

BEFORE THE CORPORATION COMMISSION OF OKLAHOMACORPORATION COMMISSIONOF OKLAHOMAAPPLICATION OF PUBLIC SERVICE)OF OKLAHOMA

APPLICATION OF PUBLIC SERVICE)	
COMPANY OF OKLAHOMA ("PSO") FOR)	
APPROVAL OF THE COST RECOVERY OF)	
THE WIND CATCHER ENERGY)	
CONNECTION PROJECT; A)	
DETERMINATION THERE IS A NEED FOR)	
THE PROJECT; APPROVAL FOR FUTURE)	
INCLUSION IN BASE RATES COST)	CAUS
RECOVERY OF PRUDENT COST)	
RECOVERY RIDER; APPROVAL OF)	
CERTAIN ACCOUNTING PROCEDURES)	
REGARDING FEDERAL PRODUCTION TAX)	
CREDITS; WAIVER OF OAC 165-35-38-5(e);)	
AND SUCH OTHER RELIEF THE)	
COMMISSION DEEMS PSO IS ENTITLED)	

CAUSE NO. PUD 201700267

RESPONSIVE TESTIMONY OF

THOMAS A. PETRIE

ON BEHALF OF

INTERVENER WINDFALL COALITION

December 4, 2017

TESTIMONY INDEX

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EXHIBITS

<u>EXHIBIT</u>

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DESCRIPTION

EXHIBIT TAP-1

Tom Petrie - Expert Report: Support Materials and Information

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<u>RESPONSIVE TESTIMONY OF THOMAS A. PETRIE</u> <u>ON BEHALF OF INTERVENER WINDFALL COALITION</u>

I. INTRODUCTION

1 Q1: PLEASE STATE YOUR NAME, POSITION AND BUSINESS ADDRESS.

- 2 A: My name is Thomas A. Petrie. I am Chairman of Petrie Partners, LLC, an energy focused
- 3 investment banking firm that offers financial advisory services to the oil and gas industry.
- 4 My firm provides specialized advice on mergers, divestitures and acquisitions and private
- 5 placements. The business address is 1700 Lincoln Street, Denver, CO 80203.

6 Q2: PLEASE BRIEFLY DESCRIBE YOUR BACKGROUND AND

7 **QUALIFICATIONS.**

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- 8 A: I received my Bachelor of Science degree from the U.S. Military Academy at West Point
 9 and received my Masters of Science in Business Administration from Boston University.
- Prior to Petrie Partners, I was Vice Chairman of Bank of America Merrill Lynch. I
 joined Merrill Lynch in 2006 when they merged with Petrie Parkman & Co., an energy

investment banking firm that I had co-founded in 1989. Before Petrie Parkman & Co., I was a Managing Director and Senior Oil Analyst of The First Boston Corporation.

In the 1970s, I began my career in the energy sector by analyzing publicly traded securities. Since then, I have been an active advisor on more than \$250 billion of energy related mergers and acquisitions. Notably, my firm Petrie Parkman & Co. advised the Kingdom of Saudi Arabia on its natural gas initiative, the State of Alaska on gas pipeline options, and the U.S. Department of Energy on the sale of the Elk Hills oilfield.

8 I am a Chartered Financial Analyst. I was past President of the Board of Directors 9 of the National Association of Petroleum Investment Analysts. Also, I served on the 10 Securities and Exchange Commission Advisory Board on Oil and Gas Accounting. 11 Additionally, I've authored the book, *FOLLOWING OIL: Four Decades of Cycle-Testing* 12 *Experiences and What They Foretell about U.S. Energy Independence.*

13 Q3: HAVE YOU OR YOUR FIRM APPEARED AS A WITNESS BEFORE ANY 14 REGULATORY COMMISSIONS?

A: No, but I have been previously involved in providing energy policy and economic input
and advice to the governmental authorities noted above.

17 Q4: WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A: I am here to provide expert testimony on my view of the intermediate and long term outlook
for natural gas supply, and resulting prices in the United States and what impact this price
may have on the economic merits of the Wind Catcher project. My price outlook contrasts
with the Base, Low and High price scenarios put forth by PSO in their supporting materials
used to justify the net present value and economic benefit of the Wind Catcher project.

RESPONSIVE TESTIMONY

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II. NATURAL GAS PRICE FORECASTS

2 Q5: WHAT WOULD YOU NEED TO KNOW ABOUT NATURAL GAS PRICES TO 3 MAKE AN INFORMED INVESTMENT DECISION ABOUT A PROJECT LIKE 4 WIND CATCHER?

5 A: The big-picture theme for natural gas is that over the last decade, and for the better part of 6 this 21st century, technological enhancements in horizontal drilling and hydraulic 7 fracturing used when exploring for and developing natural gas reserves have revolutionized 8 the extraction of hydrocarbons from shale formations. The proliferation of unconventional 9 drilling in the United States has decreased commodity price volatility, and natural gas is 10 now a relatively more stably priced and plentiful hydrocarbon resource.

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Page 5 of Exhibit TAP-1 contains the chart below, which shows surging production leading to low gas prices.



The majority of the materials and assumptions that I have reviewed relating to the project base its investment merits on the assumption of very high future natural gas prices, rising costs in broad electrical generation and consumer rates and therefore, the need for an alternative source of long term generation and supply.

RESPONSIVE TESTIMONY

Q6: PLEASE EXPLAIN YOUR NATURAL GAS PRICE OUTLOOK.

2 **A:** Although not always perfectly predictive, I believe that informed forecasts by credible, 3 independent third-party professionals and specialized organizations can form the basis for 4 a reasonable expectation and consensus perspective on likely future outcomes. Henry Hub 5 futures contracts trade on the New York Mercantile Exchange (NYMEX), and these futures 6 prices are widely used as a benchmark for forward months and years of expected natural 7 gas prices. The average of these thousands of futures contracts traded daily for natural gas 8 through 2021 are summarized in the graph below and on page 6 of Exhibit TAP-1. The 9 United States Energy Information Agency (EIA) also puts out monthly energy outlook 10 reports that provide predictions on natural gas prices. The forecast as of November 2017 11 is summarized on the same chart. Additionally, Bloomberg (BLOOM) and Factset (FCC) 12 are regarded as the authoritative clearing houses for aggregating publicly reported research 13 analyst forecasts of natural gas prices and these projections are captured below as well.

Page 6 of Exhibit TAP-1 contains the chart below. This natural gas price outlook
shows that NYMEX futures, EIA estimates and broker research estimates from both
Bloomberg and Factset expect prices to average approximately \$3.00 MMBtu for the next
several years.



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RESPONSIVE TESTIMONY

In the current commodity forecasting environment, the average of all forward futures contracts, EIA estimates, and research analyst estimates from major financial institutions provides an informed outlook on natural gas prices. Additionally, historical strip price forecasts provide differentiated price insights.

Page 7 of Exhibit TAP-1 contains the strip price chart below. The forecasts as of 2015, 2016 and 2017 for strip prices have consistently declined year over year, and the forward five-year strip is currently averaging approximately \$3.00 MMBtu.



9 The outlook for United States natural gas prices beyond ten years in the future is much 10 more uncertain. However, I know that over the long-run natural gas prices are determined 11 by supply and demand fundamentals. The natural gas market price is determined by the 12 number of producers and consumers of natural gas.

13 Q7: PLEASE EXPLAIN YOUR VIEW OF NATURAL GAS SUPPLY.

A: I believe that United States gas production will continue to outpace domestic consumption
 because of abundant shale gas reserves and low breakeven well costs. Technological
 advancements and more effective drilling programs have created a new era for United

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States gas supply, and that is why American energy companies have been increasing gas production for much of the past decade. Our country has a prolific resource base of natural gas, and the ability of operators to detect and economically extract these resources keeps improving. Additionally, operators can respond to natural gas price increases within 30-60 days by producing more of this plentiful resource, putting downward pressure on prices.

Page 14 of Exhibit TAP-1 contains the map below of basins and shale plays.
Significant amounts of natural gas resources in shale formations have become economic to
recover in recent years, thanks to drilling innovations.



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10 On January 1, 2015, the EIA estimated that the technically recoverable shale resources in 11 the United States were 1,316 trillion cubic feet. If history is any guide, the energy industry 12 will continue to find new reserves and development opportunities going forward. American 13 ingenuity in the oil and gas sector is truly unmatched.

Page 15 of Exhibit TAP-1 contains the chart below, which shows dry gas shale production increasing significantly since 2009. Key drivers of gas production growth are coming from the Appalachia Marcellus/Utica, North Louisiana Haynesville, West Texas Permian, and Oklahoma SCOOP/STACK plays.



6 It is my belief and generally accepted within the sector that shale gas production will 7 continue to grow substantially. Increased drilling activity has occurred despite sustained lower prices because drilling technology advances have lowered well costs and boosted 8 9 well productivity, improving margins and economic returns. Through my work at Petrie 10 Partners and frequent conversations with energy company executives, I have confidence 11 that technology advances will continue to be made over the next decade. Breakeven costs 12 in gas-weighted fields will keep coming down. Additionally, oil wells nationwide are 13 predicted to produce an additional 9 billion cubic feet a day of associated natural gas over 14 the next few years, according to estimates from Tudor, Pickering, Holt & Co. and 15 Macquarie Group. Most oil wells produce natural gas as a byproduct, and that gas output

RESPONSIVE TESTIMONY

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rises commensurate as oil drilling accelerates. Oil drilling activity is expected to grow in
 Oklahoma and West Texas, and these new wells will contribute to the natural gas supply
 glut in the United States.

Page 12 of Exhibit TAP-1 contains the storage chart below. For the past few years,
the United States has had elevated storage levels of natural gas, which leads to lower prices.
Henry Hub prices have averaged less than \$3.00 MMBtu during this time period.



8 Rapid growth in United States reserves and production has resulted in an overproduced 9 situation relative to domestic demand, leading to significant, sustained builds in natural gas 10 storage for the last several years. United States supply capabilities are the key reason that 11 I believe natural gas prices will stay low for decades.

12 Q8: DO YOU AGREE WITH PSO'S ASSUMPTIONS ABOUT NATURAL GAS

13 **PRICE FORECASTS?**

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A: PSO's price forecasts appear too high. Their forecast assumptions do not adequately
reflect the fundamentals that will likely drive the future supply/demand dynamic of the
United States domestic gas market.

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Slide 21 of Wind Catcher Technical Conference Presentation from October 20,
 2017 contains the chart below, which shows PSO's key pricing assumptions. The Low,
 Base and High price cases start in 2021 approximately between \$5.00 and \$6.00 MMBtu.
 Over the next 25 years, these PSO forecasts significantly increase to prices approximately
 between \$10.00 and \$12.00 MMBtu.



Page 17 of Exhibit TAP-1 contains the breakeven price chart below. Production is

profitable at prices below \$3.00 MMBtu for most of these regions.



RESPONSIVE TESTIMONY

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The vast majority of gas producing regions in the United States are extremely profitable at \$4.00 MMBtu and above gas prices.

3 Q9: IF NATURAL GAS PRICES RISE ABOVE \$4 MMBtu AS PSO FORECASTS,
4 HOW WOULD NATURAL GAS SUPPLY RESPOND?

5 A: I believe that any material increase in natural gas prices will result in a rapid acceleration
6 in development activity, bringing on additional ample supply, and this new supply would
7 drive down prices.

8 Additionally, if natural gas prices were to rise above \$4 MMBtu, substantial 9 amounts of new resources would become viewed by operators as economic to drill.

10 Q10: IS PSO's LOW PRICE FORECAST HIGHER THAN RECENT PRICES?

11 A: PSO's 2017 Low forecast assumes a \$4.69 MMBtu 2018 price average. This price is 57%

12 higher than 2017's year to date average price of approximately \$2.98 MMBtu and 62%

13 higher than the current NYMEX futures 2018 average of approximately \$2.90 MMBtu.

Page 9 of Exhibit TAP-1 contains the price chart below. Previous PSO forecasts have consistently overestimated future natural gas prices in years 2012, 2013 and most recently in 2017. These forecasts did not adequately account for significant increases in United States production, which lowered natural gas prices.



RESPONSIVE TESTIMONY

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III. ECONOMIC COST

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Q11: HOW WOULD REALISTIC NATURAL GAS PRICE EXPECTATIONS AFFECT

THE WIND CATCHER PROJECT'S ECONOMICS?

4 **A:** Page 24 of Exhibit TAP-1 contains the valuation table below. The table shows the 5 results of our illustrative net present value (NPV) analysis for \$3.00, \$4.00 and \$5.00 6 MMBtu pricing scenarios.

2020 NPV (SMM)	Prices (2021-2045)		
	\$3.00	\$4.00	\$5.00
1. Adjusted Production Cost Savings	\$582	\$892	\$1,202
2. Congestion and Loss Cost	(\$158)	(\$158)	(\$158)
3. Capacity Value	\$74	\$74	\$74
4. Wind Facility Revenue Requirement	(\$1,163)	(\$1,163)	(\$1,163)
5. Production Tax Credits	\$837	\$837	\$837
6. Gen-Tie Line Revenue Requirement	(\$538)	(\$538)	(\$538)
7. Total Benefits/(Costs)	(\$366)	(\$56)	\$254

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This analysis shows that the bulk of the NPV benefit comes in the form of production tax 8 credits and cost savings, but these benefits are not enough to offset the incremental capital 9 10 and costs of the project under likely future price scenarios.

11 **Q12: HOW DID YOU PERFORM YOUR NET PRESENT VALUE ANALYSIS?**

Our firm ran a line of best fit (regression), which was then used to calculate Adjusted 12 **A:** Production Cost Savings at realistic natural gas prices. I analyzed the effect of natural gas 13 prices on Adjusted Production Cost Savings because changes to the gas price variable had 14 an approximately 95% correlation to the results for PSO's assumed High, Base and Low 15 16 natural price scenarios. In the 2020 NPV table, lines 3 through 6 do not change due to natural gas prices, and we assumed that line 2 has the same value as PSO's Base case. 17

Q13: WHAT ARE THE SIMILARITIES BETWEEN A PRIVATE SECTOR DECISION
 TO INVEST IN A PROJECT LIKE WIND CATCHER AND THE COMMISSION'S
 DECISION TO APPROVE THE PROJECT?

4 **A:** In my 43 years of financial sector experience evaluating the economic merits of various 5 investments, I think any individual, private or public company or organization should 6 evaluate a decision on whether to invest in a significant project based on the credibility of 7 the financial assumptions, which should be consistent with realistic market conditions, and 8 that the application of these assumptions in a diligent, intellectually honest manner yield 9 an attractive (profitable) outcome. For a project like Wind Catcher, I wouldn't expect a 10 private sector investor to approve a multi-billion dollar project if it had significant 11 unresolved revenue, regulatory and profitability issues.

12 Q14: IF REALISTIC NATURAL GAS PRICE FORECASTS ARE USED, HOW MUCH

13 OF THE NET BENEFIT OF THE PROJECT IS DUE TO TAX CREDITS?

A: Without production tax credits, we calculate the Wind Catcher project would only
 breakeven at a future implied natural gas price of approximately \$6.88 MMBtu. Even with
 production tax credits of \$837 MM, we calculate Wind Catcher will have a negative net
 present value vs. potential alternatives, unless gas prices are above approximately \$4.18
 MMBtu.

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IV. CONCLUSION

21 Q15: DOES THIS CONCLUDE YOUR RESPONSIVE TESTIMONY?

22 A: Yes, it does.

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RESPONSIVE TESTIMONY

CAUSE NO. PUD 201700267 THOMAS A. PETRIE •

1	AFFIRMATION
2	I state under penalty of perjury under the laws of Oklahoma that the foregoing is true and correct
3	in substance and in fact to the best of my knowledge, information, and belief.
4	
5	Signed: Statut
6	Name: Thomas. A. Petrie
7	Date: Decomber 2, 2017
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CERTIFICATE OF SERVICE

On this 4th day of December, 2017, a true and correct copy of the above and foregoing *Responsive Testimony of Thomas A. Petrie on Behalf of Intervenor Windfall Coalition* was sent via electronic mail to the following interested parties:

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Tom Petrie – Expert Report: Support Materials and Information December 4, 2017

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Introduction

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Introduction Summary Observations

Overview

- Technological advancements by leading US E&P operators in 3D seismic surveys, horizontal drilling and hydraulic fracturing has encouraged the development of low risk, repeatable natural resources across large land positions
- ◆ The natural gas market has become much more stable and developed
 - Research analysts, government energy agencies and the current NYMEX based futures strip predict prices to average ~\$3.00 MMBtu for the foreseeable future
- ✤ Gas supply will likely outpace domestic demand
 - Elevated natural gas storage levels result in lower natural gas prices
 - US-based Cheniere, Freeport LNG, Sempra Energy and Dominion Energy expect to export over 9 Bcfpd of liquefied natural gas to international markets by 2021, as a result of oversupply
 - Many US resource basins have large gas reserves and low break-even costs
 - Production activity in the Marcellus, Utica, Permian and SCOOP/STACK shale plays continues to drive increases in US gas supply



Natural Gas Pricing Observations



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Natural Gas Pricing Observations Key Themes for US Gas Market

Overview

- Over the last 30 years, natural gas in the United States has evolved from a regulated market to become a crucial input fuel for utilities and industry
 - Natural gas is now a relatively more stably priced and plentiful hydrocarbon resource
 - The proliferation of unconventional drilling in the US has decreased oil and gas commodity price volatility
- ♦ Natural gas prices have averaged less than \$3.00 MMBtu since 2015
- Abundant gas reserves and more effective drilling programs provide real-time flexibility to US producers
 - In the event prices rise materially, producers can respond within 30-60 days to produce more natural gas
 - Supply flexibility allows market prices to return more quickly to equilibrium levels



Natural Gas Pricing Observations A Transformed Natural Gas Outlook

- Surging natural gas production has led to low prices
- * Petrochemical companies believe that US natural gas prices will remain low and globally competitive for decades
 - Natural gas is a feedstock for the chemical industry, and US chemical investment linked to shale gas is \$185 Bn and counting



U.S. Natural Gas Production vs. Prices (1982 - 2017 YTD)

Source: EIA data as of October 2017 with prices before 1997 in \$/Mcf, American Chemistry Council Fact Sheet for July 2017



Natural Gas Pricing Observations Henry Hub Gas Outlook

Market Trends

- Surging natural gas production in recent years has materially reduced prices
- Modern drilling techniques eliminate volatility by allowing producers to ramp up or ramp down production more quickly to meet demand
- Research analysts and the market strip expect natural gas prices to average approximately \$3.00 MMBtu for the foreseeable future

Historical Henry Hub Spot Price (\$/MMBtu)



Source: Market data per FactSet and Bloomberg as of November 24, 2017, EIA STEO as of November 2017.



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Natural Gas Pricing Observations Historical Strip Price Forecasts

Forward Strip (As of January 1)



Natural Gas Pricing Observations Historical Strip Price Forecasts (2009 – YTD)



Henry Hub Strip forecasts per Bloomberg for each year as of January 1. Henry Hub Strip forecast per Bloomberg as of November 24, 2017. (1) (2)



Natural Gas Pricing Observations PSO Henry Hub Price Forecasts

Summary

- Previous PSO forecasts overestimated future natural gas prices
 - Forecasts failed to account for increased US production, which lowered natural gas prices
- PSO's 2017 price forecasts are significantly higher than historical price averages for recent years







(1) AEP-PSO forecasts per 2012, 2013, 2015 and 2017 PSO IRP Reports and Karl Bletzacker's Testimony on July 31, 2017.

(2) Henry Hub historical prices per Bloomberg as of November 24, 2017



Natural Gas Supply Overview



Natural Gas Supply Overview Introduction

- Technological enhancements in horizontal drilling and hydraulic fracturing have revolutionized the extraction of oil and gas from "source rock" shale geologic formations
- ✤ As of January 1, 2015, the US Energy Information Administration estimates approximately 2,355 Tcf of technically recoverable resources of dry natural gas in the United States
 - At the 2015 resource estimate levels and the 2016 US consumption level of approximately 27.5 Tcf per year, the United States has enough currently recoverable natural gas resource to last ~86 years
- Key drivers of US gas production growth are coming from the Appalachia Marcellus/Utica, West Texas Permian and Oklahoma SCOOP/STACK plays
 - Large natural gas reserves and low breakeven costs in many shale plays ensure that the US will keep its new position as a low-cost natural gas producer for many decades
- US gas production will continue to outpace domestic consumption, and elevated storage levels leads to lower prices



Natural Gas Supply Overview Industry Supply Overview

Supply Will Outpace US Demand

- When storage levels have been significantly above 5-year average, gas prices sharply declined
- Underground storage has been near maximum 5year levels for the past two years
- EIA predicts US total gas supply will grow approximately 5.8 Bcfpd by December 2018



Natural Gas In Underground Storage (Bcf)

Storage Above/Below 5-Year Average vs Gas Price ⁽¹⁾



US Natural Gas Production and Imports (Bcfpd)



Source: EIA STEO as of November 2017, EIA Weekly Underground Storage Report as of November 22, 2017. (1) Henry Hub historical prices per Bloomberg as of November 24, 2017, storage data is monthly average of EIA weekly storage reports



Natural Gas Supply Overview Natural Gas Proved Reserves

- As technology improves, the ability to detect and extract natural gas will also improve
- If prices rise, proved reserves will increase because more hydrocarbons become economically viable
 - In 2015, average price of natural gas fell to \$2.62 MMBtu, declining over 40% compared to 2014

Proved Reserves in Shale Plays (Tcf)



Natural Gas Total Proved Reserves (December 31, 2015)



Source: EIA US Natural Gas Proved Reserves Year-end 2015.



Natural Gas Supply Overview Prolific Resource Base

Major Basins and Shale Plays Producing Significant Amounts of Natural Gas



Resource estimates as of January 1, 2015 per the EIA's Annual Energy Outlook 2017, US Geologic Survey in Haynesville Formation 2016. Proved reserves based on economic cutoff at current prices.
 EIA Drilling Productivity Report as of July and November 2017.



Natural Gas Supply Overview Historical Production by Shale Play

Dry Gas Production by Shale Play (2009-2017 YTD)



Natural Gas Supply Overview Rig Counts Through Downturn

Monthly Average of Horizontal Rigs





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Natural Gas Supply Overview Breakeven Prices For Natural Gas Plays

Wellhead Price Required For 10% IRR



Source: Evercore ISI research published on November 13, 2017, analysis assumes WTI price of \$50/Bbl.



Natural Gas Supply Overview **Permian – Growing Gas Supply**

Supply Projections

- By the end of 2020, Permian gas production is expected to increase by 5.5 Bcfpd from year-end 2016 levels ⁽¹⁾
 - By comparison, the Marcellus gas play is projected to grow production by 6.1 Bcfpd during the same period
- Most oil wells produce natural gas as a byproduct, and that gas output rises commensurate as oil drilling accelerates

Historical Permian Gas Production (2)



Tudor Pickering Holt & Co. estimates from May 30, 2017 WSJ article.
 DrillingInfo gross gas production as of August 2017.



"Natural gas is gushing out of West Texas, a byproduct of frenzied drilling for oil...So far, Permian drillers have been unresponsive to falling local gas prices, focusing instead on U.S. crude prices which are trading around a two-year high at about \$57 a barrel... Bernstein analysts estimate that the roughly 6 billion cubic feet of gas that needs to be moved out of West Texas each day will rise to 8.5 billion cubic feet by late 2019, assuming oil prices remain high enough to encourage drilling." November 20, 2017 THE WALL STREET JOURNAL



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Natural Gas Supply Overview

Marcellus and Utica – Operator Perspective





Natural Gas Supply Overview SCOOP and STACK – Operator Perspective



"Total company production for the guarter came in slightly above the high end of our forecast, averaging 1,143 million cubic feet equivalent (MMcfe) per day... Natural gas production exceeded previous estimates due to timing of completions in our Woodford downspacing pilot... Of note, Cimarex is announcing drilling results from several Woodford shale wells in its Lone Rock area. These wells...show some of the best returns the company has seen to date in the Woodford shale. 3Q17 Press Release

"10 ISTACKI wells delivered a combined maximum rate of 16,400 barrels of oil per day and 33.7mm cubic feet of gas per day, or over 22,000 Boe per day ... we also have record production report from our fifth dual-zone Woodford density test...once again highlights the tremendous resource



potential that exists in both SCOOP and STACK... the operating efficiencies and technologies we've developed over the last couple of years are unleashing the true potential of our superior geologic assets."



"A key driver of our operational momentum is the advancement of multi-zone development activity across our world-class STACK and Delaware Basin opportunities... The strongest asset-level performance in the quarter was from the company's STACK assets, where production advanced 26 percent compared to 2016 exit rates... 14 new Meramec wells brought online in the STACK play that achieved average 30-day rates of greater than 2,300 Boe per day (55 percent oil)."

3Q17 Press Release October 31, 2017

November 7, 2017

Jack Stark. President November 8, 2017



"Our primary focus remains SCOOP and STACK in the Anadarko Basin, world-class resource, top-tier economics. We've got very strong recent STACK HBP results kind of across the acreage position...the Woodford and Meramec intervals are both source rock generating and really - really we've had strong performance north to south across the SCOOP and STACK acreage block.... So. good progress here, glad that we're getting the data we need to plan for future development. And stay tuned, big, big upside potential." Lee Boothby, Chairman and CEO November 17, 2017



Natural Gas Supply Overview Operational Improvements Driving Superior Economics



Source: Company investor presentations.



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Natural Gas Supply Overview SCOOP/STACK Leading Operators



Horizontal Rig Count (#)



Current Production (MMcfepd)



Net Acres (in 000s)



SP Petrie Partners

Illustrative Impact: Economic Modelling



Illustrative Impact: Economic Modelling **NPV** Analysis

Summary

- Petrie analyzed the effect of natural gas prices to Exhibit KDP-1, KDP-2 in Pearce's July 31, 2017 testimony, making a forecast of the project's Adjusted Production Cost Savings
 - Petrie based its assumed natural gas price impact to PSO's High, Base and Low price scenarios, with a correlation to Adjusted Production Cost Savings of approximately 95%
 - In the 2020 NPV table, lines 2 through 6 are the same as the values in the Base case
- Estimated Adjusted Production Cost Savings under \$3.00, \$4.00 and \$5.00 MMBtu future price scenarios ranged between \$582 MM to \$1,202 MM vs. \$1,944 MM in Pearce's Base case

2020 NPV (\$MM)	Prices (2021-2045)		
	\$3.00	\$4.00	\$5.00
1. Adjusted Production Cost Savings	\$582	\$892	\$1,202
2. Congestion and Loss Cost	(\$158)	(\$158)	(\$158)
3. Capacity Value	\$74	\$74	\$74
4. Wind Facility Revenue Requirement	(\$1,163)	(\$1,163)	(\$1,163)
5. Production Tax Credits	\$837	\$837	\$837
6. Gen-Tie Line Revenue Requirement	(\$538)	(\$538)	(\$538)
7. Total Benefits/(Costs)	(\$366)	(\$56)	\$254

\$300 \$250 \$MM) Savings (Nominal, \$200 \$150 Cost Adjusted Production \$105.24 \$100 00 \$78.10 \$50 \$0 \$2.00 \$4.00 \$6.00 \$8.00 \$10.00 \$12.00 Natural Gas Prices (\$/MMBtu, Nominal) Base -1 ow Ultrailow Ultra Low⁽¹⁾ Base Low

Petrie

Regression Analysis Chart

Hia

Source: Wind Catcher Technical Conference Presentation as of October 20, 2017

Ultra Low price case uses 50% of PSO's Low price case for all years, OIEC's 5th Q, #8 Attachment 1



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Appendix



Appendix Thomas A. Petrie Biography

Prior to joining Petrie Partners as Chairman in 2012, Thomas A. Petrie was Vice Chairman of Bank of America Merrill Lynch. Previously, he was a co-founder of Petrie Parkman & Co., a Denver and Houston based energy investment banking firm that merged with Merrill Lynch in December 2006. Mr. Petrie was a former Managing Director and Senior Oil Analyst of The First Boston Corporation. During his career, Mr. Petrie has been an active advisor on more than \$250 billion of energy related mergers and acquisitions, including a number of the larger in the industry. Among its other assignments, Petrie Parkman advised the Kingdom of Saudi Arabia on its natural gas initiative, the State of Alaska on gas pipeline options, and the U.S. Department of Energy on the sale of the Elk Hills oilfield.



An active member of several industry associations, Mr. Petrie is a past President and member of the Board of Directors of the National Association of Petroleum Investment Analysts. He has served on the Securities and Exchange Commission Advisory Board on Oil and Gas Accounting and has delivered a number of technical papers to the Society of Petroleum Engineers on the subjects of petroleum valuation, merger and acquisition trends, and energy policy. He has been interviewed on numerous occasions by Barron's and has also appeared on "The News Hour," CNBC, Bloomberg, Fox News, and "Consuelo Mack WealthTrack" on PBS. He has also authored the book, *FOLLOWING OIL: Four Decades of Cycle-Testing Experiences and What They Foretell about U.S. Energy Independence*.

Mr. Petrie served for six years as a Trustee of the Association of Graduates of the United States Military Academy at West Point as well as ten years on the Board of Directors of the Gettysburg Foundation. Currently, he is a Trustee of the Denver Art Museum and serves on the Board of Directors of the C.M. Russell Museum as well as the Colorado School of Mines Foundation Board of Governors.

Mr. Petrie has a Bachelor of Science degree from the U.S. Military Academy at West Point and received his Masters of Science in Business Administration from Boston University. In December 2005, Mr. Petrie received an Honorary Doctorate of Engineering degree from the Colorado School of Mines. He is a Chartered Financial Analyst.





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