

**REDACTED**

Docket No. 20000-418-EA-12

Witness: Rick T. Link

BEFORE THE WYOMING PUBLIC SERVICE  
COMMISSION

ROCKY MOUNTAIN POWER

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**REDACTED**

Rebuttal Testimony of Rick T. Link

March 2013

1 **Q. Are you the same Rick T. Link that submitted direct testimony in this**  
2 **proceeding?**

3 A. Yes.

4 **Introduction and Summary**

5 **Q. What is the purpose of your rebuttal testimony?**

6 A. The purpose of my rebuttal testimony is to respond to the direct testimony of Mr.  
7 Randall J. Falkenberg on behalf of the Wyoming Industrial Energy Consumers  
8 (WIEC) and Dr. Jeremy Fisher on behalf of Sierra Club. I further explain in my  
9 testimony corrections and updates to the analysis used by the Company to support  
10 its application for a certificate of public convenience and necessity (CPCN)  
11 related to the selective catalytic reduction (SCR) investments planned for Jim  
12 Bridger Units 3 and 4 that are responsive to the concerns raised by the parties  
13 identified above.

14 **Q. Please summarize your rebuttal testimony in this proceeding.**

15 A. My rebuttal testimony specifically addresses concerns raised by the parties in this  
16 proceeding that are associated with the financial analysis supporting SCR  
17 investments at Jim Bridger Units 3 and 4. Specifically, I am providing testimony  
18 on the following:

- 19 • Updated base case analysis results that reflect corrections to the  
20 Company's original analysis and that incorporate assumption updates  
21 responsive to the parties showing a Present Value Revenue Requirement  
22 Differential (PVRR(d)) of [REDACTED] favorable to the SCR investments  
23 required at Jim Bridger Units 3 and 4.

- 1 • Updated and expanded natural gas and carbon dioxide (CO<sub>2</sub>) price  
2 scenario analysis results showing a range of PVRR(d) outcomes that  
3 support the SCR investments in six of the nine scenarios studied.
- 4 • Updates to base case natural gas price and CO<sub>2</sub> price assumptions that are  
5 aligned with the Company's September 2012 official forward price curve  
6 (OFPC).
- 7 • Updates to coal cost assumptions.
- 8 • Updates to load forecast assumptions.
- 9 • Description of a new sensitivity showing that alternative Energy Gateway  
10 transmission assumptions and Wyoming wind resource assumptions  
11 improve the PVRR(d) results in favor of the SCR investments.
- 12 • Description of a new sensitivity showing that the SCR investments are  
13 favorable to an early retirement and resource replacement alternative.

14 **Corrections**

15 **Q. Did you make any corrections to the PVRR(d) results that were summarized**  
16 **in your direct testimony?**

17 A. Yes. The PVRR(d) is derived by taking the difference in present value revenue  
18 requirement (PVRR) between two System Optimizer (SO) Model simulations –  
19 one simulation in which the SCR equipment required for continued coal-fueled  
20 operations is installed at Jim Bridger Units 3 and 4 and another simulation in  
21 which the SCR investments are not made. In the simulation where the SCR  
22 installations do not occur, the SO Model chooses to convert Jim Bridger Units 3  
23 and 4 to natural gas as the next best, albeit higher cost, alternative.

1           In the case where Jim Bridger Units 3 and 4 are converted to natural gas,  
2           mine capital costs that were assigned pro-rata to these two units were not reported  
3           in the PVRR(d) results summarized in my direct testimony, and therefore, mine  
4           capital costs were understated. This increases costs in the case where the SCR  
5           investments are not made at Jim Bridger Units 3 and 4 and, all else being equal,  
6           improves the PVRR(d) favorable to the SCR investment by [REDACTED]. Also in  
7           the case where Jim Bridger Units 3 and 4 are converted to natural gas, the  
8           PVRR(d) results summarized in my direct testimony included one year of cost for  
9           the SCR equipment on Jim Bridger Unit 4. This overstated costs in the case where  
10          the SCR investments are not made, and all else being equal, reduces the PVRR(d)  
11          favorable to the SCR investment by [REDACTED]. These two corrections result in  
12          increasing the base case PVRR(d) in my direct testimony from [REDACTED] to  
13          [REDACTED] favorable to the SCRs, prior to other assumption updates which I  
14          will discuss in the next section of my rebuttal testimony.

15       **Q. Are there any other corrections made to the SO Model analysis that you**  
16       **summarized in direct testimony?**

17       A. Yes. The capacity for the Wyodak coal-fired unit located in eastern Wyoming was  
18       modeled as a 324 megawatt (MW) generation resource instead of a 268 MW  
19       generation resource. In the Company's updated analysis, which I describe in more  
20       detail below, SO Model simulations were updated with the correct capacity for  
21       the Wyodak coal unit.

1 **Updated Base Case Assumptions**

2 **Q. Did the Company make any updates to its assumptions used in the SO Model**  
3 **for its analysis of the Jim Bridger Units 3 and 4 SCR equipment?**

4 A. Yes. It is important that the Company update its analysis with new information as  
5 it becomes available to ensure that the SCR investments being evaluated in this  
6 case are in the best interest of customers. To this end, the following assumptions  
7 have been updated in the base case SO Model analysis:

- 8 • Natural gas and CO<sub>2</sub> price assumptions;
- 9 • Coal cash cost, mine capital and mine reclamation assumptions; and
- 10 • Load forecast assumptions.

11 In addition, in the current proceeding, the Company made the adjustment  
12 proposed by WIEC to set the Gadsby peaking units and the Currant Creek  
13 combined cycle plant as must-run units.

14 **Q. How have forward natural gas prices and long-term natural gas price**  
15 **forecasts changed since the Company filed its CPCN?**

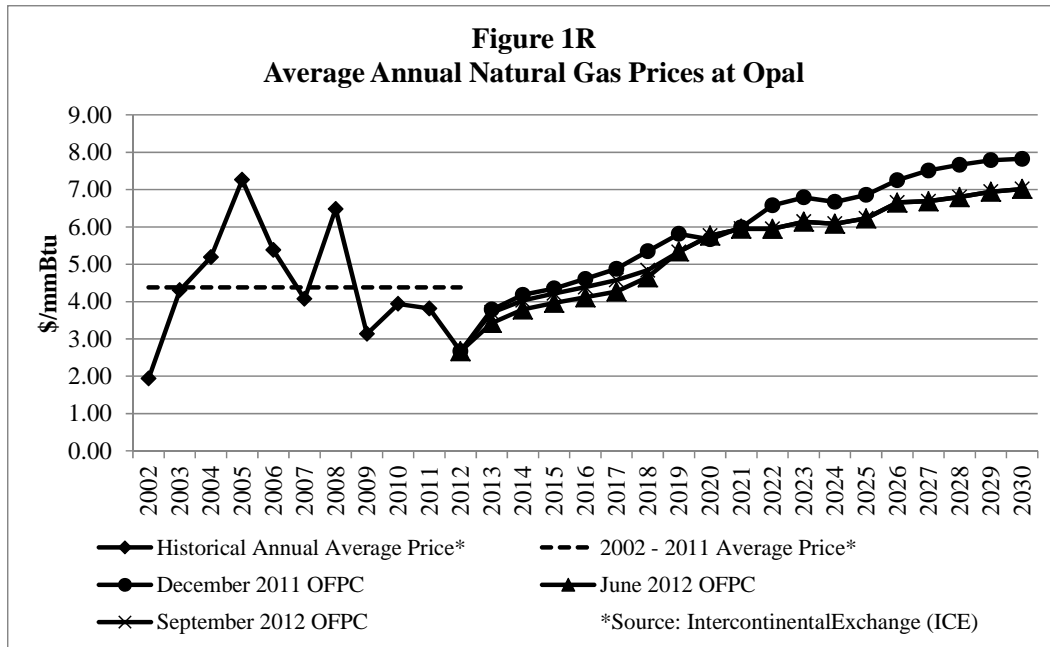
16 A. The Company relied upon its December 2011 OFPC in the base case analysis of  
17 the Jim Bridger Units 3 and 4 SCR investments and estimated the PVRR(d)  
18 impact of using its June 2012 OFPC. Average annual natural gas prices at the  
19 Opal market hub over the forward period 2016 through 2030 were down  
20 approximately nine percent in the June 2012 OFPC as compared to the December  
21 2011 OFPC. The updated base case analysis discussed herein was performed  
22 using the September 2012 OFPC. Opal natural gas prices from the September  
23 OFPC over the forward period 2020 and beyond are identical to those in the June

1 2012 OFPC and are four percent higher than average annual prices from June  
2 2012 OFPC over the forward period 2016 through 2019.

3 **Q. Describe how the forward trend in natural gas prices compares to historical**  
4 **prices at the Opal market hub.**

5 A. Figure 1R below shows historical average annual natural gas prices and forward  
6 natural gas prices from the December 2011 OFPC, the June 2012 OFPC, and the  
7 updated base case September 2012 OFPC at the Opal market hub. Over the 11-  
8 year period 2002 through 2012, prices at Opal averaged \$4.38 per mmBtu. The  
9 highest annual average price over this period is \$7.26 per mmBtu, which occurred  
10 in 2005 when hurricanes Katrina, Rita, and Wilma caused significant production  
11 losses in the Gulf of Mexico region. Average annual prices were \$6.48 per  
12 mmBtu in 2008, which coincided with the general rush to commodities in  
13 advance of the collapse of the housing bubble later that year.

14 In the September 2012 OFPC, Opal market prices over the period 2016  
15 through 2020 average \$4.98 per mmBtu. Prices over the period 2021 through  
16 2030 average \$6.45 per mmBtu, which is 29 percent higher than prices in the  
17 2016 to 2020 timeframe and 47 percent higher than average historical prices over  
18 the period 2002 through 2012. While forward prices from the September 2012  
19 OFPC have fallen in relation to forward prices from the December 2011 OFPC,  
20 average annual prices over the mid- to long-term are expected to rise above near-  
21 term forwards and historical price levels.



1 **Q. Has the Company updated its base case assumptions for CO<sub>2</sub> prices?**

2 A. Yes. The September 2012 OFPC reflects an assumed CO<sub>2</sub> policy that will be  
 3 implemented in 10 years, and as such, CO<sub>2</sub> prices are assumed to begin in 2022,  
 4 one year later than assumed in the Company’s original base case analysis. The  
 5 initial price level for CO<sub>2</sub> emissions has not changed, with prices starting at \$16  
 6 per ton and escalating at three percent plus inflation thereafter. The one-year  
 7 delay in the assumed start date for CO<sub>2</sub> prices remains consistent with  
 8 assumptions from third party forecasts, with a one-year delay observed in one  
 9 third party projection, and is consistent with the lack of legislative activity on  
 10 developing federal greenhouse gas policies in 2012.

11 **Q. Please describe how the Company’s coal cost assumptions have been updated**  
 12 **for the new base case analysis.**

13 A. Base case coal cost assumptions have been updated for both the four-unit  
 14 operation and the two-unit operation fueling plans. As I discussed in my direct

1 testimony, the two-unit operation fueling plan takes into consideration how the  
2 plant fueling requirements are affected if Jim Bridger Units 3 and 4 stop operating  
3 as coal-fueled generation assets. The updated coal cost assumptions are informed  
4 by more current mine plans and reclamation plans, which are described in more  
5 detail in the rebuttal testimony of Company witness Ms. Cindy A. Crane.

6 Updated cash coal cost assumptions, representing all non-capital related  
7 costs to fuel the Jim Bridger plant, are included alongside the cash coal costs  
8 assumed in the original base case in Confidential Exhibit RMP\_\_\_(RTL-1R). On  
9 average, over the period 2013 through 2030, cash coal costs for the four-unit  
10 operation fueling plan have [REDACTED] per mmBtu (approximately 6.6  
11 percent) as compared to the original base case assumptions. The increase in cash  
12 coal costs for the four-unit operation fueling plan reflects updated third party coal  
13 prices and transportation costs for Black Butte coal as well as updated cash  
14 operating costs for Bridger Coal Company. The increase in cost is primarily  
15 attributable to an increase in final reclamation trust contributions and the cost  
16 impact of reduced production from the Bridger surface mine in the 2015-2017  
17 timeframe.

18 Over the period 2013 through 2030, average annual cash coal costs for the  
19 two-unit operation fueling plan have [REDACTED] per mmBtu  
20 (approximately 4.3 percent) relative to the original base case assumptions. The  
21 decrease in cash coal costs for the two-unit operation fueling plan, which also  
22 reflects updated third party coal prices and transportation costs for Black Butte  
23 coal and Bridger Coal Company cash operating costs, is principally associated



1 with reduced underground mine operating costs starting in 2017. Company  
2 witness Ms. Crane describes in more detail updated coal cost assumptions.

3 **Q. Did the Company update mine capital cost assumptions given the availability**  
4 **of a more current mine plan?**

5 A. Yes. As informed by an updated mine plan, the mine capital cost assumptions for  
6 Bridger Coal Company's surface and underground mining operations have been  
7 updated for both a four-unit operation and the two-unit operation fueling plan at  
8 the Jim Bridger plant. Updated mine capital cost assumptions are included  
9 alongside the mine capital costs assumed in the original base case in Confidential  
10 Exhibit RMP\_\_\_(RTL-2R).

11 Over the period 2013 through 2030, average annual mine capital cost  
12 assumptions for a four-unit operation fueling plan are higher by about [REDACTED]  
13 [REDACTED]. Over the same period, average annual mine capital cost assumptions for a  
14 two-unit operation fueling plan at the Jim Bridger plant are higher by  
15 approximately [REDACTED]. Relative to the original base case assumptions, mine  
16 capital cost increases are most significant from 2021 through 2026, where annual  
17 average mine capital costs are higher by [REDACTED] in the four-unit operation  
18 fueling plan and higher by [REDACTED] in the two-unit operation fueling plan.  
19 Beyond 2026, average annual updated mine capital cost assumptions are lower by  
20 [REDACTED] and [REDACTED] in the four-unit and two-unit operation fueling  
21 plans, respectively.

1 **Q. Please summarize the key drivers behind the updated mine capital cost**  
2 **assumptions.**

3 A. As described in the testimony of Company witness Ms. Crane, the key drivers  
4 behind the updated mine capital costs in the cases pertain to additional surface  
5 and underground mine reserve acquisition costs as well as additional mine  
6 extension costs and longwall system rebuild/replacement costs.

7 **Q. Did the Company update mine reclamation cost assumptions in its updated**  
8 **base case analysis?**

9 A. Yes. Mine reclamation costs are included in the updated cash coal cost  
10 assumptions I described above. Cash coal costs drive the fuel cost for Jim Bridger  
11 in the SO Model analysis, which has a study horizon extending out through 2030.

12 **Q. Was the Company criticized for its treatment of mine reclamation costs**  
13 **beyond the 2030 study period used in the SO Model analysis?**

14 A. Yes. WIEC noted that reclamation costs in the continued coal operation case  
15 beyond the 2030 study horizon were not factored into the PVRR(d) results  
16 originally filed by the Company.

17 **Q. How do you respond?**

18 A. In the updated base case analysis, the Company has factored into its PVRR(d)  
19 results contributions to the mine reclamation trust that are not accounted for in the  
20 cash coal costs inputs used in the SO Model. This includes contributions to the  
21 mine reclamation trust over the period 2031 through 2037 for both the four-unit  
22 and two-unit operation fueling plans at the Jim Bridger plant. Over this  
23 timeframe, annual contributions to the mine capital trust total [REDACTED] under a

1 four-unit operation plan and [REDACTED] under a two-unit operation plan.  
2 Assumptions for contributions to the mine reclamation trust are summarized in  
3 Confidential Exhibit RMP\_\_\_(RTL-3R).

4 **Q. In its review of base case assumptions, did the Company include the most**  
5 **current load forecast in its updated SO Model analysis?**

6 A. Yes. The Company included in its updated base case analysis its most current load  
7 forecast consistent with the load forecast used in the “Needs Assessment” filed  
8 with the Utah Public Service Commission through the All Source Request for  
9 Proposals for a 2016 Resource (Utah Docket No. 11-035-73). This is the same  
10 load forecast that is being used in the Company’s 2013 IRP as referenced by  
11 WIEC.<sup>1</sup>

12 **Q. Please describe how the Company’s load forecast has changed.**

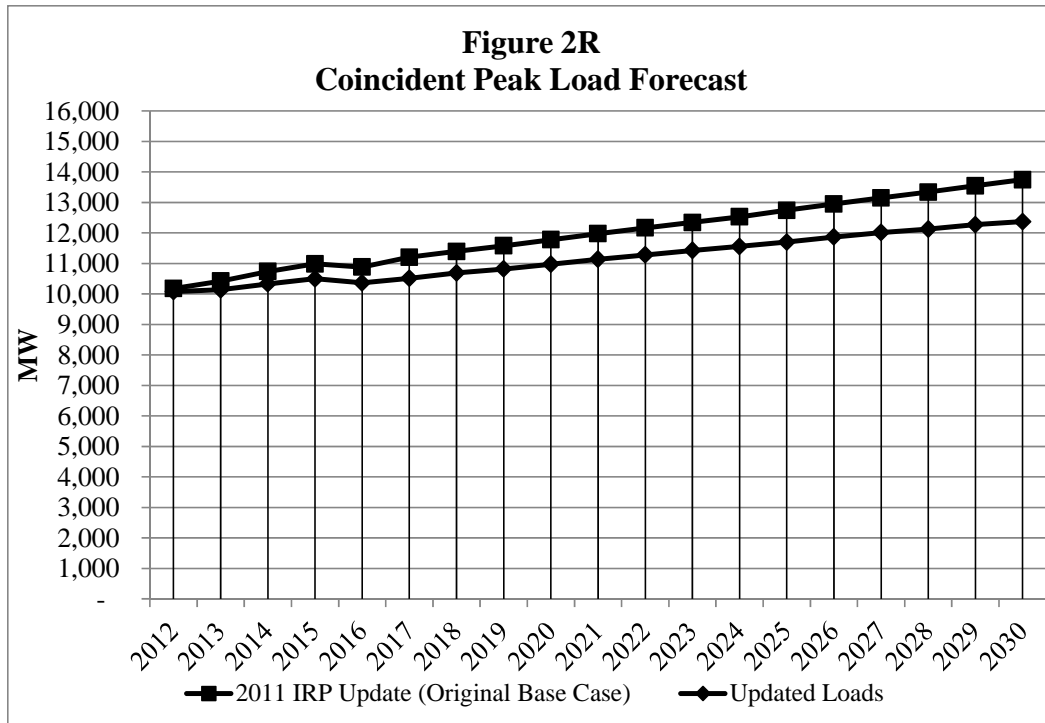
13 A. The Company’s current load forecast is lower than the load forecast used in the  
14 original base case analysis, which was consistent with the load forecast used in  
15 the Company’s 2011 IRP Update. The lower load forecast is driven by reduced  
16 industrial sector loads in Utah and Wyoming that reflect load request  
17 cancellations and postponements necessitated by prolonged recessionary impacts  
18 and permitting issues. The most current load forecast also incorporates projections  
19 of increased industrial self-generation driven largely by lower wholesale gas and  
20 electricity prices. Finally, the Company’s new industrial load forecast uses a  
21 regression analysis in place of a probability assessment of customer-provided  
22 forecasts.

23 Figure 2R below compares the updated coincident peak load forecast to

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<sup>1</sup> See Confidential Exhibit RJF-2 of WIEC witness Mr. Randall J. Falkenberg at page 8 line 13.

1 the original coincident peak load forecast used in the SO Model analysis. As  
2 compared to the original load forecast, the annual coincident peak load projection  
3 is on average reduced by 663 megawatts over the period 2015 through 2020,  
4 reduced by 934 megawatts over the period 2021 through 2025, and reduced by  
5 1,215 megawatts over the period 2026 through 2030.



6 **Q. Were any parties to this proceeding critical of how certain assets were**  
7 **dispatched in the Company’s SO Model analysis?**

8 A. Yes. WIEC was critical of the SO Model’s dispatch for the Gadsby and Currant  
9 Creek combined cycle resources and suggested that these assets should be  
10 modeled with must run assumptions as implemented in GRID studies.

11 **Q. Did you make any changes to the SO Model in response to these concerns?**

12 A. Yes. The Company enforced must run settings on the Gadsby peaking units and  
13 the Currant Creek combined cycle plant to be consistent with the must run

1 settings applied to these assets in GRID studies.

2 **Q. Did the Company update its forced outage assumptions applied to Jim**  
3 **Bridger Units 3 and 4?**

4 A. No. WIEC explains how the Company's forced outage rate assumptions for Jim  
5 Bridger Units 3 and 4 are lower than forced outage rate assumptions used in  
6 GRID for net power cost filings. The assumptions used in the SO Model analysis  
7 do not explicitly separate forced outage rates from planned outage rate  
8 assumptions. Rather, the SO Model assumptions are configured to represent  
9 projected availability, taking into consideration both planned and unplanned  
10 outage events on a forecast basis. The Company believes that forecasted unit  
11 availability data are appropriate for use in analyzing the forecasted PVRR(d)  
12 benefits or costs associated with SCR equipment required on Jim Bridger Units 3  
13 and 4.

14 **Q. How are forced outages modeled in GRID for regulatory net power cost**  
15 **filings?**

16 A. The Company uses the average of the most recent four-year historical outage data  
17 for each unit. This outage amount is used in GRID to de-rate the maximum  
18 capacity of each unit by a fixed percentage.

19 **Q. Why does the Company use a four-year historical average to model forced**  
20 **outages for net power cost studies?**

21 A. There are two primary reasons. First, use of a rolling four-year average reflects  
22 the current operation of each unit and smoothes the data to limit the magnitude of  
23 changes from year to year. Second, using actual data to determine a normalized

1 outage rate allows forecast net power costs to reflect the availability that was  
2 historically experienced by the Company.

3 **Q. How are planned outages modeled in GRID for regulatory net power cost**  
4 **filings?**

5 A. Planned outages are based on the same four-year average as forced outages. They  
6 are placed throughout the forecast period to best match the timing of the historical  
7 outages and are modeled by setting the unit that is on planned outage to zero.

8 **Q. Why does the Company use a four-year historical average to model planned**  
9 **outages for purposes of net power cost filings?**

10 A. For the same reasons stated above for forced outages.

11 **Q. Please explain why use of forecasted unit availability (planned and**  
12 **unplanned outages) is applied in the SO Model analysis supporting this case.**

13 A. Unlike a typical net power cost study, which often covers a one-year normalized  
14 forward test period, the SO Model simulates PacifiCorp's system over a study  
15 horizon extending through 2030. Use of forecasted availability rates allows the  
16 SO Model to factor into its optimization routine the anticipated timing of major  
17 maintenance activities, which are aligned with the installation of environmental  
18 equipment such as the SCR equipment required on Jim Bridger Units 3 and 4.  
19 Forecasted availability rates also allow the SO Model to reflect expected year-to-  
20 year availability changes identified by plant staff in anticipation of operational  
21 changes or regulatory requirements identified during the Company's planning  
22 processes. The availability forecasts generated by plant staff are informed by prior  
23 operating history and experience, recognized industry best practices, and original

1 equipment manufacturer recommendations, where applicable.

2 **Q. Did the Company update its assumptions for the cost of the SCR equipment**  
3 **in its updated base case analysis?**

4 A. No. The cost of the SCR equipment assumed in the Company's updated analysis  
5 is identical to the cost assumptions used in the original analysis, which are based  
6 on engineering, procurement, and construction (EPC) bids for the SCR equipment  
7 required at Jim Bridger Units 3 and 4.

8 **Q. Did any of the parties in this case raise concerns with the SCR cost**  
9 **assumption used in the Company's analysis?**

10 A. Yes. In the original analysis used to support the CPCN, the Company began  
11 analyzing the Jim Bridger Units 3 and 4 SCR investments using preliminary cost  
12 estimates as inputs to the SO Model. These cost assumptions were improved after  
13 the SO Model simulations were completed based upon refined cost data from EPC  
14 bids for the Jim Bridger SCR equipment. The Company factored the updated cost  
15 information into the original SO Model results with a manual adjustment  
16 performed outside of the model. Applying the update as an adjustment outside of  
17 the SO Model as compared to applying the update to the SO Model inputs and  
18 rerunning the SO Model would yield the same PVRR(d) results. This is because  
19 the capital cost for the SCRs is a fixed cost that does not affect how the system is  
20 dispatched, and therefore, the costs have no impact on other variables that affect  
21 the SO Model solution (i.e. system costs such as fuel costs). WIEC identified this  
22 assumption update as a "problematic assumption" and testified that the range of

1 potential impacts ranges between [REDACTED].<sup>2</sup>

2 **Q. How do you respond?**

3 A. The Company's SCR cost assumptions are not in any way "problematic". The  
4 Company applied the manual adjustment in its original analysis simply to ensure  
5 that the more current and more refined SCR costs would be reflected in the  
6 PVRR(d) results supporting the CPCN.

7 **Q. Did the Company apply manual adjustments to the updated SO Model**  
8 **results?**

9 A. No. In the original analysis supporting the CPCN, the Company performed  
10 manual adjustments to the SO Model results to reflect assumption updates made  
11 after the original SO Model simulations were completed to ensure PVRR(d)  
12 results would reflect current cost information. In updating its analysis, the  
13 Company has incorporated into the SO Model all updated assumptions, which  
14 alleviates the need for manual adjustments.<sup>3</sup>

15 **Q. Does WIEC raise any concerns with the assumed recovery of SCR costs as**  
16 **applied in the Company's analysis?**

17 A. Yes. WIEC testifies that the Company's analysis does not accurately capture the  
18 timing in which SCR costs would be included in rate base and characterizes this  
19 as an "error" in the analysis with an estimated PVRR(d) impact of [REDACTED]  
20 favorable to the Jim Bridger Units 3 and 4 SCR investments.<sup>4</sup> WIEC claims that  
21 the Company's analysis assumes the SCR systems are included in rate base in

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<sup>2</sup> See Confidential Table EX-2-1 in the direct testimony of WIEC witness Mr. Randall J. Falkenberg.

<sup>3</sup> Note, the PVRR(d) impact of mine reclamation funds over the period 2031 through 2037, which was requested by several parties, are calculated outside of the SO Model because this period extends beyond the SO Model study horizon.

<sup>4</sup> See Confidential Exhibit RJF-2 of WIEC witness Mr. Randall J. Falkenberg at page 13 line 1.



1 advance of when the equipment would be operational and are not aligned with the  
2 timing of an assumed future Wyoming general rate case.

3 **Q. How is WIEC's argument flawed?**

4 A. WIEC hypothetically assumes that the Company will file its next Wyoming  
5 general rate case on March 1, 2014. The Company has made no determination at  
6 this time that it will file a Wyoming general rate case on March 1, 2014. This date  
7 only represents the earliest date which the Company could file a rate case as a  
8 result of a prior rate case stipulation. WIEC fails to note that any extension of the  
9 next Wyoming general rate case filing beyond March 1, 2014 would include more  
10 of the SCR investments to the Wyoming case when it is eventually filed.

11 More importantly, WIEC's claim is based on an assumption that all of the  
12 Company's general rate cases in its six-state service territory follow the same  
13 commitments that were made in Wyoming, which is inaccurate. The Company  
14 can have general rate cases across its six-state service territory at varying time  
15 intervals, and each case would have different base periods, different test periods,  
16 and different rate base treatments. In this way, WIEC's hypothetical analysis is  
17 grossly oversimplified and misleading.

18 **Q. Are there any other inaccuracies in WIEC's rate recovery analysis?**

19 A. Yes. WIEC fails to apply the same principles consistently among an SCR  
20 investment scenario and to a potential gas conversion scenario – completely  
21 ignoring differences in all capital and net power cost elements between these two  
22 potential alternatives over time.

1 **Q. Did the Company update its treatment of revenue requirement for SCR costs**  
2 **in its updated analysis?**

3 A. No. The system wide modeling of major investments by the Company such as the  
4 SCRs required at Jim Bridger Units 3 and 4 is based on the assumption that there  
5 is no regulatory lag. In other words, the individual commitments made in rate  
6 cases regarding the timing of rate cases, test period dates, forecast versus average  
7 rate base and other regulatory details are not taken into account for system  
8 modeling purposes. Such an approach is the only practical means to study  
9 individual investment decisions considering that the alternative would require an  
10 assessment of how every individual investment decision being contemplated by  
11 the Company at any point in time might affect general rate case filings over time  
12 across the Company's six-state service territory.

13 **Updated Base Case Results**

14 **Q. How has the base case PVRR(d) result changed with the updated**  
15 **assumptions that were applied in the SO Model?**

16 A. As originally described in my direct testimony, the base case developed off of the  
17 December 2011 OFPC produced a PVRR(d) that was [REDACTED] favorable to  
18 the SCR investment required at Jim Bridger Units 3 and 4. The updated base case  
19 that has been developed off of the September 2012 OFPC, and that incorporates  
20 corrections and assumption updates as I described above, produces a PVRR(d)  
21 that is [REDACTED] favorable to the SCR investment required at Jim Bridger  
22 Units 3 and 4.

1 **Q. With the updated assumptions, did the SO Model continue to select gas**  
 2 **conversion as the next best, albeit higher cost, alternative to the SCR**  
 3 **investments at Jim Bridger Units 3 and 4?**

4 A. Yes.

5 **Q. Please explain how the updated assumptions contribute to the change in base**  
 6 **case PVRR(d) results.**

7 A. Confidential Table 1R below summarizes how the corrections and assumption  
 8 updates applied in the base case analysis affect the base case PVRR(d) results as  
 9 compared to what was summarized in my direct testimony. The table shows that  
 10 after accounting for the correction to mine capital and SCR costs reported in the  
 11 original two-unit operation case, updated natural gas price assumptions, and  
 12 updated coal cost assumptions are most influential to the change in PVRR(d)  
 13 results.

<b>Confidential Table 1R</b>		
<b>Change in Base Case PVRR(d) (Benefit)/Cost of SCRs</b>		
<b>\$ Million</b>		
<b>Description of Update/Correction</b>	<b>Incremental Change in PVRR(d)</b>	<b>Accumulated Change in PVRR(d)</b>
Original Base Case in CPCN (December 2011 OFPC)	n/a	██████
Correction to Mine Capital/SCR Costs	██████	██████
Correction to Wyodak capacity, application of Gadsby & Currant Creek Must Run	██████	██████
Update to September 2012 OFPC	██████	██████
Updated Coal Cost & Bridger Coal Mine Capital	██████	██████
Updated Load Forecast	██████	██████
Mine Reclamation Fund Contributions beyond 2030	██	██████

1 **Q. Please explain why the updated forward price curve assumptions make the**  
2 **PVRR(d) results less favorable to the SCR investments.**

3 A. Nominal levelized natural gas prices at the Opal market hub over the period 2016  
4 through 2030 in the December 2011 OFPC were \$6.18 per mmBtu. Nominal  
5 levelized natural gas prices at the Opal market hub from the September 2012  
6 OFPC over the same term are \$5.72 per mmBtu, which is approximately eight  
7 percent below levelized prices from December 2011. The assumed price for  
8 natural gas directly affects the cost for a gas-fueled replacement alternative, which  
9 is directionally favorable to gas conversion as an alternative to the SCR  
10 investments. Natural gas prices are also a key factor in setting wholesale power  
11 prices. As gas prices fall, the market value of energy is reduced. In this way, gas  
12 prices disproportionately affect the value of energy net of operating costs from  
13 Jim Bridger Units 3 and 4 when operating as coal-fueled resources versus the  
14 value of reduced energy output net of operating costs from a gas conversion  
15 alternative.

16 **Q. Did you identify in your direct testimony how falling natural gas prices**  
17 **might affect the PVRR(d) of the SCR investments?**

18 A. Yes. Based upon the relationship between natural gas price assumptions and  
19 PVRR(d) results described in my direct testimony, I described that the June 2012  
20 OFPC would erode the base case PVRR(d) results favorable to the Jim Bridger  
21 Units 3 and 4 SCR equipment by approximately [REDACTED]. Considering that  
22 natural gas prices from the September 2012 OFPC are slightly higher than the  
23 natural gas prices from the June 2012 OFPC through 2018 and that prices

1 between the two price curves are aligned from 2019 and beyond, the [REDACTED]  
2 incremental impact of updating forward price curve assumptions is consistent  
3 with the estimate in my direct testimony.<sup>5</sup>

4 **Q. Please explain why the updated coal costs make the PVRR(d) results less**  
5 **favorable to the SCR investments.**

6 A. As I discussed earlier in my testimony, cash coal costs were updated consistent  
7 with more current mine plans and reclamation plans for Bridger Coal Company.  
8 The updated average annual cash coal cost assumptions for the continued coal  
9 operation case have increased by approximately 6.6 percent, and the average  
10 annual cash coal costs for Jim Bridger Units 1 and 2 in the Jim Bridger Units 3  
11 and 4 gas conversion case have decreased by approximately 4.3 percent. Higher  
12 cash coal costs in the continued coal operation case and lower cash coal costs in  
13 the gas conversion case reduces the benefits of the SCR investments. Nonetheless,  
14 while the updated PVRR(d) results are directionally less favorable to the SCR  
15 investments, the updated base case analysis continues to support the SCR  
16 investments required at Jim Bridger Units 3 and 4.

17 **Q. WIEC estimates that an updated load forecast would reduce the PVRR(d)**  
18 **results in favor of the Jim Bridger SCRs by [REDACTED]. Have you**  
19 **reviewed WIEC's study?**

20 A. Yes. WIEC's analysis is based on the Company's GRID study that was used in an  
21 avoided cost filing in Utah. To arrive at the estimated PVRR(d) impact, WIEC  
22 calculated the PVRR(d) from a pair of GRID studies that were based upon the

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<sup>5</sup> Nominal levelized prices at the Opal market hub over the period 2016 through 2030 were \$5.65 per mmBtu in the June 2012 OFPC, which is just \$0.07 per mmBtu lower than levelized prices from the September 2012 OFPC.

1 avoided cost filing. In one study, WIEC assumed Jim Bridger Units 3 and 4  
2 continued operating as coal and in the other study, WIEC replaced Jim Bridger  
3 Units 3 and 4 with gas conversion alternatives. WIEC then calculated the  
4 difference between this PVRR(d) result with the PVRR(d) result from the GRID  
5 benchmarking study that I summarized in my direct testimony to arrive at their  
6 [REDACTED] estimate.

7 **Q. How did WIEC arrive at the upper range of their estimate?**

8 A. WIEC testifies that the impact could easily be 50 percent greater and simply  
9 multiplies [REDACTED] by a factor of 1.5 to arrive at the high estimate of [REDACTED]  
10 [REDACTED].

11 **Q. Does WIEC describe or otherwise indicate how they arrived at the 50 percent  
12 increase used to develop the high range of their estimate?**

13 A. No. The 50 percent increase used in WIEC's analysis is entirely unsupported.

14 **Q. Do you agree with WIEC's estimate?**

15 A. No. WIEC represents that an updated load forecast, and subsequent change in the  
16 resource expansion plan, would erode the PVRR(d) benefits of the SCR  
17 equipment by [REDACTED] to [REDACTED]. Not only is the high end of this  
18 estimate unsupported, the low end of the range has been misinterpreted by WIEC  
19 and is misleading.

20 **Q. Please explain.**

21 A. The Company's avoided cost filing includes not only an updated load forecast and  
22 corresponding resource expansion plan, but it also includes September 2012  
23 OFPC inputs for electricity and natural gas price assumptions. By comparing the

1 PVRR(d) between the two pairs of GRID studies, WIEC's estimate includes the  
2 impact of updating the forward price curve. As I discussed above and as I  
3 estimated in my direct testimony, the updated forward price curve assumptions  
4 are a significant driver to the change in the PVRR(d) results. WIEC presents their  
5 estimated load forecast impact as being driven by an updated load forecast and  
6 subsequent resource expansion plan. This is misleading considering that WIEC's  
7 estimate also includes the effect of updated forward price curve assumptions.

8 **Q. Are there any other problems with WIEC's estimate of the PVRR(d) impact**  
9 **associated with an updated load forecast?**

10 A. Yes. WIEC did not capture in their analysis how the Company's resource  
11 portfolio would be impacted if Jim Bridger Units 3 and 4 were converted to  
12 natural gas. The difference in resource portfolios was reflected in the Company's  
13 GRID benchmark studies described in my direct testimony. Not only does  
14 WIEC's estimate misleadingly include the effect of an updated forward price  
15 curve, it fails to capture how the Company's resource expansion plan would be  
16 affected if Jim Bridger Units 3 and 4 were converted to natural gas.

17 **Q. Did the Company update its base case analysis using GRID?**

18 A. No. The Company's GRID study that I summarized in my direct testimony was  
19 performed in response to parties' concerns raised in the Naughton Unit 3 CPCN  
20 proceeding. The Company does not believe that the GRID model is the  
21 appropriate tool to analyze clean air investments when alternatives to those  
22 investments include gas conversion and early retirement of generating resources.  
23 These alternatives would fundamentally influence the timing and type of new

1 resources in the Company's resource expansion plan, and therefore, impacts to the  
2 resource expansion plan are an important component to the analysis of clean air  
3 investment alternatives.

4 **Q. Do any of the parties in this proceeding criticize the Company's use of the SO**  
5 **Model as applied in this proceeding?**

6 A. Yes. WIEC argues that the SO Model is appropriate in the context of an IRP,  
7 implying that the SO Model is not well suited for the type of clean air investment  
8 analysis that the Company has performed in this proceeding. WIEC identifies that  
9 the primary advantages of the SO Model is that it enables processing of a large  
10 number of scenarios and resource options and that it can be used to develop a  
11 resource expansion plan for a given set of economic conditions. However, WIEC  
12 dismisses these benefits as being unimportant claiming that resources in coal and  
13 gas conversion simulations were nearly identical and have little practical benefit.

14 **Q. How do you respond?**

15 A. The Company's SO Model simulations show changes to the resource portfolio  
16 across the entire simulation period. These changes can include the incremental  
17 need for front office transactions, changes to demand side management resources,  
18 and shifts in the timing and type of new natural gas resources over the study  
19 period. Seemingly small changes in the optimal resource expansion plan can add  
20 up over the study period, and the magnitude of the change in the resource  
21 expansion plan can change among scenarios.



1 **Q. Are there any inconsistencies in WIEC's direct testimony as it pertains to the**  
2 **importance of an optimized expansion plan?**

3 A. Yes. WIEC claims the Company's analysis of the Jim Bridger Units 3 and 4 SCR  
4 investments failed to examine its coal fleet as a whole to determine whether other  
5 units might be candidates for natural gas conversion. WIEC witness Mr.  
6 Falkenberg makes mention of a separate analysis that he has performed in the  
7 concurrent Utah proceeding using the Cumulus model to conclude that the fate of  
8 clean air investments that might be required at other coal units could have a  
9 significant impact on the PVRR(d) results of the Jim Bridger SCR investments.  
10 WIEC's view that changes to the resource expansion plan are not important to the  
11 Jim Bridger SCR analysis is in conflict with Mr. Falkenberg's claim that clean air  
12 investment decisions on other coal units could significantly affect the Jim Bridger  
13 SCR analysis.

14 **Q. Does the Company's base case and scenario analyses allow for early**  
15 **retirement and gas conversion alternatives for other coal units beyond Jim**  
16 **Bridger Units 3 and 4.**

17 A. Yes. The Company's original analysis and updated analysis described herein has  
18 allowed for early retirement and natural gas conversion as potential alternatives to  
19 major clean air investments at other coal units in the fleet. The effects of these  
20 outcomes are included in the PVRR(d) results performed by the Company in  
21 support of this CPCN proceeding, and it is precisely this type of capability that  
22 supports the use of the SO Model. GRID is not capable of producing resource  
23 expansion plans, nor is it capable of determining whether clean air investments at

1 other coal units might lead to additional gas conversion or early retirement  
2 outcomes, as evidenced by WIEC's reference to use of the Cumulus model to  
3 draw their conclusions.

4 **Q. How do other parties in this proceeding view the use of the SO Model as used  
5 by the Company to analyze the Jim Bridger Units 3 and 4 SCR investments?**

6 A. Wyoming Office of Consumer Advocate (OCA) witness Mr. Bryce J. Freeman  
7 discusses the benefits of the SO Model as compared to GRID and concludes that  
8 the GRID model is substantially less suitable for scenario analysis as compared to  
9 the SO Model. Mr. Freeman also accurately notes that GRID does not  
10 endogenously select expansion resources, and concludes that a process to evaluate  
11 the effects of changes to the resource portfolio using GRID would be very  
12 cumbersome in comparison to the SO Model. Sierra Club, while in disagreement  
13 with certain assumptions used by the Company, approves of the Company's  
14 modeling framework as used in this proceeding.

#### 15 **Updated Natural Gas and CO<sub>2</sub> Price Scenario Assumptions**

16 **Q. Has the Company updated its natural gas price and CO<sub>2</sub> price scenario  
17 analysis?**

18 A. Yes. Concurrent with the update to base case forward price curve assumptions as  
19 discussed above, the Company reviewed the range of updated natural gas and CO<sub>2</sub>  
20 price forecasts from third parties to establish updated low and high projections.

21 **Q. Did you use the same approach to establish low and high projections for your  
22 updated analysis?**

23 A. Yes. The fundamental approach of reviewing the range of third party price

1 forecasts in relation to the base case price projections is identical to the approach  
 2 used to develop natural gas and CO<sub>2</sub> price scenarios in the Company's original  
 3 analysis. We simply included in our review more recent third party forecast data.

4 **Q. Did the Company expand the number of natural gas and CO<sub>2</sub> price scenarios**  
 5 **used to evaluate the Jim Bridger Units 3 and 4 SCR investments?**

6 A. Yes. The Company's natural gas price and CO<sub>2</sub> price scenario analysis has been  
 7 expanded to include additional scenarios that pair low natural gas price with low  
 8 CO<sub>2</sub> price assumptions and that pair high natural gas price with high CO<sub>2</sub> price  
 9 assumptions. Table 2R below summarizes the directional changes to base case  
 10 natural gas and CO<sub>2</sub> price assumptions among the nine different scenarios  
 11 included in the updated analysis. Confidential Exhibit RMP\_\_\_(RTL-4R) to my  
 12 rebuttal testimony shows how the low and high price assumptions used in the  
 13 Company's updated scenarios compare to current third party forecasts.

<b>Table 2R</b>		
<b>Natural Gas and CO<sub>2</sub> Price Scenarios</b>		
<b>Description</b>	<b>Natural Gas Prices</b>	<b>CO<sub>2</sub> Prices</b>
Base Case	September 2012 OFPC	\$16/ton in 2022 rising to \$23/ton by 2030
Low Gas, Base CO <sub>2</sub>	Low	\$16/ton in 2022 rising to \$23/ton by 2030
High Gas, Base CO <sub>2</sub>	High	\$16/ton in 2022 rising to \$23/ton by 2030
Base Gas, \$0 CO <sub>2</sub>	Base Case Adjusted for Price Response	No CO <sub>2</sub> Costs
Base Gas, High CO <sub>2</sub>	Base Case Adjusted for Price Response	\$14/ton in 2020 rising to \$65/ton by 2030
Low Gas, High CO <sub>2</sub>	Low Case Adjusted for Price Response	\$14/ton in 2020 rising to \$65/ton by 2030
High Gas, \$0 CO <sub>2</sub>	High Case Adjusted for Price Response	No CO <sub>2</sub> Costs
Low Gas, \$0 CO <sub>2</sub> (New Scenario)	Low Case Adjusted for Price Response	No CO <sub>2</sub> Costs
High Gas, High CO <sub>2</sub> (New Scenario)	High Case Adjusted for Price Response	\$14/ton in 2020 rising to \$65/ton by 2030

1 **Q. How do your updated CO<sub>2</sub> price scenarios compare to those used in your**  
2 **original analysis?**

3 A. As noted earlier, base CO<sub>2</sub> price assumptions begin in 2022 as opposed to 2021.  
4 For the low case, the Company continues to assume that there is no CO<sub>2</sub> price  
5 imputed on emissions. The high case assumes there is a tax on CO<sub>2</sub> emissions  
6 beginning 2020, two years later than in the original high case assumptions and  
7 two years earlier than in the updated base case assumptions. Relative to the  
8 original high case assumptions, CO<sub>2</sub> prices in the updated high case start at a  
9 lower price level, but escalate rapidly through 2025 and reach \$65 per ton by  
10 2030. The change in the high case CO<sub>2</sub> prices better aligns with a current high  
11 price forecast from [REDACTED], a reputable third party source.

12 **Q. How do your updated natural gas price scenarios compare to those used in**  
13 **your original analysis?**

14 A. Consistent with the drop in base case natural gas prices, third party forecasters  
15 have lowered their long-term natural gas price projections, which supports a drop  
16 in the Company's low and high natural gas price assumptions. At base CO<sub>2</sub> price  
17 levels, average annual prices in the low natural gas price forecast and the high  
18 natural gas price forecast are down by 15 percent and 13 percent, respectively,  
19 over the period 2016 through 2030.

20 **Q. Why do you adjust natural gas price assumptions in those scenarios where**  
21 **CO<sub>2</sub> price assumptions vary from the base case?**

22 A. As discussed in my direct testimony, we assume that different levels of CO<sub>2</sub>  
23 prices will affect the demand for natural gas in the electric sector of the U.S.

1 economy and that any change in natural gas demand would be balanced with a  
2 change in supply and subsequent movement in the market price for natural gas. In  
3 effect, we assume that as the intersection of supply and demand for natural gas  
4 changes, the price for natural gas will change accordingly.

5 **Q. Have any of the parties in this case identified concerns with this assumption?**

6 A. Yes. Sierra Club testifies that there is currently no definitive evidence that such a  
7 trend would occur and that it is not appropriate to assume natural gas prices will  
8 increase in the presence of a CO<sub>2</sub> price.

9 **Q. Does the Company only apply upward adjustments to natural gas prices in  
10 response to changes in CO<sub>2</sub> price level?**

11 A. No. The assumed interaction between natural gas prices and CO<sub>2</sub> prices is bi-  
12 directional. That is, the Company not only assumes natural gas prices rise in the  
13 presence of a CO<sub>2</sub> price (or with increased CO<sub>2</sub> price levels), but also incorporates  
14 downward natural gas price pressures when CO<sub>2</sub> prices are removed or lowered.

15 **Q. Is this the first time that the Company has made assumptions regarding the  
16 interaction between natural gas and CO<sub>2</sub> prices?**

17 A. No. The Company has assumed a dynamic interaction between natural gas price  
18 and CO<sub>2</sub> price assumptions in developing market price scenarios for the 2008  
19 IRP, the 2011 IRP, and in developing market price scenarios in the evaluation of  
20 bids submitted into recent all source request for proposals.

21 **Q. Are you aware of other forecasts that account for the interaction between  
22 natural gas prices and CO<sub>2</sub> prices?**

23 A. Yes. The U.S. Energy Information Administration's (EIA) 2012 Annual Energy

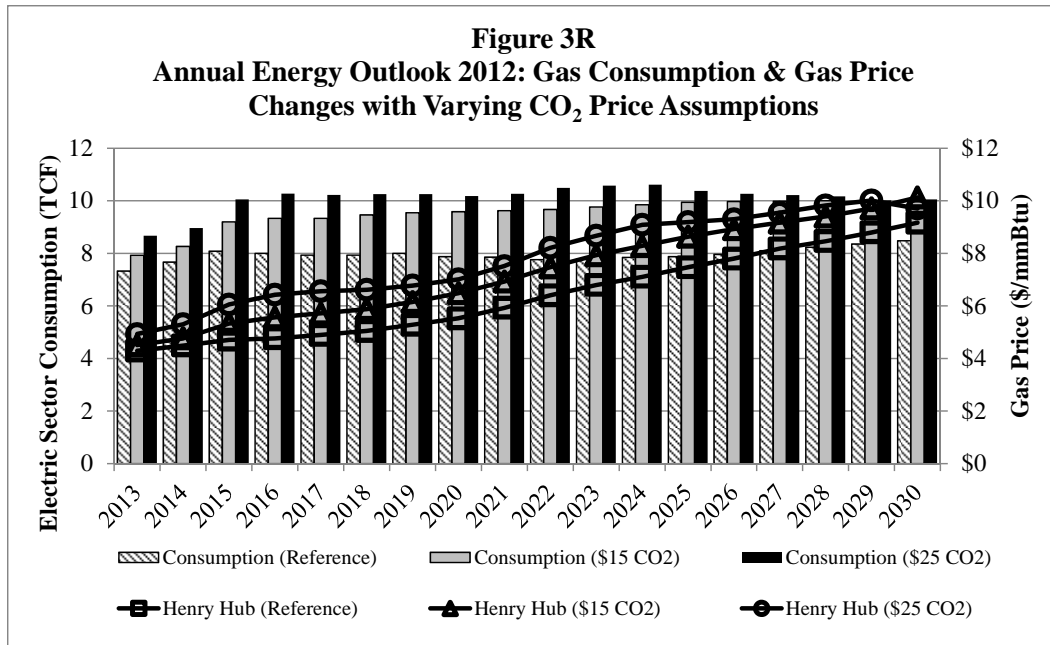
1 Outlook (AEO) includes a reference case Henry Hub natural gas price forecast  
2 and a broad range of forecast scenarios.<sup>6</sup> In one of these scenarios, EIA applies a  
3 \$15 CO<sub>2</sub> emissions fee to the U.S. economy beginning 2013. In another scenario,  
4 EIA applies a \$25 CO<sub>2</sub> emissions fee.<sup>7</sup> Under the AEO reference case and in the  
5 two CO<sub>2</sub> emission fee scenarios, EIA reports natural gas consumption by sector of  
6 the U.S. economy, including a line item for the electric sector, and a forecast of  
7 Henry Hub natural gas prices.

8 Figure 3R below shows EIA's annual electric sector natural gas  
9 consumption and the accompanying Henry Hub natural gas price forecast for the  
10 AEO 2012 reference case and the two CO<sub>2</sub> emission fee scenarios. The left  
11 horizontal axis reports electric sector gas consumption in trillion cubic feet (TCF)  
12 and the right horizontal axis reports nominal Henry Hub natural gas prices. The  
13 figure clearly shows that electric sector natural gas consumption increases from  
14 the reference case when a \$15 CO<sub>2</sub> emissions fee is assumed, and increases  
15 further when a \$25 CO<sub>2</sub> emissions fee is assumed. Moreover, the figure shows  
16 that the presence of a CO<sub>2</sub> emissions fee drives higher natural gas prices  
17 consistent with a rise in natural gas consumption, and that the magnitude of the  
18 impact increases with a higher CO<sub>2</sub> emissions fee assumption.

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<sup>6</sup> The U.S. Energy Information Administration is the statistical and analytical agency within the U.S. Department of Energy.

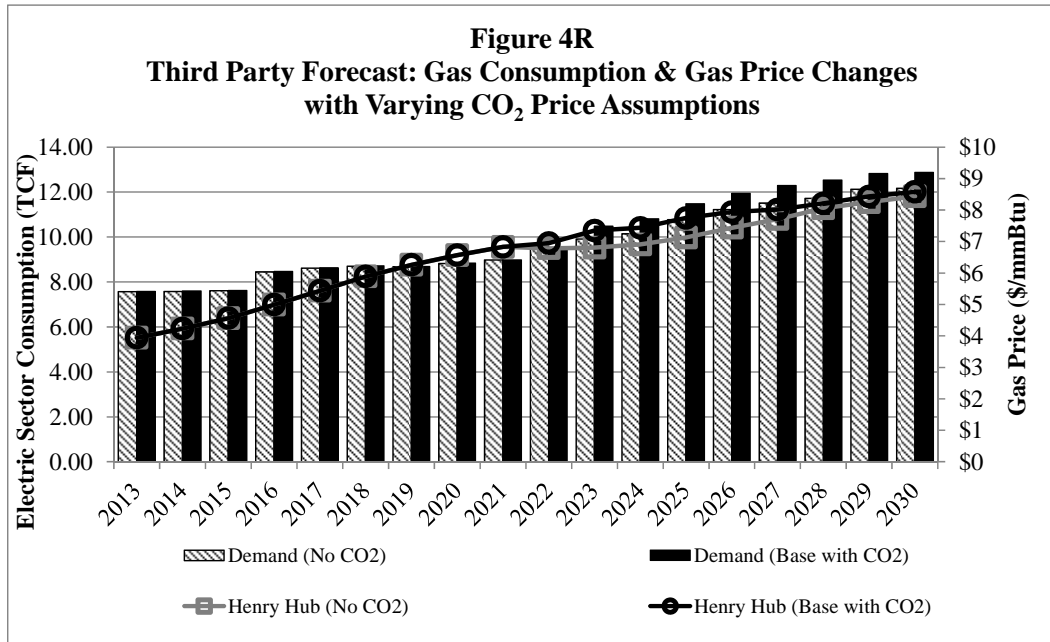
<sup>7</sup> In each CO<sub>2</sub> scenario, prices are assumed to escalate at five percent per year.



1 Q. Do any other third party forecast providers included in your review of  
 2 natural gas and CO<sub>2</sub> price forecasts assume that there is a relationship  
 3 between natural gas and CO<sub>2</sub> prices?

4 A. Yes. [REDACTED] produces a variant to their base case natural gas price  
 5 forecast that removes the CO<sub>2</sub> price assumptions included in their base case  
 6 projection. [REDACTED] assumes in their base case forecast that there is a  
 7 nominal CO<sub>2</sub> price of \$15.59 per ton beginning in 2023 escalating to \$26.77 per  
 8 ton by 2030. Figure R4 below shows [REDACTED] annual electric sector  
 9 natural gas consumption and the accompanying Henry Hub natural gas price  
 10 forecast for their base case forecast inclusive of CO<sub>2</sub> price assumptions and their  
 11 scenario forecast the removes the base case CO<sub>2</sub> price assumptions. When CO<sub>2</sub>  
 12 price assumptions are removed, [REDACTED] forecasts a drop in electric  
 13 sector demand for natural gas and a corresponding drop in natural gas price. This  
 14 interaction between CO<sub>2</sub> price, electric sector demand for natural gas, and natural

1 gas prices is consistent with forecasts produced by EIA in the 2012 AEO and  
 2 consistent with the adjustments the Company applies to natural gas prices in the  
 3 scenarios used to evaluate the SCR investments required for Jim Bridger Units 3  
 4 and 4.



5 **Q. What types of third party CO<sub>2</sub> price forecasts do you evaluate in developing**  
 6 **a reasonable range of CO<sub>2</sub> price trajectories?**

7 A. When reviewing third party CO<sub>2</sub> price forecasts, we focus on recent projections  
 8 from reputable forecast services such as [REDACTED]  
 9 [REDACTED]. As a point of reference, we often compare these forecasts with U.S. EPA’s  
 10 analysis of past policy proposals, focusing on then current baseline projections  
 11 and any CO<sub>2</sub> price ceilings and floors that may have been included in those  
 12 proposals. The intent is to provide context for how current price forecasts that  
 13 take into consideration current market conditions and the current policy



1 landscape, compare with well-known policy proposals that have been debated in  
2 the past.

3 **Q. Have any of the parties to this case suggested the Company review additional**  
4 **CO<sub>2</sub> price forecasts?**

5 A. Yes. Sierra Club describes how Synapse Energy Economics, Inc., the consulting  
6 firm that employs Sierra Club witness Dr. Fisher, has reviewed a wide range of  
7 CO<sub>2</sub> price assumptions used in IRP and utility dockets over the 2009 – 2012  
8 timeframe and further reviewed government and “other” forecasts to arrive at a  
9 range of base, low and high CO<sub>2</sub> price assumptions.<sup>8</sup> Sierra Club suggests that  
10 these data show the Company’s CO<sub>2</sub> price assumptions are too low. Moreover,  
11 Sierra Club testifies that U.S. EPA’s analysis of these past policy proposals  
12 produced a range of CO<sub>2</sub> price trajectories and that a valid mechanism of  
13 evaluating the high and low estimates of a particular bill would be to look at a  
14 range of models and range of scenarios.

15 **Q. How do you respond?**

16 A. As noted earlier, the Company has focused its review on *recent* third party  
17 forecasts. Reviewing price forecasts used by others for planning purposes dating  
18 back to 2009 is not a reasonable means to establish a range of CO<sub>2</sub> price  
19 assumptions that take into consideration current market conditions and policy  
20 developments. Natural gas prices have a significant impact on prospective CO<sub>2</sub>  
21 price levels that would be required to achieve an emissions target. Higher natural  
22 gas prices increase the cost of reducing emissions because it increases the cost of  
23 transitioning away from coal-fired generation to natural gas-fired generation.

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<sup>8</sup> Please refer to the Direct Testimony of Sierra Club witness Dr. Jeremy Fisher at page 14, line 7.

1           Conversely, lower natural gas prices reduce the cost of achieving emission  
2           reductions by reducing the cost of transitioning to natural gas-fired generation,  
3           which is more efficient and produces lower CO<sub>2</sub> emissions. Consequently, the  
4           CO<sub>2</sub> price required to achieve an emissions target is correlated with the price of  
5           natural gas, where, for a given emissions reduction target, high natural gas prices  
6           yield a higher CO<sub>2</sub> price and low natural gas prices yield a lower CO<sub>2</sub> price.  
7           Given long-term forecasts for natural gas prices have dropped significantly since  
8           2009, CO<sub>2</sub> price assumptions developed as much as four years ago are antiquated  
9           and not relevant to current market conditions.

10   **Q.    Is it reasonable to consider the entire range of CO<sub>2</sub> price forecasts developed**  
11   **for past legislative proposals?**

12   A.    No. It is not reasonable to review the range of CO<sub>2</sub> price trajectories developed by  
13   U.S. EPA's analysis of past legislative proposals, which are similarly dated. As I  
14   noted above, the range of CO<sub>2</sub> price assumptions used in the Company's scenario  
15   analysis for this proceeding are derived off of recent projections that would be  
16   aligned with current market conditions. The range is not intended to represent the  
17   range of CO<sub>2</sub> price forecasts developed for a specific piece of legislation that was  
18   not passed by Congress.

#### 19   **Updated Natural Gas and CO<sub>2</sub> Price Scenario Results**

20   **Q.    Please describe the results from the updated natural gas and CO<sub>2</sub> price**  
21   **scenarios.**

22   A.    The natural gas and CO<sub>2</sub> price scenario results show that the investment in SCRs  
23   at Jim Bridger Units 3 and 4 remains favorable to the next best, albeit higher cost

1 natural gas conversion alternative under all base and high natural gas price  
2 scenarios at all assumed CO<sub>2</sub> price levels. In these scenarios, the PVRR(d) ranges  
3 between [REDACTED] favorable to the SCRs (base gas, high CO<sub>2</sub>) and [REDACTED]  
4 favorable to the SCRs (high gas, zero CO<sub>2</sub>). The PVRR(d) results are unfavorable  
5 to the SCRs only in those scenarios where low natural gas prices are assumed.

6 When low natural gas price assumptions are paired with base CO<sub>2</sub> price  
7 assumptions, the nominal levelized price of natural gas at Opal over the period  
8 2016 to 2030 is \$3.70 per mmBtu and the PVRR(d) is [REDACTED] unfavorable  
9 to the SCR investments required at Jim Bridger Units 3 and 4. In the low gas zero  
10 CO<sub>2</sub> scenario, the nominal levelized price of natural gas at Opal is \$3.41 per  
11 mmBtu over the 2016 to 2030 timeframe, and the PVRR(d) is [REDACTED]  
12 unfavorable to the SCRs. When low natural gas prices are paired with high CO<sub>2</sub>  
13 price assumptions, the nominal levelized price at Opal over the period 2016 to  
14 2030 is \$3.78 per mmBtu, and the PVRR(d) is [REDACTED] unfavorable to the  
15 SCRs. The PVRR(d) results from the updated natural gas and CO<sub>2</sub> price scenarios  
16 are summarized alongside the base case results in Confidential Exhibit  
17 RMP\_\_\_(RTL-5R) to my rebuttal testimony.

18 **Q. How do the PVRR(d) results trend among the different updated natural gas**  
19 **price assumptions?**

20 A. As demonstrated in the Company's original analysis, the updated scenario results  
21 show that there is a strong trend between natural gas price assumptions and the  
22 PVRR(d) benefit/cost associated with the incremental pollution control  
23 investments required for continued operation of Jim Bridger Units 3 and 4 as

1 coal-fueled assets. With higher natural gas price assumptions, the incremental  
2 SCR investments become more favorable to the Jim Bridger Units 3 and 4 gas  
3 conversion alternatives. Conversely, lower natural gas prices improve the  
4 PVRR(d) results in favor of the gas conversion alternative. Lower natural gas  
5 prices lower the fuel cost of the gas conversion alternative, lowers the fuel cost of  
6 the other natural gas-fueled system resources that partially offset the generation  
7 lost from the coal-fueled Jim Bridger units, and lowers the opportunity cost of  
8 reduced off system sales when Jim Bridger Units 3 and/or 4 operate as a gas-  
9 fueled generation assets.

10 **Q. Can you infer from this trend how far natural gas prices would need to fall**  
11 **for gas conversion to become favorable to making the incremental**  
12 **environmental investments in Jim Bridger Units 3 and 4?**

13 A. Yes. Confidential Exhibit RMP\_\_\_(RTL-6R) to my rebuttal testimony graphically  
14 displays the updated relationship between the nominal levelized natural gas price  
15 at the Opal market hub over the period 2016 through 2030 and the PVRR(d)  
16 benefit/cost of the incremental investments required for continued coal operation  
17 of Jim Bridger Units 3 and 4. To isolate the effects of CO<sub>2</sub> prices, which as I  
18 described earlier are assumed to elicit a natural gas price response due to changes  
19 in demand for natural gas in the electric sector, the natural gas price relationship  
20 with PVRR(d) results is shown for the natural gas price scenarios in which the  
21 base case CO<sub>2</sub> price assumption is used. Based upon this trend, levelized natural  
22 gas prices over the period 2016 through 2030 would need to decrease by 15

1 percent, from \$5.72 per mmBtu to \$4.86 per mmBtu, to achieve a breakeven  
2 PVRR(d).

3 **Q. Has the Company's natural gas price curve for Opal changed since**  
4 **September 2012?**

5 A. Yes. The nominal levelized natural gas price at Opal from the Company's  
6 December 2012 OFPC is \$5.54 per mmBtu, which is approximately three percent  
7 lower than the updated base case. Based upon the relationship above, the  
8 predicted PVRR(d) with the most recent gas prices would be [REDACTED] and  
9 remain favorable to the SCR investments required at Jim Bridger Units 3 and 4.

10 **Q. What CO<sub>2</sub> price would be required to change the PVRR(d) results in favor of**  
11 **converting Jim Bridger Units 3 and 4 to natural gas?**

12 A. Confidential Exhibit RMP\_\_\_(RTL-7R) to my testimony includes an updated  
13 graphical representation of the relationship between the nominal levelized CO<sub>2</sub>  
14 price over the period 2016 to 2030 and the PVRR(d) benefit/cost of the  
15 incremental investments required for continued coal operation of Jim Bridger  
16 Units 3 and 4. To isolate the effects of fundamental shifts in the natural gas price  
17 assumptions, the CO<sub>2</sub> price relationship with the PVRR(d) results is shown for the  
18 two CO<sub>2</sub> price scenarios that are paired with the same underlying base case  
19 natural gas price assumption. Based upon the trend between PVRR(d) and  
20 nominal levelized CO<sub>2</sub> price assumptions, the levelized CO<sub>2</sub> prices over the  
21 period 2016 through 2030 would need to exceed \$30 per ton, more than three  
22 times the base case nominal levelized CO<sub>2</sub> price assumption, to achieve a  
23 breakeven PVRR(d) for the Jim Bridger Units 3 and 4 SCR investments.

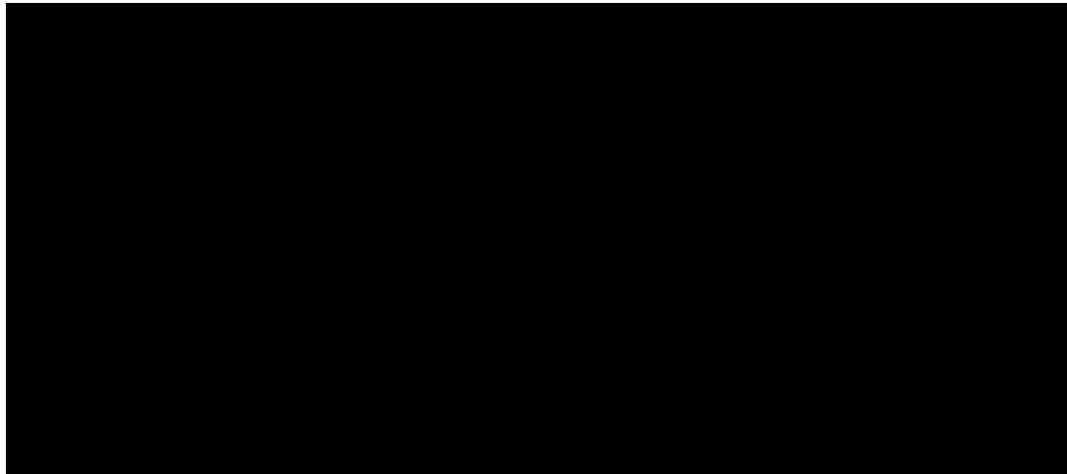
1 **Q. How does the Company use the natural gas and CO<sub>2</sub> price scenario results to**  
2 **inform the Company's decision to pursue the Jim Bridger Units 3 and 4 SCR**  
3 **investments?**

4 A. We first evaluate the magnitude of the PVRR(d) results from the base case, which  
5 is defined by assumptions representing the Company's best estimate of forward  
6 looking assumptions at any given point in time. The base case results provide an  
7 initial look at how favorable or unfavorable the SCR investments are in relation to  
8 the next best alternative and provides useful context when reviewing scenario  
9 results. The updated base case results summarized earlier in my testimony yield a  
10 PVRR(d) that is [REDACTED] favorable to the Jim Bridger Units 3 and 4 SCRs.  
11 This outcome also indicates that when the Company's best estimate of forward  
12 looking assumptions are used, there is a reasonably sized "cushion" in the  
13 PVRR(d) results allowing for some erosion of the favorable economics should  
14 long term natural gas prices or CO<sub>2</sub> prices change from what was assumed in the  
15 base case analysis. The natural gas and CO<sub>2</sub> price scenarios are then used to  
16 quantify how sensitive the PVRR(d) results are to these key assumptions and  
17 provide the foundation for judging risk.

18 **Q. Can you describe how the Company has evaluated risk in the context of the**  
19 **updated results from the natural gas and CO<sub>2</sub> price scenarios?**

20 A. Yes. Confidential Figure 5R below shows the distribution of PVRR(d) results for  
21 the base case and the eight natural gas and CO<sub>2</sub> price scenarios. The figure shows  
22 that of the nine cases analyzed, six scenarios produce a PVRR(d) favorable to the  
23 SCR investments and the three scenarios with low gas price assumptions produce

1 a PVRR(d) that is unfavorable to the SCR investments. The figure further  
2 illustrates the range of potential PVRR(d) outcomes among the scenarios  
3 analyzed. At one end of the spectrum, the PVRR(d) for the high gas zero CO<sub>2</sub>  
4 scenario is [REDACTED] favorable to the SCRs. On the other end of the spectrum,  
5 the PVRR(d) for the low gas high CO<sub>2</sub> scenario is [REDACTED] unfavorable to the  
6 Jim Bridger Units 3 and 4 SCRs. Among the scenarios analyzed, the distribution  
7 of PVRR(d) outcomes indicate a disproportionate risk profile. While there is a  
8 possibility evolution of future natural gas prices could render the decision to  
9 invest in SCRs to be higher cost than a gas conversion alternative, the cost  
10 impacts to customers of such an outcome are higher under a gas conversion  
11 alternative should future natural gas prices rise relative to the base case.

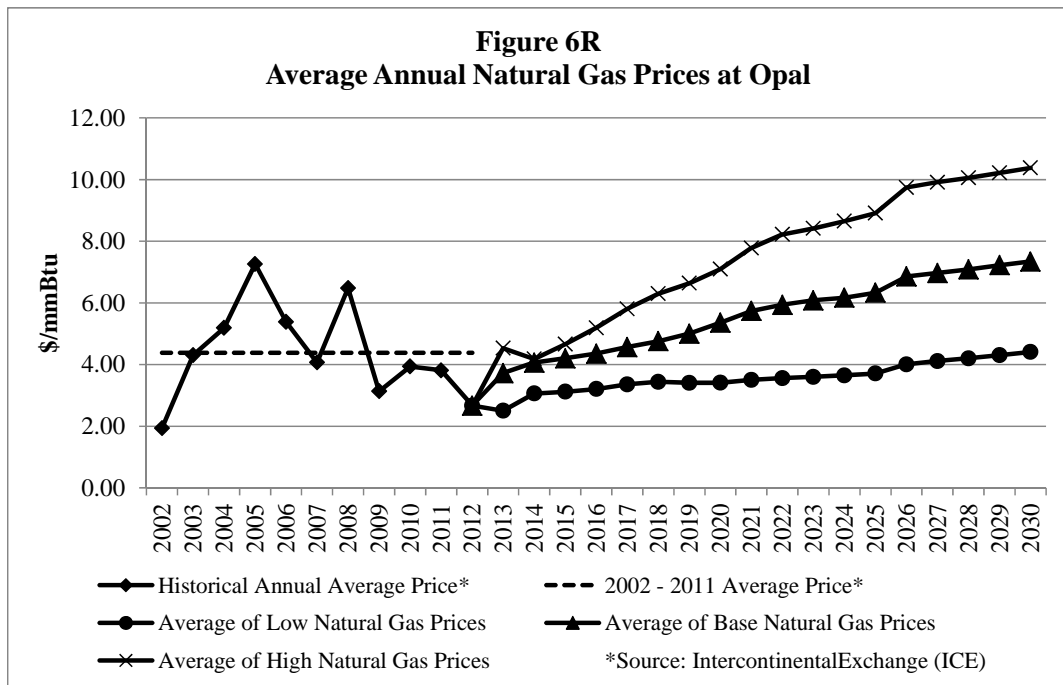


12 **Q. Given the impact of low gas prices on the PVRR(d) results, how have you**  
13 **analyzed the uncertainty around future natural gas prices?**

14 A. A useful metric is to compare the potential range of future natural gas price  
15 scenarios in the context of historical natural gas price levels. Figure 6R below  
16 plots historical natural gas prices alongside the average annual natural gas price at

1 the Opal hub among the three low natural gas price scenarios, the three base  
 2 natural gas price scenarios, and the three high natural gas price scenarios.

3 Opal natural gas prices among the low natural gas price scenarios never  
 4 reach 2002 to 2012 historical average price levels over the course of the next 18  
 5 years. Among the low natural gas price scenarios, the average annual price for  
 6 natural gas at Opal over the period 2013 through 2030 is \$3.59 per mmBtu, which  
 7 is 18 percent below 2002 to 2012 historical price levels. Among the base natural  
 8 gas price scenarios, which are representative of the best estimate of forward  
 9 looking assumptions, the average annual price for Opal natural gas is \$5.66 per  
 10 mmBtu, or 29 percent above 2002 – 2012 historical price levels. Among the high  
 11 natural gas price scenarios, Opal natural gas prices average \$7.60 per mmBtu,  
 12 representing a 73 percent increase relative to 2002 to 2012 historical prices.





1 **Additional Sensitivities**

2 **Q. Were there any other criticisms of the Company's analysis raised by parties**  
3 **in this case?**

4 A. Yes. Sierra Club has taken the position that if Jim Bridger Units 3 and 4 were  
5 retired and replaced with a resource located closer to load centers that the need for  
6 Energy Gateway transmission investments would be alleviated. Consequently,  
7 Sierra Club testifies that deferral of Energy Gateway costs should be considered  
8 as a benefit to an early retirement outcome and that this benefit was not captured  
9 in the Company's analysis. WIEC also raises concerns with the Company's  
10 Energy Gateway transmission assumptions and with Wyoming wind resource  
11 additions that are included in the Company's analysis.

12 **Q. What assumptions for Energy Gateway transmission are included in the**  
13 **Company's analysis?**

14 A. The base case and scenario analyses performed by the Company assume that all  
15 segments of the Energy Gateway project will be implemented, including Gateway  
16 West, which connects Windstar to Populus and Populus to Hemmingway.

17 **Q. Are any of the Energy Gateway transmission segments driven by the decision**  
18 **to install SCR equipment on Jim Bridger Units 3 and 4?**

19 A. No. The decision to install SCR equipment at the Jim Bridger plant is not  
20 influential to the decision-making process for Energy Gateway transmission  
21 investments. Independent of the decision to install SCRs at the Jim Bridger  
22 facility, the Gateway West segment will provide reliability benefits, increase

1 access to low cost generation resources, and allow for a more efficient use of  
2 system resources.

3 **Q. Have any of the parties suggested an alternative to how Energy Gateway**  
4 **assumptions are implemented in the SO Model simulations?**

5 A. Yes. Sierra Club testifies that the Company could use the SO Model to evaluate  
6 avoided transmission investments if Jim Bridger were retired and states:

7 ...the Company could have simply de-activated these extraneous  
8 “transmission options” in the model scenario where Jim Bridger is  
9 retired, and evaluated the total cost without these links.<sup>9</sup>

10 Sierra Club believes that the Energy Gateway investments should be included in  
11 the SO Model simulation where Jim Bridger Units 3 and 4 continue operating as  
12 coal, and removed in an SO Model simulation where Jim Bridger Units 3 and 4  
13 are retired early.

14 **Q. How do you respond?**

15 A. Sierra Club’s recommended approach to model Energy Gateway investments in  
16 the SO Model is fundamentally flawed. At the heart of Sierra Club’s  
17 recommendation is the belief that the only reason for the Gateway West project is  
18 to export energy from Wyoming west to Populus. This is not a valid assumption,  
19 and if this modeling approach were implemented, it would inappropriately assign  
20 *all* of the cost savings associated with removing Energy Gateway investments to  
21 the case where Jim Bridger Units 3 and 4 are assumed to retire early without  
22 accounting for the loss of incremental benefits that the Gateway investments  
23 would provide.

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<sup>9</sup> Please refer to the Direct Testimony of Sierra Club witness Dr. Jeremy Fisher at page 31, line 19.

1 **Q. What types of benefits does the Energy Gateway project provide?**

2 A. PacifiCorp's transmission system is a major component of the Western  
3 Interconnection, and the Energy Gateway project would allow the Company to  
4 more efficiently dispatch system resources, improve performance of the  
5 transmission system (i.e. reduced line losses), improve reliability, and allow the  
6 Company to access a diverse range of new resource alternatives over the long-  
7 term. Moreover, the Energy Gateway project would contribute to meeting the  
8 reliability needs of the region overall. Sierra Club has simply failed to recognize  
9 the breadth of the long-term benefits associated with the Energy Gateway project  
10 in its oversimplified assessment of transmission costs as it pertains to the SCR  
11 equipment being analyzed in this proceeding.

12 **Q. Did WIEC attempt to analyze the impact of Energy Gateway on the SCR  
13 investment decisions at Jim Bridger Units 3 and 4?**

14 A. Yes. WIEC performed a GRID study to evaluate how removal of the Gateway  
15 West and South Segments would impact the PVRR(d) associated with the Jim  
16 Bridger Units 3 and 4 SCR investments.

17 **Q. Did WIEC implement the approach recommended by Sierra Club as you  
18 described above?**

19 A. No. Sierra Club suggests that the different Energy Gateway assumptions should  
20 be applied to the two simulations required to calculate a PVRR(d) – one  
21 simulation where Jim Bridger Units 3 and 4 continue operating as coal-fueled  
22 assets, and one simulation where Jim Bridger Units 3 and 4 are forced to retire  
23 early. WIEC's GRID study removed the Gateway West and South Segments in

1           *both* GRID simulations needed to calculate the PVRR(d) associated with the SCR  
2           equipment.

3   **Q.    What were WIEC’s findings from this analysis?**

4    A.    WIEC found that the Gateway Project does not materially affect the value of Jim  
5           Bridger Units 3 and 4 whether operating as coal- or gas-fueled assets. WIEC  
6           summarizes these findings in its testimony, suggesting that their analysis provides  
7           evidence that the Energy Gateway investments should not be constructed.

8   **Q.    Has the Company included in its CPCN any funds related to the Energy  
9           Gateway project?**

10   A.    No.

11   **Q.    Is the Company seeking pre-approval for any of the Energy Gateway  
12          projects in this proceeding?**

13   A.    No.

14   **Q.    Did WIEC raise any additional concerns with the Company’s analysis  
15          related to long-term planning uncertainties?**

16   A.    Yes. WIEC questions the Company’s assumptions for projected incremental wind  
17          resource additions located in Wyoming that would be used to satisfy known state  
18          and potential federal renewable portfolio standard requirements. In particular,  
19          WIEC questions whether the incremental wind resources assumed to be located in  
20          Wyoming would affect the Company’s analysis of the SCR equipment required at  
21          Jim Bridger Units 3 and 4.

1 **Q. Has the Company performed additional sensitivities in response to parties’**  
2 **concerns on Energy Gateway and wind resource assumptions?**

3 A. Yes. As a variant of the updated base case analysis, the Company performed a  
4 PVRR(d) sensitivity that removes Gateway West and South transmission and all  
5 incremental wind from Wyoming.

6 **Q. What are the results of this sensitivity analysis?**

7 A. As compared to the updated base case, this sensitivity improves the economics of  
8 the continued coal-fueled operation case resulting in a PVRR(d) that is [REDACTED]  
9 [REDACTED] favorable to the Jim Bridger Units 3 and 4 SCR investments. The  
10 sensitivity shows that the Energy Gateway assumptions and Wyoming wind  
11 resource assumptions do not adversely affect base case results supporting the SCR  
12 investments.

13 **Q. Does the Company’s base case and scenario analyses allow for early**  
14 **retirement as an alternative to the SCR investments?**

15 A. Yes. The PVRR(d) is calculated by taking the difference in system costs between  
16 two SO Model simulations. One simulation assumes the SCR investments are  
17 made and Jim Bridger Units 3 and 4 continue operating as coal-fueled assets. The  
18 second simulation forces Jim Bridger Units 3 and 4 to stop operating as coal-  
19 fueled assets, allowing the model to choose among the most economical  
20 alternative to the SCR investments, which includes gas conversion and early  
21 retirement. In all of our simulations, the SO Model chose gas conversion over  
22 early retirement when it is assumed the SCR investments are not made.

1 **Q. Has the Company performed an additional sensitivity that shows gas**  
2 **conversion is a lower cost SCR alternative than early retirement with a**  
3 **replacement resource located closer to load centers?**

4 A. Yes. For this sensitivity, in the case where Jim Bridger Units 3 and 4 stop  
5 operating as coal-fueled assets, we forced each unit to retire (not allowing it to  
6 choose gas conversion) for purposes of calculating the PVRR(d).

7 **Q. What are the results of this sensitivity analysis?**

8 A. When Jim Bridger Units 3 and 4 are forced to retire early the SO Model adds a  
9 597 MW combined cycle unit located in southern Utah in 2017.<sup>10</sup> As compared  
10 to an early retirement alternative, the PVRR(d) is [REDACTED] in favor of the Jim  
11 Bridger Units 3 and 4 SCR investments. The sensitivity also shows that gas  
12 conversion, while unfavorable to the SCR investments, has a PVRR(d) that is  
13 [REDACTED] favorable to early retirement.

14 **Conclusion**

15 **Q. Please summarize the conclusions of your testimony.**

16 A. The conclusions of my testimony are as follows:

- 17 • The updated base case analysis results in a PVRR(d) that is [REDACTED]  
18 [REDACTED] favorable to the Jim Bridger Units 3 and 4 SCR investments  
19 as compared to a gas conversion alternative.
- 20 • Additional sensitivity analysis shows a PVRR(d) that is [REDACTED]  
21 favorable to the Jim Bridger Units 3 and 4 SCR investments as  
22 compared to an early retirement and resource replacement alternative.

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<sup>10</sup>Incremental front office transactions are also included in the portfolio when Jim Bridger Units 3 and 4 are forced to retire early.

- 1                   • Updated natural gas and CO<sub>2</sub> price scenario results continue to support  
2                   the SCR investments, with all scenarios but those with low natural gas  
3                   price assumptions, which do not reach historical price levels for the  
4                   next 18 years, showing a PVRR(d) that favors the installation of SCRs.
- 5                   • The Company's analysis has been updated to correct for errors and to  
6                   reflect current assumptions that do not require manual adjustments to  
7                   SO Model results, better align with assumptions used in net power cost  
8                   filings, and incorporate contributions to the mine reclamation trust  
9                   through 2037.
- 10                  • Additional sensitivity analysis shows that alternative Energy Gateway  
11                  transmission assumptions and Wyoming wind resource assumptions  
12                  improve the PVRR(d) results in favor of the SCR investments.

13   **Q.    What do you recommend?**

14   A.    I recommend that the Commission approve the CPCN based on the information  
15           and analyses presented in the case.

16   **Q.    Does this conclude your rebuttal testimony?**

17   A.    Yes.