**Q. Please state your name, business address and position with PacifiCorp dba Rocky Mountain Power ("Company").**

A. My name is Rick T. Link. My business address is 825 NE Multnomah St., Suite 600, Portland, Oregon 97232. My present position is Director, Structuring & Pricing.

**Q. Please describe your education and business experience.**

A. I received a Bachelor of Science degree in Environmental Science from the Ohio State University in 1996 and a Masters of Environmental Management from Duke University in 1999. I have been employed in the commercial & trading area of PacifiCorp since 2003 where I have held positions in market fundamentals, structuring, and planning. Currently, I direct the work of the market assessment group, the structuring & pricing group, and the integrated resource planning group. Prior to joining the Company, I was an energy and environmental economics consultant for ICF Consulting (now ICF International) from 1999 to 2003.

**Summary**

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

A. The purpose of my testimony is to explain the economic analysis used by the Company to support its Request for Approval (the "Request") related to the selective catalytic reduction ("SCR") investments planned for Jim Bridger Unit 3 and Jim Bridger Unit 4.

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

A. My testimony describes the Company's economic analysis of SCR investments at

Jim Bridger Units 3 and 4 as compared to the alternatives which includes early retirement and resource replacement or conversion to natural gas. Specifically, I will address in my testimony the following:

- Base case results from the System Optimizer model ("SO Model") showing a [redacted] present value revenue requirement differential ("PVRR(d)") favorable to the SCR and other incremental environmental investments required to continue operating Jim Bridger Units 3 and 4 as coal-fueled assets.
- A description of the methodology using the SO Model to analyze the SCR investments required to continue operating Jim Bridger Units 3 and 4 as coal-fueled facilities.
- An overview of why natural gas price and carbon dioxide ("$CO_2$") price assumptions are important to the analysis of the SCR investments required for Jim Bridger Units 3 and 4.
- A summary of third party natural gas and $CO_2$ price forecasts and how these projections were used to develop assumptions for natural gas and $CO_2$ price scenario analysis.
- Natural gas price and $CO_2$ price scenario results showing the SCR and other incremental environmental investments required for Jim Bridger Units 3 and 4 remain favorable under base gas and high gas price assumptions when paired with base case or zero $CO_2$ price assumptions.

**Methodology**

**Q. What methodology did the Company use to evaluate the SCR investments for Jim Bridger Units 3 and 4?**

A. The Company used the SO Model to perform a PVRR(d) financial analysis of the Jim Bridger Unit 3 and 4 SCR investments.

**Q. Please describe the SO Model and how it is used by the Company.**

A. The SO Model is a capacity expansion optimization tool that is used in the Company's integrated resource plan and business planning process to produce resource portfolios in support of long-term planning. The SO Model is also used in the Company's analysis of resource acquisition opportunities and resource procurement activities. It was used to support the successful acquisition of the Chehalis combined cycle plant, to support the selection of the Lake Side 2 combined cycle resource in the most recently completed request for proposals process, and is being used to evaluate bids in the currently issued request for proposals for a 2016 resource as approved by the Public Service Commission of Utah and Oregon Public Utility Commission. The SO Model endogenously considers the tradeoffs between the operating and capital revenue requirement costs of both existing and prospective new resources while simultaneously evaluating the tradeoffs in energy value between existing and prospective new resource alternatives.

**Q. Why is the SO Model an appropriate tool for analyzing incremental environmental investments required for coal resources?**

A. The SO Model is the appropriate modeling tool when evaluating capital investment decisions and alternatives to those investments that might include early retirement and replacement or conversion of assets to natural gas. The SO Model is capable of simultaneously and endogenously evaluating capacity and energy tradeoffs between making incremental investments required to meet emerging environmental regulations and a broad range of alternatives including fuel conversion, early retirement and replacement with greenfield resources, market purchases, demand side management resources, and/or renewable resources. In this way, the SO Model captures the cost implications of prospective investment decisions by evaluating net power cost impacts along with the impacts those decisions might have on future resource acquisition needs, which is particularly important when resource retirement and replacement is considered to be an investment alternative.

**Q. How was the SO Model used to analyze the PVRR(d) of the SCR investments required for Jim Bridger Units 3 and 4?**

A. For a range of market price scenarios, which I will describe later in my testimony, two SO Model simulations were completed – an optimized simulation and a change case simulation. In the optimized simulation, the SO Model determines whether continued operation of Jim Bridger Units 3 and 4 inclusive of incremental SCR and other planned costs required to achieve compliance with emerging environmental regulations is a lower cost solution than avoiding those incremental investments through early retirement and resource replacement or through conversion to natural gas. In the change case simulation, the SO Model is forced to produce a suboptimal decision by not allowing it to make the preferred decision that was made in the optimized simulation.

In the analysis for Jim Bridger Units 3 and 4, when the optimized simulation selected continued operations with incremental SCR and other planned costs, then the change case was created by removing the SCR investment as an alternative, allowing the SO Model to select the next best alternative, which in all scenarios is conversion to natural gas. In scenarios where the optimized simulation selected conversion to natural gas, then the change case forced continued operations with incremental SCR and other planned costs to calculate the PVRR(d) of making the investment. The differences in system costs, inclusive of differences in net power costs, operating costs and capital investment costs, between the two simulations for any given market price scenario represents the PVRR(d), which establishes how favorable or unfavorable the incremental environmental capital investments planned for Jim Bridger Units 3 and 4 are in relation to the next best alternative.

**Q. What incremental environmental investment costs were assumed for Jim Bridger Units 3 and 4?**

A. Incremental environmental investment costs applied in the SO Model include the cost of the SCR required for Jim Bridger Units 3 and 4 along with costs required to achieve compliance with an array of known and prospective emerging environmental regulations. This includes costs to achieve compliance with the U.S. Environmental Protection Agency's mercury and air toxics standard, and costs to achieve compliance with prospective rules on coal combustion residuals and cooling water intake structures. The incremental investment costs assumed in the SO Model for Jim Bridger Units 3 and 4 along with other coal resources in the Company's fleet are summarized in Confidential Exhibit RMP___(RTL-1) to my testimony.

**Q. What resource replacement alternatives were made available to the SO Model in the event SCR investments are not made for Jim Bridger Units 3 and 4?**

A. In addition to brown field natural gas conversion of Jim Bridger Unit 3 and/or Jim Bridger Unit 4, the SO Model was configured with a range of resource replacement alternatives, which include:

- green field natural gas resources,
- firm market purchases,
- demand side management,
- and incremental wind resources.

With the installation of SCR required by December 31, 2015 for Jim Bridger Unit 3 and by December 31, 2016 for Jim Bridger Unit 4, resource retirement and replacement alternatives were assumed to be available beginning January 2016 and January 2017 respectively. Natural gas conversion alternatives were made available beginning March 2016 for Jim Bridger Unit 3 and March 2017 for Jim Bridger Unit 4, assuming coal-fueled operation would continue as long as possible and the work to complete the gas conversion could be accomplished over a two month period.

**Q. Does the Company's SO Model analysis consider the power requirements from the SCR investments required at Jim Bridger Units 3 and 4?**

A. Yes. The SCR equipment, once installed and operational, is assumed to reduce the Company's share of capacity of both Jim Bridger Unit 3 and Unit 4 by approximately 3.5 megawatts.

**Q. Did the Company analyze the PVRR(d) for the SCR investments at Jim Bridger Units 3 and 4 together as well as individually?**

A. Yes.

**Q. Why is it important to evaluate the PVRR(d) of the SCR investments required at Jim Bridger Units 3 and 4 in this way?**

A. The decision to install SCR equipment at Jim Bridger Unit 3 can be made independent of the decision to install SCR equipment at Jim Bridger Unit 4 and vice versa. However, the cost implications, and therefore the PVRR(d), associated with SCR investment decision at each individual unit, are not necessarily additive when looking at both units collectively. By evaluating both the individual and combined investments, this analytical approach ensures that the conclusions drawn from the economic analysis of each individual unit remain unchanged when both units are analyzed together.

**Q. Does the Company's analysis consider how the fueling strategy for the Jim Bridger plant might be affected if one or more of the Jim Bridger units were to stop burning coal?**

A. Yes. The Company's analysis considers how the Jim Bridger fueling plans would be affected in the event that Jim Bridger Unit 3 and/or Jim Bridger Unit 4 were to stop burning coal. These fueling plans include coal production from Bridger Coal Company, coal contract purchases and other coals produced in Southwest Wyoming that could be used to supplement the fuel requirements at the Jim Bridger facility. The change in cost associated with changes to the fueling plans under potential early retirement and replacement or gas conversion outcomes were factored into both the optimized and change case simulation results when formulating the PVRR(d) for each scenario.

For instance, in a simulation where Jim Bridger Unit 3 stops burning coal, either due to early retirement and replacement or due to gas conversion, whether forced or optimized by the SO Model, coal cost and mine capital adjustments were applied assuming a fueling strategy for a three-coal unit operation at the Jim Bridger plant. Similarly, in a simulation where both Jim Bridger Unit 3 and Unit 4 stop burning coal, coal cost and mine capital adjustments were applied consistent with a two-unit fueling strategy for the Jim Bridger plant.

**Q. Did the Company assume coal costs at Jim Bridger are affected by its decision to convert Naughton Unit 3 to natural gas?**

A. No. The economic analysis supporting the Company's decision to convert Naughton Unit 3 to natural gas included potential take-or-pay costs identified in coal supply agreements put in place to fuel the Naughton facility. That analysis assumed minimum coal contract volumes would be taken at Naughton, and approximately one million tons would be delivered to the Jim Bridger plant in 2015 and 2016. Given that the Jim Bridger fueling plan includes market based deliveries with the expiration of a third party coal supply agreement at the end of

2014, any deliveries from Naughton could be used to fill that open position. All costs inclusive of handling and transport above delivered market prices for any shipments from Naughton to Jim Bridger would be charged to the Naughton plant and not affect coal costs at Jim Bridger. Moreover, given the SCR for Jim Bridger Unit 3 must be installed prior to December 31, 2015 and the SCR at Jim Bridger Unit 4 must be installed by December 31, 2016, any deliveries from Naughton to Jim Bridger in 2015 could be made regardless of the SCR investment decision.

**Natural Gas and $CO_2$ Price Scenarios**

**Q. Please explain why natural gas and $CO_2$ price assumptions are important when analyzing the SCR investments at Jim Bridger Units 3 and 4.**

A. Alternatives to the SCR investments include early retirement and resource replacement or conversion of Jim Bridger Unit 3 and/or Jim Bridger Unit 4 to natural gas. Consequently, the assumed price for natural gas directly affects the cost for gas-fueled replacement resources in the case of an early retirement alternative or the fuel cost and replacement energy in the case of a gas conversion alternative. The price for natural gas is also a key factor in setting wholesale power prices. In this way, gas prices disproportionately affect the value of energy net of operating costs from Jim Bridger Units 3 and 4 when operating as a coal-fueled resource versus the value of energy net of operating costs from a gas-fueled resource replacement alternative. Similarly, because of the relatively high level of carbon content in coal as compared to natural gas, higher $CO_2$ prices disproportionately affect the prospective cost of emissions between coal resources and natural gas as an alternative to the incremental investments required to continue operating Jim Bridger Units 3 and 4 as coal-fueled assets.

**Q. Has the Company evaluated different assumptions for natural gas prices and $CO_2$ prices in its analysis of the Jim Bridger Units 3 and 4 SCR investments?**

A. Yes. In the Company's analysis of the SCR investments at Jim Bridger Units 3 and 4, six different combinations of natural gas and $CO_2$ price assumptions were analyzed as variations to the base case, which is tied to the December 2011 official forward price curve ("OFPC"). Table 1 below summarizes the directional changes to base case assumptions among the six scenarios, with the scenario description indicating the $CO_2$ price assumption for the first year that $CO_2$ prices are assumed. Two scenarios assume low and high natural gas prices with base case $CO_2$ assumptions held constant; two scenarios assume low and high $CO_2$ price assumptions with the underlying base case natural gas prices held constant; and two scenarios pair different combinations of natural gas price and $CO_2$ price assumptions to serve as bookends around the base case. In any scenario where the $CO_2$ assumption varies from those used in the base case, the underlying natural gas price assumption is adjusted to account for any natural gas price response from changes in electric sector natural gas demand.

| Table 1<br>Natural Gas and $CO_2$ Price Scenarios | | |
|---|---|---|
| **Description** | **Natural Gas Prices** | **$CO_2$ Prices** |
| Base Case | December 2011 OFPC | $16/ton in 2021, escalating at 3% plus inflation |
| Low Gas, $16 $CO_2$ | Low | $16/ton in 2021, escalating at 3% plus inflation |
| High Gas, $16 $CO_2$ | High | $16/ton in 2021, escalating at 3% plus inflation |
| Base Gas, $0 $CO_2$ | Base Case Adjusted for Price Response | No $CO_2$ Costs |
| Base Gas, $34 $CO_2$ | Base Case Adjusted for Price Response | $34/ton in 2018, escalating at 5% plus inflation |
| Low Gas, $34 $CO_2$ | Low Case Adjusted for Price Response | $34/ton in 2018, escalating at 5% plus inflation |
| High Gas, $0 $CO_2$ | High Case Adjusted for Price Response | No $CO_2$ Costs |

**Q. Why are natural gas price assumptions adjusted in those scenarios where $CO_2$ price assumptions vary from the base case?**

A. $CO_2$ prices disproportionately affect the prospective cost of emissions between coal resources and natural gas alternatives. This is primarily driven by the relatively high level of carbon content in coal as compared to natural gas. With rising $CO_2$ prices, generating resources with lower $CO_2$ emissions, such as natural gas-fueled resources, begin to displace coal-fueled generation, thereby increasing the demand for natural gas within the electric sector of the U.S. economy. Displacement of coal generation is also influenced by low or zero emitting renewable generation sources; however, not enough to entirely offset increased natural gas demand. Conversely, with falling $CO_2$ prices (or a market that is absent $CO_2$ prices), there is no incremental emissions-based cost advantage for natural gas or renewable generation as compared to coal, and demand for natural gas in the electric sector of the U.S. economy is slightly lower. It is assumed that any change in natural gas demand must be balanced with a change in supply such that higher natural gas demand yields an upward movement in price and lower natural gas demand yields a downward movement in price.

**Q. How did the Company choose its natural gas and $CO_2$ price assumptions as used in the six market price scenarios?**

A. The range of low and high price assumptions are based upon the range of current third party expert forecasts and government agency price projections. Confidential Exhibit RMP___(RTL-2) to my testimony shows how the low and high price assumptions used in the Company's analysis compare to these third party forecasts.

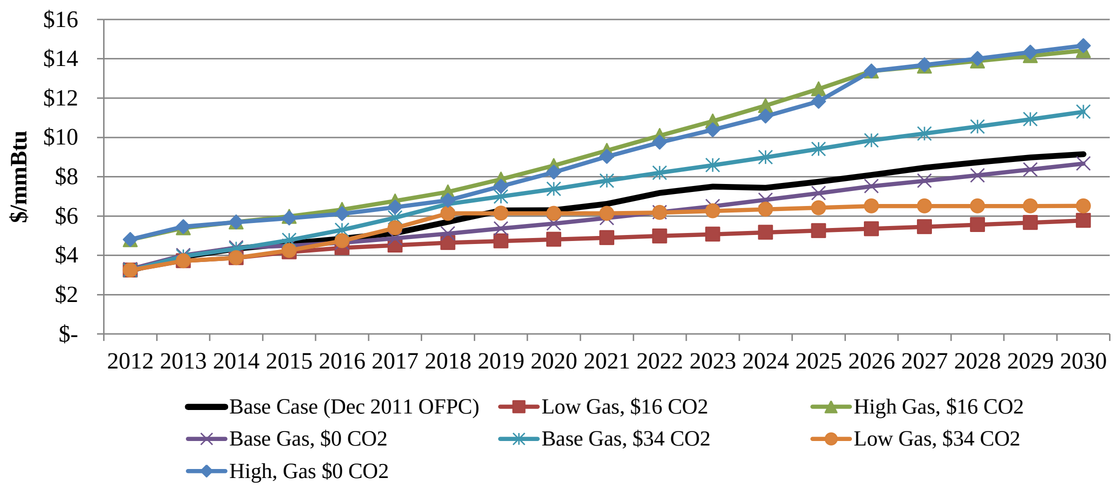
Low natural gas price assumptions are derived from a third party low price scenario, which is characterized by strong and price resilient shale gas supply growth and stagnant exports of liquefied natural gas out of the U.S. natural gas market. The high natural gas price assumptions are based on a blend of two, third-party, price scenarios. This blending approach recognizes that the most extreme high gas price forecast reviewed is a strong outlier relative to price projections from other forecasters, and yields a high price scenario that by 2018 exceeds the highest of 47 natural gas price forecasts in the U.S. Energy Information Administration's 2011 Annual Energy Outlook.[1]

Fundamental drivers to a high price scenario would include constraints or disappointments in shale gas production, linkage to rising oil prices through substantial new demand in the transportation sector, and/or significant increases

[1] The U.S. Energy Information Administration is the statistical and analytical agency within the U.S. Department of Energy. The highest natural gas price forecast in the 2011 Annual Energy Outlook assumes that total unproved technically recoverable shale gas resources are reduced by 49 percent and that the estimated ultimate recovery per shale gas well is 50 percent lower than in their reference case.

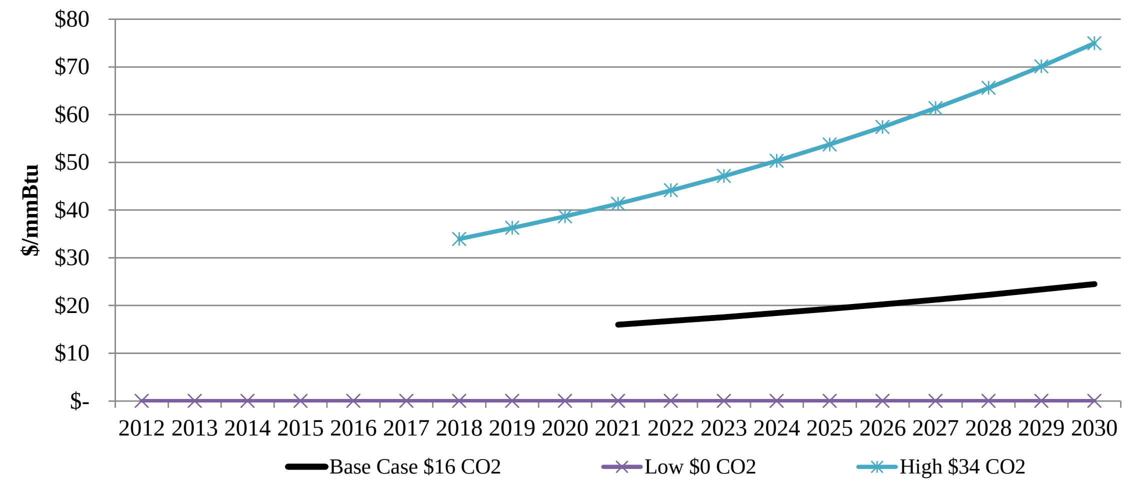
in liquefied natural gas exports out of the U.S. natural gas market. Figure 1 below shows the Henry Hub natural gas price forecast among all market price scenarios included in the analysis of SCR investments at Jim Bridger Units 3 and 4.

**Figure 1**
**Henry Hub Natural Gas Prices among All Scenarios**




The Company assumes a zero $CO_2$ price for the low scenario recognizing that there has been limited activity in the $CO_2$ policy arena, and policy makers remain unwilling or unable to address the greenhouse gas issue over the study period. For the high $CO_2$ price scenario, prices are assumed to remain consistent with the upper limit that would have been established under the American Power Act of 2010 with an assumed start date in 2018, which is higher than any of the current third party $CO_2$ price projections. The high $CO_2$ price scenario start date aligns with the earliest start date assumed by the third party price forecasts reviewed by the Company. Figure 2 below shows the three $CO_2$ price assumptions used in the market price scenarios in the analysis of SCR investments at Jim Bridger Units 3 and 4.

**Figure 2**
**CO2 Prices among All Scenarios**




**Base Case Results**

**Q. Please describe the results from the base case SO Model analysis.**

A. The optimized base case simulation from the SO Model selected the SCR investment at Jim Bridger Unit 3 and Jim Bridger Unit 4. The three change case simulations – one in which Jim Bridger Unit 3 was not allowed to select SCR, one in which Jim Bridger Unit 4 was not allowed to select SCR, and one in which Jim Bridger Units 3 *and* 4 were not allowed to select SCR – shows that gas conversion is the next best, albeit higher cost, alternative to the SCR investment. The PVRR(d) between the optimized simulation, as summarized in Confidential Exhibit RMP___(RTL-3) to my testimony, shows that SCR is:

- [redacted] favorable to gas conversion for Jim Bridger Unit 3,
- [redacted] favorable to gas conversion for Jim Bridger Unit 4, and
- [redacted] favorable to gas conversion for Jim Bridger Units 3 *and* 4.

**Q. Why do the base case results show that SCR at Jim Bridger Unit 3 is more favorable than the SCR at Jim Bridger Unit 4?**

A. This is primarily driven by differences in assumed incremental environmental capital requirements between the two units. As described in Exhibit RMP___(CAT-1) to the testimony of Company witness Mr. Chad A. Teply, there are differences in the flue gas desulfurization system at Jim Bridger Unit 4 that increase the estimated cost for the Jim Bridger Unit 4 SCR as compared to the Jim Bridger Unit 3 SCR. PacifiCorp's share of the cost for the SCR investment at Jim Bridger Unit 4 is approximately [redacted] higher than PacifiCorp's share of the estimated cost for the SCR at Jim Bridger Unit 3. The higher cost of the Jim Bridger Unit 4 SCR improves the upfront investment cost advantage of the gas conversion alternative, which reduced the PVRR(d) benefit of the SCR investment when compared to Jim Bridger Unit 3.

**Q. Why does the PVRR(d) that is favorable to the SCR investments at Jim Bridger Units 3 and 4 when analyzed individually not sum to the PVRR(d) when Jim Bridger Units 3 and 4 are analyzed together?**

A. As discussed earlier in my testimony, the analysis takes into consideration how the fueling plan for the Jim Bridger plant would change if Jim Bridger Unit 3 and/or Unit 4 were to stop burning coal. When analyzed individually, the PVRR(d) results for Jim Bridger Unit 3 and Jim Bridger Unit 4 reflect the cost differential between a three-unit operation and a four-unit operation fueling plan. When analyzed together, the PVRR(d) results for Jim Bridger Unit 3 *and* Jim Bridger Unit 4 reflect changes in cost between a two-unit operation and a four-unit operation fueling plan. The difference in cost between the two fueling plans gets applied to the Jim Bridger units that continue operating as coal-fueled assets.

**Q. How do the fueling plans for a Jim Bridger plant three- and two-unit coal operation differ from the fueling plan for a four-unit operation?**

A. As reflected in Confidential Table 2 below for the 2018 to 2030 period**,** the plant fueling requirements are supplied from Bridger Coal Company's surface and underground mining operations and from third party mines.

Confidential Table 2

| Jim Bridger Plant Fueling Plan | | | |
|---|---|---|---|
| | Annual Production (Millions of tons) | | |
| Production Source | Four Unit | Three Unit | Two Unit |
| Bridger Coal Underground | [redacted] | [redacted] | [redacted] |
| Bridger Coal Surface | [redacted] | [redacted] | [redacted] |
| Third party/Other | [redacted] | [redacted] | [redacted] |
| Total Bridger Plant | [redacted] | [redacted] | [redacted] |

Under a fueling plan for either a three unit or two unit coal operation at the Jim Bridger plant, coal production from the Bridger Coal Company's surface operation ceases and the draglines used to uncover coal are instead dedicated to final reclamation of the surface mine. Under such a scenario, final reclamation would need to be completed by 2021 to achieve Wyoming Department of Environmental Quality requirements. Because funding for final reclamation expenditures is currently amortized and recovered over the life of the surface operation, advancement of final reclamation activities from post 2037, which is

Jim Bridger plant's current depreciable life, to 2021 results in higher final reclamation amortization costs through 2021, which increases coal costs on a dollar per mmBtu basis.

Additionally, to meet the reduced coal requirements in the two-unit operation, production from the Bridger Coal underground operation would be curtailed and third party coal supplies would be terminated.

**Q. Please identify the differences in coal costs between the SCR investments at Jim Bridger Units 3 and 4 when analyzed individually and when Jim Bridger Units 3 and 4 are analyzed together.**

A. The coal costs incorporated in the SCR investment analysis for Jim Bridger Units 3 and 4 on an individual basis and Jim Bridger Units 3 and 4 collectively are included in Confidential Exhibit RMP___(RTL-4). As reflected in the change case simulation where Jim Bridger Unit 3 or Jim Bridger Unit 4 individually convert to natural gas, the 2017 coal cost associated with a three-unit coal operation is approximately [redacted] per mmBtu higher than the coal cost for a four-unit coal operation. This equates to approximately [redacted] in incremental fuel cost for the three Jim Bridger units that continue operating as coal-fueled assets in the year 2017.

In the change case simulation where Jim Bridger Unit 3 and Jim Bridger Unit 4 both convert to natural gas, the 2017 coal cost associated with a two-unit coal operation is approximately [redacted] per mmBtu higher than the coal cost for a four-unit coal operation. This equates to just over [redacted] in incremental fuel costs for the two Jim Bridger units that continue operating as coal-fueled assets.

Due to differences in fuel requirements and coal costs between a three- and two-unit coal operation, simply adding the [redacted] coal cost impact in the case where Jim Bridger Unit 3 converts to natural gas to the [redacted] coal cost impact in the case where Jim Bridger Unit 4 converts to natural gas does not sum to the [redacted] cost impact when both Jim Bridger Unit 3 and Unit 4 are converted to natural gas.

**Q. Did the Company perform a similar base case analysis of environmental upgrades required at its Naughton Unit 3 coal facility?**

A. Yes. The Company performed a similar base case analysis of SCR and bag house investments that would be required to continue operating Naughton Unit 3 as a coal-fueled facility. In contrast to the Jim Bridger Unit 3 and Unit 4 analysis discussed above, this base case analysis produced a PVRR(d) that favored converting Naughton Unit 3 to a natural gas-fueled facility.

**Q. Why would gas conversion be favorable for Naughton Unit 3, but not favorable for Jim Bridger Units 3 and 4?**

A. In the case of Naughton Unit 3, one of the primary drivers favoring gas conversion is the difference between the up-front environmental investment cost that would have been required to continue operating Naughton Unit 3 as a coal fueled facility beyond 2015 as compared to the up-front investment cost for gas conversion. For Naughton Unit 3, the upfront investment cost for gas conversion was approximately [redacted] than the up-front investment cost, inclusive of bag house and SCR costs, required for continued coal operation. In the case of Jim Bridger Units 3 and 4, the upfront investment cost for gas conversion is [redacted] than the up-front investment cost, inclusive of SCR costs, but absent the cost for bag houses, required for continued coal operation. Combined, the up-front investment cost savings for the gas conversion alternative for Jim Bridger Units 3 and 4 is [redacted] of the up-front investment cost savings for gas conversion at Naughton Unit 3.

**Q. How do run-rate capital and ongoing operating cost differences between investment in coal and investment in gas conversion at Naughton Unit 3 compare to run-rate capital and ongoing operating cost tradeoffs in the Jim Bridger Units 3 and 4 analysis?**

A. Given expectations for lower dispatch from coal units that are converted to burn natural gas, annual operating costs and run-rate capital costs for units converted to burn natural gas would be lower than operating costs and run-rate capital costs for coal-fueled facilities. Given differences in the expected operating and run-rate capital costs between Naughton Unit 3 and Jim Bridger Units 3 and 4 as coal-fueled facilities, the Naughton Unit 3 realizes proportionately greater operating and run-rate capital cost benefits when converted to natural gas than would be expected for a gas conversion alternative at Jim Bridger Units 3 and 4.

On a levelized basis, the forecasted annual operating and run-rate capital cost of Naughton Unit 3 as a coal fueled facility is approximately [redacted]. When Naughton Unit 3 converts to natural gas, levelized annual operating and run-rate capital costs are expected to be [redacted], which equates to annual levelized cost savings of approximately [redacted]. In the case of Jim Bridger Units 3 and 4, levelized annual operating and run-rate capital costs expected for continue coal-fueled operation is [redacted]. If converted to natural gas, levelized annual operating and run-rate capital costs for Jim Bridger Units 3 and 4 would be [redacted]. While there would be levelized operating and run-rate capital costs savings for a gas conversion at Jim Bridger Units 3 and 4, equating to approximately [redacted] per year on a levelized basis, the potential cost savings are approximately 21 percent less than the cost savings achieved by converting Naughton Unit 3 to a natural gas-fueled asset.

The SO Model evaluates the cost advantages of gas conversion, and other available resource options, for each of the coal units against the value of system energy, capacity and balancing needs to identify the most economic resource option for the Company. In the case of Naughton Unit 3, the SO Model analysis support gas conversion, whereas, the SO Model analysis supports making the incremental environmental investments required to continue operating Jim Bridger Units 3 and 4 as coal-fueled assets.

**Natural Gas and $CO_2$ Price Scenario Results**

**Q. Please describe the results from the natural gas and $CO_2$ price scenarios in the Company's SO Model analysis.**

A. The optimized simulations from the SO Model selected the SCR investment at Jim Bridger Unit 3 and Jim Bridger Unit 4 in all scenarios except the low gas price and high $CO_2$ price scenarios. In the low gas price scenario, the nominal levelized price of natural gas at Opal over the period 2016 to 2030 is $4.51 per mmBtu and the PVRR(d) is [redacted] to the SCR investments required at Jim Bridger Units 3 and 4. In the high $CO_2$ price scenario, $CO_2$ prices start at $33.94 per ton in 2018 and climb to $74.96 per ton by 2030, and the nominal levelized price of natural gas at Opal over the period 2016 to 2030 is $7.25 per mmBtu. In this high $CO_2$ price scenario, the PVRR(d) is [redacted] to the SCR investments.

The market price scenario results also show that the investment in SCR at Jim Bridger Unit 3 and Jim Bridger Unit 4 remains favorable to gas conversion under all base and high natural gas price scenarios that are paired with either base case $CO_2$ or zero $CO_2$ price assumptions. The PVRR(d) between the optimized simulations and the change case simulations are summarized alongside the base case results in Confidential Exhibit RMP___(RTL-3) to my testimony.

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

A. The market price scenario results show that there is a strong trend between natural gas price assumptions and the PVRR(d) benefit/cost associated with the incremental pollution control investments required for continued operation of Jim Bridger Units 3 and 4 as a coal-fueled assets. With higher natural gas price assumptions, the incremental SCR investments become more favorable to the Jim Bridger Unit 3 and Unit 4 gas conversion alternatives. Conversely, lower natural gas prices improve the PVRR(d) results in favor of the gas conversion alternative. This relationship is intuitive given that lower natural gas prices lower the fuel cost of the gas conversion alternative, lowers the fuel cost of the other natural gas-fueled system resources that partially offset the generation lost from the coal-fueled Jim Bridger units, and lowers the opportunity cost of reduced off system sales when Jim Bridger Units 3 and/or 4 operate as a gas-fueled generation assets.

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

A. Yes. Confidential Exhibit RMP___(RTL-6) to my testimony graphically displays the relationship between the nominal levelized natural gas price at the Opal market hub over the period 2016 through 2030 and the PVRR(d) benefit/cost of the incremental investments required for continued coal operation of Jim Bridger Unit 3, Jim Bridger Unit 4, and Jim Bridger Units 3 and 4 combined. To isolate the effects of $CO_2$ prices, which as I described earlier are assumed to elicit a natural gas price response due to changes in demand for natural gas in the electric sector, the natural gas price relationship with PVRR(d) results is shown for the natural gas price scenarios in which the base case $16 per ton $CO_2$ price assumption is used.

The figures in Confidential Exhibit RMP___(RTL-6) show a very strong linear relationship between the nominal levelized price of Opal natural gas prices and the PVRR(d) benefit/cost of the incremental environmental investments required at Jim Bridger Units 3 and 4. Based upon this trend, levelized natural gas prices over the period 2016 through 2030 would need to decrease by 19 percent, from $6.18 per mmBtu to $4.99 per mmBtu, to achieve a breakeven PVRR(d) for Jim Bridger Unit 3. Break even economics would require levelized gas prices to drop to $5.12 per mmBtu over the period 2016 to 2030, which is more than 17 percent below base case natural gas prices, for Jim Bridger Unit 4. When analyzed together, levelized gas prices would need to fall to $4.99 per mmBtu, or 19 percent below the base case, to achieve a breakeven PVRR(d).

**Q. Has the Company's natural gas price curve for Opal changed since December 2011?**

A. Yes. The nominal levelized natural gas price at Opal from the Company's June 2012 official forward price is $5.65 per mmBtu, which is approximately nine percent lower than the base case. Based upon the relationship above, the predicted PVRR(d) with the most recent gas prices would be [redacted] and remain favorable to the SCR investments required at Jim Bridger Units 3 and 4.

**Q. How do the PVRR(d) results trend among the different $CO_2$ price assumptions?**

A. Higher $CO_2$ price assumptions improve the PVRR(d) in favor of the gas conversion alternative, and lower $CO_2$ prices improve the economics of the investments required to continue operating Jim Bridger Units 3 and 4 as coal-fueled assets. As with the trend described in the relationship between natural gas prices and the PVRR(d) results, the relationship between $CO_2$ prices and the PVRR(d) benefit/cost of the incremental environmental investments at Jim Bridger Units 3 and 4 is intuitive. Because the $CO_2$ content of coal is nearly double the $CO_2$ content of natural gas, higher $CO_2$ prices reduces the cost of emissions for the gas conversion alternative and lowers the fuel cost of other natural gas-fueled system resources used to offset any generation lost from the coal-fueled Jim Bridger Units 3 and 4 assets.

**Q. What $CO_2$ price is required to change the PVRR(d) results in favor of converting Jim Bridger Units 3 and 4 to natural gas?**

A. Confidential Exhibit RMP___(RTL-7) to my testimony includes a graphical representation of the relationship between the nominal levelized $CO_2$ price over the period 2016 to 2030 and the PVRR(d) benefit/cost of the incremental investments required for continued coal operation of Jim Bridger Units 3 and 4. To isolate the effects of fundamental shifts in the natural gas price assumptions, the $CO_2$ price relationship with the PVRR(d) results is shown for the two $CO_2$ price scenarios that are paired with the same underlying base case natural gas price assumption.

The figure in Confidential Exhibit RMP___(RTL-7) shows a strong relationship between the nominal levelized $CO_2$ price and the PVRR(d) benefit/cost of the incremental environmental investments required at Jim Bridger Units 3 and 4. The relationship is not as linear as the relationship between natural gas prices and the PVRR(d) results because of the natural gas price response that is assumed when $CO_2$ price assumptions are changed. For instance, the PVRR(d) results from the base gas $0 $CO_2$ scenario reflect the removal of $CO_2$ costs, which directionally favors investment in coal, and a nine percent reduction in natural gas prices, which directionally favors the gas conversion alternative to the investment in coal. Similarly, the base gas $34 $CO_2$ scenario results reflect higher $CO_2$ prices that occur sooner relative to the base case, which favors the gas conversion alternative, and a 16 percent increase in natural gas prices, which directionally favors the incremental investments required for Jim Bridger Units 3 and 4 to continue operating as coal-fueled facilities. Nonetheless, the trends in the figure indicate that among the scenarios studied, the effect of the $CO_2$ price assumption tends to outweigh the effect of the natural gas price response.

Based upon the trends shown in the figures within Confidential Exhibit RMP___(RTL-7), levelized $CO_2$ prices over the period 2016 through 2030 would need to exceed $35 per ton, more than three times the base case nominal levelized $CO_2$ price assumption, to achieve a breakeven PVRR(d) for Jim Bridger Unit 3 SCR investment. Break even economics would require a levelized $CO_2$ price of $34 per ton over the period 2016 to 2030, which is 220 percent higher than base case $CO_2$ prices, for Jim Bridger Unit 4 SCR investment. When the SCR investments for both Jim Bridger Unit 3 and Unit 4 are analyzed together, nominal levelized $CO_2$ prices would need to be in excess of $36 per ton, or 239 percent above the base case, to achieve a breakeven PVRR(d).

**Q. Please describe the results from the remaining two scenarios included in the Company's scenario analysis.**

A. Two additional scenarios were included in the Company's analysis to see how combinations of natural gas price and $CO_2$ price assumptions that have amplifying upside and downside effects would affect the PVRR(d) results. These two scenarios include the low gas $34 $CO_2$ price scenario, where both the natural gas price assumptions and the $CO_2$ price assumptions directionally favor alternatives to incremental investment in coal, and the high gas zero $CO_2$ price scenario, where both the natural gas price assumptions and the $CO_2$ price assumptions favor the incremental investments required at Jim Bridger Units 3 and 4 for continued coal-fueled operation. In effect, these two scenarios establish the more extreme combinations of assumptions that serve as bookends to those assumptions used in the base case analysis.

When low natural gas prices are paired with high $CO_2$ price assumptions, the PVRR(d) is [redacted] favorable to the gas conversion alternative at Jim Bridger Unit 3, [redacted] favorable to the gas conversion alternative at Jim Bridger Unit 4, and [redacted] favorable to the gas conversion alternatives at Jim Bridger Units 3 *and* 4 when analyzed together. When high natural gas prices are paired with zero $CO_2$ price assumptions, the PVRR(d) is [redacted] favorable to making the incremental SCR and other planned environmental investments at Jim Bridger Unit 3, [redacted] favorable to the incremental environmental investments required for Jim Bridger Unit 4, and [redacted] favorable to the incremental environmental investments at Jim Bridger Units 3 *and* 4 when analyzed together. The difference in the PVRR(d) between these two scenarios is greater than [redacted] dollars when Jim Bridger Unit 3 and 4 are analyzed together, highlighting the significance of the natural gas price and $CO_2$ price assumptions in the analysis.

**Conclusions**

**Q. What do you conclude from the results of the Company's analysis?**

A. The base case results show a PVRR(d) of [redacted] favorable to the SCR and other environmental investments required to continue operating Jim Bridger Units 3 and 4 as coal-fueled assets when compared to a gas conversion alternative. Additional scenario analysis, including a broad range of natural gas price and

$CO_2$ price assumptions further support the base case results except when levelized $CO_2$ prices are more than three times those assumed in the base case and/or when long-term natural gas prices are assumed to fall by more than 19 percent below the base case forecast or nearly 12 percent below the most recent forward curve. Under the low gas scenario, long-term natural gas prices at the Opal market hub remain well below $5 per mmBtu through 2030, a scenario that would require continued strong and price resilient shale gas supply growth and stagnant exports of liquefied natural gas and/or limited growth in demand for natural gas across the U.S. economy. With consideration given to all of the scenarios, accounting for both upside and downside natural gas and $CO_2$ price risk, the SCR investment required to continue operating Jim Bridger Units 3 and 4 as coal-fueled assets is in customers best interest.

**Q. Does this conclude your direct testimony?**

A. Yes.