most recent testimony of Staff and ODOE on this issue.

**Q. IN THEIR OPENING TESTIMONY, DO THE PURCHASING UTILITIES AGREE THAT THERE IS AN INAPPROPRIATE DOUBLE DISCOUNT OF THE RENEWABLE SOLAR QF CAPACITY PAYMENT?**

**A.** No. The purchasing utilities cling to the position that the original Staff proposal was correct, and they do not address the miscalculation directly. PGE/500; Macfarlane-Morton/2,7; Idaho Power/800; Youngblood/4-12; PAC/800, Dickman/5-11

**Q. DOES THE OPENING TESTIMONY OF PACIFICORP SUPPORT THE CONCULISION THAT THERE IS NO DOUBLE DISCOUNT OF THE RENEWABLE SOLAR QF CAPACITY PAYMENT?**

**A.** No, it does not. In fact, PacifiCorp's testimony suggests that the compensation paid to a renewable solar QF project *should* be disproportionately low in comparison to the amount of capacity that it actually provides. PAC/800, Dickman/8. PacifiCorp's position is that the double discount in the original Staff proposal was intentional and appropriate rather than unintentional—and that Staff itself is now wrong about being wrong. PacifiCorp argues that the intent of Order 14-058 was to *reduce* the capacity payment made to QF projects as compared to the capacity value of the proxy. In making its argument, however, PacifiCorp simply fails (or refuses) to recognize the distinction between the

standard proxy, which has a very high capacity contribution, and the renewable proxy, which has a very low capacity contribution.

**Q. YOUR ILLUSTRATION ABOVE IS BASED ON STANDARD AVOIDED COSTS. WHAT ABOUT RENEWABLE AVOIDED COSTS?**

**A.** The renewable proxy project is a wind project. Solar provides no capacity during low load hours (except Sundays and holidays) while electric generation from wind can occur anytime during the day and night. Thus, solar projects in Oregon contribute incrementally more capacity (only counted for high load hours) than wind projects. Accordingly, solar capacity is an *adder* to the renewable proxy, as compared to a deduction from the standard proxy. Aside from PacifiCorp misguided testimony, I do not see any disagreement in the record over that. As ODOE very capably shows in its testimony, the math of the correct amount of capacity and how to obtain the correct amount of capacity dollars is essentially the same, and the math error was essentially the same for avoided cost and for renewable energy avoided cost. ODOE/800; Broad/ 2-8.

**Q. DOES THE TESTIMONY OF IDAHO POWER SUPPORT THE CONCULISION THAT THERE IS NO DOUBLE DISCOUNT OF THE RENEWABLE SOLAR QF CAPACITY PAYMENT?**

**A.** No. Whereas PacifiCorp argues in favor of the double discount, Idaho Power tries to make the case that there actually is no double discount. Idaho Power suggests that it is appropriate to adjust both the capacity payment rate and the number of hours to which the rate is applied and that this is only a single discount rather than a double discount. Idaho Power/800; Youngblood/8-9. Regardless of whether it is called a "single" or a "double" discount, however, what matters is that the capacity contribution payment made to renewable solar QF projects over the course of a year must be proportionate with the amount of capacity provided.

**Q. CAN YOU GIVE AN EXAMPLE TO EXPLAIN WHY DISCOUNTING BOTH THE RATE AND THE NUMBER OF HOURS TO WHICH THE RATE IS APPLIED WOULD RESULT IN A TOTAL PAYMENT THAT IS DISPROPORTIONATELY LOW?**

**A.** Yes. Imagine that there are two workers doing the same job with the same pay grade. One works full time at 40 hours per week and the other works 20 hours per week. The objective is proportionate compensation of the two workers. The total compensation paid to the part time worker should therefore be half of the total compensation paid to the full time worker. Accordingly, they should be paid the same hourly wage—one for 40 hours per week and the other for 20. What PacifiCorp and Idaho Power are saying in their testimony, however, is that the hourly wage paid to the part-time worker should be discounted by 1/2 because they only do half the work. Further, that discounted hourly wage should only be paid for those hours in which the part time worker is actually working because it does not make sense to pay someone an hourly wage when they are not working. The problem with this approach is that it would result in the part-time worker receiving total compensation that is only 1/4 of the total compensation of the full time worker, rather than 1/2. This is a simplistic example, to be sure, but it illustrates the principle of double discount at issue here.

**Q. DOES THE TESTIMONY OF PGE SUPPORT ITS CONCULISION THAT THERE IS NO DOUBLE DISCOUNT OF THE RENEWABLE SOLAR QF CAPACITY PAYMENT?**

**A.** No. PGE's testimony simply provides the conclusory statement that it agrees with Staff's original proposal without explanation as to why there is or is not a "double discount." PGE/500; Macfarlane-Morton/2,7. As with both PacifiCorp and Idaho Power, PGE's opening testimony disregards that Staff now agrees that its original proposal requires modification.

**Q. DOES OBSIDIAN ADVOCATE FOR A CAPACITY PAYMENT SHOULD BE PAID AS A FIXED DOLLAR AMOUNT RATHER THAN ON A PER MWh BASIS?**

**A.** No. I am aware that the purchasing utilities attribute to Obsidian, either directly or indirectly, the notion that the capacity payment should be a fixed dollar amount. Idaho Power/800; Youngblood/8-9. This is merely a straw-man argument that the purchasing utilities devised based on a misunderstanding of Obsidian's April 24, 2014 Motion for Clarification. In the Motion, Obsidian explained that *if* there is to be a discounted capacity payment rate, then such rate must be paid at nameplate capacity in all on-peak hours rather than the hours of delivered energy. The purpose of this argument was not in support of a fixed payment amount, but to show why it is erroneous to start from a discounted capacity payment rate. In the alternative, if the capacity payment is paid as an adder to the energy payment, then the capacity rate must be calculated based on the full capacity value of the resource. I believe the latter is what Staff's revised proposal is designed to accomplish, and that is also my recommendation.

## II. THE ELCC METHOD SHOULD BE USED TO CALCULATE THE CAPACITY CONTRIBUTION OF SOLAR QF PROJECTS.

**Q. WHAT IS THE CAPACITY CONTRIBUTION OF A RENEWABLE SOLAR QF PROJECT?**

**A.** The capacity contribution of a generating resource is the contribution that the resource makes to meeting a utility's reliability requirements during peak load hours. The capacity contribution is typically expressed as a percentage. For example, a hypothetical baseload generating resource that is available in all high load hours (all peak hours) would have a capacity contribution of 100%. Solar projects are not available during all peak hours and therefore have a capacity contribution less than 100%. In my experience as a solar developer, owner and operator, commercial solar projects with at least single axis tracking located in the sunny part of Oregon have a capacity contribution that is

between 32% and 38% depending on its exact location and operating characteristics. This is very consistent with PacifiCorp's 2015 IRP, as discussed below.

**Q. HOW DOES THE CALCULATION OF THE CAPACITY CONRTIBUTION AFFECT THE CAPACITY CONTRIBUTION PAYMENT AMOUNT?**

**A.** As explained above, the capacity contribution payment (or deduction) is based on the incremental difference in capacity contribution between the QF project and the proxy resource. It is critical to correctly determine the capacity contribution of renewable solar QF projects in comparison to the capacity contribution of the proxy natural gas project for avoided cost and in comparison to the avoided wind project in calculating renewable energy avoided cost. If the capacity contribution of solar is understated, or if the capacity contribution of the proxy is overstated, then the solar project will be undercompensated for the capacity benefits that it provides to the purchasing utility.

**Q. DID THE COMMISSION ADDRESS THIS ISSUE IN ORDER 14-058?**

**A.** Not directly, or at least not directly enough. The simple method of calculating capacity is the capacity factor: how many high load hours of production divided by the number of high load hours. The commission apparently agreed to allow utilities to move away from the capacity factor to calculate the more complicated capacity contribution. The Commission did not state, however, what is the appropriate method for calculating the capacity contribution of solar resources. Obsidian is therefore not asking the Commission to change anything in its Phase I order. Because this remains an open issue, it is both appropriate, and well within its authority, for the Commission to resolve the issue in Phase II of this proceeding.

**Q. DO YOU AGREE WITH USING PACIFICORP'S CAPACITY CONTRIBUTION VALUE FROM ITS 2013 IRP?**

**A**. No. The capacity contribution for solar in PacifiCorp's 2013 IRP is just13.6%. This is an unreasonably low assumption. As stated above, I believe that the capacity

contribution value of a single axis tracking solar project in Oregon actually should be about 33-38%. This is based on actual operating data that shows the availability of solar projects during peak load hours. Thus, I strongly disagree with using PacifiCorp's 13.6% number as the basis for determining the capacity payment amount for renewable solar QF projects.

**Q. WHY IS THE CAPACITY VALUE IN PACIFICORP'S 2013 IRP SO LOW?**

**A.** PacifiCorp's 2013 IRP number of 13.6% is the product of a flawed methodology. As I understand it, in its 2013 IRP PacifiCorp used its own so-called "Exceedance Methodology" for determining a solar project's contribution to PacifiCorp's peak load. The basic problem with PacifiCorp's Exceedance Methodology is that it only values the capacity contributed by the solar project during an arbitrary sub-set of peak hours determined by the utility—rather than all of the peak hours in which the project contributes capacity. In simple terms, PacifiCorp's methodology would only compensate the renewable solar QF project for a fraction of the total capacity that it contributes. PacifiCorp's unusual methodology is inconsistent with accepted practices in the electric industry. The more appropriate and widely accepted methodology for calculating a resource's capacity contribution is the ELCC method.

**Q. PLEASE BRIEFLY SUMMARIZE YOUR UNDERSTANDING OF THE ELCC METHOD OF CALCULATING SOLAR CAPACITY CONTRIBUTION.**

**A.** My understanding of the ELCC methodology is that it is an estimate of the statistical probability that a particular resource type will contribute towards meeting a utility's reliability needs during any given peak hour or hours. Although I do not purport to be an expert in statistical probabilities, I understand that ELCC calculations have been conducted for conventional resource types for some time and that the methodology (or an approximation of it) is now commonly used for variable resources as well. Based on my

experience as a developer, the ELCC method of estimating of solar capacity contribution produces results that more closely correlate to the actual availability of solar resources during all peak hours than do other methods that arbitrarily select a subset of peak hours.

**Q. PLEASE EXPLAIN YOUR STATEMENT ABOVE THAT THE ELCC METHOD IS WIDELY ACCEPTED IN THE ELECTRIC UTILITY INDUSTRY.**

**A.** The ELCC method has been accepted as the preferred means of determining the capacity value of solar resources by electric industry leaders including, but not limited to, the National Renewable Energy Laboratory, the North American Electric Reliability Corporation and state utility regulators such as the Utah Public Service Commission ("Utah PSC").

On August 16, 2013, the Utah PSC issued an Order in Docket 12-035-100 in which it expressly rejected PacifiCorp's Exceedance Method of calculating solar capacity value. The Utah PSC stated: "PacifiCorp's Exceedance Method is not an industry standard approach." The Utah PSC explained that PacifiCorp's method "arbitrarily weights company data" and "fails to consider reliability measures" in the determination of the hours evaluated. The Utah PSC concluded that "[g]iven the evidence demonstrating significant flaws in the Exceedance Method and the fact that it results in a [] capacity contribution assumption for reliability planning and QF capacity payments substantially different from values used or approved in the past, we reject its use in this case."

The Utah PSC directed PacifiCorp to calculate the capacity contribution of solar resources using either the ELCC method or an approximation of that method. The Utah PSC ordered that, pending PacifiCorp's completion of an ELCC or equivalent study, it would accept a capacity value of 84% for tracking solar QFs. Following the Utah PSC

order, PacifiCorp has in fact switched to an approximation to the ELCC methodology for its 2015 IRP.

**Q. DO YOU AGREE WITH USING THE CAPACITY VALUE FROM PACIFICORP'S 2015 IRP?**

**A.** Yes, as a basis of compromise. PacifiCorp has completed a wind and solar capacity contribution study for its 2015 IRP. PacifiCorp's revised study is based on an approximation of the ELCC methodology rather than the Exceedance Method. PacifiCorp determined that the capacity value for a single axis tracking solar facility in Oregon is actually 36.7% rather than 13.6%. Observing that solar capacity differs based on the location and technology, PacifiCorp also uses a table showing a range of values rather than a single value for solar capacity. PacifiCorp's revised wind and solar capacity contribution study is attached hereto as Exhibit A. I would have no objection to using this number for solar projects located in the sunny part of Oregon because it is consistent with my experience, as a solar developer, of the availability of solar capacity during peak hours.

**Q. DO YOU AGREE WITH USING PGE'S CAPACITY VALUE FROM ITS 2013 IRP?**

**A.** No. PGE asserts that its 2013 IRP results in a solar capacity contribution value of just 5%, a number that grossly underestimates the capacity contribution of solar projects. PGE's 2013 IRP actually ran both the Exceedance Method and the ELCC method. The Exceedance Method yields a number that PGE averages to 5%. The ELCC methodology, on the other hand, produces a capacity value that is closer to 20%. In my experience, that 20% number is still at the low end of the range for the capacity contribution of a rooftop fixed tilt system in the Willamette Valley. I did not understand PGE's IRP to conclude that 5 percent was the more correct number and I did not understand the Acknowledgement of the IRP to be specific endorsement of the 5 percent number. Until

Order 14-058, the renewable energy community did not understand that the Commission intended statements in the IRP (which is not a contested proceeding in which developers may be parties) to have conclusive effect is setting avoided cost rates. The community of solar developers is still exploring precisely how the Commission thinks interested parties will be able to contest the correctness of IRP data and conclusions. Nevertheless, PGE proposes to discard the higher ELCC results and use only the Exceedance Method.

I have two objections about the capacity contribution factor in PGE's 2013 IRP. First, in the compliance filing PGE should be required to use the industry standard ELCC methodology, rather than the Exceedance Method, for purposes calculating the capacity value for renewable solar QF projects. As explained above, this is the only way to compensate a renewable solar QF projects for all of the capacity that it actually provides during peak hours rather than an arbitrary subset of peak hours.

My second objection is that I believe that PGE's application of the ELCC method in the 2013 IRP still significantly underestimates the capacity value of more efficient solar farms located in the sunny part of the state. The capacity value of a variable resource is positively correlated to the amount of hours during high-load-hours (or peak hours) that the resource is available. In my experience, a utility scale solar resources with single-axis tracking in a commercially viable location in Oregon has available capacity about 100% more often than a rooftop resource located in the Willamette Valley. If PGE believes that 20% is the capacity value of a solar facility in the Willamette Valley, I would still expect the capacity value of a solar project with tracking that is located in a sunny part of the state to be approximately 38% (which more closely coincides with PacifiCorp's 2015 IRP results). The Commission should ensure that the assumptions being made by PGE in its ELCC study are commercially reasonable and consistent with industry standards.

**Q. WOULD IT UNDULY BURDEN THE PURCHASING UTILITIES TO REQUIRE THEM TO USE THE ELCC METHOD?**

**A.** No. As discussed above, both PGE and PacifiCorp are already doing the ELCC analysis as a basis for determining capacity values of solar resources. Thus, the problem is not in requiring the utilities to do the calculation. The problem is that PGE simply refuses to use the ELCC results and PacifiCorp refuses to use the ELCC results until its 2015 IRP is acknowledged.

**Q. DOES PACIFICORP USE THE UPDATED SOLAR CAPACITY VALUE FROM ITS 2015 IRP AS THE BASIS FOR DETERMINING AVOIDED COST RATES IN OTHER JURISDICTIONS?**

**A.** Yes. PacifiCorp uses a corrected capacity value in other jurisdictions including both Utah and Wyoming. On November 7, 2014, PacifiCorp (dba Rocky Mountain Power) filed for an adjustment of its Schedule 37 avoided costs rates applicable to QF projects in Wyoming. With respect to capacity contribution of solar resources, PacifiCorp proposed that the capacity value from its 2015 IRP serve as the basis for any avoided capacity cost payments. This Commission should also use PacifiCorp's updated capacity contribution numbers from its 2015 IRP. After all, facts are facts and mistakes should be corrected.

**Q. DOES THIS CONCLUDE YOUR TESTIMONY AT THIS TIME?**

**A.** Yes.

# EXHIBIT A

# DRAFT APPENDIX O – 2014 WIND AND SOLAR CAPACITY CONTRIBUTION STUDY

## Introduction

The capacity contribution of wind and solar resources, represented as a percentage of resource capacity, is a measure of the ability for these resources to reliably meet demand. For purposes of this report, PacifiCorp defines the peak capacity contribution of wind and solar resources as the availability among hours with the highest loss of load probability (LOLP). PacifiCorp calculated peak capacity contribution values for wind and solar resources using the capacity factor approximation method (CF Method) as outlined in a 2012 report produced by the National Renewable Energy Laboratory (NREL Report)[1].

The capacity contribution of wind and solar resources affects PacifiCorp's resource planning activities. PacifiCorp conducts its resource planning to ensure there is sufficient capacity on its system to meet its load obligation at the time of system coincident peak inclusive of a planning reserve margin. To ensure resource adequacy is maintained over time, all resource portfolios evaluated in the integrated resource plan (IRP) have sufficient capacity to meet PacifiCorp's net coincident peak load obligation inclusive of a planning reserve margin throughout a 20-year planning horizon. Consequently, planning for the coincident peak drives the amount and timing of new resources, while resource cost and performance metrics among a wide range of different resource alternatives drive the types of resources that can be chosen to minimize portfolio costs and risks.

PacifiCorp derives its planning reserve margin from a LOLP study. The study evaluates the relationship between reliability across all hours in a given year, accounting for variability and uncertainty in load and generation resources, and the cost of planning for system resources at varying levels of planning reserve margin. In this way, PacifiCorp's planning reserve margin LOLP study is the mechanism used to transform hourly reliability metrics into a resource adequacy target at the time of system coincident peak. This same LOLP study was utilized for calculating the peak capacity contribution using the CF Method. Table O.1 summarizes the peak capacity contribution results for PacifiCorp's east and west balancing authority areas (BAAs).

[1] Madaeni, S. H.; Sioshansi, R.; and Denholm, P. "Comparison of Capacity Value Methods for Photovoltaics in the Western United States." NREL/TP-6A20-54704, Denver, CO: National Renewable Energy Laboratory, July 2012 (NREL Report).
http://www.nrel.gov/docs/fy12osti/54704.pdf

**Table O.1 – Peak Capacity Contribution Values for Wind and Solar**

| | East BAA | | | West BAA | | |
|---|---|---|---|---|---|---|
| | Wind | Fixed Tilt Solar PV | Single Axis Tracking Solar PV | Wind | Fixed Tilt Solar PV | Single Axis Tracking Solar PV |
| CF Method Results | 14.5% | 34.1% | 39.1% | 25.4% | 32.2% | 36.7% |

## Methodology

The NREL Report summarizes several methods for estimating the capacity value of renewable resources that are broadly categorized into two classes: 1) reliability-based methods that are computationally intensive; and 2) approximation methods that use simplified calculations to approximate reliability-based results. The NREL Report references a study from Milligan and Parsons that evaluated capacity factor approximation methods, which use capacity factor data among varying sets of hours, relative to the more computationally intensive reliability-based effective load carrying capability (ELCC) metric. As discussed in the NREL Report, the CF Method was found to be the most dependable technique in deriving capacity contribution values that approximate those developed using the ELCC Method.

As described in the NREL Report, the CF Method "considers the capacity factor of a generator over a subset of periods during which the system faces a high risk of an outage event." When using the CF Method, hourly LOLP is calculated and then weighting factors are obtained by dividing each hour's LOLP by the total LOLP over the period. These weighting factors are then applied to the contemporaneous hourly capacity factors for a wind or solar resource to produce a weighted average capacity contribution value.

The weighting factors based on LOLP are defined as:

$$w_i = \frac{LOLP_i}{\sum_{j=1}^{T} LOLP_j}$$

where $w_i$ is the weight in hour $i$, $LOLP_i$ is the LOLP in hour $i$, and $T$ is the number of hours in the study period, which is 8,760 hours for the current study. These weights are then used to calculate the weighted average capacity factor as an approximation of the capacity contribution as:

$$CV = \sum_{i=1}^{T} w_i C_i,$$

where $C_i$ is the capacity factor of the resource in hour $i$, and $CV$ is the weighted capacity value of the resource.

To determine the capacity contribution using the CF method, PacifiCorp implemented the following two steps:

1. A 500-iteration hourly Monte Carlo simulation of PacifiCorp's system was produced using the Planning and Risk (PaR) model to simulate the dispatch of the Company's system for a sample year (calendar year 2017). This PaR study is based on the Company's 2015 IRP planning reserve margin study using a 13% target planning reserve margin level. The LOLP for each hour in the year is calculated by counting the number of iterations in an hour in which system load could not be met with available resources and dividing by 500 (the total number iterations). For example, if in hour 9 on January 12th there are two iterations with Energy Not Served (ENS) out of a total of 500 iterations, then the LOLP for that hour would be 0.4%.[2]

2. Weighting factors were determined based upon the LOLP in each hour divided by the sum of LOLP among all hours. In the example noted above, the sum of LOLP among all hours is 143%.[3] The weighting factor for hour 9 on January 12th would be 0.2797%.[4] The hourly weighting factors are then applied to the capacity factors of wind and solar resources in the corresponding hours to determine the weighted capacity contribution value in those hours. Extending the example noted, if a resource has a capacity factor of 41.0% in hour 9 on January 12th, its weighted annual capacity contribution for that hour would be 0.1146%.[5]

## Results

Table O.2 summarizes the resulting annual capacity contribution using the CF Method described above as compared to capacity contribution values assumed in the 2013 IRP.[6] In implementing the CF Method, PacifiCorp used actual wind generation data from wind resources operating in its system to derive hourly wind capacity factor inputs. For solar resources, PacifiCorp used hourly generation profiles, differentiated between single axis tracking and fixed tilt projects, from a feasibility study developed by Black and Veatch. A representative profile for Milford County, Utah was used to calculate East BAA solar capacity contribution values, and a representative profile for Lakeview County, Oregon was used to calculate West BAA solar capacity contribution values.

[2] 0.4% = 2 / 500.
[3] For each hour, the hourly LOLP is calculated as the number of iterations with ENS divided by the total of 500 iterations. There are 715 ENS iteration-hours out of total of 8,760 hours. As a result, the sum of LOLP is 715 / 500 = 143%.
[4] 0.2797% = 0.4% / 143%, or simply 0.2797% = 2 / 715.
[5] 0.1146% = 0.2797% x 41.0%.
[6] In its 2013 IRP, PacifiCorp estimated capacity contribution values for wind and solar resources by evaluating capacity factors for wind and solar resources at a 90% probability level among the top 100 load hours in a given year.

**Table O.2 – Peak Capacity Contribution Values for Wind and Solar**

| | East BAA | | | West BAA | | |
|---|---|---|---|---|---|---|
| | Wind | Fixed Tilt Solar PV | Single Axis Tracking Solar PV | Wind | Fixed Tilt Solar PV | Single Axis Tracking Solar PV |
| CF Method Results | 14.5% | 34.1% | 39.1% | 25.4% | 32.2% | 36.7% |
| 2013 IRP Results | 4.2% | 13.6% | n/a | 4.2% | 13.6% | n/a |

Figure O.1 presents daily average LOLP results from the PaR simulation, which shows that loss of load events are most likely to occur during the spring, when maintenance is often planned, and during peak load months, which occur in the summer and the winter.

**Figure O.1 - Daily LOLP**

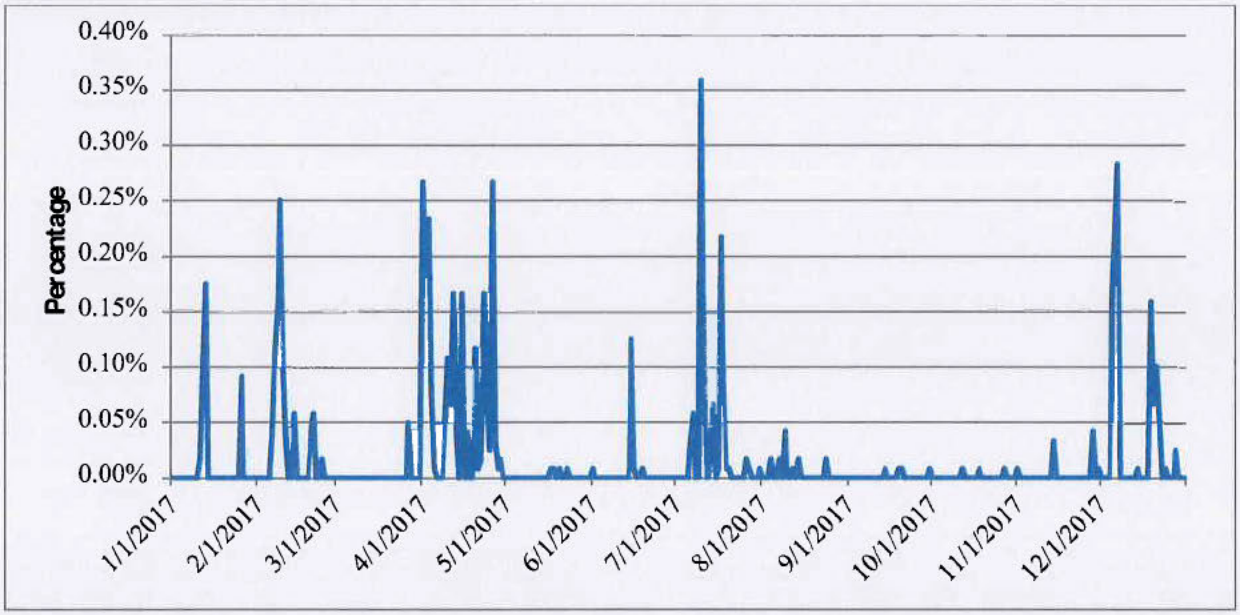
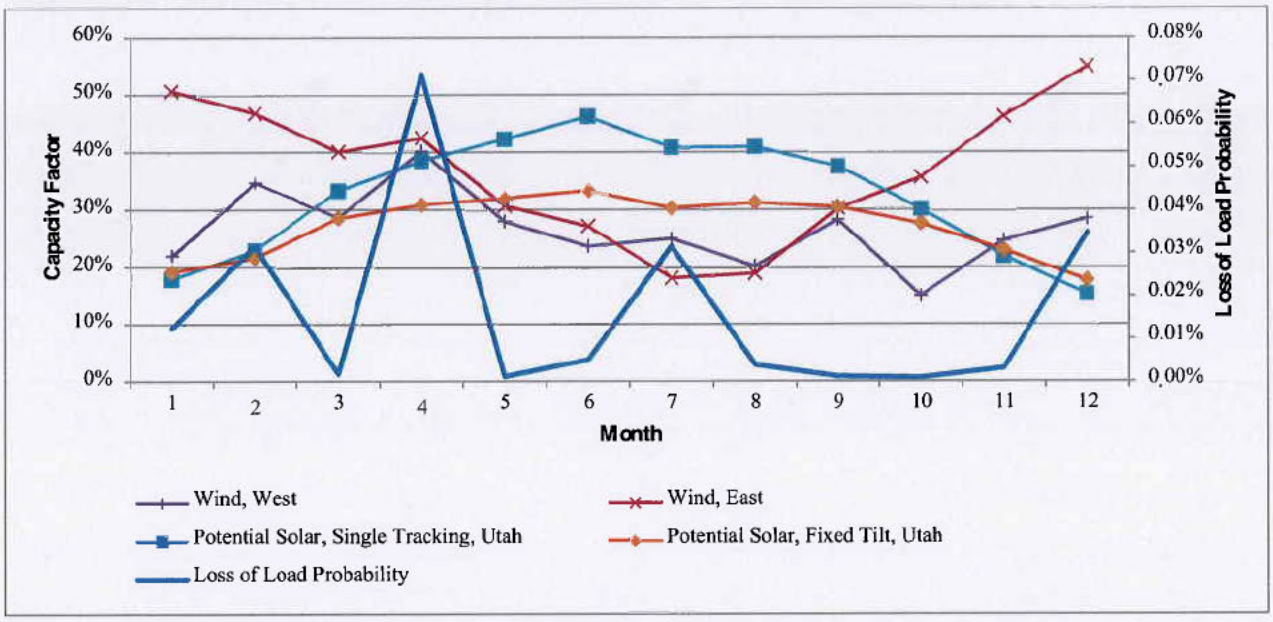



Figure O.2 presents the relationship between monthly capacity factors among wind and solar resources (primary y-axis) and average monthly LOLP from the PaR simulation (secondary y-axis) in PacifiCorp's CF Method analysis. As noted above, the average monthly LOLP is most prominent in April (spring maintenance period), summer (July peak loads), and winter (when loads are high).

**Figure O.2 - Monthly Resource Capacity Factors as Compared to LOLP**




Figures O.3 through O.5 present the hourly distribution of capacity factors among wind and solar resources (primary y-axis) as compared to the hourly distribution of LOLP (secondary y-axis) for a typical day in the months of April, July, and December, respectively. Among a typical day in April, LOLP events peak during morning and evening ramp periods when generating units are transitioning between on-peak and off-peak operation. Among a typical day in July, LOLP events peak during higher load hours and during the evening ramp. In December, LOLP events peak during higher load evening hours.

**Figure O.3 - Hourly Resource Capacity Factors as Compared to LOLP for an Average Day in April**

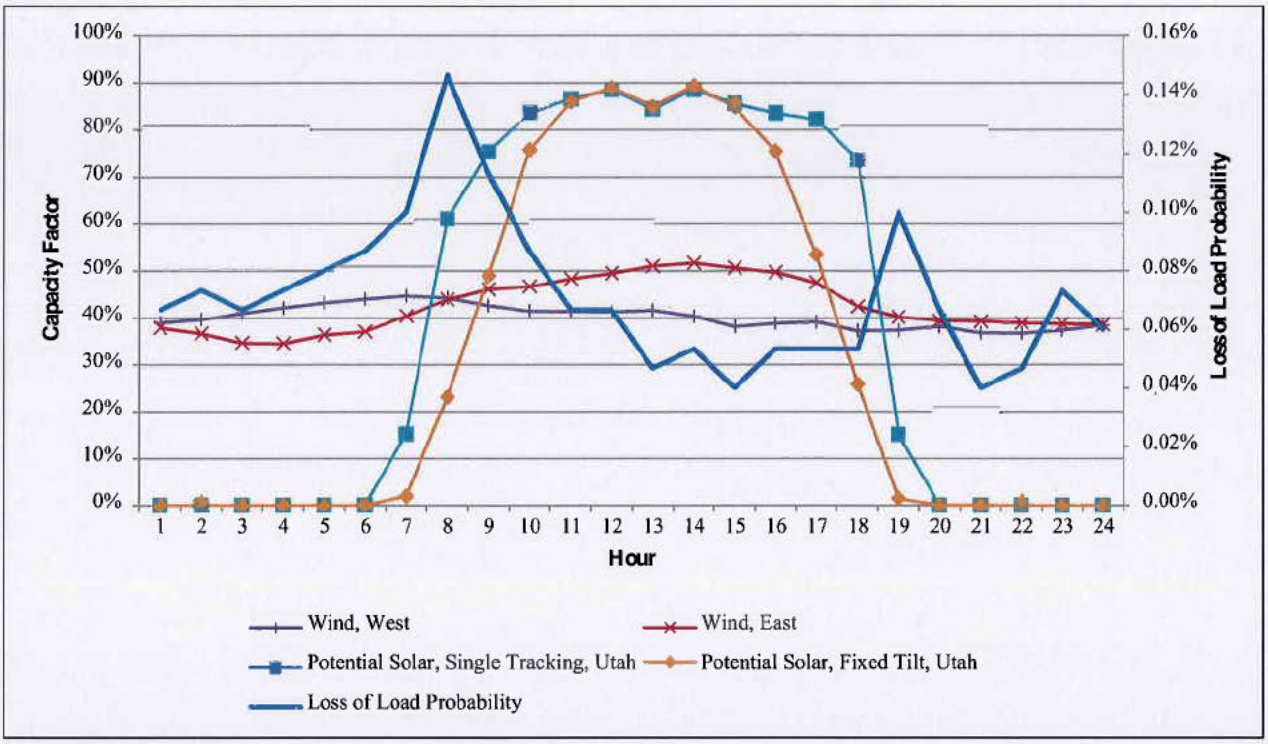



**Figure O.4 – Hourly Resource Capacity Factors as Compared to LOLP for an Average Day in July**

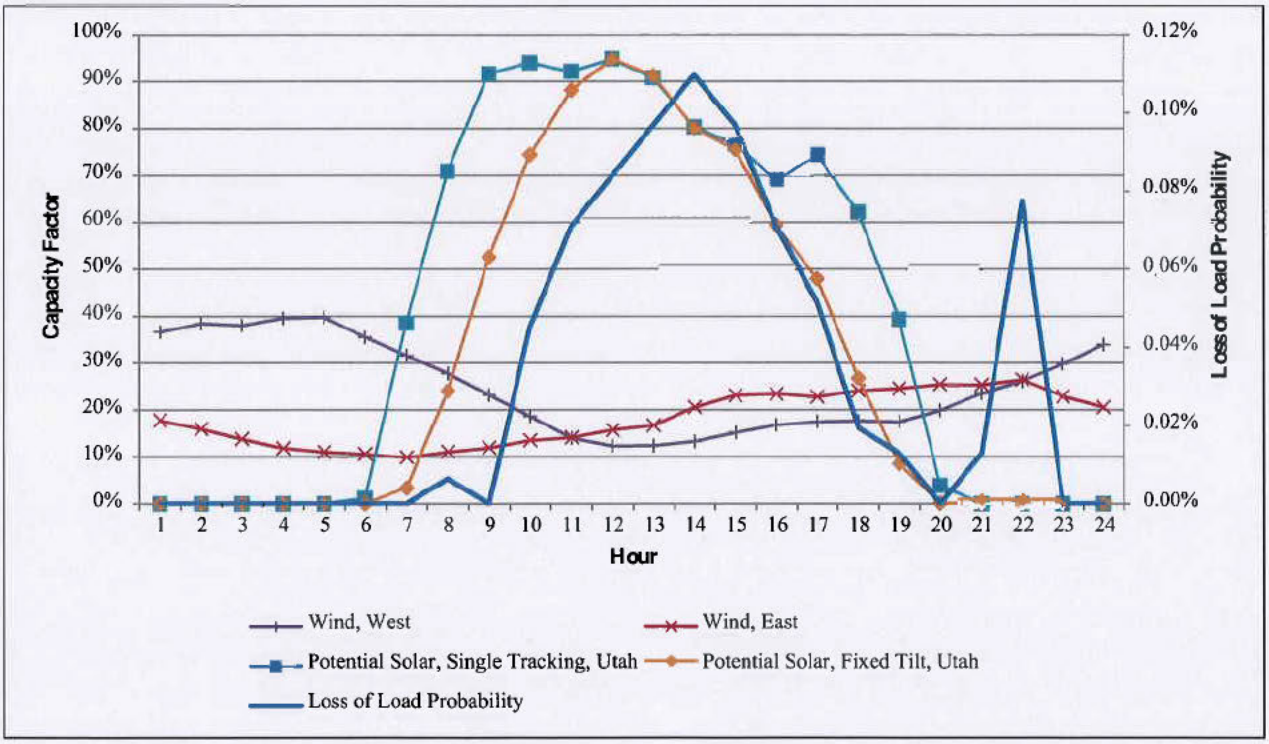
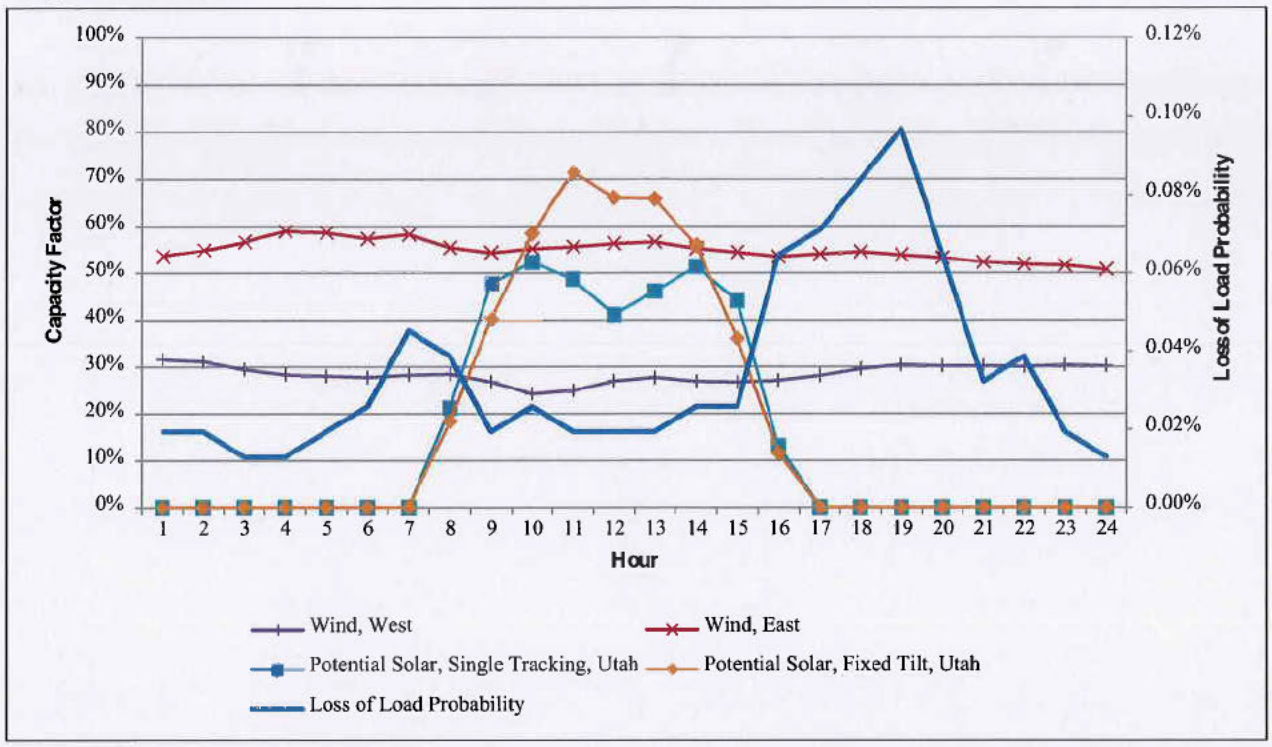


**Figure O.5 – Hourly Resource Capacity Factors as Compared to LOLP for an Average Day in December**




## Conclusion

PacifiCorp conducts its resource planning by ensuring there is sufficient capacity on its system to meet its net load obligation at the time of system coincident peak inclusive of a planning reserve margin. The peak capacity contribution of wind and solar resources, represented as a percentage of resource capacity, is the weighted average capacity factor of these resources at the time when the load cannot be met with available resources. The peak capacity contribution values developed using the CF Method are based on a LOLP study that aligns with PacifiCorp's 13% planning reserve margin, and therefore, the values represent the expected contribution that wind and solar resources make toward achieving PacifiCorp's target resource planning criteria.