

**EXHIBIT NO. ___(MM-1HCT)
DOCKETS UE-17 ___/UG-17 ___
2017 PSE GENERAL RATE CASE
WITNESS: MICHAEL MULLALLY**

**BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

**WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION,**

Complainant,

v.

PUGET SOUND ENERGY,

Respondent.

**Docket UE-17 ___
Docket UG-17 ___**

PREFILED DIRECT TESTIMONY (HIGHLY CONFIDENTIAL) OF

MICHAEL MULLALLY

ON BEHALF OF PUGET SOUND ENERGY

**REDACTED
VERSION**

JANUARY 13, 2017

PUGET SOUND ENERGY
PREFILED DIRECT TESTIMONY (HIGHLY CONFIDENTIAL) OF
MICHAEL MULLALLY

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2 **PREFILED DIRECT TESTIMONY (HIGHLY CONFIDENTIAL) OF**
3 **MICHAEL MULLALLY**

4 **I. INTRODUCTION**

5 **Q. Please state your name, business address, and position with Puget Sound**
6 **Energy.**

7 A. My name is Michael Mullally. My business address is 355 110th Ave. N.E.,
8 Bellevue, WA 98004. I am the Manager, Business Initiatives within the Strategic
9 Initiatives department for Puget Sound Energy (“PSE”).

10 **Q. Have you prepared an exhibit describing your professional qualifications?**

11 A. Yes, I have. It is Exhibit No. ____ (MM-2).

12 **Q. What are your duties as Manager, Business Initiatives within the Strategic**
13 **Initiatives department for PSE?**

14 A. My responsibilities include conducting PSE’s request-for-proposals process for
15 resource additions, selling generation assets, developing greenfield resource
16 options, and monitoring emerging technologies.

17 **Q. What is the nature of your prefiled direct testimony?**

18 A. This testimony:

- 19
 - demonstrates that PSE’s purchase of the Buckley Natural Gas Distribution

20 System (“the Buckley gas system”) is reasonable;

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- demonstrates that the costs and rates associated with serving customers in the certificated area of Buckley are reasonable;
- describes the evaluation approach and results used by PSE in its decision to acquire the Buckley gas system, and
- supports a finding that the acquisition of the Buckley gas system is reasonable.

My testimony also

- demonstrates that the Glacier Battery Storage System pilot project (“Glacier Project”) is needed to reliably serve PSE’s customers;
- describes the evaluation approach and results used by PSE in its decision to acquire and construct the Glacier Project;
- describes the status of construction of the Glacier Project, and
- supports a finding that the acquisition and construction of the Glacier Project are reasonable.

In addition, my testimony

- demonstrates that PSE’s agreement to purchase power from the Wells Hydroelectric Project (“Wells PPA”) is reasonable;
- demonstrates that the costs associated with the Wells PPA are reasonable;
- describes the qualitative and quantitative evaluation approach and results used by PSE in its decision to enter into the Wells PPA, and
- supports a finding that the acquisition of the Wells PPA is reasonable.

1 **II. THE CITY OF BUCKLEY GAS SYSTEM**

2 **Q. Please describe PSE’s purchase of the Buckley gas system (“Buckley**
3 **System”).**

4 A. On June 26, 2014, PSE purchased for \$5.4 million the Buckley gas system, which
5 serves customers within a roughly 4.1 square-mile area of Buckley. The all-in
6 cost to PSE to acquire the facility was \$6.4 million.

7 **Q. Has the Commission issued any rulings regarding PSE’s acquisition of the**
8 **Buckley gas system?**

9 A. Yes. In Order 1 of Docket UG-140088, the Commission granted PSE’s
10 application to amend PSE’s Certificate of Public Convenience and Necessity.

11 **Q. Did the Commission render a determination regarding the reasonableness of**
12 **PSE’s decision to purchase the Buckley gas system?**

13 A. No. The Commission reserved such a determination for a future proceeding.

14 **Q. How did PSE become aware of the opportunity to acquire the Buckley gas**
15 **system?**

16 A. The City of Buckley (“City”) was negatively impacted by the global recession in
17 2008, and increasing administrative tasks to meet Washington state regulatory
18 requirements were challenging the City’s limited resources. Following a public
19 poll in which 76 percent of respondents were in favor of selling the City’s gas
20 system, the Buckley City Council unanimously approved a resolution to issue a
21 request for proposals (“RFP”). The City released an RFP to sell its natural gas

1 utility in January 2013. Bids, along with a bond of not less than five percent of
2 the total bid amount, were due to the City by June 13, 2013. Exhibit
3 No. ___(MM-3) is a copy of the RFP to sell Buckley’s natural gas utility.

4 **Q. Why did PSE decide to submit a bid?**

5 A. Upon completion of a thorough due diligence review, PSE staff determined that
6 the condition of the City’s natural gas system was comparable to PSE’s existing
7 system, and PSE uncovered no fatal flaws that would prevent PSE from acquiring
8 the facility. Exhibit No. ___(MM-4) is a copy of PSE’s presentation and report to
9 PSE’s Energy Management Committee (“EMC”) recommending that PSE submit
10 a bid to acquire the City’s gas utility. Exhibit No. ___(MM-5) is a copy of PSE’s
11 bid to purchase the utility.

12 **Q. Please describe the Buckley gas system.**

13 A. The Buckley gas utility consists of 36.73 miles of distribution lines (“mains”).
14 Most of the system is composed of wrapped steel mains, 20 miles of which were
15 installed in the 1950s as part of the original system. Newer sections of pipe are
16 made of high density polyethylene (“HDPE”) 3408. The newer HDPE pipe
17 installations make up 35 percent of the system’s mains and 37 percent of service
18 lines. The system includes one gate station (where gas is delivered from the City
19 of Enumclaw’s system) and three regulator stations.

1 **Q. Describe the Buckley community and customer base.**

2 A. The Buckley gas utility serves customers within the City limits. Utility customers
3 include 1,189 residential, 186 commercial, and the Rainier School. Thirty-eight
4 percent of the City's total gas load comes from the Rainier School, which is a
5 residential school for developmentally disabled individuals run by Washington's
6 Department of Social and Health Services.

7 **A. PSE's Evaluation of the Buckley System**

8 **Q. Describe PSE's evaluation team and summarize the review process for**
9 **acquisition of the Buckley System.**

10 A. From January to mid-May 2013, a cross-functional team of internal experts
11 assembled to evaluate the City's natural gas system. The team included
12 representatives from functional groups throughout PSE, such as engineering and
13 operations, gas supply and transportation, community and customer relations,
14 legal, insurance, real estate, environmental, rates and regulatory, accounting,
15 human resources, and financial planning and strategic initiatives.

16 As part of the due diligence process, the team reviewed RFP materials provided
17 by the City, submitted data requests, sought publicly-available information as
18 needed, spoke with City employees to address questions, conducted a leak survey,
19 and toured the above-ground gas-utility facilities.

1 **Q. Please describe PSE's evaluation of the gas system.**

2 A. The engineering and operations group reviewed a variety of materials supplied by
3 the City, including the operations and maintenance ("O&M") manual, inspection
4 and Commission action reports, and current maintenance records. PSE staff also
5 performed a field inspection of the above-ground facilities and analyzed the
6 system's capacity. The group determined that the Buckley System appears to be
7 comparable to the gas distribution system already owned and operated by PSE.
8 They uncovered no fatal flaws in the physical system during the course of its
9 evaluation. As such, the facility is believed to be reasonable to serve the
10 certificated area of Buckley.

11 **Q. Describe PSE's approach to evaluating real estate matters related to the**
12 **Buckley System.**

13 A. PSE's real estate due diligence confirmed that the City either held or would
14 acquire all necessary property rights to operate and maintain the gas utility. Title
15 research confirmed many existing easements. New easements were acquired over
16 lands with existing gas infrastructure, but without an easement or other operating
17 rights.

18 **Q. Please describe PSE's environmental review related to the Buckley System.**

19 A. PSE engaged consultant GeoEngineers to review and prepare a report of potential
20 environmental matters associated with the purchase of the Buckley gas system.
21 See Exhibit No. ___(MM-6) for a copy of the GeoEngineers report. Given the

1 relative youth of the gas system, the potential for system-related environmental
2 concerns is limited. Additionally, the potential for third-party contamination
3 impacting pipeline alignment is consistent with conditions throughout PSE's gas
4 and electric system. GeoEngineers and PSE ultimately determined that there were
5 no known environmental risks that would prevent PSE from acquiring the City's
6 gas system.

7 **Q. Describe the pipeline and natural gas supply arrangements established by**
8 **the City to serve Buckley's customers.**

9 A. Prior to PSE ownership, the City held three contracts related to pipeline and
10 natural gas supply. All three of the contracts were assignable to PSE. See Exhibit
11 No. ___(MM-7) for copies of the transfer agreements. PSE determined that the
12 existing gas and pipeline agreements were sufficient to meet the needs of Buckley
13 customers, and the pipeline and supply agreements were assigned to PSE.
14 Additionally, PSE required that a new transportation agreement be executed with
15 the City of Enumclaw to clarify various vague terms and uncertainties contained
16 in the original agreement. See Exhibit No. ___(MM-8) for a copy of the new
17 agreement.

1 **Q. Has PSE prepared an exhibit that includes analysis results and pro forma**
2 **financial statements for the Buckley gas system?**

3 **A.** Yes. PSE prepared Exhibit No. ___(MM-9C), which summarizes the results of
4 the gas system valuation and includes long-term financial projections for the
5 facility.

6 **Q. What was PSE's estimate of the total transaction costs to acquire the Buckley**
7 **gas system at the time PSE submitted its bid and subsequently completed the**
8 **purchase?**

9 **A.** PSE estimated total acquisition costs in the amount of \$6.1 million, which
10 included the purchase price, transaction costs, and one-time capital and O&M
11 costs to integrate the Buckley gas system into PSE's existing system.

12 **Q. How did PSE determine the value of the Buckley gas system and select its bid**
13 **price?**

14 **A.** PSE used the Discounted Cash Flow valuation method to consider a range of
15 potential payback periods and establish the value of the gas system. PSE's
16 analysis focused on potential payback periods between 20 and 30 years, which
17 produced a corresponding range of purchase price results between \$5.0 and \$6.4
18 million net of transaction costs. The assumed depreciable life of the purchased
19 asset is 36 years. The acquisition will provide a net benefit to existing customers
20 with payback less than the depreciable life. PSE selected a purchase price and

1 corresponding payback period at the low end of the range, resulting in a \$5.4
2 million purchase price to be recovered over a 22-year payback period.

3 PSE's analysis used a 6.70 percent discount rate based on PSE's approved after-
4 tax cost of capital from the 2011 General Rate Case. PSE's analysis indicates that
5 a purchase price of \$5.4 million is reasonable.

6 **Q. How will PSE's acquisition affect rates?**

7 A. PSE's analysis projected that former residential Buckley customers would see a
8 5.4 percent decrease in rates, commercial rates would stay flat, and the Rainier
9 School would see a 5.2 percent increase. PSE's acquisition of the Buckley gas
10 system will not impact the rates of other PSE customers.

11 **Q. Please describe PSE's efforts to keep PSE management informed during the**
12 **evaluation process.**

13 A. PSE provided a series of updates to the Energy Management Committee
14 throughout the process, including three formal presentations in May 2013 prior to
15 submitting a bid for the gas system and one on February 20, 2014 prior to
16 acquiring the gas system.

17 **B. Current Status of the Transition**

18 **Q. Please provide an update on the status of the transition.**

19 A. PSE's planned integration work is complete. Specifically, PSE has completed 1)
20 adding supervisory control and data acquisition ("SCADA") and remote terminal

1 unit (“RTU”) capabilities, 2) replacing existing meters with models used by PSE’s
2 system and adding automated meter reading (“AMR”) capabilities, 3) replacing
3 some of the regulators and overpressure protection devices with models used by
4 PSE, 4) transferring and integrating mapping data to PSE’s system, and 5)
5 performing a leak survey. PSE found no significant leaks.

6 **Q. What was the actual cost for the Buckley gas system?**

7 A. The actual costs to acquire and integrate the Buckley gas system total \$6.41
8 million. Combined, capital and O&M costs were \$280 thousand higher than
9 PSE’s original estimate. This increase was driven by the manner in which PSE
10 implemented the system integration process. PSE originally planned to replace
11 Buckley’s meters over an extended period of several months through the normal
12 course of business operations. Instead, PSE replaced the meters over several
13 weekends for a quicker transition prior to the start of the heating season.

14 The integration overruns did not significantly impact the financial benefits of the
15 purchase. The payback period increased one year from 22 to 23 years (offset by
16 underestimated usage).

1 **III. GLACIER**

2 **Q. Please describe the Glacier Battery Storage System pilot project (“Glacier**
3 **Project”).**

4 A. The Glacier Project is a 2.0 MW/4.4 MWh lithium-iron phosphate¹ battery
5 storage system located in Whatcom County, Washington. The Glacier Project is
6 located on land owned by PSE adjacent to the Glacier substation, and
7 interconnects to the 12.5 kV Glacier-12 distribution circuit.

8 **Q. Describe the system benefits of the Glacier Project.**

9 A. The Glacier Project is designed to be a valuable distributed generation resource
10 that can address multiple system needs from a single facility including
11 distribution system improvements, new system resources,² enhanced operational
12 flexibility, and a deeper understanding and firsthand experience with grid-scale
13 energy storage systems.

14 **Q. Describe the benefit of energy storage to operational flexibility on PSE’s**
15 **system.**

16 A. Load fluctuations, balancing authority obligations to integrate scheduled
17 interchanges, unexpected events like forced outages, and the need to maintain

¹ Lithium-iron phosphate is one of the most common lithium-ion battery chemistries. It compares favorably with other lithium-ion battery chemistries in areas of versatility, safety, performance and cost.

² As identified in PSE’s 2013 Integrated Resource Plan (“IRP”).

1 contingency reserves to assist other balancing authorities with sudden load
2 balancing needs all place demands on generators to provide system flexibility.

3 The hydro generation resources on the middle Columbia (“Mid-C”) are typically
4 used to provide frequency regulation and spinning reserves, but during periods of
5 constrained operations, PSE often uses simple-cycle combustion turbines for
6 spinning reserves, which incur start charges, fuel costs, and O&M costs. Year-to-
7 year there can be high variability in hydro conditions and other factors that drive
8 the costs and challenges of providing adequate flexibility. Battery storage
9 systems are well-suited to provide flexibility services. In fact, the majority of
10 large battery storage systems deployed on the grid today are for frequency
11 regulation services.

12 **Q. How did PSE keep management informed during the evaluation of the**
13 **Glacier Project?**

14 A. PSE provided a series of presentations and updates to PSE management: one in
15 2013 (November 7), two in 2014 (October 31 and December 5), and six in 2015
16 (February 16, March 19, April 13, April 27, and July 21).

17 **Q. Describe the Clean Energy Fund grant.**

18 A. In 2013, the Washington Legislature allocated \$40 million in the state capital
19 budget for clean energy programs to be administered by the Washington State
20 Department of Commerce (“Commerce”). Fifteen million dollars were allocated
21 for the Smart Grid Program. Selected smart grid projects, including energy

1 storage, could receive up to a 50 percent cost match from the Clean Energy Fund
2 (“CEF”).

3 Given PSE’s ongoing need for distribution system solutions on a number of
4 circuits and the need for electric capacity resources established by PSE’s 2013
5 integrated resource plan, PSE recognized that a battery storage system could offer
6 the following benefits:

- 7 • support Washington state’s energy strategy and policy priorities,
- 8 • help meet multiple distribution and generation resource needs with one
9 facility,
- 10 • gain experience developing and operating a demonstration resource
11 utilizing an innovative new technology of meaningful size at a reduced
12 cost and risk,
- 13 • establish credibility for potential future storage solutions to address system
14 needs,
- 15 • work with Snohomish Public Utility District and other partners (Doosan
16 GridTech,³ Alstom) to develop modular energy storage architecture
17 (“MESA”) standards.

18 PSE submitted a grant application in December 2013 and was awarded \$3.8
19 million in July 2014. This represented an approximately 39 percent cost match.⁴

³ Formerly 1Energy.

⁴ As the Glacier Project matured through the planning, design and engineering, and construction phases, PSE refined its estimated costs based on further due diligence and actual, rather than estimated costs.

1 **A. PSE's Evaluation of the Glacier Project**

2 **Q. Please describe PSE's process in evaluating the decision to acquire the**
3 **Glacier Project.**

4 A PSE's evaluation process included both an initial feasibility assessment performed
5 prior to PSE's decision to submit a CEF grant application in December 2013, and
6 a planning phase that included further due diligence between January and
7 December 2014 prior to PSE's decision to execute key Glacier Project contracts.
8 PSE evaluated multiple sites for construction, and ultimately selected the Glacier-
9 12 site, which is located on land already owned by PSE adjacent to the Glacier
10 substation in the North Cascade foothills. Ultimately, PSE selected the Glacier-
11 12 site for the following reasons: (1) PSE's annual planning assessments
12 indicated a need for improved reliability on the Glacier-12 circuit/line; (2) the site
13 experiences frequent long outages in an area difficult to repair during storms; (3)
14 there is no good alternative solution or mitigation plan; (4) the load profile of the
15 area is such that all or part of the downtown area could be islanded in an outage to
16 run on the battery system alone, offering short-term relief to local businesses and
17 needed services to customers, and (5) the potential to use existing hydro
18 generation on the circuit to create a microgrid that could island both the
19 downtown Glacier corridor and local residential customers during an outage, and
20 could effectively eliminate transmission-related outages in this area.

1 **Q. How did PSE identify and evaluate potential engineering, procurement and**
2 **construction (“EPC”) contractors for the Glacier Project?**

3 A. PSE issued a request for qualifications (“RFQ”) for parties interested in the role
4 of EPC contractor for a battery storage project. PSE received four responses to
5 the RFQ. Based on these responses, the Glacier Project team evaluated and
6 scored respondents on each of the following key criteria: experience with battery
7 storage projects and technology selection, O&M services, willingness to perform
8 under an open book or cost-plus arrangement, vendor preferences or partnerships,
9 warranty and performance guarantee terms, references, relationship and/or prior
10 experience working with PSE, and relationships with local vendor partners.
11 Additionally, PSE included a miscellaneous category to include strengths that did
12 not naturally fit into one of the other categories. Miscellaneous strengths included
13 demonstrating proactive behavior during the RFQ evaluation process, sharing cost
14 estimates, responsiveness to PSE requests, and a willingness to work within and
15 support MESA architecture. Exhibit No. ___(MM-10HC) compares the
16 individual respondent scores. PSE ultimately selected the respondent with the
17 highest total score, RES Americas (“RES”).

18 **Q. Why did PSE select lithium-iron phosphate batteries for the Glacier Project?**

19 A. Lithium-iron phosphate is one of the most common lithium ion battery
20 chemistries. It is a versatile technology that compares well with other lithium-ion
21 batteries in areas of safety, performance and cost. Lithium-ion batteries can adapt
22 to a range of power and energy ratings, and can perform a wide variety of

1 services. Advantages include high energy density, high power, high efficiency,
2 low self-discharge, lack of cell “memory” and fast response time.

3 Further, lithium-ion battery technology is a proven technology that has been the
4 subject of tremendous research and development investment in recent years.

5 These batteries have become affordable, long-lasting, and can now be
6 manufactured at the scale required for use in utility grids. Battery systems like
7 this are currently being used by many other utilities, commercial, industrial and
8 even residential customers. There are approximately 70 lithium-ion battery
9 storage systems with power ratings 1 MW or greater currently operating
10 worldwide.⁵

11 **Q. Who did PSE choose to supply its batteries?**

12 A. PSE chose BYD, which is the world’s largest and most experienced lithium-iron
13 phosphate battery manufacturer. RES has used the same BYD battery systems for
14 two other energy storage projects.

15 **Q. Describe the engineering and design phase of project development.**

16 A. During the engineering and design phase, PSE worked with its project partners to
17 perform permitting, detailed design work, IT/SCADA development and islanding
18 design (for backup power). PSE initiated the interconnection process, which in
19 turn triggered the System Impact Study and Facility Study processes.

20 Additionally, as development work progressed, PSE updated its cost estimates

⁵ U.S. Department of Energy Global Energy Storage Database (DOE GESDB), August 2015. (<http://www.energystorageexchange.org>).

1 and schedule to reflect the most current information available prior to the
2 construction phase.

3 **Q. Please describe the System Impact and Facility studies?**

4 A. A draft System Impact Study (“SIS”) released on March 6, 2015 revealed that
5 substation upgrades, primarily a circuit switcher on the high side of the Glacier
6 transformer, would be required to interconnect the Glacier Energy Storage System
7 (“ESS”) to PSE’s distribution system at its planned 2 MW capacity. Because
8 Glacier is an older substation, needed upgrades were expected to be more
9 substantial and likely more expensive than typical. PSE estimated that costs
10 could be between \$900,000 and \$2.0 million, and schedule impacts were expected
11 to be roughly four to six months. A Facility Study was then performed, which
12 produced refined cost estimates for interconnection, including a more realistic
13 estimate of \$1.5 million for the circuit switcher. In addition to the Facility Study,
14 PSE continued to evaluate alternative sites.

15 **Q. What was the result of the Facility Study and alternative site evaluation?**

16 A. The alternative site evaluation favored the Glacier Project and, along with the
17 development progress to date and the near-complete Facility Study, PSE staff felt
18 confident that the Glacier Project remained the best option. The Glacier Project
19 was in an advanced stage of design (90 percent complete) and nearly shovel-
20 ready. Whatcom County had issued the conditional use permit in June 2015. The
21 Phase 1 interconnection agreement, land disturbance permit, and factory testing of
22 the battery system were all expected to be completed in August 2015, and

1 delivery of the battery system was expected in October. Finally, the team had a
2 limited window to re-start construction before missing a contractual clearing and
3 grading date with RES (August 26, 2015) that could result in additional cost.

4 **B. Current Status of the Glacier Project**

5 **Q. Please provide an update on the status of the construction work.**

6 A. Construction of the first phase of the Glacier Project was completed spring 2016.
7 This phase connected the batteries to the PSE distribution circuit allowing remote
8 discharge of up to 300 kW. The second phase of the Glacier Project required
9 upgrades to the existing Glacier substation, allowing remote dispatch of the full
10 output up to 2 MW. The rebuilt substation was energized September 2016.
11 Islanding testing is on-going, with full islanding capabilities planned for 2017.
12 Now that the upgrades are complete and the battery system is fully functional,
13 Pacific Northwest National Laboratory (“PNNL”) can conduct use-case testing
14 and analysis. PNNL’s evaluation will help PSE determine how best to utilize the
15 batteries for PSE’s system.

16 **Q. Please describe any material changes to the budget since management**
17 **approved execution of the project in July 2015.**

18 A. Table 1 is a revised budget for the Glacier Project based on current cost estimates
19 and actuals. The revised budget reflects cost increases associated with the
20 substation upgrades required for interconnection (higher circuit switcher and
21 associated infrastructure improvement costs), clearing and grading, PSE internal

1 support of ESS, and other costs that were a challenge to anticipate given the
 2 research and development nature and remote location of the Glacier Project.
 3 These upgrades increased the cost by approximately \$1.5 million.

4 **Table 1. Revised cost estimate for 2 MW Glacier ESS**

PROJECT COST (ex. AFUDC) (\$000)	Jul 2015	Oct 2016	Variance	Notes
EPC Contract	████	████	0	
Development, Permitting	██	██	12	
Electrical	████	████	598	Substation upgrades & islanding infrastructure
Site/Civil	██	██	101	Clearing, grading & security
IT/SCADA	██	██	21	Islanding hardware & software costs
Control System	██	██	63	Doosan GridTech consulting & PNNL testing support
Support of GLA-ESS (Support of Glacier Battery Site)	██	██	643	PSE support of EPC contract, including design, construction, testing and commissioning; PNNL testing support
Total Cost	9,763	11,201	1438	
Commerce Grant	(3,800)	(3,800)	-	
Net Cost	5,963	7,401	1,438	

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1 **IV. WELLS HYDROELECTRIC PROJECT POWER**
2 **PURCHASE AGREEMENT**

3 **Q. Please describe the Wells Hydroelectric Project.**

4 A. The Wells Hydroelectric Project (“Wells Project”) is a 10-unit, 840 MW
5 hydroelectric facility owned and operated by Public Utility District No. 1 of
6 Douglas County, Washington (“Douglas PUD”) and located on the Columbia
7 River. The Wells Project began commercial operation in 1967 and the Federal
8 Energy Regulatory Commission issued a new 40-year license in May 2012. The
9 Wells Project produces an average of four million MWh of electricity per year.
10 The Wells Project is currently used to serve local load in Douglas County, and
11 surplus energy is sold to third-parties under an existing power purchase agreement
12 (“PPA”). PSE has contracted to purchase a portion of the output of the Wells
13 Project since it began operating in 1967.

14 **Q. Please describe the first Wells PPA.**

15 A. The first Wells PPA was executed between Douglas County PUD and PSE in
16 1963, while the project was still under construction. Nearly identical agreements
17 were signed at that time by Portland General Electric, PacifiCorp, and Avista.
18 Under the first Wells PPA, PSE pays a share of the actual Wells Project costs that
19 is proportional to PSE’s share of the output. Project costs include operations and
20 maintenance expenses, payments of principal and interest on project debt, and all
21 taxes and fees associated with operation of the project. PSE’s current share of the
22 output is 29.9 percent, (approximately 251 MW), resulting in a cost of

1 approximately \$17 million per year. The first Wells PPA term expires August 31,
2 2018.

3 **Q. Has PSE negotiated a renewal of the first Wells PPA?**

4 A. Yes. Over the last several years, PSE and the three other purchasing parties have
5 negotiated as a group with Douglas County PUD to renew the first Wells PPA.
6 The resulting multi-party agreement has been offered to the four original
7 purchasers. Under the new Wells PPA, each of the purchasing parties would
8 receive a share of benefits and obligations in proportion to its participation in the
9 first Wells PPA. Specifically:

- 10 (i) PSE would receive 50.5 percent of the output of the Wells Project
11 offered by Douglas County PUD to the original purchasers;
- 12 (ii) Portland General Electric would receive 32.8 percent of the output
13 of the Wells Project offered by Douglas County PUD to the
14 original purchasers;
- 15 (iii) PacifiCorp would receive 11.1 percent of the output of the Wells
16 Project offered by Douglas County PUD to the original purchasers;
17 and
- 18 (iv) Avista would receive 5.6 percent of the output of the Wells Project
19 offered by Douglas County PUD to the original purchasers.

20 Since finalizing the terms and conditions of the new Wells PPA, [REDACTED]
21 [REDACTED]

22 If [REDACTED] ultimately chooses not to enter into the new contract, the three
23 remaining purchasers would each receive a pro rata share of the [REDACTED] share.

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1 **A. Terms and Benefits of the New Wells PPA**

2 **Q. Describe generally the key terms of the new Wells PPA.**

3 A. As stated earlier in my testimony, Wells Project output is partially used to serve
4 local load in Douglas County. The new Wells PPA offers a proportional share of
5 the output that is surplus to Douglas County PUD's load requirements for a period
6 of ten years, from September 2018 through August 2028. Share volume under the
7 new Wells PPA will be calculated annually and will decrease over time based on
8 Douglas County PUD's load growth. This calculation is subject to contractual
9 minimum quantities guaranteed to the purchasers that may not be reduced, even if
10 Douglas County PUD is unable to meet its own load. However, Douglas County
11 PUD's load growth would have to be extraordinarily high in order for the
12 contractual minimum quantities to be effective.

13 In addition to a percentage allocation of Wells Project output, energy reserved for
14 Douglas County that exceeds Douglas County PUD's customer load will be
15 purchased on a short-term basis. The new Wells PPA may be terminated early if
16 the Wells Project is unable to generate output.

17 **Q. What are the anticipated costs of the new Wells PPA?**

18 A. The price per unit for the new Wells PPA is relatively flat, around \$ [REDACTED] per MWh
19 over the ten-year term. The estimated total cost of the new Wells PPA depends
20 on how much Wells Project output is allocated to PSE. As described above, that
21 quantity will depend on Douglas County PUD's load growth. Table 2 below

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1 illustrates a range of potential total PPA costs with and without an allocation of
2 the [REDACTED] share.

3 **Table 2. Range of Potential Total Costs of the New Wells PPA**
4

Scenario	Total Cost of New Wells PPA (\$ in thousands)
New Wells PPA - High Quantity (without [REDACTED] share)	\$416,783
New Wells PPA - Minimum Quantity (without [REDACTED] share)	\$239,406
New Wells PPA - High Quantity (with [REDACTED] share)	\$500,140
New Wells PPA - Minimum Quantity (with [REDACTED] share)	\$287,288

5 “Minimum” values assume PSE’s allocation of Wells output is equal to the
6 contractual minimum guaranteed quantities. “High” values assume relatively low
7 Douglas County load growth, as was projected by Douglas County PUD in 2015.
8 Douglas County PUD’s 2016 long-term load forecast was significantly higher
9 (corresponding to lower PSE allocation share and lower all-in total cost), and that
10 more recent forecast has been used to develop the “Likely outcomes” in the
11 analysis described below.

12 **Q. Does the new Wells PPA provide benefits to PSE and its customers?**

13 A. Yes; the new Wells PPA provides clear benefits to PSE and its customers,
14 including:

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1 **The new Wells PPA helps PSE to achieve lower overall resource portfolio**
2 **costs.** PSE’s evaluation of the new Wells PPA using the Portfolio Screening
3 Model III (“PSM III”) demonstrates a net present value benefit to PSE’s electric
4 portfolio of between \$15 and \$40 million (see Figure 6, below), depending upon
5 the allocation of the Wells Project output.

6 **The new Wells PPA helps to reduce PSE’s projected long-term energy and**
7 **capacity deficit.** The new Wells PPA is consistent with PSE’s Integrated
8 Resource Plan and eliminates the sudden loss of more than 200 MW of existing
9 resources in 2018. Instead, the new Wells PPA gradually ramps down, allowing
10 PSE the ability to plan for and replace the resource over time rather than all at
11 once.

12 **The new Wells PPA secures critical operational flexibility and ancillary**
13 **products.** The new Wells PPA assures PSE of continued access to one of the
14 region’s most valuable and scarce hydroelectric resources. Wells Project output is
15 a flexible resource that allows frequent and rapid changes to generation levels.
16 This capability is used by PSE to balance its system within each hour and to
17 respond to rapid changes in load or the output of other resources. Continued
18 access to this large hydroelectric resource is a critical step toward assuring a
19 stable, reliable, and low cost electric supply, including certain ancillary services,
20 and helps to ensure PSE’s ability to meet base-load, daily and seasonal peaking
21 requirements, and to integrate existing and incremental wind and other variable
22 production resources into PSE’s supply portfolio.

1 **The new Wells PPA is an emission free resource offering valuable diversity to**
2 **PSE’s portfolio that helps limit PSE’s exposure to thermal resource risks.**

3 Washington regulations such as the state Renewable Portfolio Standards (Chapter
4 19.285 RCW) and the recently established Clean Air Rule (Chapter 173-442
5 WAC), have increasingly sought to promote renewable resources and to limit
6 emissions from thermal resources. The new Wells PPA allows PSE to safeguard
7 its valuable hydroelectric resources at a time when natural gas resources,
8 particularly those with fast-start capabilities, are becoming more difficult to
9 permit and opportunities to acquire additional hydro power are scarce. PSE
10 anticipates that the flexibility and emissions-free nature of the Wells Project will
11 continue to provide valuable qualitative as well as quantitative benefits over the
12 life of the contract.

13 **Q. What is the risk if PSE chooses not to renew the PPA at this time?**

14 A. Douglas County PUD strongly prefers to execute a single agreement with all of
15 the purchasing parties at once, rather than separate agreements with each
16 individual purchaser. Therefore, it has taken years to negotiate the currently
17 offered terms. Douglas County PUD has indicated that further delay in executing
18 the multi-party new Wells PPA would result in changes to the offered terms, and
19 Douglas County PUD would likely seek alternative buyers for the Wells Project
20 output. PSE does have a right of first refusal for its share of the Wells Project
21 output under the original Wells PPA, which PSE could exercise if a contract for

1 PSE's share was offered to another party. However, it is likely that the new
2 contract terms would be less favorable than the currently offered terms.

3 **Q. What is PSE's share of the projected capacity under the new Wells PPA?**

4 A. Actual capacity varies throughout the year according to an annual calculation of
5 PSE's seasonal allocation percentages; however, the contract offers PSE a
6 guaranteed minimum share based on Douglas County PUD's projected load, less
7 a margin of safety. As shown in Figure 1, the minimum guaranteed allocation
8 starts at ■ MW in 2018 but decreases over time to ■ MW in 2027. PSE has
9 also estimated "high" and "likely" values for its capacity share based on Douglas
10 County PUD's most recent load forecast. The red bar in Figure 1 represents the
11 likely allocation based on current projections of Douglas County PUD's retail
12 load growth. PSE's estimate for the high end of the range begins at ■ MW in
13 2018, but decreases to ■ MW by 2027.

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1

Figure 1. PSE Winter Capacity New Wells PPA (MW)



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In the event that [REDACTED] does not renew its share of the new Wells PPA, PSE

4

would pursue a pro rata share of the [REDACTED] share. As shown in Figure 2, the

5

additional pro rata share is estimated to result in an increase of between [REDACTED] to

6

[REDACTED] MW of additional capacity starting in 2018, depending on Douglas County

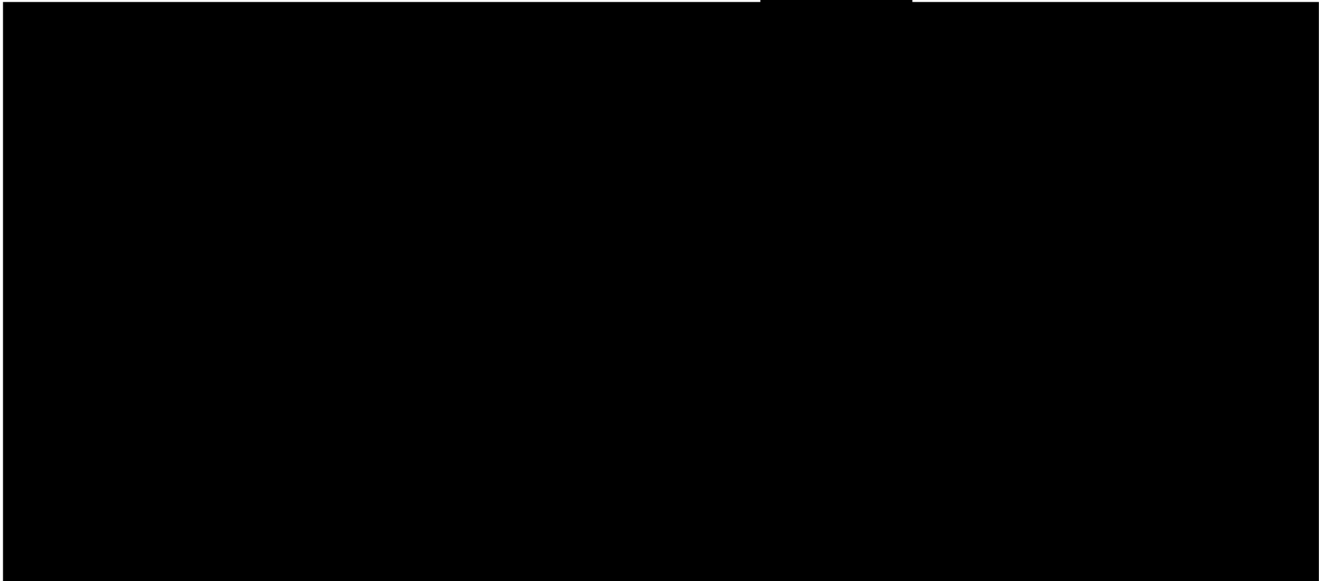
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PUD's load growth.

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Figure 2. PSE Winter Capacity with [REDACTED] Share (MW)



Q. Does PSE have a peak capacity need for this resource in 2018?

A. Yes. While PSE’s revised 2015 Integrated Resource Plan (“IRP”) need assessment indicates that there is no need to acquire new electric resources until 2022, this assessment assumed that the new Wells PPA would be renewed at current contractual levels in 2018. As shown in Table 3, if the contract is not renewed as anticipated, PSE would have a peak capacity need of 154 MW beginning in 2018.

Table 3. Projected PSE Capacity Need

	2017	2018	2019	2020	2021	Surplus/(Need)		2023	2024	2025	2026	2027
Revised 2015 IRP - 2016 Load Forecast	255	58	43	114	75	(220)	(226)	(245)	(342)	(703)	(742)	
Less Wells		(212)	(212)	(212)	(212)	(212)	(212)	(212)	(212)	(212)	(212)	(212)
Projected Need	255	(154)	(169)	(98)	(137)	(432)	(438)	(457)	(554)	(915)	(954)	

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1 **B. PSE's Quantitative Evaluation of the New Wells PPA**

2 **Q. What quantitative modeling tools did PSE use to evaluate the PPA?**

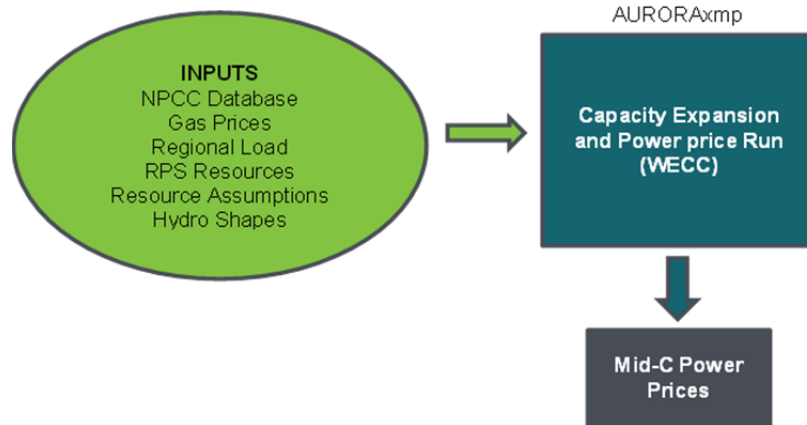
3 A. PSE used the 2015 IRP model framework to evaluate the potential cost or benefit
4 of the new Wells PPA to PSE's power portfolio. Two models were used to
5 perform this evaluation: AURORA[®] and PSE's Portfolio Screening
6 Model III ("PSM III"). Detailed descriptions of the two models, their inputs and
7 outputs can be found in Appendix N. See Exhibit No. ____ (MM-11) for a copy of
8 Appendix N to PSE's 2015 IRP.

9 **Q. Please describe PSE's quantitative evaluation.**

10 A. First, PSE used the AURORA model to create power prices. AURORA analyzes
11 the Western power market to produce hourly electricity price forecasts of
12 potential future market conditions and resource dispatch. Various inputs are used
13 to develop the market prices as illustrated below in Figure 3.

1

Figure 3. Inputs Used to Develop Market Prices



2

PSE’s portfolio was then isolated and re-run in AURORA to determine the dispatch of specific units within the portfolio. The AURORA analysis produces estimates of energy (MWh), variable costs (fuel costs + variable O&M), and the market value of energy.

6

Second, PSE optimized PSM III to determine the optimal portfolio, with and without the new Wells PPA, to meet PSE’s resource need. The purpose of the optimization model is to create an optimal mix of new generic resources that minimizes the net present value of the revenue requirement⁶ while meeting the peak capacity requirements and the renewable portfolio standard across the portfolio. The model takes into account market projections for gas and electric projects derived from the AURORA model.

13

If PSE does execute the new Wells PPA, it will be deficient in meeting its peak capacity requirement beginning in 2018, when the original Wells PPA expires.

15

The least cost alternative resource is a simple cycle frame peaker, which could be

⁶ The revenue requirement is the incremental portfolio cost for the 20-year forecast.

1 on-line in 2021. In the short term from 2018 to 2020, the analysis assumes a
2 power bridging agreement.

3 **Q. Please describe the Portfolio Screening Model III.**

4 A. The PSM III is a spreadsheet-based capacity expansion model that PSE developed
5 to evaluate the incremental costs and risks of a wide variety of resource
6 alternatives and portfolio strategies. This model produces the least-cost mix of
7 resources using a linear programming, dual-simplex method that minimizes the
8 present value of portfolio costs subject to planning margin and renewable
9 portfolio standard constraints.

10 The solver used for the linear programming optimization is Frontline Systems'
11 Risk Solver Platform. This is an MS Excel add-in that works with the in-house
12 financial model. Incremental costs include: a) the variable fuel cost and emissions
13 for PSE's existing fleet, b) the variable cost of fuel emissions and operations and
14 maintenance for new resources, c) the fixed depreciation and capital cost of
15 investments in new resources, d) the booked cost and offsetting market benefit
16 remaining at the end of the 20-year model horizon (called the "end effects"), and
17 e) the market purchases or sales in hours when resource-dispatched outputs are
18 deficient or surplus to meet PSE's need.

19 The primary input assumptions to the PSM are:

- 20 1. PSE's peak and energy demand forecasts,
21 2. PSE's existing and generic resources along with their capacities
22 and outage rates,

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- 3. expected dispatched energy (MWh), variable cost (\$000), and revenue (\$000) from AURORAxmp for existing contracts and existing and generic resources,
- 4. capital and fixed-cost assumptions of generic resources,
- 5. financial assumptions such as cost of capital, taxes, depreciation, and escalation rates, and
- 6. capacity contributions, planning margin constraints, and renewable portfolio targets.

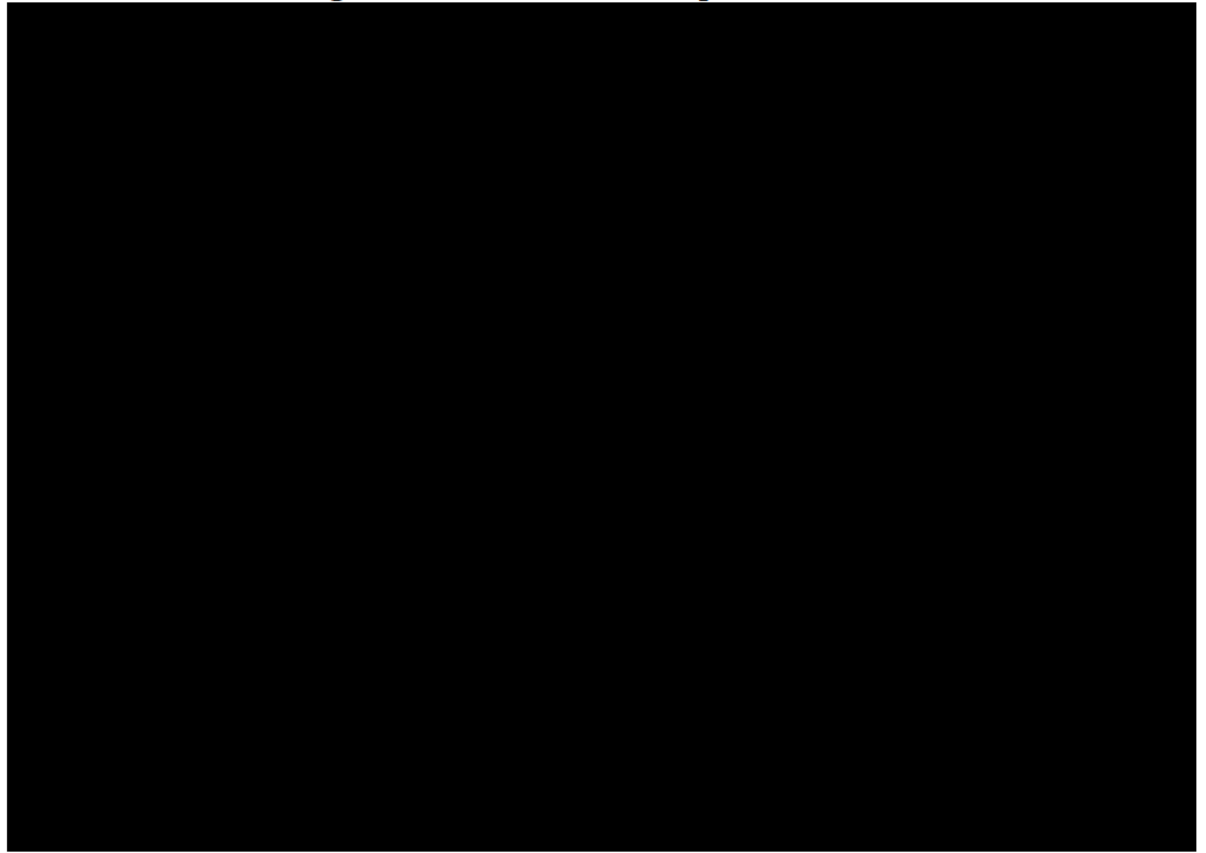
Q. Did PSE update PSM III after the 2015 IRP?

A. Yes. PSE revised several of its modeling assumptions after the 2015 IRP. PSE updated natural gas prices, which resulted in lower electric prices. PSE returned to using a 5 percent loss of load probability to establish peak capacity need in response to Commission guidance in its 2015 IRP acceptance letter. PSE updated capital costs based on new projections. Finally, PSE assumed the shutdown of Colstrip Units 1 and 2 in mid-2022.

Q. What gas prices were assumed in the evaluation of the new Wells PPA?

A. PSE used the gas price forecasts depicted in Figure 4, which were updated as of November 2015.

Figure 4. Gas Price Comparison



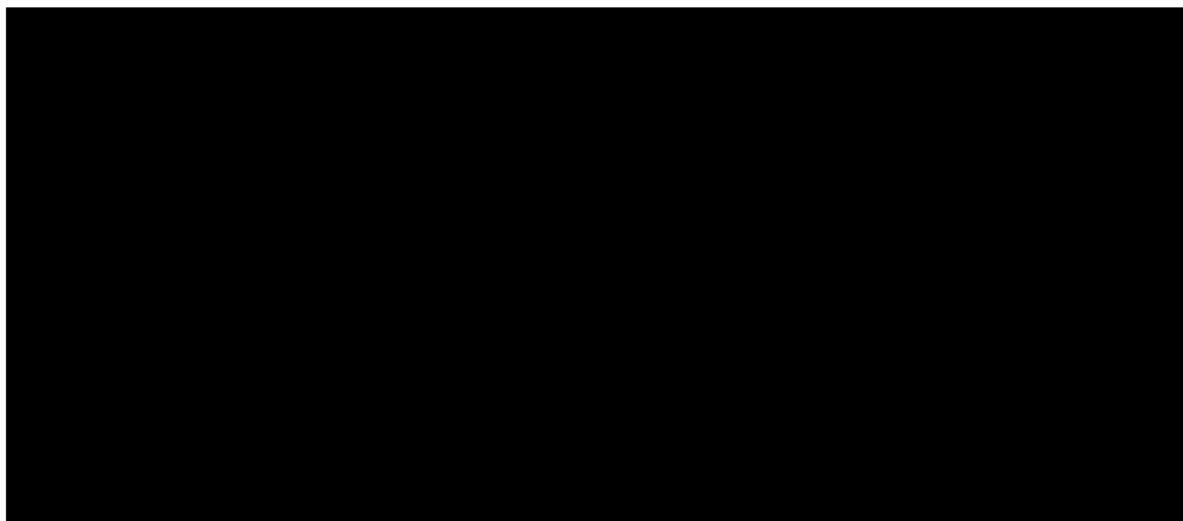
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3 **Q. Did PSE compare the new Wells PPA price with a current estimate of**
4 **equivalent market power?**

5 A. Yes; PSE developed an estimate of the price of market power using
6 AURORAxmp®. The AURORA model, its inputs and outputs are described in
7 detail in Exhibit No. ___(MM-11). PSE then compared the annual new Wells
8 PPA prices with the AURORA forecast of market prices.

9 As depicted in Figure 5, the new Wells PPA price remains relatively flat,
10 remaining in the mid-█ in \$/MWh, over the life of the contract. In the early
11 years of the new Wells PPA, the price is higher than the AURORA forecast, but

1 during the latter years of the contract, as market prices escalate, the new Wells
2 PPA price is lower.

3 **Figure 5. New PPA Price vs. Market Forecast (\$/MWh)**



4
5 **Q. Describe how PSE modeled its resource portfolio with and without the Wells**
6 **PPA.**

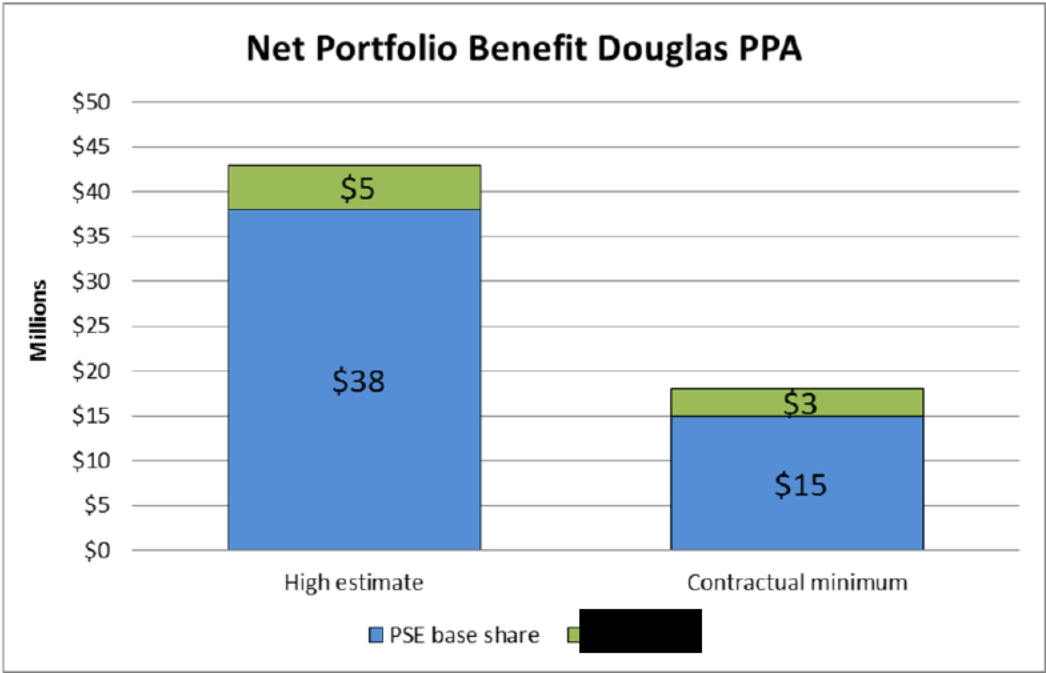
7 A. PSM III was optimized on a non-integer basis, allowing partial builds to fill gaps
8 to meet the capacity need. Running the model in partial-build mode eliminates
9 the unevenness of adding resources in large chunks. In this mode, the model
10 assumes the portfolio can be built around a particular resource choice to perfectly
11 meet the established need. In each scenario, the capacity gap is filled with power
12 bridging agreements at varying levels until a plant can be built to fill the gap in
13 2021.

14 **Q. What were the results of the economic evaluation?**

15 A. As illustrated in Figure 5, the results show that the new Wells PPA will provide a
16 net benefit to the portfolio between \$15 and \$40 million, depending on actual

1 allocations. At the time of the evaluation, [REDACTED] had only recently indicated
2 that it would not execute the new Wells PPA. The [REDACTED] share shown in
3 Figure 6 represents [REDACTED] percent of the [REDACTED] share. However, PSE would
4 receive a pro rata share of the [REDACTED] share, roughly half of the amount that
5 was originally modeled.

6 **Figure 6. Net Portfolio Benefit of New Wells PPA**



7 PSE’s estimated portfolio costs with and without the new Wells PPA are shown in
8 Table 4. Portfolio costs include the variable fuel costs of PSE’s existing portfolio,
9 fixed and variable costs of assumed new resources, market purchases when the
10 portfolio is deficient in any hour and market sales when the portfolio is surplus.
11 PSE ran the model in two ways: 1) partial builds, which represent how the
12 portfolio fits around the resources, and 2) full builds, which represent how the
13 resource fits into the portfolio builds.
14

Table 4. Portfolio Cost: Partial and Full Builds

\$ in Millions

Partial Builds (Non-Integer)	Wells w/ PSE share only -High estimate	Wells w/ PAC - High estimate	Wells w/ PSE share only - Contractual minimum	Wells w/ PAC share - Contractual minimum
Douglas Wells PPA Scenarios	\$8,035	\$8,030	\$8,058	\$8,055
Without Douglas Wells PPA Scenarios	\$8,073	\$8,073	\$8,073	\$8,073
Savings	\$38	\$43	\$15	\$18

Full Builds (Integer)	Wells w/ PSE share only -High estimate	Wells w/ PAC - High estimate	Wells w/ PSE share only - Contractual minimum	Wells w/ PAC share - Contractual minimum
Douglas Wells PPA Scenarios	\$8,028	\$8,031	\$8,064	\$8,065
Without Douglas Wells PPA Scenarios	\$8,075	\$8,075	\$8,075	\$8,075
Savings	\$47	\$44	\$11	\$10

Q. How does the portfolio analysis for the Douglas Wells PPA compare to other resource proposals PSE has received?

A. In Q4 2016 [REDACTED] and [REDACTED] each initiated conversations with PSE to determine our interest in their [REDACTED] and [REDACTED] facilities, respectively. The two [REDACTED] plants have similar attributes and both resources are sized to produce more than [REDACTED] MW of electrical output. This exceeds PSE's projected resource need (see Table 2) through 2025. Assuming a \$ [REDACTED] million purchase price for each of the facilities, the total cost to PSE's resource portfolio to own and operate these plants ranges from \$150 to \$300 million when compared to building a generic simple cycle natural gas plant.

1

This compares unfavorably with the new Wells PPA, which provides a net benefit to the portfolio ranging from \$15 to \$43 million.

2

3

Q. Did PSE evaluate the Douglas Wells PPA under different pricing scenarios?

4

A Yes. The scenario analysis used price strips from the 2015 IRP to determine how Douglas Wells PPA would perform under different pricing assumptions. The four scenarios tested are (1) Low Gas Price, (2) Base Gas Price, (3) Base Gas Price + CO2 Tax, and (4) High Gas price + CO2 Tax. Figure 7 summarizes the electric prices used in the scenario comparison.

5

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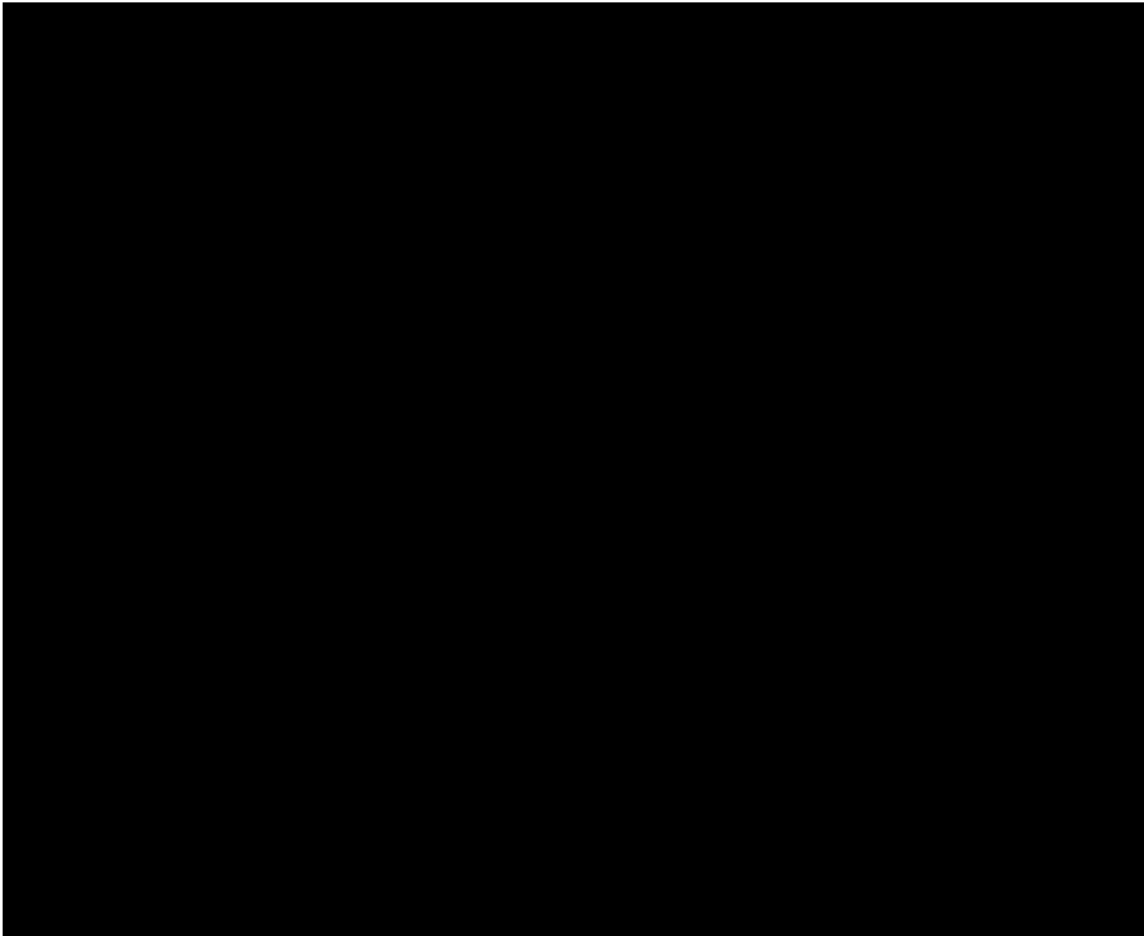
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Figure 7. Electric Price Forecast



10

The scenario analysis indicates that the new Wells PPA would provide a portfolio benefit in each of the four tested 2015 IRP pricing scenarios (see Table 5). Since the new Wells PPA price is fixed, the PPA provides greater value when electric prices are higher and less value when electric prices are lower. As such, the new Wells PPA acts as hedge against higher prices.

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Table 5. Portfolio Benefit Pricing Scenarios

Douglas Wells PPA - Portfolio Benefit 2015 IRP Pricing				
\$ in Millions	Low	Base	Base+C02	High + CO2
Wells Minimum Take	\$12	\$49	\$76	\$106
Wells High Take	\$31	\$94	\$139	\$190
Wells Minimum + █████ Share	\$13	\$59	\$91	\$127
Wells High + █████ Share	\$34	\$111	\$164	\$225

Q. Did PSE keep management informed during its evaluation of the Douglas Wells PPA?

A. Yes; PSE staff presented three informational updates to the Energy Management Committee (“EMC”) between April 16, 2015 and October 20, 2016. The EMC authorized PSE to enter into the new Wells PPA with Douglas County PUD on September 15, 2016.⁷ Copies of the EMC presentations are provided as Exhibit No. ___(MM-12C).

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V. CONCLUSION

Q. Does this conclude your pre-filed direct testimony?

A. Yes.

⁷ At the time the EMC approved the PSE proportional share of the output in September 2016, there were still four purchasers. PSE returned to the EMC in October to request approval to make an offer for the additional pro rata share of the █████ share.