BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO

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IN THE MATTER OF THE APPLICATION OF PUBLIC SERVICE COMPANY OF COLORADO FOR APPROVAL OF THE 600 MW RUSH CREEK WIND PROJECT PURSUANT TO RULE 3660(H), A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR THE RUSH CREEK WIND FARM, AND A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR THE 345 KV RUSH CREEK TO MISSILE SITE GENERATION TIE TRANSMISSION LINE AND ASSOCIATED FINDINGS OF NOISE AND MAGNETIC FIELD REASONABLENESS.	)	**PROCEEDING NO. 16A-0117E**

DIRECT TESTIMONY AND ATTACHMENTS OF JAMES F. HILL

ON

BEHALF OF

PUBLIC SERVICE COMPANY OF COLORADO

May 13, 2016

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO**

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IN THE MATTER OF THE APPLICATION OF PUBLIC SERVICE COMPANY OF COLORADO FOR APPROVAL OF THE 600 MW RUSH CREEK WIND PROJECT PURSUANT TO RULE 3660(H), A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR THE RUSH CREEK WIND FARM, AND A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR THE 345 KV RUSH CREEK TO MISSILE SITE GENERATION TIE TRANSMISSION LINE AND ASSOCIATED FINDINGS OF NOISE AND MAGNETIC FIELD REASONABLENESS.	**) PROCEEDING NO. 16A-0117E**

<u>SUMMARY OF THE DIRECT TESTIMONY OF JAMES F. HILL</u>

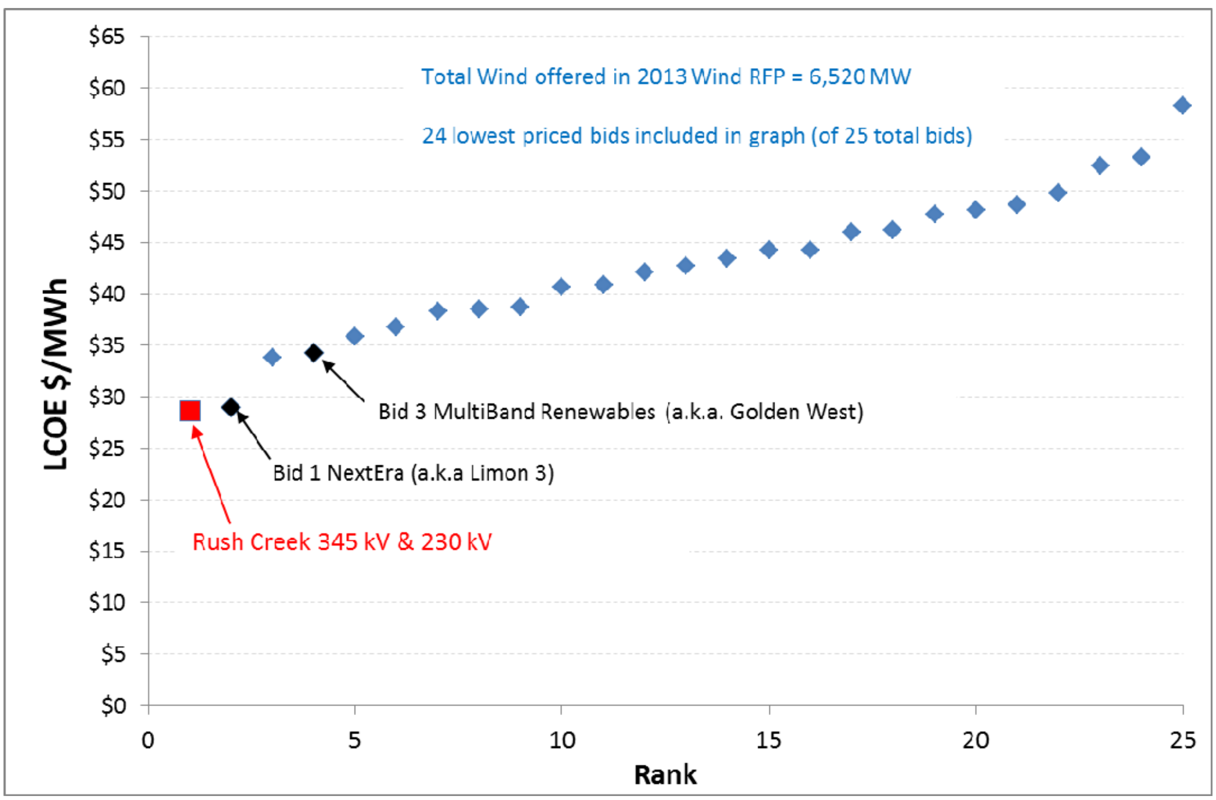
Mr. Hill is Director, Resource Planning of Xcel Energy Services Inc. In his Direct Testimony Mr. Hill presents an economic evaluation of the Rush Creek Wind Project from two different perspectives: (1) the <u>cost-reasonableness</u> of the Project on a net present value cost of energy, also called levelized cost of energy (LCOE), basis, and (2) the <u>cost-effectiveness</u> of the Project on a present value of revenue requirements (PVRR) basis, which compares the costs and benefits of the Project over a forty year planning period.

The LCOE for the Rush Creek Wind Project is just under $29.00/MWh. This LCOE value was derived using the Company's detailed cost estimates to construct

the Project, the Company's current cost of capital and discount rate, and the expected level of wind generation from the Project identified by Vaisala. Mr. Hill compared this cost with the bid prices Public Service received from the market in its 2011 and 2013 Wind Requests for Proposals ("RFPs").

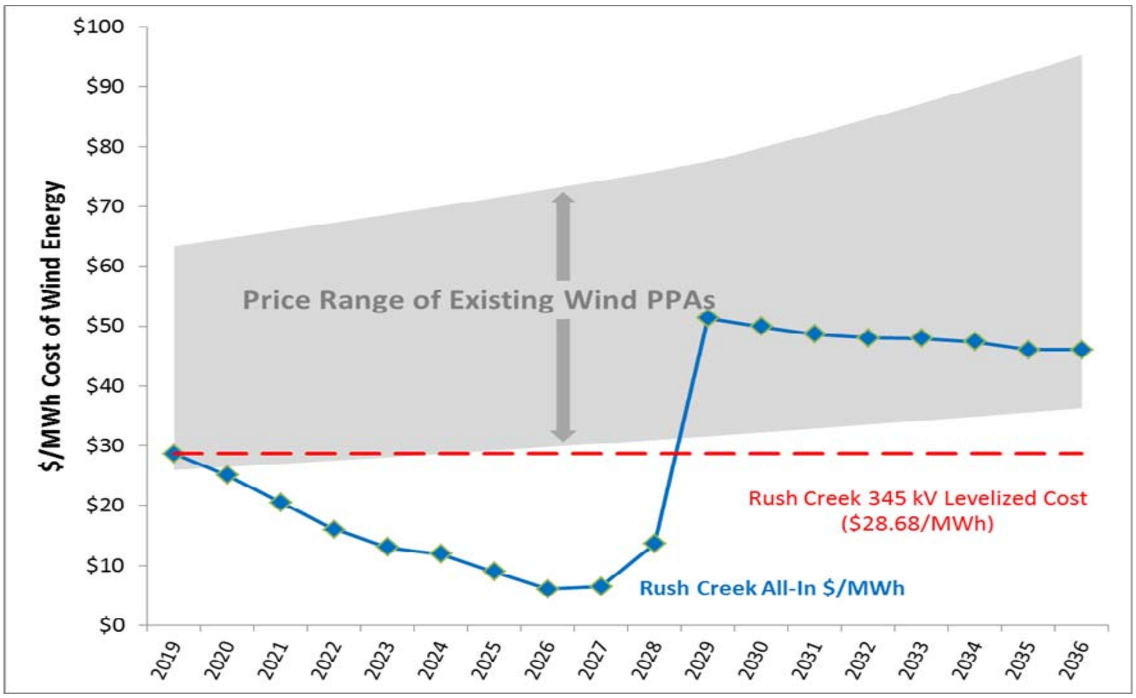
The LCOE for the Rush Creek Wind Project is lower than all of the projects (over 12,000 MW) offered by the market in the last two wind RFPs. The following figure (taken from Figure JFH-1 of Mr. Hill's testimony) shows a LCOE comparison of the Project versus the wind bids from the Company's most recent wind RFP:

2013 Wind RFP LCOE vs Rush Creek Wind LCOE



The annual all-in cost of the Rush Creek Wind Project also compares favorably to the 2,560 MW of existing wind PPAs that Public Service has acquired through Commission approved processes and proceedings, as presented in Figure JFH-3 of Mr. Hill's testimony:

$/MWh Comparison Rush Creek & Existing Wind PPAs



In addition, Mr. Hill performed a cost-effectiveness evaluation that shows the Rush Creek Wind Project results in customer savings of $443 million PVRR. The cost-effectiveness evaluation uses Strategist modeling of all project–related costs (including the full cost of a 345 kV Gen-Tie) and customer savings.

The cost-effectiveness evaluation included examination of customer savings across a range of sensitivities. The following table (taken from Table JFH-9 of Mr.

Hill's testimony) shows a summary of PVRR savings to customers based on varying gas prices, wind production levels, and transmission cost assignment:

Summary of Strategist Sensitivity Analysis

Gas Price	Wind Production[2]	Transmission Cost Assignment	2013 All-Source Portfolio 16	Rush Creek 345 kV Savings (PVRR $M)	Rush Creek 230 kV Savings (PVRR $M)
High	Expected	100%	NA	$744	$729
Base	Expected	100%	NA	$443	$437
Low	Expected	100%	NA	$213	$213
Base	Low	100%	NA	$383	$379
Base	Expected	Pro-Rata	NA	$513	$453
Base[1]	Expected	100%	Yes	$431	NA

Notes:
1) Base gas prices in this sensitivity were those approved for use in the 2013 All-Source
2) NCFs for low wind production sensitivities were 42% and 41% for 345 kV and 230 kV respectively

The cost-effectiveness evaluation also shows that, after taking into account the energy value of lower line losses at a 345 kV voltage level, the proposed 345 kV alternative is slightly less expensive ($6 million PVRR) than the 230 kV alternative.

Lastly, Mr. Hill discusses the interaction of this Application with other proceedings before the Commission, including the 2016 Electric Resource Plan proceeding.

**BEFORE THE PUBLIC UTILITIES COMMISSION
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DIRECT TESTIMONY AND ATTACHMENTS OF JAMES F. HILL

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ATTACHMENT LIST

Attachment JFH-1	Proceeding No. 16A-0138E Attachment A (Modeling Assumptions)
Attachment JFH-2	An Effective Load Carrying Capability Study of Existing and Incremental Wind Generation Resources on the Public Service Company of Colorado System
Attachment JFH-3	Wind and Solar-Induced Coal Plant Cycling and Curtailment Costs on the Public Service Company of Colorado System
Attachment JFH-4	Public Service Company of Colorado 2 GW and 3 GW Wind Integration Cost Study

GLOSSARY OF ACRONYMS AND DEFINED TERMS

Acronym/Defined Term	Meaning
CACJA	Clean Air-Clean Jobs Act
CERA	Cambridge Energy Research Associates
COP	Curtailment Operating Procedure
CPCN	Certificate of Public Convenience and Necessity
ELCC	Effective Load Carrying Capability
ERP	Electric Resource Plan
ERZ	Electric Resource Zone
GPVM	Gas Price Volatility Mitigation
GW	Gigawatt
GWh	Gigawatt hour
IPP	Independent Power Producer(s)
kV	Kilovolt
LCOE	Levelized Cost of Energy
LCI	Load Cummutated Inverter
mmBtu	Million BTU
MW	Megawatt(s)
NCF	Net Capacity Factor
NYMEX	New York Mercantile Exchange
O&M	Operations and Maintenance

Acronym/Defined Term	Meaning
PIRA	PIRA Energy Group
PTC	Production Tax Credit
Public Service or Company	Public Service Company of Colorado
PVRR	Present Value of Revenue Requirements
RFP	Request for Proposal
VOM	Variable Operations and Maintenance
WACC	Weighted Average Cost of Capital
Xcel Energy	Xcel Energy Inc.
XES or Service Company	Xcel Energy Services Inc.

**BEFORE THE PUBLIC UTILITIES COMMISSION
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DIRECT TESTIMONY AND ATTACHMENTS OF JAMES F. HILL

I. INTRODUCTION, QUALIFICATIONS, AND PURPOSE OF TESTIMONY

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. James F. Hill. 1800 Larimer Street, Denver, Colorado 80202.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by Xcel Energy Services Inc. ("XES") as Director, Resource Planning. XES is a wholly-owned subsidiary of Xcel Energy Inc. ("Xcel Energy"), and provides an array of support services to Public Service Company of Colorado ("Public Service" or "Company") and the other utility operating company subsidiaries of Xcel Energy on a coordinated basis.

Q. PLEASE SUMMARIZE YOUR RESPONSIBILITIES AND QUALIFICATIONS.

A. As the Director, Resource Planning, I am responsible for overseeing the Company's resource planning and competitive resource acquisition processes, as well as the various technical analyses of the generation resource options that are available to Xcel Energy's operating companies for meeting customer demand. A description of my qualifications, duties, and responsibilities is included at the end of my testimony.

Q. WHAT IS THE PURPOSE OF YOUR DIRECT TESTIMONY?

A. The primary purpose of my testimony is to describe the Company's economic evaluation of the proposed 600 MW Rush Creek Wind Project. I present this economic evaluation from two different perspectives:

1. The <u>cost-reasonableness</u> of the Project as compared with the cost of other wind projects that were made available to Public Service from the market in prior proceedings. This cost-reasonableness evaluation looks only at the cost of the energy produced by the Project in terms of dollars per megawatt-hour ("$/MWh"). The cost-reasonableness evaluation does not consider how the Project interacts with the rest of the Public Service system and does not attempt to quantify the benefits of the Project to the Company's power supply system (primarily, avoided fuel costs). Cost-reasonableness by itself, while instructive, does not necessarily ensure

that adding the wind project to the Public Service system will prove to be cost-effective, that is, will it result in net costs or savings to our customers.

2. The cost-effectiveness of the Project, which requires a more rigorous Strategist modeling analysis of the Project costs and benefits by incorporating the generation of the proposed wind farm into the dispatch of the entire Public Service power supply system. This evaluation looks at both the costs and benefits of the Project, including avoided fuel costs, to determine whether adding the Project will it result in overall costs, or savings, to customers.

I also address the interaction between this proceeding and the 2016 ERP proceeding including a discussion on how the Company will incorporate/coordinate a decision in this proceeding into the ERP.

Q. HOW IS THE REMAINDER OF YOUR TESTIMONY STRUCTURED?

A. The remainder of my testimony is structured to address four main categories of issues:

1. Rule 3660(h) Filing Summary;
2. The cost-reasonableness of the Rush Creek Wind Project;
3. The use of the Strategist model and the assumptions used in the modeling;
4. The cost-effectiveness of the Project as modeled in Strategist; and
5. The interaction of this application with other proceedings, primarily our 2016 ERP filing, which we will file before June 1, 2016.

I also show, as a preliminary matter, the economic benefits of the Company's proposed 345 kV transmission line into the Missile Site substation over a 230 kV alternative.

II. 3660(h) FILING SUMMARY

Q. PLEASE SUMMARIZE THE COMPANY'S 3660 FILING THAT WAS SUBMITTED TO THE COMMISSION ON MAY 13, 2016?

A. In her Direct Testimony, Company witness Ms. Alice Jackson provides our recommendations regarding the Company's request for the Commission to grant our Application to construct, own, and operate a 600 MW wind generating facility (i.e., the Rush Creek Wind Project) pursuant to Rule 3660(h) of the Commission's Rules Regulating Electric Utilities. As noted by Ms. Jackson, the Application also complies with Commission Rule 3611(e). The Company also requests that the Commission grant a Certificate of Public Convenience and Necessity ("CPCN") for the Rush Creek Wind Project, as well as a CPCN for the proposed 345 kV transmission line that will deliver the electric generation output of Rush Creek to our existing Missile Site substation.

Q. WHAT PRINCIPAL COMMISSION RULES REGARDING THE RUSH CREEK WIND PROJECT COSTS DO YOU ADDRESS IN YOUR TESTIMONY?

A. I address the Company's evaluation and conclusion that the Rush Creek Wind Project will be constructed at a reasonable cost (i.e., its cost-reasonableness) in accordance with Rule 3660(h). I also show that the Company's cost-effectiveness evaluation of the Rush Creek Wind Project demonstrates that it is a cost-effective resource for customers, and therefore has a reasonable cost relative to customer benefits and is in the public interest.

Q. MS. JACKSON IDENTIFIES THAT THE PROJECT COULD UTILIZE EITHER A 345 KV OR 230 KV TRANSMISSION LINE TO DELIVER ITS ELECTRIC OUTPUT TO CUSTOMERS. DID YOU EVALUATE THE PROJECT ECONOMICS UNDER BOTH OF THESE TRANSMISSION LINE VOLTAGE ALTERNATIVES?

A. Yes. I evaluated both the cost-reasonableness and cost-effectiveness of the Project for both the proposed 345 kV transmission line and a 230 kV alternative. Table JFH-1 summarizes the key parameters of the Project with a 345 kV versus a 230 kV transmission line. Table JFH-1 labels the 600 MW Rush Creek Wind Project that utilizes the proposed 345 kV transmission line as “Rush Creek 345 kV,” and the alternative that utilizes a 230 kV transmission line as “Rush Creek 230 kV”.

Table JFH-1 Rush Creek Wind Project Parameters

Parameter	Rush Creek 345kV	Rush Creek 230kV
Transmission line Capital Cost ($M)	$121	$90
Wind Project Capital Cost ($M)	$915	$915
Total Project Capital Cost ($M)	$1,036	$1,005
Level of PTC Eligibility	100%	100%
Wind Project Nameplate Rating (MW)	600	600
Expected Annual Generation (GWh)(1)	2,293	2,241
Net Capacity Factor (1)	43.6%	42.6%
Levelized Cost of Energy ($/MWh)(1)	$28.68	$28.65
PVRR Savings to Customers ($M)[2]	$443	$437

Notes:
(1) Based on energy delivered to Missile Site Substation
(2) As modeled in Strategist using Base Case assumptions and a 2016-2054 planning period consistent with the 2016 ERP

Q. DID YOUR EVALUATION OF THE RUSH CREEK WIND PROJECT SHOW A MATERIAL DIFFERENCE BETWEEN THE 345 KV AND 230 KV ALTERNATIVES?

A. No. Both the cost-reasonableness and cost-effectiveness evaluations show that customers would be essentially economically neutral to either the 345 kV or the 230 kV alternatives, but over the 25-year life cycle of the Project, the 345 kV alternative is expected to provide increased net customer benefits. The cost-reasonableness evaluation, on a $/MWh Levelized Cost of Energy ("LCOE") basis, shows the proposed 345 kV alternative costs slightly more

($0.03/MWh) than the 230 kV alternative. However, the cost-effectiveness evaluation, which takes into account the energy value of lower line losses with 345 kV, shows that the proposed 345 kV alternative is slightly less expensive ($6 million PVRR[1]) for customers over the planning period. In addition to these energy related customer benefits, there are additional benefits that would come with the 345 kV alternative that are not reflected in Strategist, such as the future opportunity to interconnect additional generation capacity to the 345 kV line, and the ability to utilize the 345 kV line as a network resource in the larger interconnected transmission system. These additional benefits are discussed in the testimonies of Company witness Ms. Betty Mirzayi. It is for these reasons that the Company recommends the 345 kV alternative over the 230 kV alternative.

[1] Unless otherwise noted, when discussing Strategist modeled PVRR savings of the Rush Creek Wind Project, the timeframe over which the PVRR is calculated is the 40 year planning period (2016-2054) to align with that of the 2016 ERP and to capture on-going costs of the Rush Creek transmission line into the Missile Site substation.

III. COST-REASONABLENESS OF RUSH CREEK WIND PROJECT

Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?

A. In this section I describe Public Service's evaluation of the cost-reasonableness of the Rush Creek Wind Project. Specifically, I demonstrate that the Project cost, at under $29.00/MWh, is reasonable compared to: 1) the cost of all 12,000 MW of wind projects offered to the Company in our 2011 and 2013 wind RFPs, and 2) the cost of all 2,560 MW of existing wind power purchase agreements ("PPA") on the Public Service system.

Q. HOW DID YOU ASSESS WHETHER THE RUSH CREEK WIND PROJECT CAN BE CONSTRUCTED AT A REASONABLE COST?

A. I assessed the cost-reasonableness of the Rush Creek Wind Project (both the 345 kV and 230 kV alternatives) using two different approaches: 1) through a $/MWh LCOE comparison with wind generating facilities that were offered to Public Service from the market in response to our last two wind request for proposals ("RFPs"), and 2) through a comparison of the annual $/MWh cost of the Project with the annual $/MWh pricing of the existing 2,560 MW of wind PPAs currently operating on the Company's system.

Q. WHY DID YOU FOCUS YOUR COST-REASONABLENESS COMPARISON ON WIND PROJECTS THAT WERE PREVIOUSLY OFFERED TO PUBLIC SERVICE IN AN RFP?

A. The LCOE for a wind project is largely dependent on three factors:

1. the cost of the wind facility (construction cost);

2. the cost to deliver the wind energy to the Public Service system (transmission cost); and,
3. the amount of energy the wind project generates.

As a result, the LCOE of a wind project is specific to the location of the project and its proximity to the Public Service transmission system where the electric energy will be delivered and consumed. It would not be appropriate, for example, to compare the LCOE from a wind project in Texas with a wind project being considered for the Public Service system without including all of the costs and operational requirements to move that Texas wind energy to the Company's transmission system in Colorado. As a result, it is only appropriate to compare the LCOE of the Rush Creek Wind Project with the LCOE of wind projects that are situated to deliver their wind energy directly to the Public Service transmission system. The recent Public Service RFPs for wind provide the best data we have representing the market cost of wind resources delivered to the Public Service transmission system.

Q. WHEN DID THE LAST TWO WIND RFP PROCESSES TAKE PLACE?

A. The most recent wind RFP was part of the 2013 Phase II competitive acquisition issued in early 2013 and approved by the Commission[2] in December 2013. The next most recent wind RFP was issued in early 2011. The results of these two wind RFPs were filed with the Commission in

[2] See Decision No. C13-1566 in Proceeding No. 11A-869E.

Proceeding Nos. 11A-869E and 10A-905E, respectively. I will refer to these RFPs herein as the 2013 Wind RFP and 2011 Wind RFP.

Q. DID THE COMPANY SEE A SIGNIFICANT DIFFERENCE IN WIND BID PRICING BETWEEN THE 2011 AND 2013 RFPS?

A. No. The lowest cost ~1,200-2,000 MW of wind bids from the 2013 Wind RFP averaged about $2/MWh lower than those from the 2011 Wind RFP, or about 5% lower. I don't consider a 5% drop as a significant decrease in pricing between the last two wind RFPs conducted by the Company. This comparison excludes the Limon 3 bid, which I consider an outlier.

Q. WHY DO YOU CONSIDER THE LIMON 3 BID AN OUTLIER?

A. Limon 3 was a 200 MW expansion of the 400 MW Limon wind facility. Phase 1 and Phase 2 of the Limon facility were each about 200 MW and offered LCOE pricing of $35.11/MWh and $34.75/MWh respectively, a difference of about $0.36/MWh or about 1%. It seems likely that the developer of the Limon facility recovered most of the cost of the 345 kV radial line from the Limon wind facility to the Missile Site Substation in the pricing of the 400 MW of Limon 1 and Limon 2, thereby allowing the third phase Limon 3 expansion facility to be less encumbered by the costs of the radial line. Limon 3 was offered to Public Service at a LCOE of $29/MWh, 17% below that of Limon 1 and 2, and lower than any other wind bid from both the 2011 and 2013 Wind RFPs.

Q. PLEASE EXPLAIN WHAT THE LCOE REPRESENTS AND WHY IT IS APPROPRIATE TO USE AS A METRIC TO COMPARE THE COST OF THE RUSH CREEK WIND PROJECT TO THE COSTS OF PROJECTS OFFERED FROM THE MARKET?

A. The LCOE for a generating facility is a single $/MWh metric that represents the net present value cost of the energy generated from the facility. LCOE incorporates all costs over a generating facility's lifetime, including: initial investment, operations and maintenance, cost of fuel, cost of capital, the expected energy production from the project, the time value of those costs, and production levels. The Commission has accepted the appropriateness of using LCOE when analyzing and comparing bids of the same generation technology (i.e., wind vs. wind, or gas vs. gas) in a Phase II ERP proceeding. See Decision No. C09-1257 in Proceeding No. 07A-447E. Further, the Commission found it appropriate to utilize the Company's after-tax weighted average cost of capital ("WACC") at the time of the proceeding in discounting the costs and generation of the projects over their expected lifetime.

Q. CAN YOU PROVIDE AN EXAMPLE OF HOW LCOE IS CALCULATED FOR A WIND PROJECT?

A. Yes. Table JFH-2 contains a simplified example of how a LCOE would be calculated for two different projects.

Table JFH-2 Example LCOE Calculation (Illustrative)

	Project A		Project B	
Year	Annual Cost ($)	Annual Generation (MWh)	Annual Cost ($)	Annual Generation (MWh)
1	$ 2,500,000	100,000	$ 3,000,000	100,000
2	$ 2,550,058	100,000	$ 3,000,000	100,000
3	$ 2,601,119	100,000	$ 3,000,000	100,000
4	$ 2,653,201	100,000	$ 3,000,000	100,000
5	$ 2,706,327	100,000	$ 3,000,000	100,000
6	$ 2,760,516	100,000	$ 3,000,000	100,000
7	$ 2,815,791	100,000	$ 3,000,000	100,000
8	$ 2,872,172	100,000	$ 3,000,000	100,000
9	$ 2,929,682	100,000	$ 3,000,000	100,000
10	$ 2,988,344	100,000	$ 3,000,000	100,000
11	$ 3,048,180	100,000	$ 3,000,000	100,000
12	$ 3,109,215	100,000	$ 3,000,000	100,000
13	$ 3,171,471	100,000	$ 3,000,000	100,000
14	$ 3,234,975	100,000	$ 3,000,000	100,000
15	$ 3,299,749	100,000	$ 3,000,000	100,000
16	$ 3,365,821	100,000	$ 3,000,000	100,000
17	$ 3,433,216	100,000	$ 3,000,000	100,000
18	$ 3,501,960	100,000	$ 3,000,000	100,000
19	$ 3,572,080	100,000	$ 3,000,000	100,000
20	$ 3,643,605	100,000	$ 3,000,000	100,000
21	$ 3,716,562	100,000	$ 3,000,000	100,000
22	$ 3,790,979	100,000	$ 3,000,000	100,000
23	$ 3,866,887	100,000	$ 3,000,000	100,000
24	$ 3,944,315	100,000	$ 3,000,000	100,000
25	$ 4,023,293	100,000	$ 3,000,000	100,000
Present Value	$ 35,664,698	1,188,823	$ 35,664,698	1,188,823
LCOE($/MWh)	**$30.00**		**$30.00**	
Discount Rate	6.78%	6.78%	6.78%	6.78%

In this example, the Annual Cost ($) values represent the annual cost associated with each project over a 25-year life. These costs could be either the annual payments under a PPA or the annual revenue requirements of an owned project. The Annual Generation (MWh) values represent the annual generation from each project, which is assumed to be constant each year in this example. The LCOE ($/MWh) values are derived by taking the present value of Annual Costs and dividing by the present value of Annual Generation. Present values for both costs and generation are derived in this example using a 6.78% discount rate. In this example, even though the annual costs for each project differ, on a LCOE basis the two projects are economically equivalent.

Q. WHAT IS THE LCOE OF THE RUSH CREEK WIND PROJECT?

A. As identified in Table JFH-1, the LCOE for the Project is just under $29/MWh for both the 345kV and 230kV alternatives. These LCOE values are derived using the Company's detailed cost estimates to construct the Project, the Company's current cost of capital and discount rate, and the expected level of wind generation from the Project identified by 3TIER by Vaisala ("Vaisala")[3]. Later in my testimony I discuss how the LCOE of the Project can be influenced by the assumptions and estimates used in the calculation. For example, using a conservative (lower) level of wind generation than what is expected for the Project results in a LCOE of $30.65/MWh. Even under this conservative view, the Project LCOE remains at the very low end of what we have seen from the market.

Q. WHAT LCOE WIND PRICING WAS OFFERED FROM THE MARKET IN THE 2013 WIND RFP?

A. In response to the 2013 Wind RFP, the Company received bids offering a total of approximately 6,500 MW of wind proposals with LCOE prices ranging from $29/MWh to over $58/MWh. Table JFH-3 includes a summary of the wind bids and their individual LCOE pricing. All of the bid LCOEs reflect the benefit of the PTC and all include transmission related costs to interconnect the Project to the Public Service system. The information in Table JFH-3 was provided publically in accordance with Commission Rule 3613(k).

Table JFH-3 2013 Wind RFP Bid LCOE[4]

No.	Bidder Name	Levelized Cost of Energy ($/MWh)	Technology Type	Nameplate Capacity (MW)	Contract Duration/Useful Life of Asset
1	NextEra	$29.00	Wind	199	25
2	Enbridge	$33.85	Wind	200	25
3	MultiBand Renewables	$34.30	Wind	250	25
4	E.ON Climate and Renewables	$35.83	Wind	250	20
5	E.ON Climate and Renewables	$36.82	Wind	150	20
6	Iberdrola Renewables	$38.28	Wind	87	20
7	Clear Creek Power	$38.53	Wind	99	25
8	Intermountain Wind	$38.76	Wind	250	25
9	TradeWind	$40.71	Wind	250	20
10	Arion Energy	$40.89	Wind	86	25
11	Duke Energy Renewables	$42.14	Wind	200	25
12	Invenergy	$42.69	Wind	60	25
13	EDF Renewable Energy	$43.42	Wind	250	25
14	Wyoming Wind and Power	$44.27	Wind	330	25
15	Wyoming Wind and Power	$44.27	Wind	901	25
16	Wyoming Wind and Power	$45.95	Wind	502	25
17	Wyoming Wind and Power	$46.21	Wind	330	40
18	EDP Renewables	$47.75	Wind	100	25
19	Colorado Highlands Wind	$48.15	Wind	100	20
20	Iberdrola Renewables	$48.69	Wind	75	20
21	EDP Renewables	$49.75	Wind	200	25
22	NextEra	$52.47	Wind	150	25
23	Wyoming Wind and Power	$53.25	Wind	502	40
24	Wyoming Wind and Power	$58.29	Wind	901	25

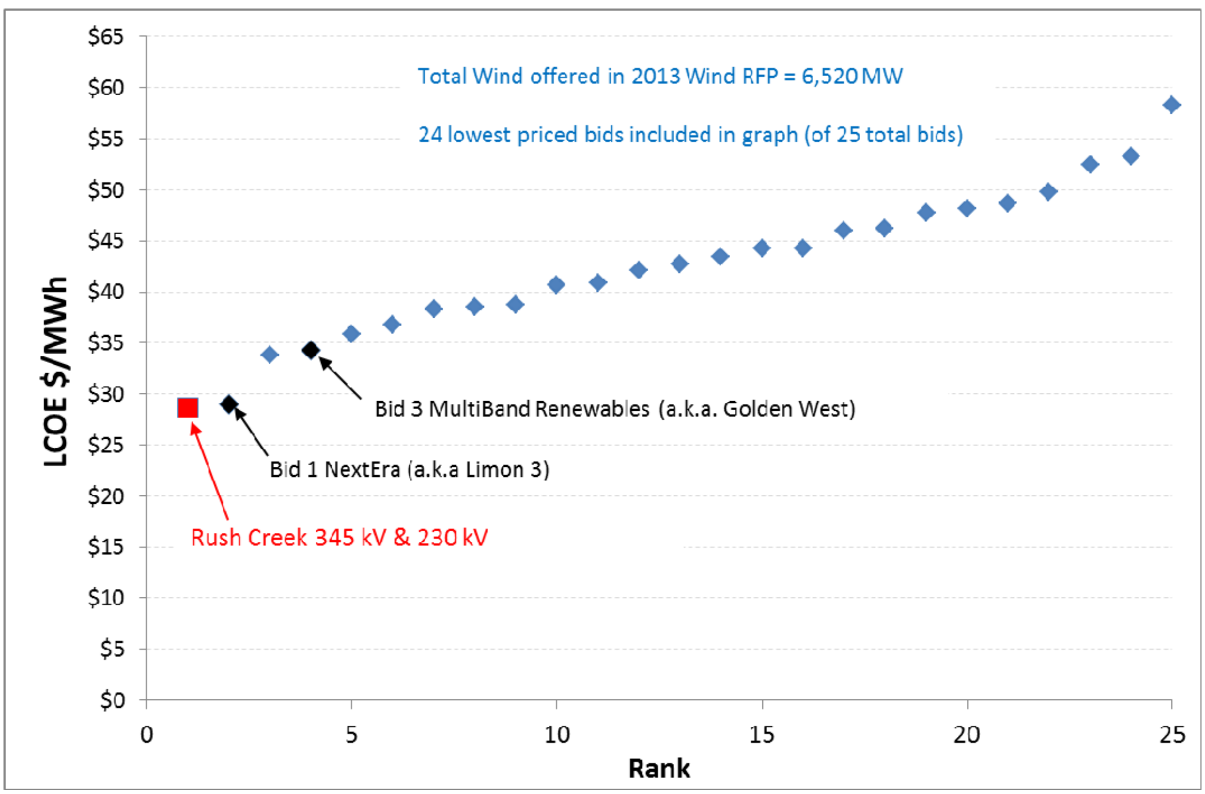
[3] Mr. Matt Hendrickson, an expert witness from Vaisala, discusses the expected level of generation from the Rush Creek Project in his Direct Testimony.

[4] Publicly provided pursuant to Rule 3613(k), at: https://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/3613(k)_Wind_and_Solar(FINAL).pdf.

Q. HOW DOES THE LCOE OF THE RUSH CREEK WIND PROJECT COMPARE WITH THE LCOE OF THE 2013 WIND RFP BIDS?

A. The LCOE of the Project (with either the proposed 345 kV transmission line or the 230 kV alternative) is lower than the LCOE of all of the projects offered by the market in Table JFH-3. Figure JFH-1 provides a graphical illustration of how the Rush Creek Wind Project LCOE compares with the 2013 wind bid LCOEs. The LCOEs of the 345kV and 230kV alternatives are reflected in Figure JFH-1 using a single point that is the average of the $28.68/MWh and $28.65/MWh LCOE values from Table JFH-1.

Figure JFH-1 2013 Wind RFP LCOE vs Rush Creek Wind LCOE



Q. DID THE COMPANY SELECT ANY WIND BIDS FROM THE 2013 WIND RFP THAT RESULTED IN POWER PURCHASE AGREEMENTS?

A. Yes. We selected bids 1 and 3 representing a total of approximately 450 MW (199 MW and 250 MW). Power Purchase Agreements ("PPAs") were executed with these two projects in 2013. The 199 MW project (Bid 1) is the Limon 3 facility discussed earlier. This 199 MW facility began commercial operation in fall 2014 and the 250 MW project (Bid 3) began commercial operation in fall 2015. Bid 2 in Table JFH-3 was not selected due to transmission limitations.

Q. IS IT FAIR TO COMPARE THE LCOE OF WIND BIDS THAT BEGAN COMMERCIAL OPERATION IN 2014 AND 2015 WITH THE LCOE OF THE RUSH CREEK PROJECT, WHICH WILL BEGIN COMMERCIAL OPERATION IN 2018?

A. Yes. While there are a number of variables that may change over time, I believe you can get a fair comparison of projects that are developed and placed in-service within a reasonably close timeframe with one another. The variables that are most influential in this LCOE comparison include the $/MWh of the projects and the time value of money represented by the discount rate. For example, the LCOE calculation for the Rush Creek Wind Project uses a lower discount rate (6.78%) than the discount rates used in the LCOE calculations of the 2011 and 2013 wind bids (7.61% and 7.14% respectively). The 2011 and 2013 wind bid LCOEs would increase if calculated using a lower discount rate. On the other hand, improvements in technology over time could act to decrease the LCOE of the 2011 and 2013 wind bids had those same projects been offered today, although as noted earlier we did not see a significant decrease in RFP bid pricing between 2011 and 2013. Because these variables would tend to offset work against one another, the Company did not attempt to adjust for them in our LCOE comparison.

Q. OF THE REMAINING WIND BIDS FROM THE 2013 WIND RFP, WHAT WAS THE LCOE OF THE NEXT 600 MW OF WIND THAT WAS AVAILABLE FOR SELECTION FROM THAT RFP?

A. After bid 1 and bid 3, the next lowest priced bids that in combination would provide ~ 600 MW from the 2013 Wind RFP would be bids 2, 4, and 5 from Table JFH-3. The combined LCOE for these three bids was $41/MWh[5], approximately 43% higher than the LCOE of the Rush Creek Wind Project.

Q. IN TABLE JFH-3, WERE BIDS 4 AND 5 PROPOSALS TO BUILD WIND FARMS ON THE SAME SITES AS WHERE THE COMPANY IS NOW PROPOSING TO BUILD RUSH CREEK I AND RUSH CREEK II?

A. Yes. Bid 4 in Table JFH-3 proposed to construct a 250 MW wind facility on the same site as the Company's 400 MW Rush Creek I facility, and bid 5 proposed to construct a 150 MW facility on the same site as the Company's 200 MW Rush Creek II facility.

Q. WHAT NCF DID THE DEVELOPER PROPOSE FOR BIDS 4 AND 5, AND HOW DO THOSE NCFS COMPARE WITH THE NCF THE COMPANY IS PROJECTING FOR THE RUSH CREEK PROJECT?

A. Bid 4 proposed a 250 MW facility at the Rush Creek I site at a 49% annual net capacity factor ("NCF"), and bid 5 proposed a 150 MW facility at the Rush Creek II site at a 53% NCF. Public service is using considerably more conservative (lower) NCFs of 42.5% for Rush Creek I and 46.2% for Rush Creek II in our calculation of the Project LCOE[6], as well as in our Strategist modeling of the Project's cost-effectiveness that I will discuss later.

Q. HOW IS THE $/MWH LCOE OF A WIND PROJECT INFLUENCED BY THE NCF USED IN THE LCOE CALCULATION?

A. A higher NCF assumption will produce a lower $/MWh LCOE. For example, if the Rush Creek Wind Project LCOE were to be calculated using the same 49% and 53% NCFs previously proposed by developers for the Rush Creek I and II sites, respectively, the Project LCOE would fall to approximately $22.00/MWh and $21.86/MWh for the 345kV and 230 kV alternatives, respectively.

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[5] The combined LCOE was derived by weighting the individual LCOEs by their respective expected energy generation.

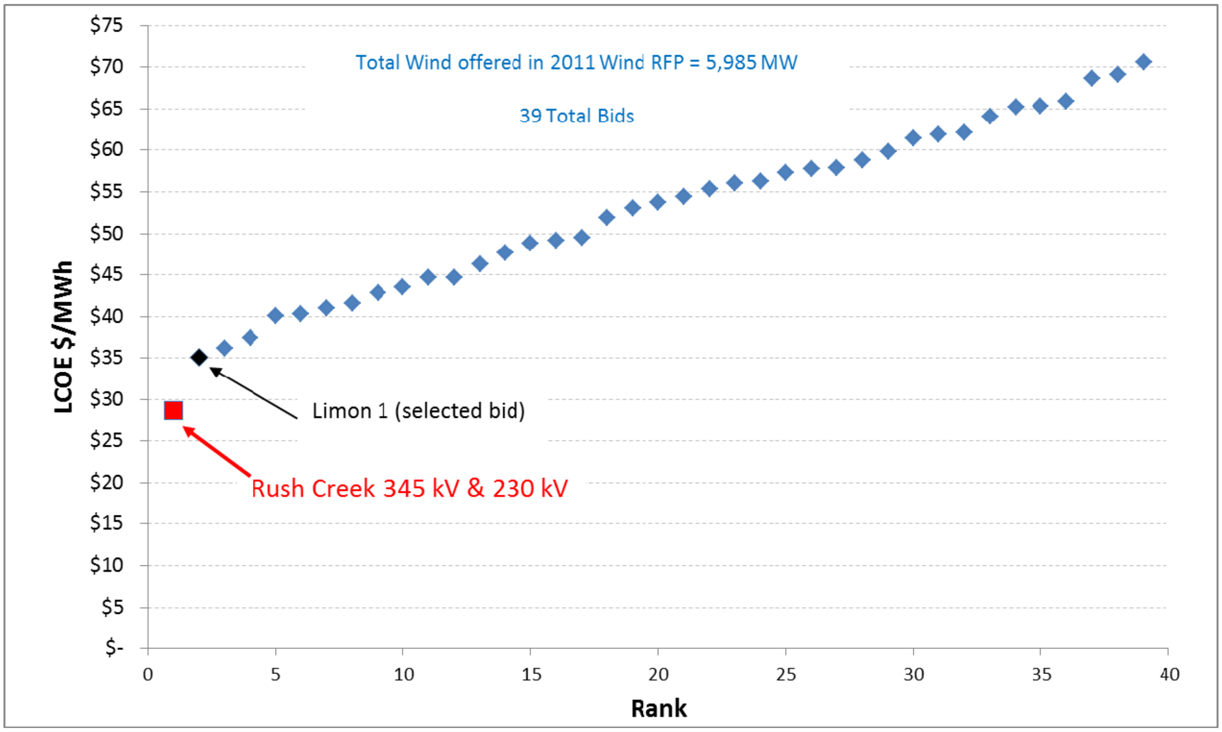
[6] Both of these NCF values reflect line losses between the Rush Creek I and II wind facilities and the Missile Site substation.

Q. WHAT LCOE WIND PRICING WAS OFFERED FROM THE MARKET IN THE 2011 WIND RFP?

A. In response to the 2011 Wind RFP, the Company received bids offering approximately 6,000 MW of wind proposals with LCOE prices ranging from about $35/MWh to over $70/MWh. The LCOE of both the 345 kV and 230 kV Rush Creek Wind Project alternatives are lower than any of the bids offered by the market in the 2011 Wind RFP. Figure JFH-2 provides a graphical illustration of how the Rush Creek Wind Project LCOE compares with the 2011 Wind RFP bid LCOEs. Note that LCOE for the wind bids in Figure JFH-2 are calculated using a 7.609% discount rate while the Rush Creek Wind Project LCOE was calculated with a 6.78% discount rate. The 7.609% rate was approved by the Commission[7] for use in the Company's 2011 ERP. Again, the LCOEs of 345kV and 230kV Rush Creek alternatives are reflected in Figure JFH-2 using a single point that is the average of the $28.68/MWh and $28.65/MWh LCOE values from Table JFH-1.

[7] See Decision No. C13-0094 in Proceeding No. 11A-869E.

Figure JFH-2 2011 Wind RFP LCOE vs Rush Creek LCOE



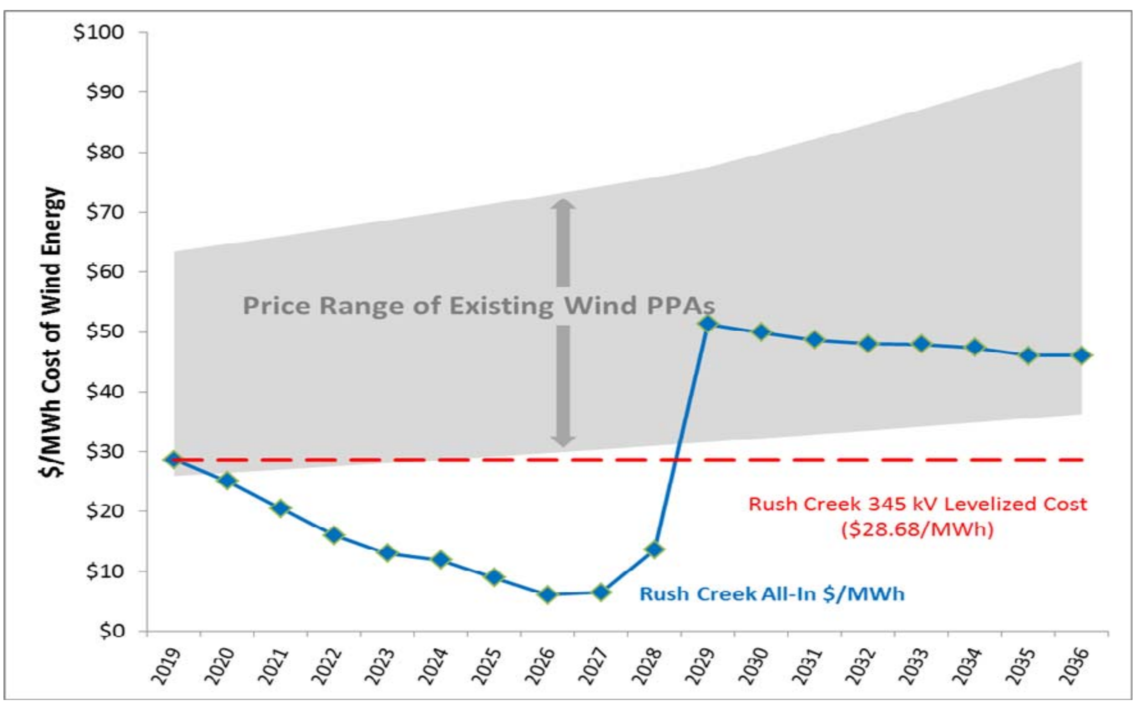
Q. DID THE COMPANY SELECT ANY WIND PPAs FROM THE 2011 WIND RFP?

A. Yes. We selected the 200 MW Limon 1 wind bid which was the lowest cost bid offered from the market in that solicitation. The Company executed a PPA for that facility, and the Limon 1 project has been operating on the Public Service system for several years.

Q. MOVING AWAY FROM LCOE, YOU MENTIONED THAT YOU ALSO COMPARED THE RUSH CREEK WIND PROJECT ON AN <u>ANNUAL</u> COST BASIS WITH PUBLIC SERVICE'S 2,560 MW OF EXISTING WIND POWER PURCHASE AGREEMENTS. PLEASE DISCUSS THIS COMPARISON.

A. For this comparison, we took the stream of annual $/MWh costs for the 345 kV Rush Creek alternative and compared them with the annual $/MWh pricing of the existing 2,560 MW of wind PPAs currently operating on the Public Service system. Figure JFH-3 contains a graphical depiction of this comparison. Figure JFH-3 also shows the LCOE for the Project for comparison purposes.

Figure JFH-3 $/MWh Comparison Rush Creek & Existing Wind PPAs



The pricing of the selected wind bids from both the 2011 and 2013 Wind RFPs from Figures JFH-1 and JFH-2 above are included in the gray shaded area of Figure JFH-3[8].

Q. WHAT DO YOU CONCLUDE FROM YOUR EVALUATION OF THE COST-REASONABLENESS OF THE RUSH CREEK WIND PROJECT?

A. Overall, the LCOE of the Rush Creek Wind Project is shown to be very reasonable in comparison to the LCOE of other wind projects that offered to deliver energy directly to the Public Service transmission system. The Rush Creek Wind Project is being proposed at a cost that is reasonable compared to the costs of: 1) the over 12,000 MW of similar new wind facilities that have been offered to Public Service from the market in recent years, and 2) the 2,560 MW of existing wind PPAs that were acquired through Commission approved processes and proceedings. Furthermore, as shown in the next two sections of my testimony, the cost of the Rush Creek Project is reasonable relative to the net savings that customers will see over the life of the Project across a range of sensitivities.

[8] Also included in the gray area of Figure JFH-3 is the pricing of the Limon 2 PPA, which was acquired in a process outside the 2011 Wind RFP and the 2013 Wind RFP.

IV. STRATEGIST MODEL ASSUMPTIONS AND COST- EFFECTIVENESS EVALUATION

Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?

A. In this section I provide an overview of how the Commission and parties in past proceedings have relied upon the Company's Strategist modeling when considering the costs and benefits of new generation additions to the system. I also describe the basic modeling approach and the assumptions the Company employed to evaluate the cost-effectiveness of the Rush Creek Wind Project in Strategist.

Q. WHY IS THE USE OF STRATEGIST IMPORTANT TO THE EVALUATION OF THE COST-EFFECTIVENESS OF THE RUSH CREEK PROJECT AND, IN EXPLORING THE INTERACTION BETWEEN THIS PROCEEDING AND THE ERP?

A. Strategist is a multifaceted model that allows the Company to evaluate the overall impact of adding generation resources to the existing Public Service power supply system. Not only can Strategist be used to reinforce the LCOE evaluation discussed above, it can be used to represent the longer term costs and benefits of adding more wind generation to the system and how those additions might influence the economics of future resource additions.

Q. HAS THE COMMISSION RELIED ON STRATEGIST MODELING FOR THE PURPOSE OF DETERMINING THE COST-EFFECTIVENESS OF GENERATION RESOURCES IN PAST PROCEEDINGS?

A. Yes, the Commission and parties have a long history of relying on the Company's utilization of the Strategist computer model to evaluate the cost-effectiveness of generation resource options available to the Company to serve the electric needs of our customers. In fact, going back to the 1999 ERP, the Commission has relied on cost-effectiveness analyses using the Strategist model to consider and ultimately approve the Company's acquisition of over 7,600 MW of generation resources[9]. Table JFH-4 summarizes the resources acquired in the prior four ERPs.

Table JFH-4 Generation Acquired in past ERPs (Nameplate MW)

	1999 ERP[10]	2003 ERP[10]	2007 ERP[10]	2011 ERP[10]
Wind	198	775	703	450
Solar			60	170
Gas	1,894	1,477	879	320
Coal		750		
Total	**2,092**	**3,002**	**1,642**	**940**

[9] The 7,600 MW value aggregates the nameplate MW rating of the generation facilities acquired through various ERPs.
[10] 99A-549E, 04A-214E (consolidated with 04A-215E and 04A-216E), 07A-447E, 11A-869E

Q. WHAT IS THE LEVEL OF RENEWABLE RESOURCE INVESTMENT ASSOCIATED WITH THESE PAST ERP ACQUISITIONS?

A. All 2,356 MW of renewable resource acquisitions in Table JFH-4 were procured through PPAs with Independent Power Producers ("IPPs"). The IPPs that develop, construct, and own these renewable resources do not divulge to the Company the level of investment they have in the projects. However, assuming a conservative range of construction costs, $1,800-$2,000/kW for wind and $2,000-$3,000/kW for solar resources[11], I estimate that the Commission has approved the acquisition of roughly $4 to $5 billion dollars of IPP investment in renewable generation additions to the Public Service electric power supply system.

Q. WHAT IS THE RELEVANCE OF THIS $4 TO $5 BILLION INVESTMENT ESTIMATE IN THIS PROCEEDING?

A. I believe it may help the Commission and parties put the Company's request to construct the $1 billion Rush Creek Wind Project into perspective. The fact that past Commissions have relied on the Company's cost-effectiveness analyses using Strategist for purposes of considering, and ultimately approving, the acquisition of approximately $4 to $5 billion of IPP investments in renewable resources should provide assurance that the Strategist analysis presented in this proceeding can also be relied upon for determining the cost-effectiveness of the proposed Rush Creek Wind Project. In short, the use of

Strategist for evaluating generation resource cost-effectiveness is a long-held and accepted practice before the Commission.

Q. PLEASE DESCRIBE THE ASSUMPTIONS USED IN THE STRATEGIST MODEL TO EVALUATE THE COST-EFFECTIVENESS OF THE RUSH CREEK WIND PROJECT.

A. The Company used the same set of assumptions as those that were used in ongoing proceedings pending before the Commission[12]. These assumptions were filed in the Electric Resource Plan Technical Inputs and Assumptions Proceeding (Proceeding No. 16A-0138E) as Attachment A, which is attached to my testimony as Attachment JFH-1. Both the ERP evaluation of alternative plans and the evaluation of the Rush Creek Wind Project incorporate updates to the values for coal cycling costs and for solar integration costs from those contained in Attachment A[13]. The updated values from these two studies do not materially impact the cost-effectiveness evaluation of the Rush Creek Wind Project. The study report containing the updated coal cycling cost values is included as Attachment JFH-3 to my testimony. The study report containing the updated solar integration costs will be filed by June 1. Regarding Wind ELCC, the values contained in Attachment A provided February 29 were used in the evaluation of the Rush Creek Wind Project.

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[11] EIA 2010 and 2013 cite capital cost estimates for onshore wind of $2,438/kW and $2,213/kW respectively and for utility scale solar $4,755/kW and $3,873/kW respectively.

[12] These proceedings are the 2017 RE Plan (16A-0139E), the Electric Resource Plan Technical Inputs and Assumptions (16A-0138E), and the 2016 ERP (expected to be filed on or before June 1, 2016.

The study report supporting those Wind ELCC values however was not available on February 29 when Attachment A was provided. The updated Wind ELCC study report is now available and is included as Attachment JFH-2 to my testimony. Furthermore, in response to Staff's general concerns submitted in Proceeding No. 16A-0138E regarding the Company's 2GW / 3GW Wind Integration study, the Company has decided to update that study. Once the study update is complete (targeting late May) it will be submitted through supplemental testimony in this Rule 3660 application proceeding.

Q. HOW DID THE COMPANY ADDRESS STAFF'S CONCERN REGARDING CURRENT GAS PRICES BEING LOWER THAN THE RANGE OF PRICES USED IN THE 2 GW / 3 GW WIND INTEGRATION STUDY?

A. In the cost-effectiveness evaluation of the Rush Creek Wind Project, we did not allow the wind integration costs modeled in Strategist to fall below $2.93/MWh, which is the integration cost associated with a gas price of $3.24/mmBtu. Establishing this $2.93/MWh floor on integration costs, should address Staff's concern.

Q. WHY IS IT IMPORTANT THAT THE ASSUMPTIONS USED IN EVALUATING THE RUSH CREEK WIND PROJECT BE THE SAME ASSUMPTIONS USED IN OTHER PENDING PROCEEDINGS?

A. It is an issue of consistency. Many of the pending proceedings involve or include estimates of how the addition or avoidance of electric generation

[13] The Company identified that these assumptions could be updated on page 1 of Attachment A in

capacity and or energy on the system might impact customer costs. Using a consistent set of assumptions to estimate customer cost impacts in these ongoing proceedings helps the Commission understand and weigh the various issues in these proceedings within a consistent framework.

Q. OF THE THIRTY-TWO ASSUMPTIONS IDENTIFIED IN PROCEEDING NO. 16A-0138E, ARE SOME MORE IMPACTFUL THAN OTHERS IN INFLUENCING THE COST-EFFECTIVENESS EVALUATION OF THE RUSH CREEK WIND PROJECT?

A. Yes. Other than the cost to construct, interconnect, and operate the Project and the expected generation from the Project, the following assumptions are likely the most influential in the Strategist modeling evaluation of the Projects cost-effectiveness.

1) Natural Gas Price Forecast – The Company's natural gas price forecast is based upon a blend of four different sources, PIRA, CERA, Wood McKenzie and a NYMEX quote. This four source blend methodology has been used in numerous resource plan proceedings and is intended to take into account the different perspectives the market may have relative to the future expectations of natural gas prices. Attachment JFH-1 includes the Company's current natural gas price forecast. The natural gas price forecast is influential in the cost effectiveness evaluation of the wind Project within Strategist due to the interaction between wind generation and natural gas

Proceeding No. 16A-0138E.

generation within the model dispatch of the system generation resources. Because wind is primarily an energy resource[14], the wind generation avoids/displaces energy generation (and the attendant fuel costs) from natural gas-fired and/or coal-fired units. Wind resources on the Public Service system avoid/displace more gas-fired energy than coal-fired energy. As a result, the forecasted price of natural gas is a key driver as to whether new wind resources will show a cost or savings to customers in the evaluation. The gas price forecast also influences the integration cost of wind, since the gas-fired resources shoulder the majority of the integration duty.

2) Wind Integration – Integrating wind resources onto an electric power supply system imparts certain costs to the system. These costs are referred to as wind integration costs. Three categories of wind integration costs were included in the evaluation of the Rush Creek Wind Project:

a) System operation related costs - The results from the Company's August 19, 2011 wind integration study were used to estimate the system operation related costs associated with adding the Rush Creek Wind Project to the system. This category of costs is influenced by the gas price forecast. The Commission approved use of this study in the evaluation of wind bids received in the 2013 Wind RFP discussed earlier in my

[14] Wind resources generally provide generation capacity to the system at about 10% of their nameplate MW rating and yet provide energy to the system at a NCF of about 43%.

b) testimony. This August 2011 study, entitled *"Public Service Company of Colorado 2 GW and 3 GW Wind Integration Cost Study,"* is included as Attachment JFH-4 to my testimony. The study estimates integration costs for approximately 2,000 MW and 3,000 MW of wind generation on the Public Service system. Currently the Company has 2,560 MW of interconnected wind, of which 197 MW are subject to PPAs that expire by early 2019. Excluding this 197 MW, and including the proposed 600 MW Rush Creek Wind Project, the Company will have 2,963 MW of wind resource generation starting in 2019, which is consistent with the MW range studied. System operation related integration costs included in the Rush Creek evaluation range from $2.93/MWh in 2019 to $4.98/MWh in 2044. As noted earlier, in the cost-effectiveness evaluation of the Rush Creek Wind Project, we did not allow the wind integration costs modeled in Strategist to fall below $2.93/MWh which is the integration cost associated with a gas price of $3.24/mmBtu.

c) <u>Coal cycling costs</u>- The results from the Company's "*Wind Induced Coal Plant Cycling Costs and the Implications of Wind Curtailment*" study completed in May 2016 were used in the

Rush Creek Wind Project evaluation[15]. This May 2016 study is an update[16] to the coal cycling study that was previously approved by the Commission for use in the evaluation of wind bids received in the 2013 Wind RFP. This study is included as Attachment JFH-3 to my testimony. Wind induced coal cycling costs included in the Rush Creek evaluation range from $0.97/MWh in 2019 to $0.00/MWh in 2044.

d) Flexible resource costs - As a conservative measure, Public Service included a $3 million cost for additional generation flexibility into the cost-effectiveness evaluation of the Rush Creek Wind Project[17]. This $3 million is an estimate of what it would cost the Company to install another Load Commutated Inverter ("LCI") at our Fort St Vrain Units 5 and 6 combustion turbines. Currently these turbines have a single LCI which requires they be started in series (one first, then the other). Installation of an additional LCI will allow the two turbines to be started simultaneously, thereby providing an additional 145 MW of 30-minute capable flexible generation to the system. Public

[15] In the Strategist modeling of the Rush Creek Wind Project, coal cycling costs were applied to the Project starting 1/1/2019. No coal cycling costs were assigned to the Project for its first three months of operation (Oct, Nov, and Dec 2018). Coal cycling costs for these first three months are estimated to be about $0.5 million in 2016 PV dollars.

[16] The study methodology remained the same, but the modeling inputs were updated.

[17] The $3 million LCI cost was not included in the calculation of LCOE for the Rush Creek Wind Project. This added cost of an LCI for the system was however included in all Strategist modeling of the Project's cost-effectiveness.

Service has budgeted for the installation of this LCI. Company witness Mr. John Welch's Direct Testimony discusses that the Company has sufficient flexible generation resources to reliably manage the addition of the 600 MW Rush Creek Wind Project. Notwithstanding that conclusion, to be conservative in our evaluation, we included the cost of an additional LCI in the Strategist modeling.

The remaining thirty or so assumptions in Attachment A have considerably less influence on the evaluation results. Later in my testimony I test the robustness of the modeling by performing sensitivity analyses on certain assumptions.

Q. ARE THERE OTHER CHARACTERISTICS OF WIND GENERATION THAT CAN IMPACT ITS COST EFFECTIVENESS IN THE STRATEGIST MODELING?

A. Yes. Given that we are not in control of when our wind generators will produce energy, there will be times when we cannot accept all the wind energy being generated and still maintain the real-time balance of load and generation. During these situations, the output of certain wind generators will be reduced or curtailed. There is a cost associated with these curtailments that should be reflected in the cost-effectiveness evaluation.

Q. WERE THE EFFECTS OF INCREASED WIND CURTAILMENTS ACCOUNTED FOR IN THE COST-EFFECTIVENESS EVALUATION OF THE RUSH CREEK WIND PROJECT?

A. Yes, the costs associated with additional wind curtailments that might occur on the Public Service system as a result of adding the Rush Creek Wind Project were included within the Strategist PVRR analysis. There are two general categories of wind curtailment: 1) those associated with generation bottoming issues; and 2) those associated with limitations on the transmission system. Bottoming-related costs are estimated within the Strategist model and therefore are embedded within the model PVRR outputs. Transmission related curtailment costs were evaluated outside Strategist. I discuss both types of wind curtailment costs in Section V of my testimony, below.

V. COST- EFFECTIVENESS EVALUATION AND STRATEGIST RESULTS

Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?

A. In this section of my testimony I describe the basic framework for evaluating the cost-effectiveness of the Rush Creek Wind Project in Strategist, including how the Project costs were represented in the modeling, and how that modeling demonstrates customer savings of $443 million. I discuss how approximately 70% of this $443 million of customer savings is expected to occur in the first 10-years of operation. I also discuss how the cost-effectiveness of the Project can be equated to an equivalent price of natural gas of approximately $3.19/mmBtu.

Q. PLEASE DESCRIBE THE BASIC APPROACH THE COMPANY EMPLOYED TO EVALUATE THE COST-EFFECTIVENESS OF THE PROPOSED RUSH CREEK WIND PROJECT IN STRATEGIST.

A. The Project was evaluated using the same long-standing modeling approaches applied in prior ERPs and the methodologies approved by the Commission in the most recent 2011 ERP. The basic evaluation approach is to estimate the project-related costs and benefits as follows:

Figure JFH-4 Basic Cost-Effectiveness Evaluation Approach

Costs: + Project Revenue Requirements
+ Transmission line Revenue Requirements
+ LCI on Fort St. Vrain[18]
+ Integration costs
+ Wind curtailment costs

Benefits: - Avoided energy (fuel & VOM)
- Avoided capacity

Cost-effectiveness = Cost - Benefits

With the exception of wind curtailment costs, the different project-related costs are inputs to the Strategist model. The Strategist model calculates the curtailment costs and the avoided energy and avoided capacity benefits or savings. A project's cost-effectiveness is derived by taking the present value of the cost less the present value of the benefits over its life. If the present value of costs exceeds that of the benefits, the project will show a net cost to customers. If the present value of benefits exceeds that of costs, the project will show a net savings to customers.

[18] As explained above, this is for what it would cost the Company to install another Load Commutated Inverter (LCI) at our Fort St Vrain Units 5 and 6 combustion turbines to provide additional CT starting capability within 30 minutes.

Q. HOW WAS THE COST TO CONSTRUCT AND OPERATE THE RUSH CREEK WIND PROJECT REPRESENTED IN THE COST-EFFECTIVENESS EVALUATION?

A. The cost to construct and operate the Rush Creek Wind Project was represented by estimates of the life cycle revenue requirements the Company would collect from customers in order to recover the capital cost to construct the Project, plus the ongoing costs to maintain the project over its 25-year life. Company witness Ms. Deborah Blair discusses these estimates in her testimony.

Q. HOW WAS THE COST TO INTERCONNECT THE RUSH CREEK WIND PROJECT TO THE COMPANY'S ELECTRIC TRANSMISSION SYSTEM REPRESENTED IN THE COST-EFFECTIVENESS EVALUATION?

A. The cost to interconnect the Project was represented using estimates of the life cycle revenue requirements for a new 90 mile electric transmission line from the Rush Creek I and II wind generation sites to the Company's Missile Site Substation at both the 345 kV and 230 kV alternatives. Company witnesses Mr. Riley Hill and Ms. Betty Mirzayi describe the Rush Creek Gen-Tie to Missile Site, and Ms. Deborah Blair describes the estimate of revenue requirements associated with the transmission line in her testimony.

Q. WHAT PORTION OF THE NEW TRANSMISSION LINE COST WAS INCLUDED IN THE COST-EFFECTIVENESS EVALUATION OF THE RUSH CREEK WIND PROJECT?

A. For both the 345 kV and 230 kV alternatives, the entire cost of the new Gen-Tie (approximately $121 million and $90 million, respectively) was included in the cost-effectiveness evaluation of the Project. As a sensitivity analysis, the Project was also evaluated using a pro-rata share cost assignment of the new transmission line costs. I discuss this sensitivity analysis later in my testimony.

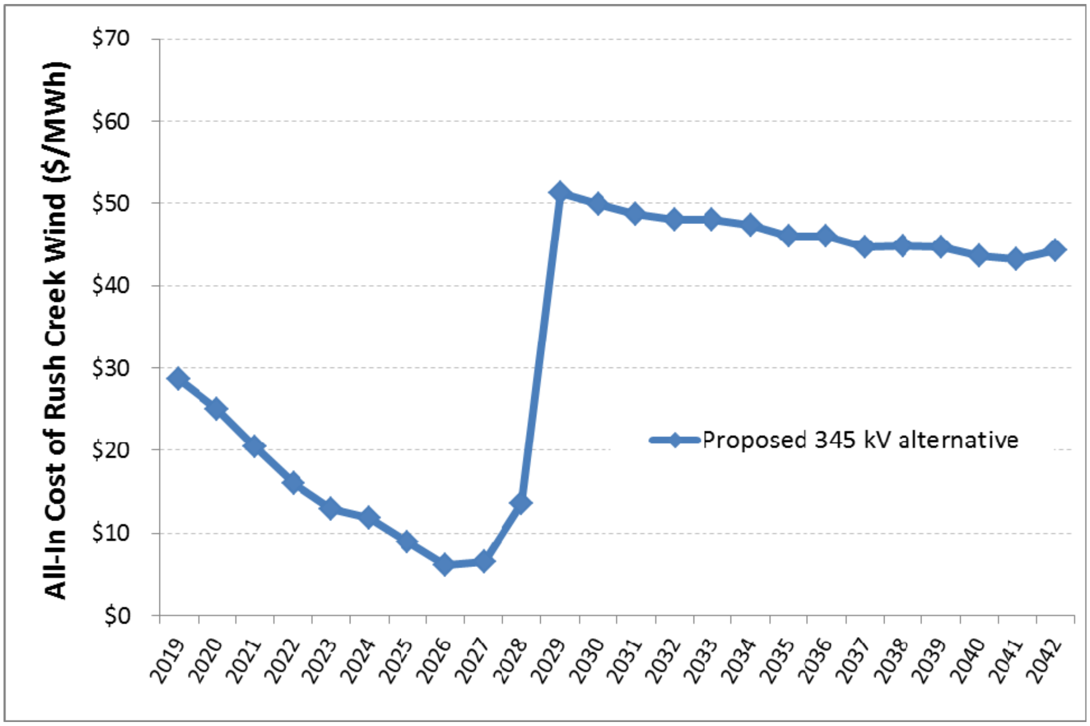
Q. HOW WAS THE GENERATION OUTPUT OF THE RUSH CREEK WIND PROJECT REPRESENTED IN THE COST-EFFECTIVENESS EVALUATION?

A. The Rush Creek Wind Project was modeled using the expected generation output developed by Vaisala. Mr. Matt Hendrickson, an expert witness from Vaisala, describes these generation projections in his direct testimony.

Q. WHAT IS THE ESTIMATED ALL-IN COST OF THE RUSH CREEK WIND PROJECT ON AN ANNUAL $/MWH BASIS?

A. The all-in $/MWh cost for the Project each year are presented in Figure JFH-5. All-in costs include the revenue requirements associated with the construction, operation, and maintenance of Rush Creek I and II, plus the total revenue requirements associated with the Rush Creek Gen-Tie. These costs are divided by the expected annual generation from the facility to derive an all-in $/MWh cost for the Project. Figure JFH-5 illustrates the all-in costs of the Rush Creek Wind Project for the proposed 345 kV alternative with 100% of the transmission line cost assigned to the Project.

Figure JFH-5 All-In $/MWh Cost of Rush Creek Wind Project



The all-in costs in Figure JFH-5 are also representative of those for the 230 kV alternative.

Q. WHAT CAUSES THE 2019-2028 $/MWH COSTS TO BE CONSIDERABLY LOWER THAN THE LATER YEAR COSTS IN FIGURE JFH-5?

A. The lower $/MWh cost during the first 10-years of operation are a result of the Project qualifying for 100% of the PTC which represent approximately $55 to $65 million of tax credits <u>each year</u> from 2019-2028. Ms. Jackson describes how the Project can qualify for 100% of the PTC. Figure JFH-5 highlights the importance of the Project timeliness in qualifying for safe harbor to receive 100% of the PTC.

Q. WHAT IS THE ECONOMIC IMPACT TO CUSTOMERS IF THE PROJECT WERE TO QUALIFY FOR A LOWER PERCENT OF THE PTC?

A. The estimated savings of the Project erode by approximately $125 million (PVRR) for every 20% reduction in the level of PTC qualification[19]. For example, at the 100% PTC level, the 345 kV project alternative is estimated to provide customers $443 million in savings. If, however, the Project is delayed and qualifies at the 80% PTC level, customer savings drop by $125 million down to $318 million.

Q. EARLIER YOU DESCRIBED HOW WIND GENERATION DISPLACES NATURAL GAS-FIRED GENERATION AND AS A RESULT, THE ECONOMIC VALUE OF WIND ENERGY IS TIED TO THE PRICE OF NATURAL GAS. IS THERE A WAY TO EQUATE THE COST OF ENERGY FROM THE PROJECT WITH A PRICE OF NATURAL GAS?

A. Yes. Knowing that the Project will provide energy to the system at a levelized cost of approximately $29/MWh, one can estimate the price of gas, that when burned in a gas-fired generator, would also produce energy to the system at a levelized cost of approximately $29/MWh. This results in an estimate of the gas price that the Rush Creek Project will in essence “lock in” for customers for the 25-year duration of the projects life.

[19] This estimated $125 million of lost savings applies to both the 345kV and 230kV alternatives.

Q. HAVE YOU PERFORMED THAT ANALYSIS AND IF SO, WHAT WERE THE RESULTS?

A. Yes. Our analysis shows that the Project would lock-in approximately 14 billion cubic feet[20] of natural gas each year at a levelized gas price of approximately $3.19/mmBtu. More specifically, this $3.19/mmBtu estimate represents the price of gas if burned in a combined cycle unit operating at a 7,250 Btu/kWh heat rate, with $3/MWh variable O&M cost, and the $0.61/mmBtu GPVM adder[21], would produce energy at a $/MWh cost equal to that produced by the Rush Creek Wind Project[22]. Later in Section VI of my testimony, I show how this estimated gas value of the Project is at the very low end of gas price forecasts and serves as another measure of the cost-effectiveness of the Project.

Q. WHAT ARE THE RESULTS OF THE STRATEGIST COST-EFFECTIVENESS ANALYSIS OF THE PROJECT IN TERMS OF CUSTOMER SAVINGS?

A. Under the base assumptions for electric sales and natural gas prices, and the expected level of wind generation, the addition of the Company's proposed Rush Creek Wind Project resulted in $443 million and $437 million in PVRR customer savings for the 345 kV and 230 kV alternatives respectively. These customer savings projections are derived by taking the difference in costs

[20] 14 billion cubic feet of natural gas represents approximately 11% of Public Services annual gas burn for electric production.

[21] This Gas Price Volatility Mitigation (GPVM) assumption is discussed in Attachment A of Proceeding No. 16A-0138E.

between the 2016-2054 PVRR of a base case model run that did not include the Rush Creek Wind Project, and a model run that did include Rush Creek Wind Project.

Q. WHAT IS THE PROJECTED DISTRIBUTION OF THE $443 MILLION IN PVRR SAVINGS?

A. The majority of the savings are projected to occur in the first 10 years of operation of the Rush Creek Wind Project. Not surprisingly, the annual pattern of savings mimics the annual all-in $/MWh pattern of cost for the project presented in Figure JFH-5 above. Figure JFH-6 illustrates when the annual costs and savings of the 345 kV alternative occur each year over the 25-year life of the Project. Figure JFH-6 also indicates that $310 million, or 70% of the $443 million of total savings occur in the first 10 years of operation.

[22] Plus estimates of the $/MWh cost to integrate Rush Creek Wind onto the system.

Figure JFH-6 – Annual Distribution of Rush Creek 345 kV Savings[23]

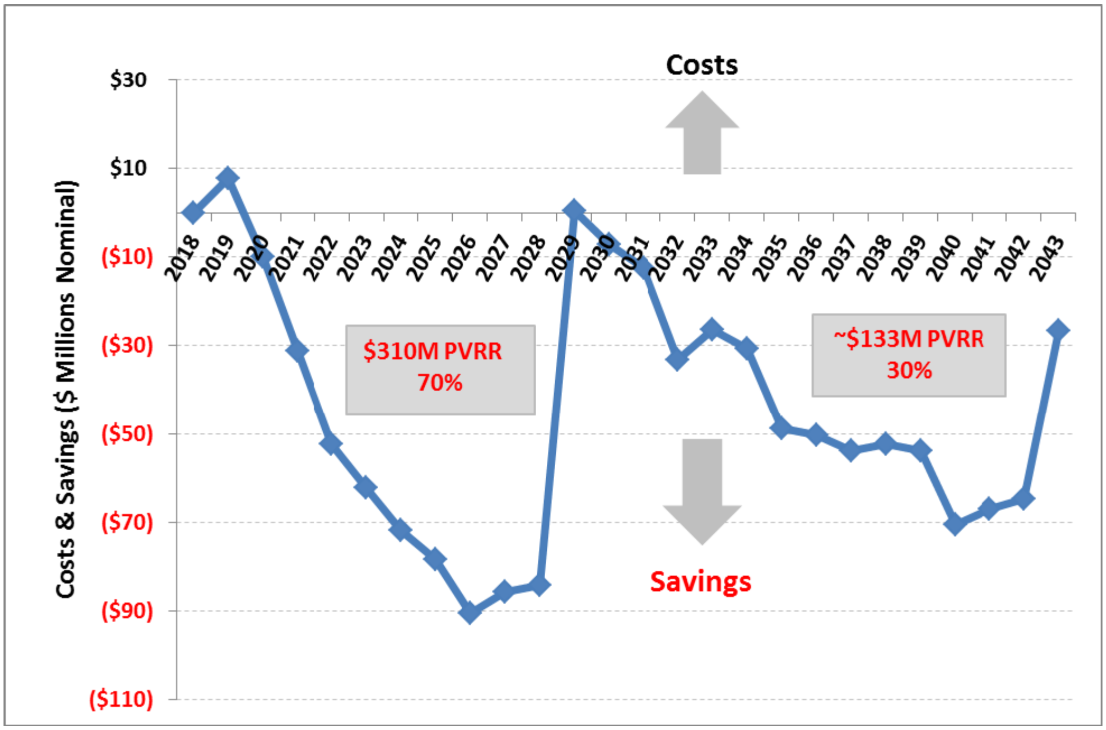


Figure JFH-6 indicates there will be a net cost to customers of about $8 million in 2019 as the Project begins operation. The Project will then begin providing a net savings to customers of $10 million in year 2020, an additional $31 million in 2021, an additional $52 million in 2022, and so forth as depicted above. In the tenth year of operation, the PTC ends and the Project is cost neutral to customers' that year. Beyond 2028 when the PTCs expire, the project continues to show customers savings each year ranging from $7 million to $70 million annually.

[23] The distribution of costs and savings of the 230 kV alternative are not included in Figure JFH-6 since they essentially overlay those of the proposed 345 kV alternative that is plotted.

Q. EARLIER YOU INDICATED THAT YOU HAD INCLUDED THE IMPACTS OF POTENTIAL WIND CURTAILMENT IN THE STRATEGIST MODELING. CAN YOU PLEASE PROVIDE MORE DETAIL AS TO THE CURTAILMENT ANALYSIS THE COMPANY COMPLETED?

A. Yes. Considering the amount of wind generation already operating on the Public Service system, the Company wanted to ensure that our cost-effectiveness evaluation of Rush Creek Wind Project includes the economic impact of future wind curtailments. The discussion and conclusions in this section apply equally to both the 345 kV and 230 kV alternatives.

Q. DOES PUBLIC SERVICE EXPECT THAT THE ADDITION OF THE RUSH CREEK WIND PROJECT WILL RESULT IN ADDITIONAL WIND ENERGY CURTAILMENTS ON ITS SYSTEM?

A. Yes. As detailed in the testimony of Mr. John Welch, we believe the level of curtailment will be manageable and will not pose a reliability risk to the system. Further, these curtailments are not expected to be material to the overall cost-effectiveness of the Project.

Q. WHAT CAN CAUSE THE NEED TO CURTAIL WIND?

A. As described by Mr. John Welch, there are two general categories of curtailments:

1. Bottoming or system balancing – curtailments that are needed in order to maintain a balance between system load and system generation caused when certain dispatchable units are at their minimum loadings and cannot

be taken down any further. All of the Company's coal-fired units have minimum loading levels as do many of our PPAs.

2. Transmission related - curtailments caused by maintenance outages on transmission system components, lack of transfer capability on a specific transmission system element, or wind curtailment ordered by a system dispatcher to ensure adequate balance between the anticipated level of wind resource generation and the level of available flexible resources.

Q. WHICH OF THESE CURTAILMENT CATEGORIES ARE REFLECTED IN THE STRATEGIST MODELING PVRR RESULTS?

A. The added cost associated with bottoming or system balancing curtailments are estimated within Strategist and thus are embedded within the PVRR values produced by the model. These added costs are reflected in the fuel burned in each plan within the model.

Q. CAN YOU ESTIMATE THE GENERAL MAGNITUDE OF THESE BOTTOMING CURTAILMENT COSTS THAT ARE EMBEDDED IN THE PVRR VALUES?

A. Yes. An estimate of these embedded costs can be made by taking the MWh of curtailed[24] energy each year from the model and multiplying those values by the $/MWh estimate of the energy that would have been avoided had the wind not been curtailed. Table JFH-5 contains these calculations through 2025.

Table JFH-5 Estimated Wind Curtailment Costs

	2019	2020	2021	2022	2023	2024	2025
Curtailed Wind (GWh)	86	86	52	39	19	13	14
Fossil Fuel ($/MWh)	$21.15	$21.36	$22.31	$22.53	$20.77	$21.32	$21.97
Curtailment Cost ($M)	$1.81	$1.83	$1.16	$0.88	$0.39	$0.28	$0.30

The values labeled Fossil Fuel ($/MWh) in Table JFH-5 represent the average cost of energy from the Company's coal units as modeled in Strategist. The majority of bottoming related curtailments result when the coal units are loaded to their minimum generation levels and cannot be taken down further (i.e., they are bottomed out). When wind is curtailed in these situations the fuel cost associated with this curtailment is best represented by that of the coal units whose energy would have been displaced by the wind but for the bottoming.

Q. IF ACTUAL SYSTEM WIND CURTAILMENTS END UP BEING HIGHER THAN THOSE ESTIMATED IN STRATEGIST, HOW MIGHT THAT IMPACT THE COST-EFFECTIVENESS OF THE PROJECT?

A. The present value of the curtailment costs in Table JFH-5 is approximately $5 million PVRR. Even if the actual system wind curtailments were a factor of two, three, four or even five times higher than those embedded in Strategist, this would reduce the $443 million of savings by only $10 to $25 million. Thus, additional system wind curtailments as a result of adding the Rush Creek

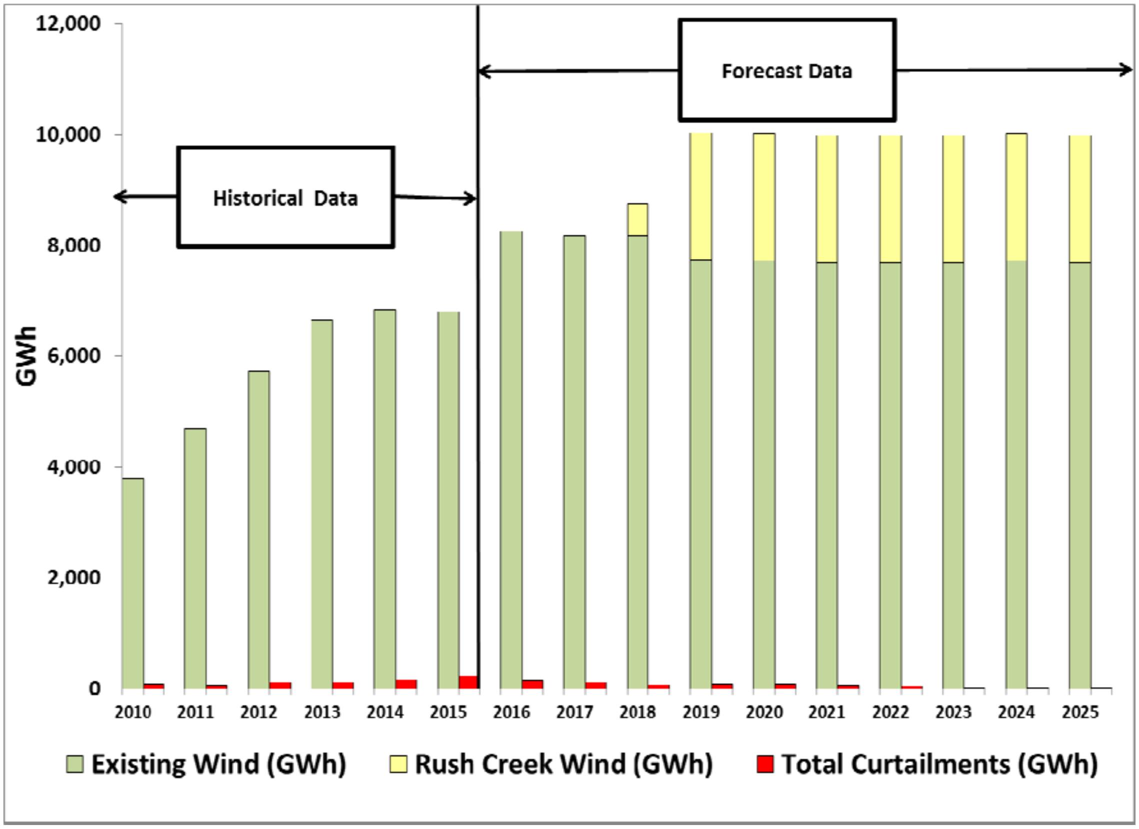
[24] Curtailing wind energy refers to a situation where the electric output of a wind generator is manually reduced by a system operator to a level below what the current wind speeds could produce.

Wind Project do not significantly influence the overall cost-effectiveness of the Project.

Q. HOW DO THE LEVEL OF CURTAILMENTS PROJECTED BY THE STRATEGIST PVRR MODELING COMPARE TO THE HISTORICAL LEVELS OF WIND CURTAILMENT?

A. The left side of Figure JFH-7 compares the historical amount of wind energy on the Public Service system with how much of that wind energy was curtailed. The right side of Figure JFH-7 compares a forecast of the amount of wind that will be on the system (and included in Strategist) with the amount of that wind energy curtailed by Strategist.

Figure JFH-7 Historical vs. Forecast Wind Generation and Curtailment



Q. WHAT WOULD CAUSE THE CURTAILMENTS TO FALL OFF OVER TIME AS WIND GENERATION INCREASES AS DEPICTED IN FIGURE JFH-7?

A. The Public Service system is becoming more flexible in its ability to accommodate increased levels of wind generation. This increased flexibility is the result of a combination of: 1) reduced bottoming limitations on the system over time as actions related to the Clean Air Clean Jobs Act (CACJA) are implemented[25], as well as the termination of PPAs with minimum take requirements; and, 2) load growth. Figure JFH-8 illustrates how the Public Service system bottoming changes over time. This change in bottoming is well correlated with the reduction in wind curtailments in Strategist that are illustrated in Figure JFH-7 above.

Figure JFH-8 Changes to System Bottoming

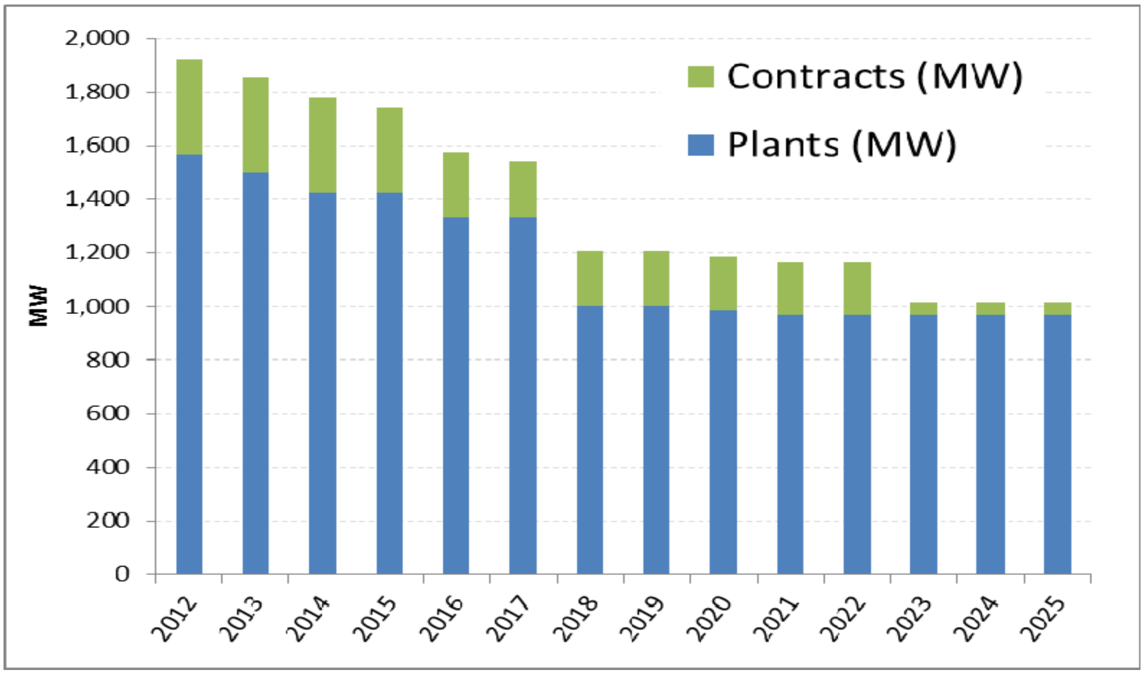


Figure JFH-8 helps explain why the level of estimated system wind curtailments decline from 2015 to 2019, and then further by 2025. From 2015 to 2019 when the Project would see its first full year of operation, the MW amount of the system bottom drops over 500 MW. From 2019 to 2025, the system bottom drops another 200 MW, for a total drop of over 700 MW.

[25] The remaining actions include the retirement Valmont 5 and the fuel switching of 352 MW at Cherokee 4, both of which will be completed at the end of 2017.

Q. IN THE COST-EFFECTIVENESS MODELING OF THE PROJECT DID THE COMPANY INCLUDE ANY ADDED COSTS FOR TRANSMISSION RELATED CURTAILMENTS OF WIND?

A. No, we did not add any cost associated with transmission-related wind curtailments due to the addition of the Rush Creek Wind Project. As noted in the Direct Testimony of Mr. John Welch, system operators will continue to utilize the Curtailment Operating Procedure ("COP") to prioritize which wind facilities to curtail. Mr. Welch also explains that as of January 1, 2019, Public Service will have over 1,424 MW of non-PTC wind resources in its portfolio, and these non-PTC wind resources will get curtailed before any curtailment of PTC wind resources such as Rush Creek.

Q. WHAT DO YOU CONCLUDE FROM YOUR STRATEGIST MODEL EVALUATION OF THE COST-EFFECTIVENESS OF THE RUSH CREEK WIND PROJECT USING BASE CASE MODELING ASSUMPTIONS?

A. Overall, the Rush Creek Wind Project is shown to provide substantial customer savings over both the first 10 years of operation ($310 million PVRR) as well as for the remaining 15 years of the Project's life ($133 million PVRR). Furthermore, the Project will in essence act to lock in approximately 11% of the Company's total gas burn for electric generation at a gas price of about $3.19/mmBtu, thereby reducing our electric customers' exposure to increases in the future price of natural gas. A summary of these Strategist base case results is depicted in Table JFH-6.

Table JFH-6 Summary of Strategist Base Case Results

Gas Prices	NCF	Transmission Cost Assignment	Rush Creek 345 kV Savings (PVRR $M)	Rush Creek 230 kV Savings (PVRR $M)
Base	Expected	100%	$443	$437

VI. STRATEGIST MODELING SENSITIVITY ANALYSES

Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?

A. In this section of my testimony I discuss how the results of the Project cost-effectiveness evaluation change under different modeling assumptions and different modeling frameworks. I also demonstrate how an evaluation of the Rush Creek Wind Project's cost-effectiveness to customers using the Commission approved modeling assumptions from the 2013 All-Source bid evaluation produces similar results as those in Table JFH-6.

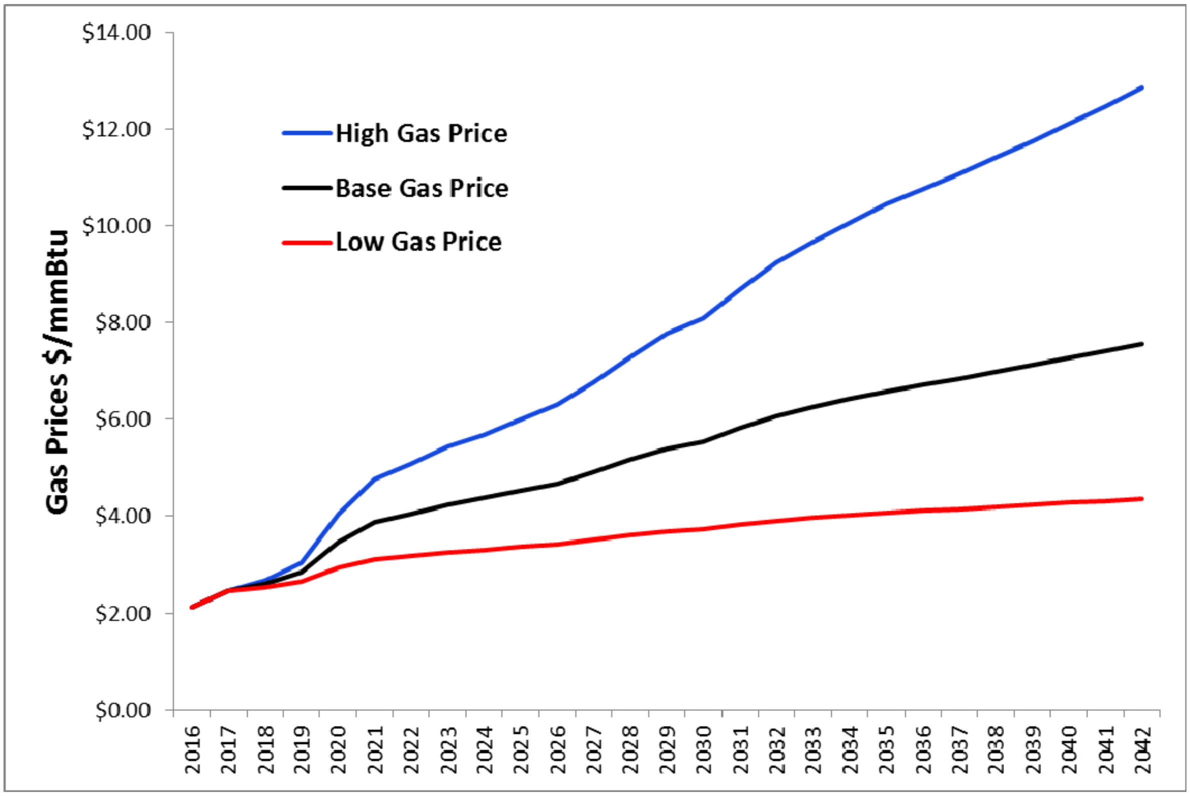
Q. EARLIER YOU DESCRIBED HOW NATURAL GAS PRICES ARE A VERY INFLUENTIAL ASSUMPTION IN THE COST-EFFECTIVENESS EVALUATION OF THE PROJECT. HOW DID YOU TEST THE INFLUENCE THAT GAS PRICES HAVE IN THE EVALUATION?

A. We evaluated the cost-effectiveness of the Rush Creek Wind Project under a range of natural gas price forecasts to test the robustness of our projected $443 million of customer savings that were derived under base gas prices.

Q. WHAT WERE THE $/MMBTU GAS PRICES FOR THE BASE, LOW, AND HIGH FORECASTS USED IN YOUR SENSITIVITY ANALYSIS?

A. Figure JFH-9 contains a plot of the gas prices for each of the three forecasts.

Figure JFH-9 Range of Gas Price Forecasts used in Sensitivity Analysis



Q. HOW DOES THE $443 MILLION OF PROJECTED SAVINGS CHANGE UNDER DIFFERENT GAS PRICE ASSUMPTIONS?

A. As would be expected, the projected savings from the Strategist modeling shows lower savings in the low gas price sensitivity scenario and higher savings in the high gas price sensitivity scenario. Table JFH-7 summarizes the changes in PVRR when modeled at the different forecasts of natural gas prices shown in Figure JFH-9.

Table JFH-7 Gas Price Sensitivity Analysis of Rush Creek Savings

Gas Price Forecast	PVRR Savings ($millions)	
	345 kV Alternative	230 kV Alternative
High	$744	$729
Base	$443	$437
Low	$213	$213

Q. HOW DOES THE DISTRIBUTION OF COSTS AND SAVINGS CHANGE UNDER THESE DIFFERENT GAS PRICE ASSUMPTIONS?

A. Again as expected, the distribution of annual costs and savings follows the same general pattern as that for base gas prices in Figure JFH-6. The pattern of costs and savings that comprise the $213 and $744 million in PVRR savings for the proposed 345 kV alternative from Table JFH-7 are illustrated in Figure JFH-10.

Figure JFH-10 – Gas Price Sensitivity Analysis of Rush Creek Savings

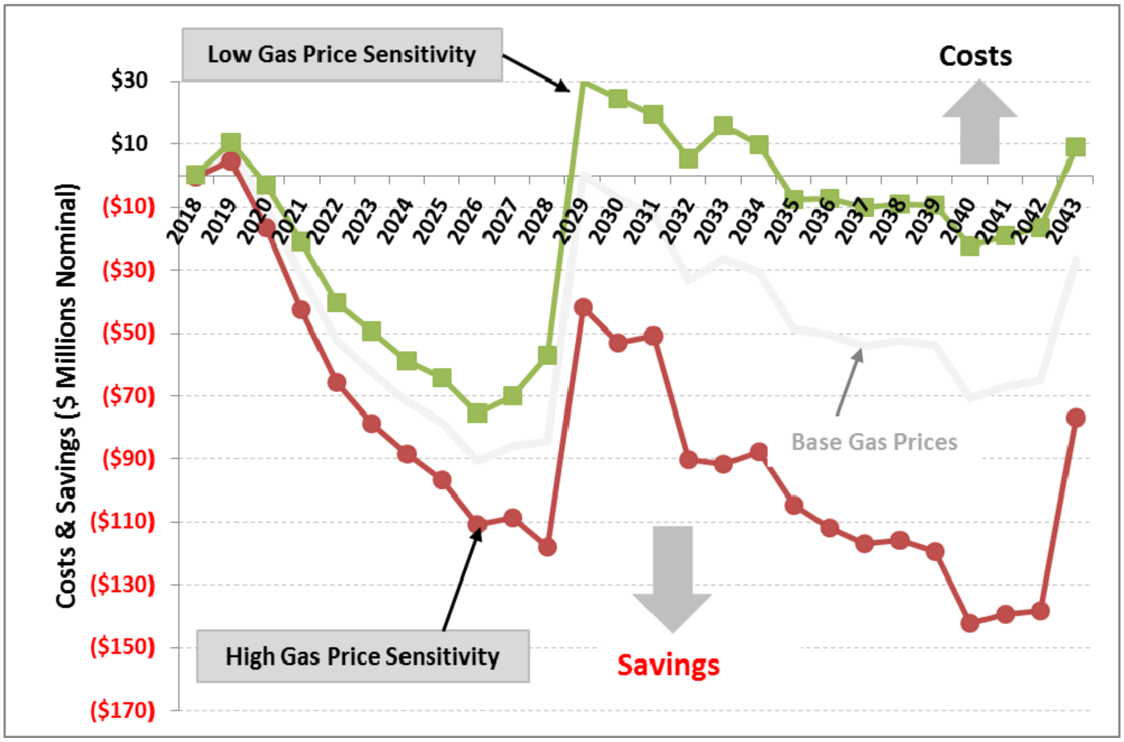
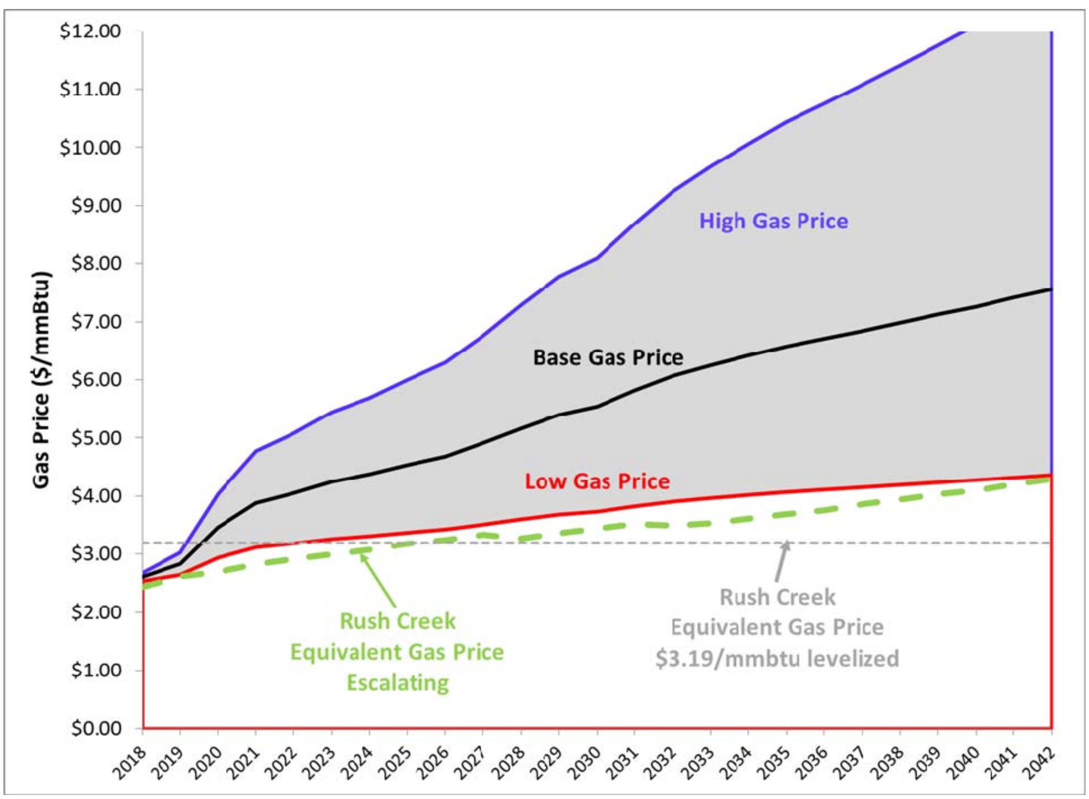


Figure JFH-10 shows that the general pattern of costs and savings for the range of gas prices modeled is a small <u>net cost</u> in 2019 followed by considerable <u>net savings</u> each year during the 2020-2028 timeframe that the PTCs are available to the Project. Beyond 2028 after the PTCs expire, under the low gas price forecast the modeling shows net costs in several years (e.g., 2029-2034) and net savings in other years (e.g., 2035-2042). Beyond 2028 under the high gas price forecast the modeling shows substantial net savings for all years. The distribution of costs and savings of the 345 kV alternative in Figure JFH-10 are also representative of those for the 230 kV alternative.

Q. HOW DOES THE $3.19/MMBTU GAS VALUE OF THE PROJECT DISCUSSED EARLIER IN YOUR TESTIMONY COMPARE WITH THE RANGE OF GAS PRICES IN FIGURE JFH-9?

A. Figure JFH-11 illustrates how the equivalent gas value is lower than the all three gas price forecasts (high, base, and low). The $3.19/mmBtu levelized price is also presented in Figure JFH-11 as an escalating gas price. The $3.19 levelized price and the escalating price are equivalent on a present value basis.

Figure JFH-11 Equivalent Gas Value of Rush Creek Project

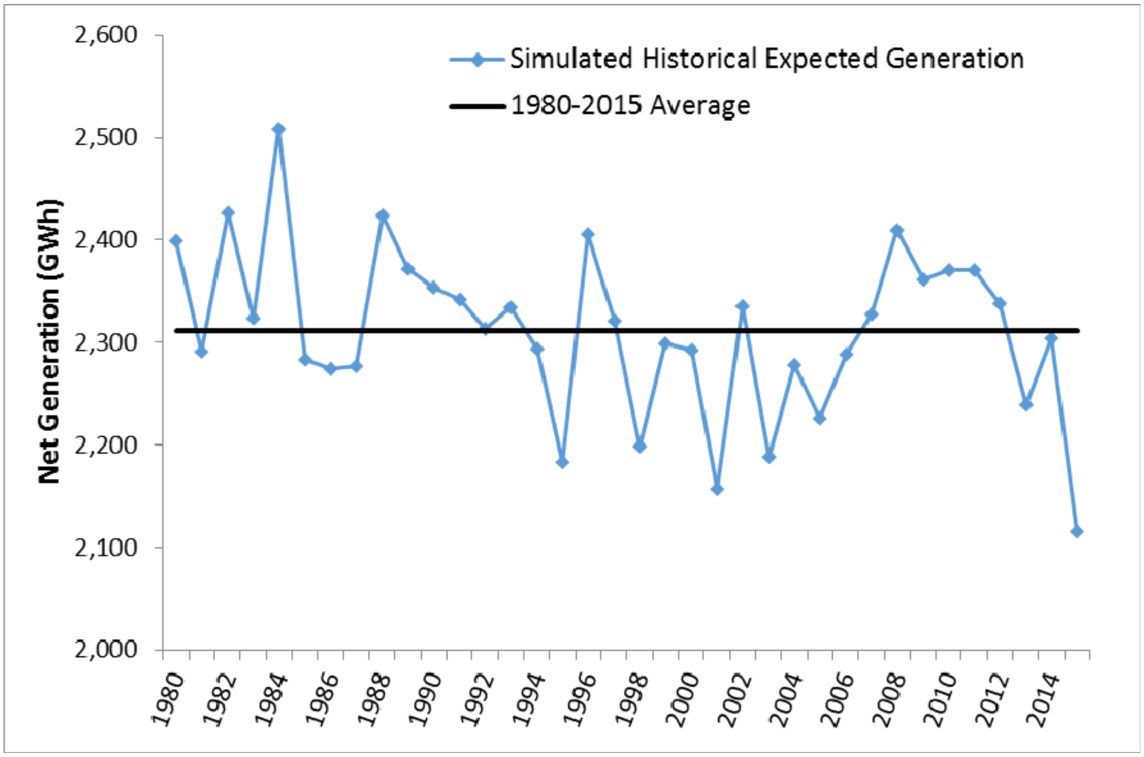


In summary, Figure JFH-11 indicates that the proposed Project will provide wind generation to the system that in essence locks-in an equivalent gas price below the low gas price forecast for its entire 25-year life. Figure JFH-11 also provides insight why the cost-effectiveness evaluation of the project under low gas prices continued to show cost savings to customers of $213 million PVRR.

Q. HOW DOES THE $443 MILLION OF PROJECTED SAVINGS CHANGE UNDER DIFFERENT ASSUMPTIONS FOR THE LEVEL OF ENERGY GENERATED FROM THE RUSH CREEK WIND PROJECT?

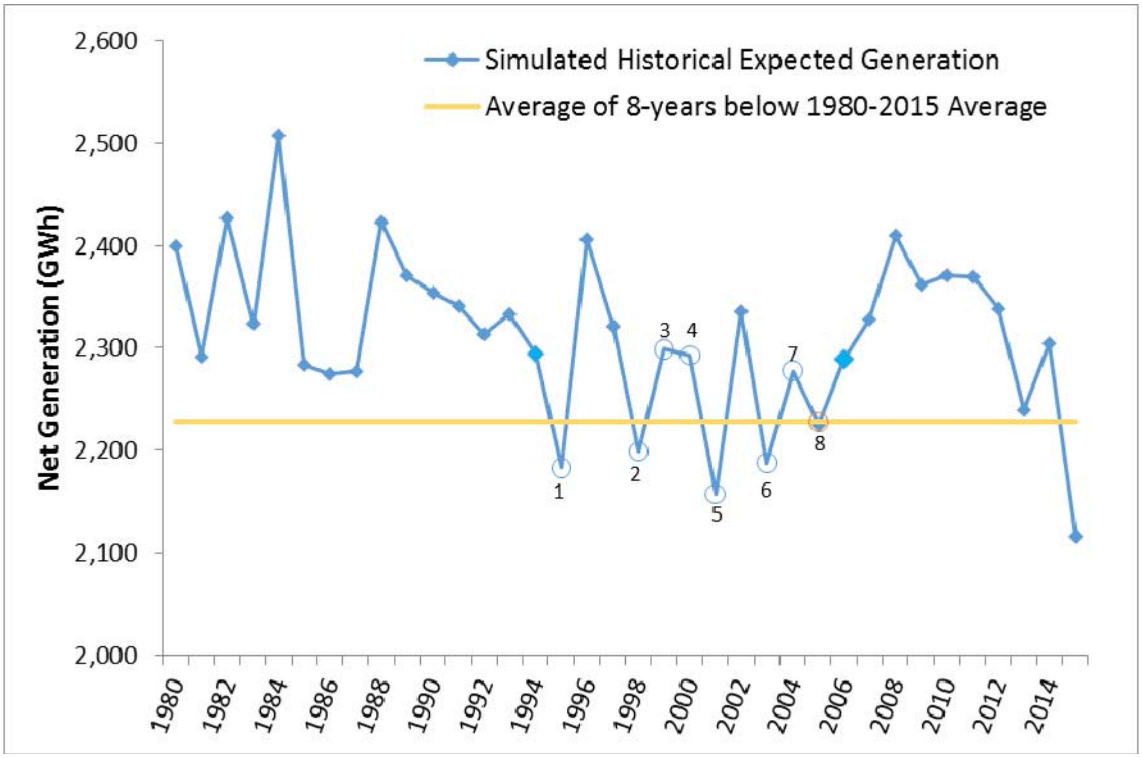
A. This sensitivity was performed by first looking at the 35-year (1980-2015) historical simulation of expected generation from the Project developed by Vaisala in Figure JFH-12. See expert witness Mr. Matt Hendrickson's Direct Testimony. The flat line in Figure JFH-12 labeled '1980-2015 Average' represents the expected generation from the Rush Creek Wind Project at the low side of the step up transformer located near the Rush Creek I wind farm site.

Figure JFH-12 Vaisala Rush Creek Historical Generation Simulation



We looked at the 11-year period of consecutive years that showed the lowest net generation from the historical simulation, years 1995-2005. We then calculated the average net generation level of all years that were below the expected generation level (i.e., years 1995, 1998, 1999, 2000, 2001, 2003, 2004, and 2005). The cost-effectiveness of the Project was evaluated by assuming the project would generate over its life-cycle at a level equal to the average generation level of those eight years. Figure JFH-13 shows how this low average generation assumption compares with all thirty years of simulated generation.

Figure JFH-13 Vaisala Rush Creek Historical Generation Simulation



Q. WHAT WERE THE RESULTS OF THIS SENSITIVITY ANALYSIS?

A. Even at this reduced level of generation, the Rush Creek Wind Project continues to result in substantial customer savings across a range of gas price forecasts. The Project savings using the average of the 8-years identified from Figure JFH-13 are summarized in Table JFH-8 for all three gas price forecasts.

Table JFH-8 NCF & Gas Price Sensitivity Analysis

	Expected Generation NCF 43.6% (2,293 GWh)	**8-Year Average Generation NCF 42.0% (2,210 GWh)**
Gas Price Forecast	**PVRR Savings ($millions)**	**PVRR Savings ($millions)**
High	$744	$670
Base	$443	$383
Low	$213	$163

While the results in Table JFH-8 are for the 345 kV alternative they are equally representative of the results for the 230 kV alternative.

Q. DID THE COMPANY PERFORM ANY OTHER SENSITIVITY ANALYSES IN EVALUATING THE COST-EFFECTIVENESS OF THE RUSH CREEK WIND PROJECT?

A. Yes. In an attempt to eliminate potential concerns regarding use of assumptions/methodologies that have not been vetted in the 2016 ERP, we analyzed the cost-effectiveness of the Project within a framework that has been fully vetted by parties in a litigated ERP and approved by the Commission.

Q. PLEASE EXPLAIN THIS ANALYSIS.

A. We retrieved and loaded the Strategist model database that was used in the 2013 All-Source bid evaluation, added the 345 kV Rush Creek alternative to

Portfolio 16,[26] and compared the resulting PVRR impacts of the modified portfolio with those of the original portfolio. The Rush Creek Wind Project was modeled into Portfolio 16 using the same revenue requirements (with full 345 kV transmission line cost assignment) and MWh of expected generation that was modeled in the 2016 ERP alternative plan analysis that produced the $443 million PVRR savings.

Q. HOW DID THE PVRR OF PORTFOLIO 16 CHANGE WITH THE ADDITION OF THE RUSH CREEK WIND PROJECT?

A. The Portfolio 16 PVRR decreased by $431 million[27] for the time period of 2016-2050, reflecting a $431 million cost savings to customers. This PVRR value is consistent with the range of PVRR savings discussed throughout my testimony, and provides added assurance of the Project's cost-effectiveness.

Q. WHAT INFORMATION SHOULD THE COMMISSION GLEAN FROM THIS PORTFOLIO 16 PVRR ANALYSIS FROM THE 2013 ALL-SOURCE BID EVALUATION?

A. That the technical assumptions the Company filed as Attachment A in Proceeding No. 16A-0138E and used in the analysis of the Rush Creek Wind Project[28], while not yet fully vetted through a litigated proceeding, are not materially different from those that the Commission and parties did fully vet in the 2011 ERP.

[26] Portfolio 16 was the Company's Preferred Portfolio from the 2013 All Source Solicitation as presented in the 120 Day Report filed with the Commission on September 9, 2013. See Proceeding No. 11A-869E.
[27] Calculated with a 7.14% discount rate as approved by the Commission for the 2013 All-Source.

Q. EARLIER YOU INDICATED THAT YOU HAD EVALUATED THE RUSH CREEK PROJECT WITH THE ENTIRE COST OF THE TRANSMISSION LINE ALLOCATED TO THE PROJECT, IS THERE ANOTHER WAY THE COMMISSION COULD LOOK AT THE ALLOCATION OF THE COST OF THIS TRANSMISSION LINE?

A. Yes. The new Rush Creek Gen-Tie is rated to carry approximately 750 MW at 230 kV and 1,600 MW at 345kV. The Rush Creek Wind Project is rated at 600 MW. As a result, both the 230 kV and 345 kV transmission line alternatives will have additional capacity to accommodate more generation resources and deliver those resources to the Missile Site Substation. From a pro-rata share perspective, the 600 MW Project would use 80% and 37.5% of the 750 MW and 1,600 MW capacity of a 230 kV and 345 kV transmission line, respectively (600/750 = 80% and 600/1,600= 37.5%). Therefore, from a cost-effectiveness perspective the Project could be evaluated as contributing to either 80% or 37.5% of the new transmission line cost. It is common for new high-voltage transmission lines (e.g., 230 kV or 345 kV) to provide more transfer capacity than what is needed to allow delivery of the generation project(s) for which they are initially built. As a result, these lines are often capable of being utilized by future generation projects as well. The application of a pro-rata share of the transmission delivery costs in the evaluation of new generating facilities is a way to recognize this reality.

[28] These assumptions were also used in the 2017 RE Plan and will be used in the 2016 ERP.

Q. IS THERE ANY BASIS FOR USING A PRO-RATA SHARE OF THE COST OF A NEW TRANSMISSION LINE IN EVALUATING THE COST-EFFECTIVENESS OF NEW GENERATING FACILITIES?

A. Yes. In past ERP proceedings the Commission has adopted a bid evaluation methodology in which transmission delivery costs are assigned to bids based on their pro-rata share of any transmission upgrades that would be needed to move the proposed generators output to customers. In contrast, proposed generators that utilize either existing transmission or transmission projects that have been granted a CPCN at the time of the bid evaluation are not assigned transmission delivery costs. This transmission cost allocation approach has been adopted by the Commission in the 2007 ERP Phase 1 (Decision No. C08-0929 in Proceeding No. 07A-447E) and in the 2011 ERP Phase I (Decision No. C13-0094 in Proceeding No. 11A-869E) proceedings.

Q. HOW DOES THE FACT THAT THE NEW TRANSMISSION LINE WILL SERVE AS A GENERATOR TIE-LINE FOR THE RUSH CREEK WIND PROJECT FACTOR INTO WHETHER A PRO-RATA SHARE APPROACH IS APPROPRIATE?

A. If a transmission line is expected to only ever function as a radial from a generator to the Company's transmission system (i.e., a gen-tie), then a pro-rata share approach would not be appropriate and the entire cost of the transmission line should be assigned to the generation project for which the line is built. If, however, there is a reasonable likelihood that over the life of the transmission line that it will be utilized by other generators for transmission service or will be further interconnected into the Public Service transmission system, then a pro-rata share cost assignment approach would be appropriate. Company witness Ms. Betty Mirzayi describes in her Direct Testimony that the 90-mile 345 kV Gen-Tie alternative will have the potential to provide transmission service that can, in the future, be integrated into other portions of the transmission system, potentially enhancing the Company's ability to deliver energy from Energy Resource Zone ERZ 2. Ms. Mirzayi's testimony also indicates that it is anticipated that new interconnection requests along this Rush Creek Gen-Tie could be submitted. This indicates that a pro-rata share approach would be appropriate in evaluating the cost-effectiveness of the Rush Creek Wind Project at 345 kV. There is less potential for the 230 kV transmission line alternative to serve as a high voltage network element in the future and therefore a pro-rata share approach may not be appropriate for a 230 kV line.

Q. WHAT IS THE IMPACT TO THE RUSH CREEK WIND PROJECT'S PVRR OF EITHER A 37.5% OR 80% PRO-RATA SHARE OF TRANSMISSION LINE COSTS ASSIGNMENT VERSUS A 100% COST ASSIGNMENT?

A. From a cost-reasonableness perspective, the proposed 345kV alternative LCOE would fall to $25.82/MWh and the 230 kV alternative would fall to $27.96/MWh. From a cost-effectiveness perspective, using a 37.5% pro-rata share cost assignment for the 345 kV alternative or a 80% pro-rata share cost assignment for the 230kV alternative results in increased customer savings of $70 million and $16 million PVRR, respectively.

Q. WHAT ARE YOUR OVERALL CONCLUSIONS REGARDING THE VARIOUS SENSITIVITIES THAT WERE PERFORMED TO TEST THE COST- EFFECTIVENESS OF THE RUSH CREEK WIND PROJECT?

A. The sensitivity analyses demonstrate the robustness of the Project's cost-effectiveness. The Project was shown to provide substantial customer savings under all sensitivities examined. Even under low gas prices the Project showed over $200 million in customer savings, most of which occur in its first 10 years of operation. Under the low wind production sensitivity the Project showed over $380 million in savings, again most of which occur in the first 10 years of operation. The robustness of the Project cost-effectiveness was further demonstrated through an analysis of Portfolio 16 from the Company's 2013 All-Source bid evaluation. That analysis showed the Project would provide $431 million PVRR customer savings, a level of savings very much in line with the $443 million PVRR derived using updated Strategist modeling assumptions.

Table JFH-9 Summary of Strategist Sensitivity Analysis

Gas Price	Wind Production[2]	Transmission Cost Assignment	2013 All-Source Portfolio 16	Rush Creek 345 kV Savings (PVRR $M)	Rush Creek 230 kV Savings (PVRR $M)
High	Expected	100%	NA	$744	$729
Base	Expected	100%	NA	$443	$437
Low	Expected	100%	NA	$213	$213
Base	Low	100%	NA	$383	$379
Base	Expected	Pro-Rata	NA	$513	$453
Base[1]	Expected	100%	Yes	$431	NA

Notes:
1) Base gas prices in this Portfolio 16 sensitivity were those approved for use in the 2013 All-Source
2) NCFs for low wind production sensitivities were 42% and 41% for 345 kV and 230 kV respectively

VII. INTERACTION WITH OTHER PROCEEDINGS

Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?

A. In this section of my testimony I discuss the interaction between this proceeding and other proceedings that are or will be before the Commission this year. I address how the Company will incorporate any Commission decision in this proceeding into those other proceedings. I also address a potential concern that the need for additional wind was not approved in a previous resource plan proceeding.

Q. DO YOU BELIEVE THAT THE COMMISSION SHOULD BE CONCERNED WITH RELYING ON SAVINGS PROJECTIONS PRESENTED OUTSIDE AN ERP PROCEEDING?

A. No. As I discussed earlier, the PVRR savings projections for the Rush Creek Wind Project were derived within modeling and analyses of alternative plans in the 2016 ERP using the same methodologies approved by the Commission in Phase 1 of the 2011 ERP. In addition, the Company retrieved the Strategist model used to produce the Commission approved Portfolio 16 from the 2013 All-Source bid evaluation, demonstrating the Rush Creek Wind Project is cost effective under these approved modeling assumptions.

Q. SHOULD THE COMMISSION BE CONCERNED THAT APPROVAL OF THE PROPOSED 600 MW RUSH CREEK WIND PROJECT IN THIS PROCEEDING COULD SOMEHOW COMPROMISE THE ABILITY TO PROCURE A LEAST-COST PORTFOLIO OF RESOURCES IN PHASE 2 OF THE 2016 ERP?

A. No. Consideration and approval of the Company's proposed 600 MW wind facility through this Rule 3660(h) application in advance of the Phase 2 acquisition process will not compromise the ability for the Company or the Commission, through the combined efforts of the Rule 3660(h) filing and Phase 2 of the 2016 ERP, to produce a least-cost portfolio of resources for customers.

Q. HAS THE COMPANY FACED A SIMILAR SITUATION IN PAST PROCEEDINGS?

A. Yes. As recent as the 2013 Phase 2 acquisition process, the Company had to evaluate wind proposals in advance of other technologies in order to ensure customers could take advantage of cost savings through the PTC. Public Service suggested and the Commission approved a process by which the Company performed a final test to confirm that the wind savings estimated prior to the Phase 2 bid evaluation process would in fact still exist in the modeling of Phase 2 bids. The test confirmed that the savings to customers estimated in advance of receiving the gas bids were within approximately 10% of those calculated in the final test. This is not a surprise considering that most of the cost savings from wind energy is due to avoided fuel and Variable Operations and Maintenance ("VOM") costs from coal and gas-fired units. As a result, the projected level of savings we present in this Rule 3660 proceeding are predictable and stable in nature, and are not likely to change materially when we evaluate Phase 2 bids in the 2016 ERP.

Q. HAVE YOU ALIGNED THE MODELING AND ANALYSIS COMPLETED FOR THE RUSH CREEK WIND PROJECT WITH THE INFORMATION PRESENTED IN THE 2016 ERP AND IN OTHER PROCEEDINGS BEFORE THE COMMISSION?

A. Yes, the cost-effectiveness evaluation of the Rush Creek Wind Project aligns with the Strategist modeling analysis of alternative plans that is presented in the Company's 2016 ERP and with the plans presented in the 2017 RE Plan proceeding.

Q. IF THE COMMISSION APPROVES PUBLIC SERVICE'S PROPOSED 600 MW RUSH CREEK WIND PROJECT UNDER RULE 3660(h), WILL THE COMPANY ALLOW ADDITIONAL RENEWABLE RESOURCES TO BE OFFERED AND CONSIDERED IN PHASE 2 OF THE 2016 ERP?

A. Yes. We will allow additional renewable resources to be offered and considered, and encourage suppliers to offer those resources into the Phase 2 competitive acquisition process. This process will allow all generation technologies to be considered, including IPP-proposed wind and solar resources.

Q. WILL APPROVAL OF THE PROPOSED RUSH CREEK WIND PROJECT ELIMINATE THE NEED TO ACQUIRE ADDITIONAL RESOURCES IN PHASE 2 OF THE 2016 ERP?

A. No, there will still be a need for additional resources after the 600 MW Rush Creek Wind Project is operational, assuming it is approved by the Commission. Wind resources provide a substantial amount of energy (MW-hours) to the system, but relatively little generation capacity (MWs of effective load carrying capability, or ELCC). As a result, the ELCC[29] accredited to wind resources in the planning process is considerable less than their nameplate MW rating. Commission approval of the Company's proposed 600 MW wind facility will act to reduce the Company's resource need by about 49 MW[30], from 664 MW down to 615 MW, which is over twice the resource need than that of the 2011 ERP[31].

Q. HOW WILL THE COMPANY REFLECT THE COMMISSION DECISION IN THIS PROCEEDING INTO THE DETERMINATION OF NEED TO BE FILLED IN PHASE 2 OF THE 2016 ERP?

A We are requesting a Commission decision regarding our proposed Rush Creek Wind Project by November 10, 2016. The 2016 ERP Phase 2 acquisition process likely won't begin until summer or fall 2017. After the

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[29] ELCC is a measure of the reliability contribution that a generator provides to the power supply system. Public Service uses ELCC to derive the equivalent generation capacity credit to be afforded wind and solar facilities within its planning processes.

[30] Based on the Company's most recent wind ELCC study, the additional 600 MW wind project would be accredited an ELCC of approximately 8% of its nameplate rating. The Company used an ELCC of 12.5% for wind resources prior to this most recent study.

Commission renders its decision in Phase 1 of the ERP (expected in Q1 2017) and before the Company initiates the Phase 2 acquisition process, we expect to be updating a variety of values and forecasts in accordance with the Commission's Phase 1 order. It would be during this update process that we would also incorporate the effect of a Commission decision in this and other proceedings into the resource need that is to be filled in Phase 2 of the 2016 ERP.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes.

[31] Based on the 250 MW need identified in the 2013 All-Source RFPs.

Statement of Qualifications

James F. Hill

As the Director of the Resource Planning and Bidding Group I am responsible for overseeing the Company resource planning and competitive resource acquisition processes as well as the various technical analyses on the generation resource options that are available to Xcel Energy's operating companies for meeting future customer demand. I graduated from Colorado State University with a Bachelor of Science degree in Natural Resource Management and from the University of Colorado with a Bachelor of Science degree in Mechanical Engineering. I have been employed by Public Service Company of Colorado, New Century Services, Inc., and now Xcel Energy Services Inc. for over 30 years. I have testified before the Colorado Public Utilities Commission regarding electric resource planning issues in numerous dockets.