

BEFORE THE CORPORATION COMMISSION OF OKLAHOMA

IN THE MATTER OF THE APPLICATION OF )  
OKLAHOMA GAS AND ELECTRIC COMPANY )  
FOR COMMISSION AUTHORIZATION OF A PLAN )  
TO COMPLY WITH THE FEDERAL CLEAN AIR )  
ACT AND COST RECOVERY; AND FOR )  
APPROVAL OF THE MUSTANG MODERNIZATION )  
AND COST RECECOVERY )

Cause No. PUD 201400229

RESPONSIVE TESTIMONY

OF

MICHAEL GOGGIN

**FILED**  
DEC 16 2014

COURT CLERK'S OFFICE - OKC  
CORPORATION COMMISSION  
OF OKLAHOMA

SUBMITTED ON BEHALF OF:

THE WIND COALITION

DECEMBER 16, 2014

## TABLE OF CONTENTS

1. INTRODUCTION .....	1
2. Data on wind resource quality and cost in Oklahoma and SPP.....	2
3. Wind energy reduces electricity prices for Oklahoma consumers, and also protects them from uncertain and increasing fuel prices and the impact of EPA regulations .....	13
4. Responses to OG&E .....	26

1 **1. Introduction**

2 **Q: Please state your name, job title, and business address.**

3 **A:** My name is Michael Goggin, and I am the Director of Research for the  
4 American Wind Energy Association (“AWEA”). My business address is  
5 1501 M St NW, Suite 1000, Washington DC, 20005.

6  
7 **Q: For whom are you testifying?**

8 **A:** I am testifying on behalf of The Wind Coalition, though I would like to  
9 include a customary disclaimer that each member of the Coalition does  
10 not necessarily support all opinions expressed in my testimony.

11  
12 **Q: Have you testified in proceedings in front of the Public Utilities  
13 Commission (“PUC”) before?**

14 **A:** Not in Oklahoma, but in several transmission proceedings before the  
15 Illinois Commerce Commission, the Minnesota Public Utilities  
16 Commission, the Missouri Public Service Commission, and the Public  
17 Service Commission of Wisconsin.<sup>1</sup>

18  
19 **Q: What is your background and educational experience?**

20 **A:** I have conducted analysis related to wind’s role on the power system for  
21 AWEA since February 2008.<sup>2</sup> Before that, I worked for Sentech, Inc., an  
22 energy consulting firm, and for two environmental advocacy groups before  
23 that. I have an undergraduate degree with honors from Harvard  
24 University.

25  
26 **Q: What is the purpose of your testimony?**

---

<sup>1</sup> The Illinois Commerce Commission transmission cases include the Illinois Rivers project (Docket No. 12-0598), Rock Island Clean Line project (Docket No. 12-0598), and Grand Prairie Gateway project (Docket No. 13-0657); the case in Minnesota was the Interstate Transmission Company’s Minnesota to Iowa 345 kV line (Docket No. ET6675/CN-12-1053); the case in Missouri was the Grain Belt Express transmission line (Docket No. EA-2014-0207); and the case in Wisconsin was American Transmission Company’s Badger-Coulee line (Docket No. 5-CE-142).

1 **A:** My testimony supports the finding that Oklahoma Gas and Electric  
2 (OG&E) customers would benefit if OG&E added more wind energy to its  
3 portfolio. I also provide testimony responding to Donald R. Rowlett, Leon  
4 Howell, Usha-Maria Turner, John J. Reed, and Robert J. Burch.

5

6 **Q: Please outline your testimony.**

7 **A:** I first discuss the high quality and low cost of wind energy resources  
8 available to OG&E, and present data on the current cost of wind energy in  
9 Oklahoma, including the impact of the federal renewable Production Tax  
10 Credit and other incentives. I describe the prices that other utilities in the  
11 region have recently paid for wind energy, how wind energy offers unique  
12 long-term price certainty due to its lack of fuel costs, and the importance  
13 of taking advantage of wind PPAs that are currently available that have  
14 reduced costs due to the value of renewable Production Tax Credit. I then  
15 describe the value and consumer benefits of adding wind energy to the  
16 OG&E portfolio, including protecting consumers from increases and  
17 volatility in the price of other fuels, as well as reducing the cost of  
18 complying with pending EPA regulations.

19 Next, I list concerns about the methods, scenarios, and inputs used in  
20 OG&E's analysis, and also correct the information provided by OG&E on  
21 the capacity credit given to wind energy in the Southwest Power Pool  
22 (SPP). Finally, I will discuss the transmission investment being made by  
23 SPP, and how that is likely to reduce the transmission constraints  
24 mentioned by OG&E.

25

26 **2. Data on wind resource quality and cost in Oklahoma and SPP**

27 **Q: How does the quantity of the wind energy resource in Oklahoma and**  
28 **neighboring states compare to that of other regions?**

---

<sup>2</sup> See Résumé of Michael Stephen Goggin attached as Schedule MG-2.

1 **A:** The wind energy resource in Oklahoma and other states in the Southwest  
2 Power Pool is one of the best in the United States, if not the world.  
3 According to the United States Department of Energy's National  
4 Renewable Energy Laboratory's (NREL) wind resource assessment data,  
5 Oklahoma has 561,822 MW of developable wind energy resources,  
6 enough to provide 1,788,910 GWh of generation per year.<sup>3</sup> For  
7 comparison, Oklahoma's total electricity sales in 2012 were 59,341 GWh,<sup>4</sup>  
8 so Oklahoma's wind resource is sufficient to provide 30 times more  
9 electricity than the state consumes. Oklahoma's wind resource is  
10 sufficient to provide nearly half of total U.S. electricity consumption.  
11 Oklahoma's neighbors in the Southwest Power Pool also have world-class  
12 wind resources. NREL estimates that Kansas alone has 952,371 MW of  
13 viable wind energy resources, enough to provide 3,646,590 GWh per  
14 year, just short of total U.S. electricity consumption in 2012. Nebraska is  
15 similarly estimated to have 917,999 MW of developable wind energy  
16 resources, which could provide 3,540,370 GWh per year. Texas has the  
17 largest wind energy resource of any state, and a significant quantity of  
18 that is located in portions of the Texas Panhandle that fall within the SPP  
19 footprint. Missouri also has 274,355 MW of wind resource that can  
20 provide 810,619 GWh per year, and a significant share of that is located  
21 in the SPP portion of the state.

22  
23 **Q: What about the quality of wind resources in Oklahoma and**  
24 **neighboring states?**

25 **A:** The wind energy resource in Oklahoma and much of SPP is of extremely  
26 high quality. NREL's wind resource map, included as Schedule MG-3,  
27 shows that nearly the entire state of Oklahoma has high-quality wind

---

<sup>3</sup> NREL, Estimates of Windy Land Area and Wind Energy Potential, by State, for areas  $\geq 30\%$  Capacity Factor at 80m ("NREL Wind Energy Estimates"), (April 13, 2011). The document can be found at: [http://www.windpoweringamerica.gov/docs/wind\\_potential\\_80m\\_30percent.xls](http://www.windpoweringamerica.gov/docs/wind_potential_80m_30percent.xls)

<sup>4</sup> <http://www.eia.gov/electricity/state/>

1 resources.<sup>5</sup> Western Oklahoma and the Oklahoma Panhandle in  
2 particular have some of the best wind energy resources in the U.S.<sup>6</sup>  
3 Importantly, the energy available for wind energy production is  
4 proportional to the mathematical cube of wind speed, so the difference  
5 between the orange and purple areas in the wind speed map is actually  
6 quite significant. For example, the 8.5-9 meter/second area of the map,  
7 which is the dark purple area that covers some portions of the Oklahoma  
8 Panhandle, has about 76% more energy available in the wind than in the  
9 7.0-7.5 meter/second dark orange area that represents the best wind  
10 resource in most other parts of the country, and 274% more energy than  
11 the 6.0-6.5 meter/second brown areas that is prevalent in other regions.  
12

13 **Q: Are NREL's wind resource assessments accurate?**

14 **A:** If anything, NREL's assessments are likely to be conservative, as they  
15 assume the use of wind turbines with a hub height of 80 meters and do  
16 not include the use of new turbine designs that use longer blades. Many  
17 wind turbines being installed today have hub heights of 100 meters or  
18 more, providing access to the increasingly strong wind energy resources  
19 that one typically finds as one moves farther above the earth's surface.  
20 For example, NREL's analysis, included as Schedule MG-4, shows that  
21 the quantity of Oklahoma's developable wind resources that would  
22 produce greater than a very high 45% capacity factor more than doubles,  
23 from around 80,000 MW to nearly 200,000 MW, as one increases from an  
24 80m hub height to 100m hub height.<sup>7</sup>

25 In addition, "low-wind-speed turbines" with longer blades and other  
26 features that increase wind turbine capacity factors are being used in all  
27 regions of the country, including high wind resource areas of SPP, to

---

<sup>5</sup> [http://apps2.eere.energy.gov/wind/windexchange/wind\\_resource\\_maps.asp?stateab=ok](http://apps2.eere.energy.gov/wind/windexchange/wind_resource_maps.asp?stateab=ok)

<sup>6</sup> [http://apps2.eere.energy.gov/wind/windexchange/wind\\_maps.asp#us](http://apps2.eere.energy.gov/wind/windexchange/wind_maps.asp#us)

<sup>7</sup> [http://apps2.eere.energy.gov/wind/windexchange/pdfs/wind\\_maps/ok\\_wind\\_potential\\_chart.pdf](http://apps2.eere.energy.gov/wind/windexchange/pdfs/wind_maps/ok_wind_potential_chart.pdf)

1 increase wind power output and reduce cost.<sup>8</sup> Because these turbines  
2 have only recently achieved widespread commercial deployment, the use  
3 of these turbines was not accounted for in NREL's analysis. In addition,  
4 NREL's database assumes that significant amounts of land would be  
5 excluded from wind energy development because it is currently used for  
6 other purposes.<sup>9</sup> Regardless, the data is clear that Oklahoma has  
7 tremendous quantities of high-quality wind energy resources that far  
8 exceed its electricity needs.

9  
10 **Q: How does the wind resource quality translate to the expected output**  
11 **of wind plants?**

12 **A:** Capacity factor, defined as the amount of electricity produced by a power  
13 plant in a typical year divided by the amount of electricity that that power  
14 plant could provide if it ran at 100% of its nameplate capacity for all 8,760  
15 hours in that year, is a common metric for the expected output of wind  
16 plants. Capacity factor is strongly related to the average wind speed of an  
17 area.

18 As indicated in the Lawrence Berkeley National Laboratory (LBNL) data  
19 shown in Schedule MG-5,<sup>10</sup> the average capacity factor in 2013 for wind  
20 projects installed in the "Interior" region in 2012, which includes Iowa,  
21 North and South Dakota, and Minnesota, plus Nebraska, Kansas,  
22 Oklahoma, Missouri, Texas, New Mexico, Colorado, Wyoming, and  
23 Montana, was 38.1%, versus a national average wind capacity factor of  
24 33.4%.

---

<sup>8</sup> Lawrence Berkeley National Laboratory, 2013 Wind Technologies Market Report, at 30 (August 2014) available at [http://energy.gov/sites/prod/files/2014/08/f18/2013%20Wind%20Technologies%20Market%20Report\\_1.pdf](http://energy.gov/sites/prod/files/2014/08/f18/2013%20Wind%20Technologies%20Market%20Report_1.pdf)

<sup>9</sup> NREL, Estimates of Windy Land Area and Wind Energy Potential, by State, for areas >=30% Capacity Factor at 80m ("NREL Wind Energy Estimates"), (April 13, 2011). The document can be found at: [http://www.windpoweringamerica.gov/docs/wind\\_potential\\_80m\\_30percent.xls](http://www.windpoweringamerica.gov/docs/wind_potential_80m_30percent.xls).

<sup>10</sup> Lawrence Berkeley National Laboratory, 2013 Wind Technologies Market Report, at 61, Fig. 48.

1 Department of Energy data, included as Schedule MG-6, show that  
2 existing wind projects in Oklahoma had an average capacity factor of  
3 40.6% in 2013, putting Oklahoma above the already high average  
4 capacity factor for the Interior region.<sup>11</sup> This figure is conservative, as it is  
5 a fleet-wide average that includes many projects made up of smaller and  
6 less productive turbines installed as far back as 2003. Several large wind  
7 projects installed in recent years, such as Rocky Ridge I, Minco III, Blue  
8 Canyon VI, and Blackwell, have capacity factors well in excess of 45%.  
9 NREL's wind resource data, included in Schedule MG-4, confirm that  
10 Oklahoma has large quantities of wind resources with extremely high  
11 capacity factors. With 100 meter turbines, this includes tens of thousands  
12 of MWs of wind resources with capacity factors in excess of 50%, nearly  
13 200,000 MW in excess of 45% capacity factor, and nearly 400,000 MW in  
14 excess of 40% capacity factor. With 80 meter turbines, the resource  
15 potential includes thousands of MWs in excess of 50% capacity factor,  
16 around 80,000 MW in excess of 45% capacity factor, and around 250,000  
17 MW in excess of 40% capacity factor.<sup>12</sup>

18  
19 **Q: What is the impact of capacity factor on the cost of wind energy?**

20 **A:** Capacity factor is the most important determinant of the cost of wind  
21 energy, as the quantity of MWh a wind project produces determines at  
22 what price it must sell those MWh for the project to be financially viable.  
23 Virtually all of a wind project's costs are fixed costs, mostly up-front capital  
24 costs but also some ongoing fixed maintenance costs. Because the  
25 variable cost for a wind project to produce a MWh is close to zero, with no  
26 fuel cost, producing more MWh allows those fixed costs to be spread over

---

<sup>11</sup> Form EIA-923 detailed data, with 2013 data from EIA-923M and 2012 data from EIA-923, available at <http://www.eia.gov/electricity/data/eia923/>. Wind project capacity and year online data from AWEA's database of wind projects, available at <http://www.awea.org/Resources/Content.aspx?ItemNumber=5728&navItemNumber=5776>.

<sup>12</sup> [http://apps2.eere.energy.gov/wind/windexchange/pdfs/wind\\_maps/ok\\_wind\\_potential\\_chart.pdf](http://apps2.eere.energy.gov/wind/windexchange/pdfs/wind_maps/ok_wind_potential_chart.pdf)

1 more MWh. The primary federal and state incentives for wind energy are  
2 also based on the amount of production. As a result, it is important for  
3 wind projects to be built in areas with sufficient wind resources to yield  
4 high capacity factors. Accordingly, wind projects built in Oklahoma and  
5 neighboring states are able to sell their energy at very low costs under  
6 long-term power purchase agreements.

7  
8 **Q: What other factors affect the cost of wind energy?**

9 **A:** Installed project costs are also an important factor. Data in the LBNL  
10 report shows that the installed capital cost for wind projects in the Interior  
11 region, which includes Oklahoma and most of SPP, was \$1,755/kW for  
12 projects installed in 2012 and 2013, about 9% lower than the national  
13 average cost of \$1,939/kW.<sup>13</sup> Oklahoma and SPP fall below the national  
14 average due to lower costs for land, labor, permitting, and other cost  
15 inputs.

16 For wind projects installed in 2013, the LBNL report finds that the national  
17 average installed capital cost of wind fell to \$1,630/kW.<sup>14</sup> While wind costs  
18 are rapidly declining, falling by more than half over the last five years,<sup>15</sup>  
19 the DOE/LBNL report estimates wind projects slated for installation in  
20 2014 are likely to see a slightly higher national average installed cost of  
21 \$1,750/kW. This is because the projects installed in 2013 were heavily  
22 concentrated in the Interior regions of the U.S., including Oklahoma and  
23 other parts of SPP, which have below average costs for wind plant  
24 installation. Thus, the report concludes that \$1,750/kW may be a more  
25 representative indication of wind's current installed costs on a national  
26 basis. However, the average cost in Oklahoma and SPP is significantly  
27 lower than that.

---

<sup>13</sup> <http://emp.lbl.gov/sites/all/files/lbnl-6809e.pdf>, page 52. Data file available at  
<http://emp.lbl.gov/publications/2013-wind-technologies-market-report>, Figure 42.

<sup>14</sup> <http://emp.lbl.gov/sites/all/files/lbnl-6809e.pdf>, pages 49-50

<sup>15</sup> <http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf>

1 O&M costs are another cost factor. On a national basis, the LBNL report  
2 indicates average O&M costs are \$23/kW-year for wind projects  
3 constructed since 2010.<sup>16</sup>  
4

5 **Q: What is the current national levelized cost of wind energy?**

6 **A:** Wall Street investment firm Lazard publishes an annual report tracking the  
7 levelized cost of all electricity generating technologies, based on  
8 information Lazard obtains from conducting financial transactions for all  
9 types of generation projects and from industry experts. Lazard's most  
10 recent figures indicate the current cost range for U.S. wind energy is  
11 between \$37/MWh and \$81/MWh.<sup>17</sup> Accounting for the impact of the  
12 federal renewable Production Tax Credit (PTC), that range falls to  
13 between \$14/MWh and \$67/MWh. The Power Purchase Agreement  
14 (PPA) prices discussed below confirm that Oklahoma and other SPP  
15 states fall on the low end of those cost ranges, given their high capacity  
16 factors and low fixed costs for wind.

17 This cost is consistent with the range of PPA prices indicated in the LBNL  
18 report, as indicated in Schedule MG-7. For PPAs signed in 2013, the  
19 national average wind PPA price was \$25.59/MWh, with an average price  
20 of \$21.91/MWh in the Interior region that includes Oklahoma and most of  
21 SPP.<sup>18</sup> In contrast, in 2013 the average wind PPA price in the Great Lakes  
22 region was \$43.69/MWh, and \$59.38/MWh in the Western U.S. When  
23 evaluating information on wind prices, it is important to use regional  
24 pricing information that accounts for the quality and cost of the wind  
25 resource in that region, and not rely on national average cost or pricing  
26 data.

---

<sup>16</sup> <http://emp.lbl.gov/sites/all/files/lbnl-6809e.pdf>, footnote 57 on page 53

<sup>17</sup> <http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf>

<sup>18</sup> Data file available at <http://emp.lbl.gov/publications/2013-wind-technologies-market-report>,  
Figure 46.

1 **Q: How does Lazard's reported levelized cost of wind energy compare**  
2 **to its cost assessment for other forms of generation?**

3 **A:** Even without the benefit of the federal PTC and the incentives for other  
4 forms of generation, wind was by far the lowest-cost generation option in  
5 Lazard's analysis. The range of un-incentivized costs for the next closest  
6 competitor, new combined cycle natural gas generation, was between  
7 \$61/MWh and \$87/MWh, while as mentioned above wind's range was  
8 between \$37/MWh and \$81/MWh, with Oklahoma and SPP wind almost  
9 certainly at the very low end of that range. Lazard's gas generation cost is  
10 based on a \$4.50/MMBtu delivered gas cost, which is consistent with the  
11 \$4.38/MMBtu national average cost of gas delivered to the power sector  
12 in 2013, and only slightly higher than the \$3.99/MMBtu average delivered  
13 cost in Oklahoma.<sup>19</sup> New coal generation came in at a range of \$66-  
14 151/MWh, assuming the use of \$1.99/MMBtu Powder River Basin coal,  
15 while all other forms of generation had a significantly higher cost.

16  
17 **Q: How have wind costs changed in recent years?**

18 **A:** Wind costs have declined by more than half, thanks to technological  
19 advances and economies of scale driven by greater wind project  
20 deployment. Lazard's data confirm that the levelized cost of wind energy  
21 has fallen by 58% since 2009,<sup>20</sup> from an un-incentivized range of \$101-  
22 169/MWh in 2009 to \$37-81/MWh in 2014. LBNL's data confirm that wind  
23 PPA prices have fallen by more than 60% since 2009, from \$68.19/MWh  
24 to \$25.59/MWh.

25 A primary factor has been the use of larger turbines with longer blades  
26 and taller towers to increase access to higher quality wind resources and  
27 increase the productivity of individual wind turbines. Scaling up the

---

<sup>19</sup> [http://www.eia.gov/electricity/monthly/current\\_year/february2014.pdf](http://www.eia.gov/electricity/monthly/current_year/february2014.pdf), Table 4.13B

<sup>20</sup> <http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf>,  
page 9

1 domestic wind turbine supply chain, which now boasts more than 500  
2 manufacturing facilities in 43 states, has also reduced costs.

3  
4 **Q: What is the current cost of wind energy in Oklahoma and SPP?**

5 **A:** The LBNL data, included as Schedule MG-7, document that wind PPA  
6 prices in the Interior region, which includes Oklahoma and most of SPP,  
7 averaged around \$21.91/MWh for contracts signed in 2013. These low  
8 prices are still available, as confirmed by several recent wind PPAs in  
9 SPP. For example, Southwestern Public Service recently signed three  
10 wind PPAs priced at \$22/MWh to \$24/MWh for nearly 700 MW of wind  
11 generation,<sup>21</sup> and in filings has documented that these PPAs will save its  
12 ratepayers \$590 million in fuel costs over 20 years.<sup>22</sup> Similarly, a recent  
13 wind purchase by the Grand River Dam Authority in Oklahoma is  
14 expected to save its customers about \$50 million over the project's  
15 lifetime.<sup>23</sup>

16 OG&E's IRP report at first cites an excessively high installed capital cost  
17 for wind, \$2,263/kW. As noted above, the national average capital cost for  
18 wind projects installed in 2013 was \$1,630/kW, with Oklahoma and SPP  
19 wind projects having some of the lowest capital costs. On page 31 of the  
20 IRP, OG&E notes that its wind "costs are lower than suggested by the EIA  
21 analysis." OG&E notes supplemental information it obtained from 20  
22 prospective wind projects in Oklahoma and Kansas through a recent RFI,  
23 indicating "Base pricing averaged approximately \$22/MWh and is less  
24 than that provided in previous RFI's with respondents citing improved  
25 technology resulting in increased capacity factors and reductions in  
26 turbine prices." \$22/MWh is perfectly consistent with the average PPA

---

<sup>21</sup> <http://www.utilitydive.com/news/why-utilities-are-betting-on-wind/201066/>

<sup>22</sup> <http://amarillo.com/news/local-news/2013-07-10/xcel-customers-save-590m-wind-deals>

<sup>23</sup> <http://www.grda.com/with-potential-to-save-customers-50-million-over-the-projects-lifetime-grda-signs-100-mw-renewable-energy-purchase-agreement-with-apex-clean-energy/>

1 price for the Interior region in LBNL's analysis, and with the \$22-24/MWh  
2 price for the Southwestern Public Service PPAs.

3  
4 **Q: Is the federal Production Tax Credit a factor in the price of wind  
5 available to OG&E?**

6 **A:** Yes. The federal renewable Production Tax Credit provides an additional  
7 revenue source for the wind project owner, which allows the owner to offer  
8 a lower PPA price to the utility purchaser and therefore the utility's  
9 ratepayers. The federal Production Tax Credit pays the wind project  
10 owner \$23/MWh for all electricity produced over the first 10 years of the  
11 wind project's operation, which significantly lowers the PPA price that a  
12 wind project owner can offer and still have a financially viable wind project.  
13 As noted above, the Lazard analysis found that the federal PTC lowered  
14 the levelized cost of wind energy from between \$37/MWh and \$81/MWh  
15 to between \$14/MWh and \$67/MWh.<sup>24</sup>

16  
17 **Q: Are there additional incentives in Oklahoma that make wind energy  
18 purchases more attractive in price?**

19 **A:** Yes. Oklahoma offers a \$5/MWh Zero-Emission Facilities Production Tax  
20 Credit for all MWh of wind energy produced between now and January 1,  
21 2021.<sup>25</sup> Like the federal PTC, this credit provides an additional revenue  
22 stream that lowers the PPA price that a wind project owner can offer to a  
23 utility.

24  
25 **Q: OG&E's testimony states that the uncertainty around the extension  
26 of the PTC is one of the factors causing it to hold off on adding wind  
27 energy to its portfolio. Do you agree with this strategy?**

28 **A:** No.

---

<sup>24</sup> <http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf>

<sup>25</sup> [http://dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=OK02F&re=0&ee=0](http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=OK02F&re=0&ee=0)

1 **Q: Please explain.**

2 **A:** A number of wind projects that qualified for the PTC that expired at the  
3 end of 2013 are still seeking but have not yet signed long-term PPAs to  
4 sell their output to utilities. We are aware of several under construction  
5 SPP wind projects representing more than 600 MW of installed capacity  
6 that qualified for the PTC that expired in 2013 but do not yet have publicly  
7 announced PPAs in place. OG&E could sign a PPA with one or more of  
8 these wind projects that have qualified for the PTC, thereby taking  
9 advantage of the reduced PPA pricing enabled by the PTC.

10 This flexibility is enabled by Congress's inclusion of "start construction"  
11 language in the PTC extension that ran through the end of 2013. Many of  
12 the wind projects that are currently seeking PPAs have not yet begun  
13 commercial operation, but they are qualified to receive the PTC under  
14 existing law because they took certain steps that qualify as having "started  
15 construction" by the end of 2013. These steps could include satisfying a  
16 safe harbor provision by spending more than 5% of total project costs by  
17 the end of 2013, such as by placing a deposit for a wind turbine order; or  
18 by beginning "physical work of a significant nature" by the end of 2013.<sup>26</sup>  
19 Wind projects that have met and continue to meet those requirements will  
20 be eligible to receive the PTC for 10 years from the date they begin  
21 commercial operation.

22 Moreover, as I write this, Congress is in the midst of passing an extension  
23 of the PTC with the same "start construction" language through the end of  
24 2014. There are likely to be some additional wind projects, expansions of  
25 existing wind projects, and projects that were unlikely to proceed under  
26 the PTC that expired in 2013 that will be able to qualify for the PTC that  
27 expires at the end of 2014. Thus, OG&E has a large selection of PTC-  
28 qualified and therefore low-cost wind projects with which it can sign PPAs,  
29 if it moves quickly. In fact, OG&E's claims about the uncertainty of further

---

<sup>26</sup><http://www.irs.gov/pub/irs-drop/n-14-46.pdf>

1 PTC extensions are actually an argument for why it should quickly move  
2 forward with signing PPAs with wind projects that have qualified for the  
3 2013 and 2014 PTC, as such low PPA prices are not certain to be  
4 available if it waits.

5 Other Oklahoma utilities have taken advantage of the low-cost wind PPAs  
6 made available by the 2013 PTC extension. Jay Godfrey with American  
7 Electric Power (AEP) was recently quoted in the New York Times  
8 describing how AEP subsidiary Public Service Company of Oklahoma  
9 “had ended up tripling the amount of wind power it had originally sought  
10 after seeing how low the bids came in last year,” stating that “Wind was on  
11 sale — it was a Blue Light Special.”<sup>27</sup>

12 In addition to the Grand River Dam Authority and Southwestern Public  
13 Service PPAs discussed above, Westar Energy also recently entered into  
14 a low-cost wind PPA, taking advantage of the opportunity to purchase the  
15 output from a PTC-qualified wind project.<sup>28</sup> However, as time goes by and  
16 other utilities snap up these low-cost wind PPAs, OG&E risks missing the  
17 opportunity to purchase output from wind projects that have qualified  
18 under either the 2013 or 2014 PTCs.

19  
20 **3. Wind energy reduces electricity prices for Oklahoma consumers,**  
21 **and also protects them from uncertain and increasing fuel prices and**  
22 **the impact of EPA regulations.**

23 **Q: What is the impact of wind energy on electricity prices?**

24 **A:** Adding wind energy to the power system displaces the most expensive,  
25 least efficient, and most volatily-priced power plants with a fixed-priced,  
26 zero-fuel-cost, zero-emission energy source. Wind energy also benefits  
27 consumers by protecting against electricity price spikes and reducing the  
28 use of the most expensive power plants, decreasing the market clearing

---

<sup>27</sup> <http://www.nytimes.com/2014/11/24/business/energy-environment/solar-and-wind-energy-start-to-win-on-price-vs-conventional-fuels.html>

<sup>28</sup> <http://aweablog.org/blog/post/westar-to-buy-200-mw-of-wind>

1 price for all electricity purchased in the market. These impacts are purely  
2 market driven, occurring exclusively because zero-fuel-cost wind energy is  
3 used to displace more expensive forms of energy.

4 Wind energy reduces power system production costs because zero-fuel  
5 cost wind energy directly displaces the output of the most expensive and  
6 least efficient power plants that are currently operating. Like the  
7 functioning of almost any market, electricity market operators rank power  
8 plants based on their cost of producing an incremental amount of  
9 electricity. They then start by using the least-cost power plants first, and  
10 then move up the supply curve until they have enough electricity to meet  
11 demand. The power plant rank order is based on the marginal cost for  
12 that plant to produce an incremental amount of electricity, so only fuel  
13 costs and variable operations and maintenance costs are considered,  
14 while fixed costs are not. As a result, wind energy and other low fuel cost  
15 resources are always used first, and they are used to displace the most  
16 expensive power plants that otherwise would have operated. Because that  
17 is almost always the least efficient fossil-fired power plant, adding wind  
18 energy greatly reduces fossil fuel energy costs and pollution. These cost  
19 savings provide significant benefits for society and consumers.

20 The reduction in the need for conventional generation described above  
21 also allows demand to be met by conventional generators with lower fuel  
22 cost, and therefore a lower cost of producing electricity. This is known as  
23 the “merit order” effect because it allows the market operator to move  
24 down the merit order, or supply curve, to use generators with a lower  
25 marginal production cost to meet demand. This results in a lower  
26 electricity market price because this less expensive power plant’s offer  
27 cost is now the market clearing price. This drives down the market price  
28 for all electricity that is being purchased in the market, not just the wind  
29 electricity. As an example, the chart in the link in the footnote shows a

1 hypothetical electricity supply curve for a fictitious grid operating area.<sup>29</sup>  
2 Adding low marginal cost generation like wind to the left side of the curve  
3 will push the supply curve out to the right, allowing electricity demand to  
4 be met by a lower cost power plant and therefore reducing the price of  
5 electricity. Because some parts of the generation supply curve can be  
6 quite steep, even a modest amount of additional supply can greatly  
7 benefit consumers.

8  
9 **Q: Have you conducted analysis examining the impact of wind energy**  
10 **on production costs and wholesale electricity prices in SPP?**

11 **A:** Last month, AWEA released analysis that uses hourly wind and other  
12 generation data from SPP and power plant production cost data from SNL  
13 Energy to calculate the economic and consumer benefits provided by  
14 wind energy in the region.<sup>30</sup> The results show that in 2013, SPP wind  
15 energy reduced the cost of producing electricity by \$828 million. Thanks to  
16 wind energy, the cost of consumers' wholesale electricity market  
17 purchases declined by \$840 million. These are gross benefits, in that they  
18 only capture the impact of wind energy on wholesale electricity market  
19 costs and prices and not the cost of wind energy PPAs, which are  
20 recovered outside of the wholesale electricity market. However, given that  
21 the \$/MWh cost of recent SPP wind PPAs is significantly lower than the  
22 gross benefits wind energy provides to SPP consumers on a \$/MWh-  
23 basis, these results indicate that adding new wind energy to SPP creates  
24 net benefits for society and consumers. Detailed information about the  
25 methodology and hourly results of the analysis can be found in the full  
26 report, which is available at the link indicated in the footnote.

27 **Q: Have other studies documented the tendency of wind energy to**  
28 **reduce electricity market prices?**

---

<sup>29</sup> <http://www.eia.gov/todayinenergy/detail.cfm?id=7590>

<sup>30</sup> <http://awea.files.cms-plus.com/SPP%20report%20November%202014%20final.pdf>

1 **A:** A European literature review identified six peer-reviewed articles that have  
2 found wind energy tends to drive electricity market prices downward. As  
3 that report explains,

4 Wind power normally has a low marginal cost (zero fuel  
5 costs) and therefore enters near the bottom of the supply  
6 curve. Graphically, this shifts the supply curve to the right,  
7 resulting in a lower power price, depending on the price  
8 elasticity of the power demand.... When wind power reduces  
9 the spot power price, it has a significant influence on the  
10 price of power for consumers. When the spot price is  
11 lowered, this is beneficial to all power consumers, since the  
12 reduction in price applies to all electricity traded – not only to  
13 electricity generated by wind power.<sup>31</sup>

14  
15 A February 2014 report by the American Wind Energy Association  
16 summarizes 15 studies by state governments, grid operators, and  
17 academics that have documented wind energy's role in reducing electricity  
18 prices.<sup>32</sup> For example, Charles River Associates found that wind and  
19 transmission investment in SPP would provide \$1 billion in annual  
20 consumer savings, and net savings of \$628-728 million per year, after  
21 accounting for wind and transmission costs.<sup>33</sup> Another recent analysis in  
22 PJM found that doubling the use of wind energy beyond existing RPS  
23 requirements would produce net savings for consumers of \$6.9 billion per  
24 year.<sup>34</sup>

25

26 **Q:** In addition to the utility wind purchases documented above, have  
27 other utilities noted the consumer benefits of wind energy?

28 **A:** Yes, AWEA's report documented a number of quotes from utilities and  
29 state regulators confirming the savings wind energy is providing to their

---

<sup>31</sup> PÖyry, *Wind Energy and Electricity Prices*, at pages 11 and 12

[http://www.ewea.org/fileadmin/ewea\\_documents/documents/publications/reports/MeritOrder.pdf](http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/MeritOrder.pdf)

<sup>32</sup> <http://awea.files.cms-plus.com/AWEA%20White%20Paper-Consumer%20Benefits%20final.pdf>,  
at page 4

<sup>33</sup> <http://phx.corporate-ir.net/phoenix.zhtml?c=97435&p=irol-newsArticle&ID=1227218>

<sup>34</sup> Synapse Energy Economics, *The Net Benefits of Increased Wind Power in PJM*, (May 2013),  
available at [http://www.synapse-energy.com/sites/default/files/SynapseReport.2013-05.EFC\\_Increased-Wind-Power-in-PJM.12-062.pdf](http://www.synapse-energy.com/sites/default/files/SynapseReport.2013-05.EFC_Increased-Wind-Power-in-PJM.12-062.pdf)

1 ratepayers.<sup>35</sup> Notable examples include statements made when American  
2 Electric Power subsidiary Southwestern Electric Power Co. (“SWEPCO”)  
3 signed long-term power purchase agreements for a total of 358.65 MW  
4 from wind projects in Texas, Oklahoma and Kansas. SWEPCO said in a  
5 news release that it estimated an average decrease in cost to its  
6 customers of about 0.1 cents per kilowatt-hour over a 10-year period  
7 starting in 2013.<sup>36</sup> As another example, Oklahoma Gas and Electric  
8 estimates that a single wind project will save its customers \$46 million.<sup>37</sup>  
9 As a final example, Alabama Power and Georgia Power have made  
10 several recent wind power purchases from Oklahoma and Kansas,  
11 indicating the favorable economics of SPP’s wind resources. John Kelley,  
12 their parent company’s Director of Forecasting and Resource Planning,  
13 explained that “These agreements are good for our customers for one  
14 very basic reason, and that is, they save our customers money.”<sup>38</sup>

15  
16 **Q: What is the expected trajectory of natural gas prices?**

17 **A:** OG&E’s IRP report uses fuel price projections from the Department of  
18 Energy’s Annual Energy Outlook, which is widely used as a source of  
19 forecasts in the electric power sector. As shown in Schedule MG-8, a  
20 chart that appears in the LBNL Annual Wind Technologies Market Report,  
21 and also in data that appears on page 35 of OG&E’s IRP report, this  
22 analysis projects electric sector natural gas prices and coal prices will  
23 increase significantly in the coming years and decades. This chart actually  
24 understates the costs of gas generation, as it just shows the fuel costs  
25 associated with gas generation without including any capital or O&M

---

<sup>35</sup> <http://awea.files.cms-plus.com/AWEA%20White%20Paper-Consumer%20Benefits%20final.pdf>  
at page 5

<sup>36</sup> AEP Southwestern Electric Power Company, AEP SWEPCO Signs Wind Power Purchase Agreements for 359 Megawatts, (1/25/2012), available at <https://www.swepco.com/info/news/ViewRelease.aspx?releaseID=1183>

<sup>37</sup> Direct Testimony of Gregory W. Tillman before the Arkansas Public Service Commission, (August 2012), available at [http://www.apscservices.info/pdf/12/12-067-u\\_2\\_1.pdf](http://www.apscservices.info/pdf/12/12-067-u_2_1.pdf).

1 costs. Schedule MG-8 also notes the significant uncertainty about future  
2 gas prices, but in all scenarios the Department of Energy (DOE) predicts  
3 that gas prices will increase significantly from their current levels. In  
4 contrast, the Schedule MG-8 shows that wind project PPAs tend to have  
5 declining costs over time in real terms, as many PPAs are not indexed for  
6 inflation or have escalation clauses that are below the expected rate of  
7 inflation.<sup>39</sup> If anything the DOE fuel price predictions should be viewed as  
8 conservative, as DOE has a long history of underestimating gas price  
9 increases. DOE has historically underestimated future gas prices 67% of  
10 the time, coal prices 62% of the time, and oil prices 82% of the time.<sup>40</sup>

11  
12 **Q: What does this chart indicate about the expected total costs of wind  
13 and gas generation over the lives of both projects?**

14 **A:** While current wind energy costs are already low relative to the current  
15 cost of gas generation, over the full lifetimes of both projects it is even  
16 clearer that wind energy will be the lowest cost resource. Even in the AEO  
17 scenario with the lowest gas cost and a relatively high cost of wind  
18 energy, the cost of current wind PPAs in future years, and cumulatively  
19 over the lives of the projects, is well below that of gas generation.

20 This was also documented in a recent Lawrence Berkeley National  
21 Laboratory report which concluded that

22 Comparing the wind PPA sample to the range of long-term  
23 gas price projections reveals that even in today's low gas  
24 price environment, and with the promise of shale gas having  
25 driven down future gas price expectations, wind power can  
26 still provide long-term protection against many of the higher-  
27 priced natural gas scenarios contemplated by the EIA  
28 [United States Energy Information Administration].<sup>41</sup>

---

<sup>38</sup> Alabama Power, Alabama Power among leaders in SE in wind power, (October 2012), available at [http://www.youtube.com/watch?v=6q6Q0\\_C1SX0](http://www.youtube.com/watch?v=6q6Q0_C1SX0) at 2:25.

<sup>39</sup> <http://emp.lbl.gov/sites/all/files/lbni-6809e.pdf>, page 62

<sup>40</sup> <http://www.eia.gov/forecasts/aeo/retrospective/>

<sup>41</sup> Lawrence Berkeley National Laboratory, Revisiting the Long-Term Hedge Value of Wind Power in an Era of Low Natural Gas Prices, page i, (March 2013) available at <http://emp.lbl.gov/sites/all/files/lbni-6103e.pdf>.

1 **Q: Was this value of wind generation accounted for in your analysis?**

2 **A:** Yes, this value is in addition to the production cost and consumer benefits  
3 discussed above. To account for the value wind generation is providing  
4 over its lifetime, relative to the increasing fuel prices for SPP's other  
5 generation resources, we incorporated DOE's fuel price forecast into the  
6 cost calculations for other power plants. Taking these expected fuel prices  
7 into account, our analysis calculated additional annualized net present  
8 value production cost savings of \$266 million for the amount of wind  
9 generation in SPP in 2013, in addition to the \$828 million in production  
10 cost savings discussed above. Similarly, the annualized net present value  
11 of additional electricity price reductions was found to be \$355 million, in  
12 addition to the \$840 million in consumer electricity price reductions  
13 discussed above.

14  
15 **Q: How does wind energy compare to other resources on fuel price  
16 uncertainty?**

17 **A:** A unique benefit of renewable energy is that it has no fuel cost and  
18 therefore no fuel price uncertainty. Wind energy therefore protects  
19 consumers from uncertainty in the price of other fuels that are used to  
20 produce electricity, particularly fossil fuels. The risk of fuel price volatility  
21 makes consumers worse off, and one of the most effective tools for  
22 reducing that risk is by diversifying the energy mix with zero-fuel-cost wind  
23 energy. Wind energy helps to hedge against volatility in the price of fossil  
24 fuels, much like a fixed-rate mortgage protects consumers from interest  
25 rate fluctuations. In Schedule MG-8, the grey area indicates the large  
26 uncertainty about future fuel prices.

27 The cost of this uncertainty is distinct from and in addition to the cost of  
28 the expected increase in fuel prices, indicated by the black line in the  
29 Schedule MG-8. To separate the cost of this uncertainty from the cost of  
30 expected increases in fuel prices, in another report LBNL experts simply  
31 calculated the premium at which forward gas contracts, which set a fixed

1 price for future delivery, trade relative to current projections of gas price  
2 increases.<sup>42</sup> This market price premium, which was found to be  
3 \$.776/MMBtu in LBNL's analysis,<sup>43</sup> indicates the value provided by a  
4 contract providing a known future price. For our analysis, we used this  
5 market price premium of \$0.776/MMBtu as an adder to the cost of gas  
6 used at SPP power plants, to reflect the economic cost of the uncertainty  
7 in gas prices for SPP consumers relative to a fixed-cost resource like a  
8 wind PPA. This yielded an additional net present value annualized  
9 production cost saving of \$126 million based on the level of wind output in  
10 SPP in 2013, in addition to the \$828 million and \$266 million in annualized  
11 production cost savings identified above.

12 To make an accurate comparison among different generation options, it is  
13 essential to account for the real cost of fuel price uncertainty over the life  
14 of that asset, in addition to the cost of expected fuel price increases.  
15 Finding the price premium at which forward fuel contracts trade relative to  
16 fuel price projections is one method for quantifying the cost of fuel price  
17 risk. Other methods can be adopted from well-established practices for  
18 quantifying risk in the financial sector. The list on pages 5-6 of the  
19 following LBNL study provides a summary of these methods.<sup>44</sup>

20  
21 **Q: In your analysis, what was the total sum of all benefits SPP wind is**  
22 **providing?**

23 The total economic benefits included \$828 million in production cost  
24 savings in 2013, additional net present value savings of \$266 million per  
25 year once AEO-projected gas price increases were taken into account,  
26 \$126 million per year in economic value from fuel price risk reduction, and

---

<sup>42</sup> <http://emp.lbl.gov/sites/all/files/REPORT%20lbnl%20-%2053587.pdf>, page 60

<sup>43</sup> Lawrence Berkeley National Laboratory experts found that fixed price gas futures contracts trade at an average premium of \$0.6/MMBtu (2003\$) relative to gas price predictions, with a range of \$0.4-0.8/MMBtu, indicating that this is the cost of fuel price risk for a futures gas market trader. \$0.6/MMBtu was converted to \$0.776/MMBtu in 2014 dollars.

<sup>44</sup> <http://emp.lbl.gov/sites/all/files/REPORT%20lbnl%20-%2053587.pdf>

1 \$1.565 billion per year in additional economic savings from avoided  
2 environmental and public health impacts from wind's role in reducing air  
3 pollution, for a total of \$2.8 billion in annual economic benefits, or \$109 in  
4 benefits for each MWh of wind energy produced in SPP.

5 Total consumer benefits included \$840 million in reduced electricity prices  
6 in 2013, plus \$355 million in additional net present value savings to  
7 account for expected fuel price increases, for a total of \$1.2 billion per  
8 year, or \$47 per MWh of wind energy produced in SPP.

9 These are gross benefits, in that they only capture the impact of wind  
10 energy on wholesale electricity market costs and prices and not the cost  
11 of wind energy PPAs, which are recovered outside of the wholesale  
12 electricity market. However, given that the \$/MWh cost of recent SPP  
13 wind PPAs is significantly lower than the gross economic and consumer  
14 benefits wind energy provides on a \$/MWh-basis, these results indicate  
15 that adding new wind energy to SPP creates net benefits for society and  
16 consumers.

17  
18 **Q: Can wind energy help Oklahoma comply with proposed EPA**  
19 **regulations of carbon emissions from existing power plants?**

20 **A:** The U.S. EPA is in process of developing a new rule to regulate carbon  
21 dioxide emissions from existing power plants under section 111(d) of the  
22 Clean Air Act. On June 2, 2014, the U.S. EPA published a draft rule,  
23 called the Clean Power Plan, to reduce the carbon dioxide emissions from  
24 existing fossil fuel generation plants to target levels set by the U.S. EPA.  
25 A final rule is expected to be issued in 2015. States will have one to three  
26 years to develop a compliance plan, depending on whether they are  
27 developing a plan for their own state or in conjunction with multiple states.  
28 The compliance period will run from 2020 to 2030. The draft Clean Power  
29 Plan rule specifically allows for the use of renewable energy as a way to  
30 comply with the required carbon emission reduction targets. Thus,

1 Oklahoma can use its abundant wind energy to comply with the  
2 requirements of EPA's Clean Power Plan at low cost.

3  
4 **Q: What is Oklahoma's carbon reduction requirement under EPA's  
5 proposal for 111(d)?**

6 **A:** EPA proposes that Oklahoma be required to reduce its emissions rate  
7 from 1,387 lbs of CO<sub>2</sub>/MWh to 895 lbs/MWh by 2030, a reduction of  
8 35.5%.<sup>45</sup> In developing the proposed 111d standards for each state, EPA  
9 assumed that each of four "building blocks" would be utilized to bring a  
10 state into compliance, and one of those building blocks is the expansion  
11 of renewable and nuclear energy. EPA's method assumed Oklahoma  
12 would use 15.6 million MWh of renewable energy by 2030 to bring the  
13 state into compliance, up significantly from the 8.5 million MWh of  
14 renewable energy that Oklahoma produced in 2012.

15 Under EPA's "alternative" method for establishing the state renewable  
16 energy targets, a method that EPA expressed significant interest in  
17 pursuing in its October 2014 Notice of Data Availability,<sup>46</sup> EPA assumed  
18 that Oklahoma could deploy 24.3 million MWh of renewable energy by  
19 2030.<sup>47</sup> That would significantly increase the stringency of the proposed  
20 rule, causing Oklahoma's 2030 carbon emission target rate to be the more  
21 aggressive 816 lbs/MWh,<sup>48</sup> instead of 895 lbs/MWh under the proposed  
22 method. Increasing its use of wind generation would help ensure that  
23 Oklahoma can meet either standard at low cost.

---

<sup>45</sup> <http://www.c2es.org/federal/executive/epa/carbon-pollution-standards-map>

<sup>46</sup> <http://www2.epa.gov/sites/production/files/2014-10/documents/20141028noda-clean-power-plan.pdf>, pages 46-51

<sup>47</sup> U.S. EPA, [Alternative RE Approach Technical Support Document](http://www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-alternative-re-approach.pdf), available at:  
<http://www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-alternative-re-approach.pdf>

<sup>48</sup> This number is calculated by inputting the 24.3 million MWhs into this EPA model, available at:  
[Data File: Goal Computation - Appendix 1 and 2 \(XLS\)](#)

1 If a state decides not to fully utilize one of the four building blocks, that  
2 shortfall must be made up by using greater amounts of the other building  
3 blocks, exceeding EPA's assessment of what was cost-effective for those  
4 other building blocks. Conversely, exceeding EPA's assumption on the  
5 amount of renewable energy that would be utilized will reduce the burden  
6 and cost of using other compliance mechanisms.

7  
8 **Q: How can wind resources be used to meet the section 111(d)**  
9 **requirements?**

10 **A:** The draft Clean Power Plan rule allows states to incorporate renewable  
11 energy resources into their state implementation plan for purposes of  
12 compliance. The draft rule states the following in outlining one of the ways  
13 states could account for the emissions reductions provided by renewable  
14 energy:

15 We are proposing that RE [renewable energy] and demand-  
16 side EE [energy efficiency] measures may be incorporated  
17 into a rate-based approach through an adjustment or  
18 tradable credit system applied to an EGU's [existing  
19 generating units] reported CO2 emission rate. Under such a  
20 process, measures that avoid EGU CO2 emission from  
21 affected EGUs, such as quantified and verified end-use  
22 energy savings and renewable energy generation, could be  
23 credited toward a demonstrated CO2 emission rate for EGU  
24 compliance purposes or used by the state to administratively  
25 adjust the average CO2 emission rate of affected EGUs  
26 when demonstrating achievement of the required rate-based  
27 emission performance level in a state plan. 79 Fed. Reg.  
28 117 at 34919 (June 18, 2014)

29  
30 **Q: How much can wind generation contribute to complying with 111(d)?**

31 **A:** Because wind energy displaces output from the most expensive power  
32 plant that is currently operating, the pollution savings from using wind  
33 energy are quite large. Wind energy output is used by the Independent  
34 System Operator's (in this case the Southwest Power Pool) market-based  
35 dispatch to displace generation from the generator with the highest  
36 marginal cost of production at that time, which is typically the least

1 efficient and most polluting fossil-fired power plant of the fuel type  
2 (typically either coal or gas) that is on the margin at that point in time.

3 To calculate the emissions reductions produced by actual 2013 wind  
4 production in SPP, I used EPA's AVOIDed Emissions and geneRation Tool  
5 (AVERT),<sup>49</sup> which uses empirical power system data and a statistical  
6 algorithm to identify which of a region's power plants will have their output  
7 displaced by the addition of wind energy.<sup>50</sup> I found that the average  
8 emissions reduction for each MWh of wind energy produced in or  
9 physically delivered to AVERT's Lower Midwest region, which includes  
10 most of SPP, to be 2.33 lbs of SO<sub>2</sub>/MWh of wind, 1.65 lbs of NO<sub>x</sub>/MWh,  
11 and 1,675 lbs of CO<sub>2</sub>/MWh. These results were used in the analysis of the  
12 economic value of SPP wind, as described above. This is among the  
13 highest emissions savings rates for any region in the country, driven by  
14 the fact that in SPP coal is typically the most expensive generation  
15 source, particularly during periods when wind output is at its highest, so  
16 therefore coal is the resource most commonly displaced by the addition of  
17 wind energy. As a result, using wind energy in Oklahoma will provide  
18 significant emissions reductions that can be used for compliance with  
19 EPA's Clean Power Plan.

20  
21 **Q: Do you foresee Oklahoma having a need for wind resources to  
22 comply with section 111(d) requirements?**

23 **A:** Oklahoma has the flexibility to decide which combination of solutions it will  
24 use to comply. However, given the stringency of Oklahoma's emissions  
25 target, and the large contribution that renewable energy is expected to  
26 make towards meeting that target, it would be exceedingly difficult and  
27 costly for Oklahoma to comply if it chose a pathway that did not include a

---

<sup>49</sup> AVERT available at <http://epa.gov/statelocalclimate/resources/avert/index.html>; I used the "Upper Midwest" Regional Data File and modeled the addition of the amount of wind capacity necessary to produce 41 million MWh of wind energy annually.

<sup>50</sup> [http://awea.files.cms-plus.com/FileDownloads/pdfs/AWEA\\_Clean\\_Air\\_Benefits\\_WhitePaper%20Final.pdf](http://awea.files.cms-plus.com/FileDownloads/pdfs/AWEA_Clean_Air_Benefits_WhitePaper%20Final.pdf)

1 major expansion of wind energy use. To the extent Oklahoma exceeds  
2 EPA's assumed level of renewable deployment, that will reduce the  
3 burden and cost of using other compliance mechanisms.  
4

5 **Q: Does wind energy's lack of fuel price risk provide it with additional**  
6 **advantages for use for Clean Power Plan compliance?**

7 **A:** Yes, in at least two ways. Fuel price fluctuations make it difficult to count  
8 on other resources providing the expected level of emissions reductions at  
9 a predictable cost. For example, some of the emissions reductions gas  
10 generation delivered several years ago have subsided as the price of gas  
11 has increased. In contrast, wind energy continues to provide sustained  
12 emissions reductions regardless of changes in fuel price.<sup>51</sup> In its IRP filing,  
13 OG&E notes the value wind energy and other clean energy options have  
14 provided for ensuring that the utility is well-positioned to comply with  
15 uncertain environmental regulations.<sup>52</sup>

16 Another critical factor is how Clean Power Plan compliance will affect  
17 generating portfolio diversity and fuel price risk. EPA expects fuel-shifting  
18 from coal to gas generation to play a major role in Clean Power Plan  
19 compliance in many states, which will increase natural gas use and prices  
20 if the increased gas demand is not offset by Clean Power Plan-driven  
21 energy efficiency.<sup>53</sup> A state compliance plan that relies heavily on  
22 increasing dependence on gas generation exposes consumers to greater  
23 fuel price risk. Wind energy's benefits for hedging against fuel price risk  
24 are compounded when evaluating options for Clean Power Plan  
25 compliance.

---

<sup>51</sup> For a summary of the DOE data that support this conclusion, see

<http://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=5748>

<sup>52</sup> OG&E IRP, referring to wind energy purchases and other clean energy measures at pages 3-4, "As a result of these actions, OG&E's customers have benefited in the short term through lower costs and the Company is better positioned to address an uncertain environmental future."

<sup>53</sup> <http://www2.epa.gov/sites/production/files/2014-06/documents/20140602ria-clean-power-plan.pdf>, pages 3-27 through 3-38. EPA's results show gas price increases are contained, though

1 OG&E notes the critical importance of protecting against the uncertainty of  
2 both fuel prices and environmental regulations. On page 8 of his  
3 testimony, Leon Howell notes that “Fuel diversity, as an objective, is  
4 closely related to the concepts of lowest reasonable cost and portfolio  
5 risk. For example, the NPVCC [net present value of consumer cost] of a  
6 portfolio that is heavily weighted toward natural gas plants will be relatively  
7 insulated from the impact of carbon prices but will swing widely in  
8 response to volatility in natural gas prices. Similarly, the NPVCC of a  
9 portfolio that is heavily dependent on coal resources will be relatively  
10 sensitive to the risk of carbon prices and also be at risk should regulation  
11 of CO2 take a less flexible form than a market-based approach. In our  
12 view, relying predominantly on a single technology or a single fuel is a  
13 risky strategy.” Unfortunately, OG&E’s IRP failed to account for wind  
14 energy’s value for protecting against both of these risks.

15  
16 **4. Responses to OG&E**

17 **Q: In the IRP, did OG&E make a substantive evaluation of the value**  
18 **wind generation could provide to its energy portfolio?**

19 **A:** No. OG&E excluded wind from any substantive consideration in its IRP  
20 analysis. As the IRP notes in a brief, one-page explanation: “OG&E  
21 considered including wind generation as an element of the environmental  
22 compliance plan analysis but determined that it would not add any  
23 incremental insights that would affect the analysis or recommendation.”  
24 OG&E states that this decision was based on two claims, neither of which  
25 is valid.

26  
27 **Q: What was the first claim?**

---

that is because EPA assumed aggressive deployment of energy efficiency that kept increased gas demand in check.

1 **A:** OG&E concluded that it should exclude wind because “SPP only  
2 recognizes approximately 5% of nameplate wind generation capability for  
3 capacity margin purposes,” so “wind generation would not serve as an  
4 effective resource to address the planning capacity needs in OG&E’s  
5 environmental compliance plan.”  
6

7 **Q:** **Is it true that SPP recognizes only 5% of nameplate wind generation**  
8 **capability for capacity margin purposes?**

9 **A:** No. The SPP Board recently changed the calculation of accredited  
10 capacity for wind and solar resources. The new method reduces the  
11 number of peak hours evaluated in the calculation but also reduces the  
12 required level of confidence that a resource will be available. According to  
13 presentations provided to stakeholders and the SPP Board, this change  
14 will result in significant increases in accredited capacity for most wind  
15 plants. According to a table from a December 4, 2013, presentation to  
16 SPP stakeholders,<sup>54</sup> reproduced as Schedule MG-9, a 50% confidence  
17 level for resource availability for either the top 3% or 5% of load hours  
18 would result in an average wind plant accredited capacity of 14% of  
19 nameplate capacity for existing SPP wind, nearly three times higher than  
20 the 5% level that SPP had used. Using a 60% confidence level for the top  
21 3% of hours, which is the methodology the SPP has now adopted, should  
22 result in an average accredited capacity percentage for existing SPP wind  
23 that is slightly less than 14%. The accredited capacity value is calculated  
24 for each wind plant based on its actual output data, so the number varies  
25 significantly depending on the location and turbine type of the wind plant.  
26 Notably, the 14% accredited capacity figure was calculated based on data  
27 from existing SPP wind projects. Because new wind projects being built in  
28 SPP are making widespread use of “low-wind speed turbines” with longer  
29 blades and other features designed specifically to increase generation

---

<sup>54</sup> Presentation entitled “Wind Capacity,” December 4, 2013

1 during periods of low wind speeds, the accredited capacity number for  
2 new wind projects is likely to be significantly higher. The increased  
3 capacity factor for these new wind turbine designs has been almost  
4 entirely driven by significantly increasing the level of output during periods  
5 of lower wind speeds and increasing the number of hours when a wind  
6 turbine is producing power. As a result, the use of these turbines should  
7 disproportionately increase output, and therefore accredited capacity,  
8 during the peak hours and at the confidence interval employed in SPP's  
9 new methodology. The construction of new wind projects in higher  
10 capacity factor wind resource areas, enabled by the completion of new  
11 transmission, should also significantly increase the on-peak generation  
12 and therefore accredited capacity for new wind projects.

13 OG&E has greatly underestimated the accredited capacity of new wind  
14 generation by using an old methodology that SPP no longer employs and  
15 failing to account for how higher capacity factors have increased the  
16 accredited capacity of wind.

17

18 **Q: Regardless, is OG&E reasonable to reject wind energy from**  
19 **consideration based solely on its accredited capacity?**

20 **A:** Even if the above error were corrected, focusing exclusively on the value  
21 of wind generation for meeting peak capacity needs would be an  
22 inaccurate lens through which to evaluate wind's benefits to OG&E's  
23 energy portfolio. Wind energy is primarily added to the power system as  
24 an energy resource, as wind's greatest value is its ability to provide energy  
25 with no fuel cost, fuel price risk, or emissions. The power system needs  
26 energy, capacity, and flexibility to operate cost-effectively and reliably,<sup>55</sup>  
27 so focusing only on the attribute of capacity is an inaccurate  
28 representation of the value of any resource, but particularly wind  
29 generation. Energy accounts for the vast majority of power system costs,

1 accounting for around 75% of total power system costs in the PJM  
2 market, versus only 12% for capacity,<sup>56</sup> so it should be a primary focus  
3 when evaluating the value provided by different resources.  
4 Because wind resources are not generally added for their accredited  
5 capacity value, arguing that many multiples of the nameplate of wind  
6 resources would be needed to replace capacity is meaningless. Wind  
7 resources are added for the value they bring because of the price of  
8 energy, the stability of the price of energy, the environmental value, and  
9 the hedging value in protecting against the volatility of fuel prices and  
10 environmental policy. The analysis should be whether adding wind  
11 resources to the overall portfolio is a better choice than not adding these  
12 resources. OG&E's decision to exclude wind generation from  
13 consideration based on accredited capacity concerns is also inconsistent  
14 with OG&E's methods in previous IRP analyses, which have primarily  
15 evaluated wind energy's value based on its ability to provide low-cost  
16 energy. By displacing more expensive energy sources and reducing  
17 wholesale market electricity prices, adding wind energy will tend to reduce  
18 the cost of providing energy to Oklahoma consumers. Energy is also the  
19 only factor that matters when evaluating the best portfolio to comply with  
20 EPA's pending Clean Power Plan.

21  
22 **Q: Is there a better way to evaluate the contributions of different**  
23 **resources in an IRP process?**

24 **A:** Yes. In conducting its analysis of the relative merits of different coal and  
25 gas generation options, OG&E's IRP correctly focuses on the cost of  
26 energy and related factors, such as fuel price risk and carbon price risk.  
27 Wind generation would have done quite well in that analysis, had it not

---

<sup>55</sup> For more background on this topic, see

<http://www.awea.org/Issues/Content.aspx?ItemNumber=5453>

<sup>56</sup> [http://www.monitoringanalytics.com/reports/PJM\\_State\\_of\\_the\\_Market/2014/2014q3-som-pjm.pdf](http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2014/2014q3-som-pjm.pdf), page 13

1           been unjustifiably excluded by OG&E's arbitrary decision to use  
2           accredited capacity as a screen for what resources are allowed to  
3           proceed to that stage of the analysis.

4           The goal of an IRP analysis should be to find the lowest cost mix of  
5           resources that satisfies all of the power system's needs for energy,  
6           capacity, and flexibility, while also minimizing risk.<sup>57</sup> Because energy is by  
7           far the largest component of consumer electricity costs, securing low-cost  
8           and stably-priced energy should be the primary focus of an IRP analysis.

9           At the very least, OG&E should have evaluated portfolio options that  
10          included various combinations of wind generation and low-cost capacity  
11          resources, such as natural gas, energy efficiency, and demand response  
12          resources. Xcel Energy made such a comparison in recent filings with the  
13          Colorado PUC. As described by former Colorado Commissioner Ron  
14          Binz,<sup>58</sup> the analysis found that "A gas plant plus a wind farm can cost less  
15          than a gas plant alone." He added, "This analysis doesn't even count  
16          avoided carbon emissions [or the] value of wind as a hedge on natural  
17          gas prices."

18          This symbiotic relationship between wind and gas, such that the  
19          combination of the two resources is more valuable than either resource in  
20          isolation, is discussed in more detail in a report I co-authored for the Wind  
21          Energy Foundation, which can be accessed at the link below.<sup>59</sup> As  
22          discussed in that report and in more detail at the link in this footnote,<sup>60</sup> few  
23          power plants excel at providing all three of the attributes needed for a  
24          reliable and cost-effective power system: energy, capacity, and flexibility.  
25          As a result, the most cost-effective generating resource portfolios typically  
26          make use of a "division of labor," with some power plants specializing in

---

<sup>57</sup> <http://www.ceres.org/resources/reports/practicing-risk-aware-electricity-regulation>

<sup>58</sup> Binz, "Adding More Wind Power," presentation at WINDPOWER conference, May 2014

<sup>59</sup> Wind Energy Foundation, "Wind Energy and Natural Gas: A Bright Future," March 2014,  
available at [http://awea.files.cms-plus.com/WEF\\_Wind%20Gas%20White%20Paper\\_031914.pdf](http://awea.files.cms-plus.com/WEF_Wind%20Gas%20White%20Paper_031914.pdf)

<sup>60</sup> <http://www.awea.org/Issues/Content.aspx?ItemNumber=5453>

1 providing energy while others specialize in providing capacity and  
2 flexibility.

3 For example, gas combustion turbines are a low-cost source of capacity  
4 and flexibility, but they are a high-cost source of energy. Wind generation  
5 is actually similar to nuclear generation or baseload coal generation, in  
6 that all three resources are primarily added as a low-cost source of  
7 energy, even though baseload resources are not typically an ideal source  
8 of flexibility, just as wind generation is not an ideal source of capacity.

9 In addition to OG&E's use of an incorrect value for new wind generation's  
10 accredited capacity, OG&E's IRP is more fundamentally flawed because it  
11 uses accredited capacity as a screen for which resources were allowed to  
12 be fully considered in the IRP analysis. This method is likely to result in a  
13 sub-optimal mix of resources for OG&E's ratepayers. A more holistic  
14 approach to the IRP, focused on finding the lowest cost mix of resources  
15 that satisfies all of the power system's needs for energy, capacity, and  
16 flexibility, while also minimizing risk, would better serve OG&E's  
17 ratepayers. As a result, the OG&E IRP submission should be deemed  
18 insufficient, and further modeling and analysis should be required by the  
19 Commission. This type of analysis would almost certainly conclude that  
20 wind energy should have an expanded role in OG&E's energy portfolio.

21  
22 **Q: What is the second reason OG&E gave for excluding wind**  
23 **generation from serious consideration in its IRP analysis?**

24 **A:** OG&E expresses concern that the risk of transmission congestion and  
25 curtailment could affect the economic value of new wind generation:  
26 "Based on recent experience with wind energy there is considerable SPP  
27 IM price risk and the respondents to our 2013 RFI declined to assume this  
28 risk. We expect that this price risk will diminish as new transmission  
29 capacity is placed in service and will monitor this risk. However, given this

1 risk, OG&E has made a decision not to pursue additional wind generation  
2 at this time.”<sup>61</sup>

3 **Q: Do you believe this is a valid reason for not pursuing further wind**  
4 **generation?**

5 **A:** I do not. As OG&E correctly notes in its IRP report, “this price risk will  
6 diminish as new transmission capacity is placed in service.” SPP and its  
7 transmission owners are nearing completion of major transmission  
8 upgrades that will greatly enhance the deliverability of wind energy and  
9 reduce or eliminate the price risk that has been caused by transmission  
10 congestion and curtailment to date. In a presentation at SPP’s December  
11 3, 2014, CAWG meeting, Cary Frizzell provided the status of this  
12 transmission construction in a “Project Tracking Update.”<sup>62</sup> This report  
13 shows that nearly \$3.5 billion of transmission upgrades have been  
14 completed between 2012 and 2014, with over \$1.8 billion completed in  
15 2014 alone. Between 2015 and 2018, the start of the time period  
16 considered in OG&E’s IRP analysis, another \$3.5 billion of transmission  
17 upgrades are expected to be completed.

18 These projects include many transmission lines that will greatly expand  
19 wind energy deliverability. For example, the update notes that most of the  
20 Priority Projects that are most critical for wind energy deliverability have  
21 already been completed or are slated for completion by the end of  
22 December 2014. Nearly all of the Balanced Portfolio lines have already  
23 been completed as well.

24 In response to Data Request OIEC-2, request 2-5, dated September 3,  
25 2014, OG&E notes that the primary example of its concern is transmission  
26 congestion that has occurred on transmission lines connected to the

---

<sup>61</sup> IRP report, page 49.

<sup>62</sup> Cary Frizzell, “Project Tracking Update,” SPP’s December 3, 2014 CAWG meeting

1 Woodward substation in Oklahoma, which is in a wind-producing area.  
2 This transmission congestion is and will be greatly alleviated by the new  
3 transmission lines that have been added in that area, as many of the new  
4 lines directly interconnect with the Woodward substation. Cary Frizzell's  
5 December 3, 2014, update indicates that the Balanced Portfolio Tuco –  
6 Woodward 345 kV project was completed on September 25, 2014, while  
7 the Priority Project Hitchland – Woodward District 345 kV double circuit  
8 was completed on May 16, 2014. Several additional Priority Projects that  
9 will connect to that line and allow full delivery of wind generation to load  
10 centers have been completed or will be completed by the end of 2014,  
11 including Thistle – Woodward District 345 kV double circuit, Spearville –  
12 Ironwood – Clark Co. – Thistle 345 kV double circuit, and Thistle –  
13 Wichita 345 kV double circuit.

14 **Q: What will be the impact of these lines on the transmission**  
15 **congestion and curtailment that has occurred to date?**

16 **A:** The congestion and curtailment should be greatly reduced, if not  
17 eliminated. In SPP's Priority Projects Phase II planning report, the Priority  
18 Projects were found to "provide for improvements in the GI and AS  
19 queues and relieve know[n] congestion while also improving west to east  
20 transmission system capabilities."<sup>63</sup>

21 In fact, OG&E's 2012 IRP took a far more positive tone, and conducted a  
22 far more detailed analysis, of the opportunity afforded by these  
23 transmission upgrades. It concluded that "Major transmission upgrades  
24 are expected to be in place by 2014 due to SPP's planned transmission  
25 expansion. The Integrated Transmission Planning process assumed an  
26 additional 3,000 to 5,000 MW of wind generation could be added with  
27 these transmission upgrades. The cost of these upgrades has been

---

<sup>63</sup> <http://www.spp.org/publications/Priority%20Projects%20Phase%20II%20Report.pdf>, page 5

1 allocated to the SPP members and, therefore, OG&E assumes no  
2 additional transmission improvement costs associated in its wind  
3 generation expansion analysis.

4 "Transmission improvements identified in the STEP were included in the  
5 transmission models for this IRP. Some of the benefits provided by these  
6 improvements include reliability and the capacity for expansion of  
7 Oklahoma's wind energy."

8 "Wind was analyzed in 2012 through a RFI process. The results indicated  
9 that firm transmission service was not available until at least 2014.  
10 Therefore wind additions should only be made after transmission  
11 infrastructure is in place in 2014. Nonetheless OG&E may submit a RFI  
12 for wind in 2013 to update the 2012 price information. Final determination  
13 to add wind will be based on customer savings analysis that includes  
14 consideration of the impact wind has on the operations of OG&E's  
15 generation portfolio."

16 **Q: Have you seen data on the frequency of wind curtailment facing**  
17 **existing OG&E wind projects?**

18 **A:** Yes, in response to Data Request OIEC-3, request 3-25, dated  
19 September 29, 2014, OG&E lists approximately 25 total hours of wind  
20 curtailment that have occurred across 5 separate wind projects since the  
21 start of SPP's Integrated Marketplace on March 1, 2014. That is equal to  
22 an average of 5 hours per wind project over that 7 month period, which  
23 amounts to less than one hour per wind project per month, or about one  
24 tenth of 1% of the total hours over the 7 month period. This level of  
25 curtailment is well below that seen in other markets where utilities are  
26 actively purchasing new wind energy, and should not have a significant  
27 negative impact on the economics of OG&E's wind purchases.

1 More recent data is not available to assess what has happened and will  
2 happen to curtailment frequency as the remainder of the Priority Projects  
3 and Balanced Portfolio projects are completed, though I would expect that  
4 transmission congestion and curtailment should be further reduced. It is  
5 also possible that some of the curtailment that has occurred recently was  
6 caused by transmission lines or substation equipment temporarily being  
7 taken out of service so that new transmission infrastructure can be  
8 connected, a theory supported by the fact that most of the wind  
9 curtailment experienced by OG&E occurred during the low-load month of  
10 September, when transmission outages are often scheduled.

11

12 **Q: Will there be protections against curtailment of wind resources, in**  
13 **addition to the transmission capacity that is being built?**

14 **A:** Yes. First OG&E may access the available capacity on the transmission  
15 system. If it designates a wind plant for firm transmission service,  
16 additional enhancements required under SPP's Aggregate Study process  
17 will reduce the likelihood of curtailments. Potential curtailment issues for a  
18 new resource would be addressed in the SPP Generation Interconnection  
19 and Aggregate Transmission Service studies. Potential reliability issues  
20 will typically be corrected with upgrades necessary for firm transmission  
21 for a resource designated for network service by OG&E during the  
22 Aggregate Study process. It is not possible to specifically discuss the  
23 potential curtailment of a generation resource without a detailed  
24 generation interconnection or transmission service study.

25 In addition, the implementation of the day ahead Integrated Market (IM) in  
26 SPP and the consolidation of balancing authorities has increased the  
27 efficiency of dispatch in the region. It is my understanding that since its  
28 implementation, the frequency of manual curtailments in the SPP footprint  
29 has decreased, as one would expect. When combined with transmission  
30 capacity increases, it seems clear that any curtailment issues are being

1 addressed, and concerns that may have been noted prior to the IM and  
2 the completion of transmission upgrades should be discounted greatly.

3 **Q: Have other regions seen the impact of transmission expansion on**  
4 **transmission congestion and resulting wind curtailment and market**  
5 **price risk?**

6 **A:** Yes, due to the completion of the Competitive Renewable Energy Zone  
7 (CREZ) lines, ERCOT has seen greatly reduced congestion, wind  
8 curtailment, and market price risk. The LBNL report documents that wind  
9 curtailment fell by more than a factor of 10 from a high of 17.1% of  
10 potential wind generation in 2009, to 8.5% in 2011, to only 1.2% in 2013,  
11 thanks to the completion of the CREZ lines and other transmission and  
12 market design upgrades.<sup>64</sup> While full year curtailment data for 2014 is not  
13 year available, wind curtailment appears to be even lower in ERCOT's  
14 monthly operating reports for 2014, even during hours when wind output  
15 is extremely high.<sup>65</sup>

16 The completion of the CREZ lines has also greatly reduced market price  
17 separation between ERCOT's West zone and the rest of ERCOT. At  
18 times in previous years West ERCOT has had significantly lower market  
19 clearing prices than the rest of ERCOT due to transmission congestion.  
20 ERCOT hub pricing data indicate that in 2013, the simple average hub  
21 price in West ERCOT was only 4.4%, or \$1.36/MWh, lower than the  
22 simple average for ERCOT hubs as a whole.<sup>66</sup> In contrast, in 2011 prices  
23 at the West hub were \$3.88/MWh, or 9.4%, lower than the simple average  
24 for all ERCOT hubs.

---

<sup>64</sup> <http://emp.lbl.gov/sites/all/files/lbnl-6809e.pdf>, page 39

<sup>65</sup> See Monthly Operational Overviews available at <http://www.ercot.com/committees/board>. For examples of low curtailment during periods of extremely high wind output, see slide 5 at [http://www.ercot.com/content/committees/board/keydocs/2014/ERCOT\\_Monthly\\_Operational\\_Overview\\_201411.pdf](http://www.ercot.com/content/committees/board/keydocs/2014/ERCOT_Monthly_Operational_Overview_201411.pdf)

<sup>66</sup> <http://mis.ercot.com/misapp/GetReports.do?reportTypeId=13061&reportTitle=Historical%20RTM%20Load%20Zone%20and%20Hub%20Prices&showHTMLView=&mimicKey>

1 Data from other grid operating areas, including MISO and PJM, also show  
2 a drastic drop in the occurrence of negative prices in recent years.<sup>67</sup>

3 **Q: Do you think OG&E's proposed approach to wait and see how**  
4 **transmission congestion and wind curtailment evolve before**  
5 **deciding whether to purchase wind energy makes sense?**

6 **A:** OG&E explains in its testimony that "OG&E has been utilizing wind as a  
7 source of generation for a decade now. The Company keenly understands  
8 the value of wind energy and is always looking at wind as a way to create  
9 customer savings." It goes on to note that "It is very possible, if not likely,  
10 that OG&E will increase its reliance on wind energy over the coming  
11 decade, if the transmission constraints are addressed and if the cost of  
12 wind offers our customers savings."

13 While I share OG&E's positive assessment of the value and benefits of  
14 wind energy, OG&E's proposed timeline of taking a "wait and see"  
15 approach will likely result in the company missing the boat on current  
16 record-low wind PPA prices. As OG&E notes, the prospects for securing  
17 further PTC extensions are anything but certain. Given that the PTC has a  
18 major impact on wind PPA prices, and that a number of under  
19 construction SPP wind projects that have qualified for the PTC under the  
20 2013 and soon-to-be-enacted 2014 PTC extensions are currently seeking  
21 long-term PPAs with utilities, OG&E would be doing a disservice to its  
22 ratepayers to not take advantage of the current opportunity. The  
23 transmission upgrades currently nearing completion in SPP, plus the  
24 additional \$3.5 billion of upgrades planned through 2018, are perfectly  
25 timed to coincide with the completion of wind projects that have qualified  
26 for the PTC and are currently seeking PPAs.

---

67 <http://www.scottmadden.com/insight/678/energy-supply-demand-and-markets-winter->

1 **Q:** Does this conclude your testimony?

2 **A:** Yes.

## Schedule MG-2

Michael Goggin

### Education:

Harvard University class of 2004, B.A.

- Graduated *cum laude* in Social Studies
- Wrote thesis "Is it Time for a Change? Science, Policy, and Climate Change"

### Experience:

AWEA Research Director, Senior Electric Industry Analyst February 2008-present

- Provide analytical support and advocacy on transmission and grid integration and issues related to wind energy's impact on markets
- Communicate with the press, the public, and policymakers about wind energy
- Work with AWEA members to develop the organization's policy positions

Sentech, Inc. Research Analyst October 2005-February 2008

- Author white papers, feasibility studies, and economic analyses of solar, wind, geothermal, and energy storage technologies for Department of Energy officials
- Model performance and economics of innovative renewable energy and energy storage technologies
- Research and write fact sheets and presentations for DOE clients
- Provide analytical support for DOE's selection of recipients for renewable energy technology R&D funding

Union of Concerned Scientists Clean Energy Intern May 2005-October 2005

- Worked with the legislative and field staff to promote the inclusion of pro-renewable energy measures in the Energy Policy Act of 2005
- Mobilized clean energy businesspeople and advocates to lobby elected officials
- Prepared fact sheets to support passage of pro-renewable policies

State Public Interest Research Groups Policy Analyst August 2004-May 2005

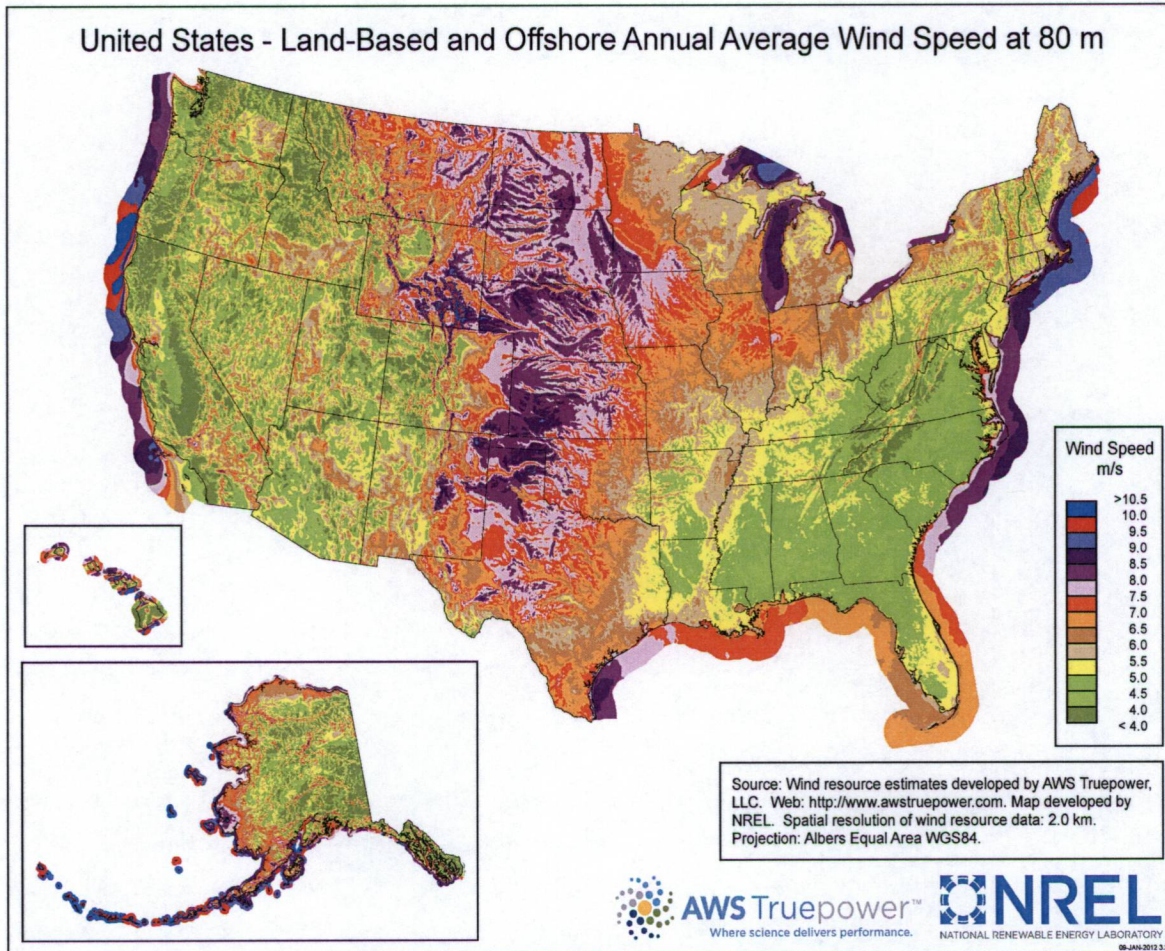
- Wrote reports advocating pro-renewable energy policies at the state, regional, and federal level
- Gathered and analyzed data to be included in advocacy reports

### Publications:

- R. Gramlich and M. Goggin, "The Ability of Current U.S. Electric Industry Structure and Transmission Rules to Accommodate High Wind Energy Penetration," October 2008, presented at 7th International Workshop on Large Scale Integration of Wind Power and on Transmission Networks for Offshore Wind Farms
- M. Milligan, et al., "Impact of Electric Industry Structure on High Wind Penetration Potential," July 2009, NREL Technical Report TP-550-46273
- R. Gramlich and M. Goggin, "What's Next for Wind Power," March 2013, Electricity Journal
- Michael Goggin, "Wind Energy's Emissions Reductions: A Statistical Analysis," July 2013, presented at IEEE PES annual conference

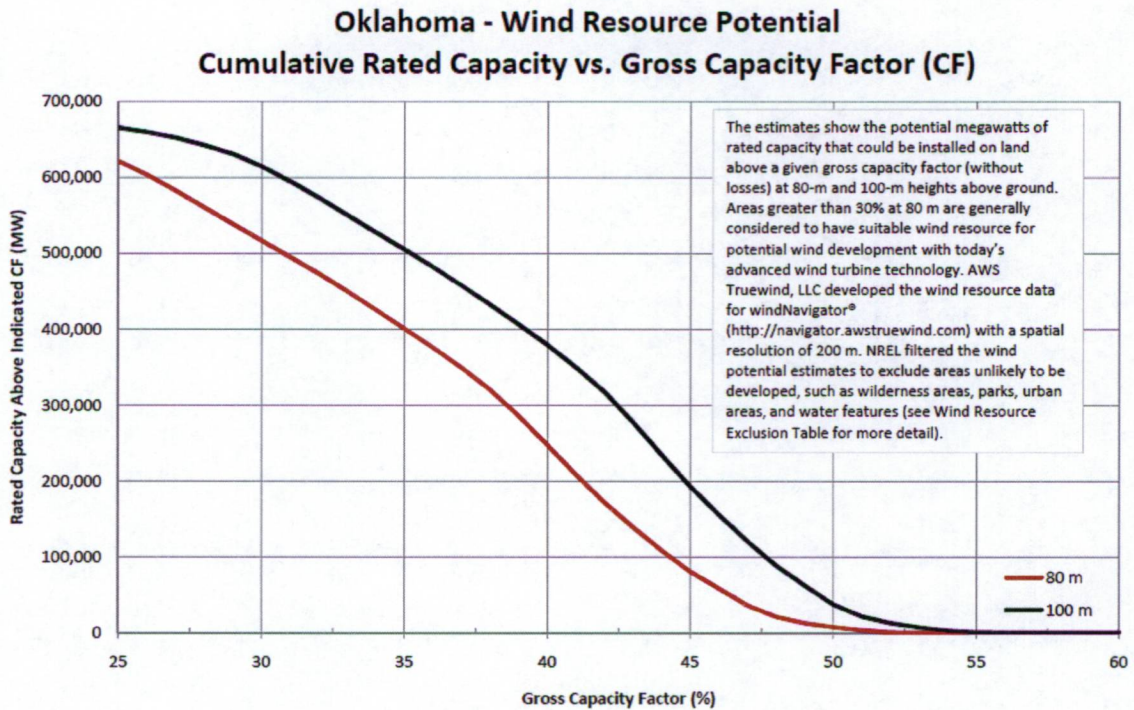
### Schedule MG-3

NREL wind resource assessment map of the U.S. as of December 16, 2014, available at [http://www.nrel.gov/wind/resource\\_assessment.html](http://www.nrel.gov/wind/resource_assessment.html), downloaded by Michael S. Goggin.



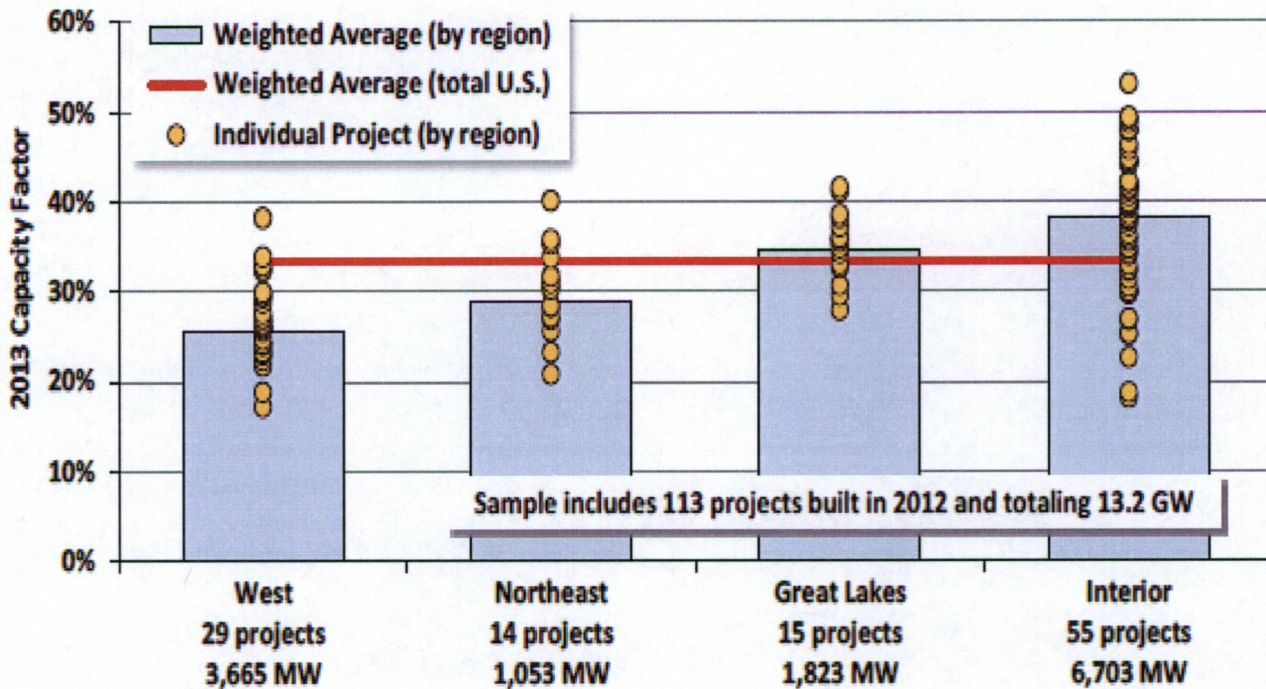
## Schedule MG-4

NREL wind resource assessment for Oklahoma as of December 16, 2014,  
available at  
[http://apps2.eere.energy.gov/wind/windexchange/pdfs/wind\\_maps/ok\\_wind\\_potential\\_chart.pdf](http://apps2.eere.energy.gov/wind/windexchange/pdfs/wind_maps/ok_wind_potential_chart.pdf) , downloaded by Michael S. Goggin.



Schedule MG-5

Capacity factor by region, from Lawrence Berkeley National Laboratories, 2013 Wind Technologies Report, fig. 36 at 45 (August 2014), [http://energy.gov/sites/prod/files/2014/08/f18/2013%20Wind%20Technologies%20Market%20Report\\_1.pdf](http://energy.gov/sites/prod/files/2014/08/f18/2013%20Wind%20Technologies%20Market%20Report_1.pdf)



Source: Berkeley Lab

Figure 36. 2013 capacity factors by region: 2012 projects only

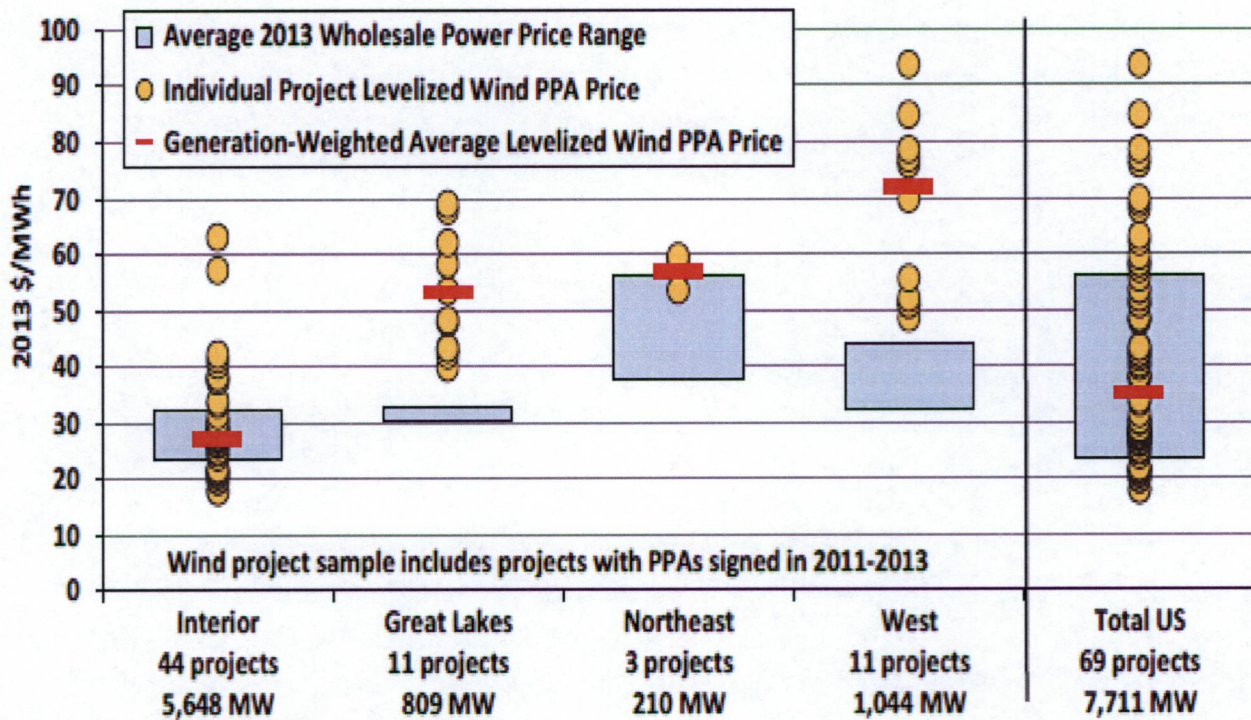
## Schedule MG-6

Oklahoma wind project capacity factor data. Form EIA-923 detailed data, with 2013 data from EIA-923M and 2012 data from EIA-923, available at <http://www.eia.gov/electricity/data/eia923/>. Wind project capacity and year online data from AWEA's database of wind projects, available at <http://www.awea.org/Resources/Content.aspx?ItemNumber=5728&navItemNumber=5776>.

Plant Name	Year Online	Project Capacity (MW)	2013 Capacity Factor
Blue Canyon VI	2011	99	46.4%
Minco II	2011	100.8	41.3%
Taloga	2011	129.6	41.5%
Big Smile Wind Farm at Dempsey Ridge	2012	132	34.2%
Blackwell	2012	59.8	47.1%
Canadian Hills	2012	298.45	42.1%
Chisholm View	2012	235.2	26.1%
KODE Novus I	2012	80	25.2%
KODE Novus II	2012	40	26.9%
Minco III	2012	100.8	48.0%
Rocky Ridge I	2012	148.8	46.2%
	2006		
Centennial	2007	120	36.9%
	2009		
Elk City, Elk City II	2010	199.7	39.4%
	2011		
Crossroads	2012	227.5	44.3%

## Schedule MG-7

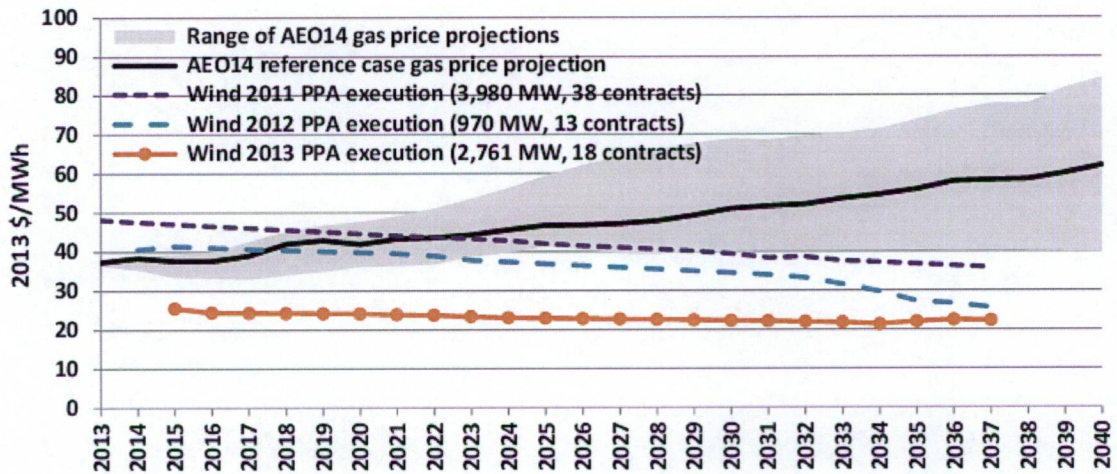
Wind PPA price by region, from Lawrence Berkeley National Laboratories, 2013 Wind Technologies Report, fig. 48 at 60 (August 2014), [http://energy.gov/sites/prod/files/2014/08/f18/2013%20Wind%20Technologies%20Market%20Report\\_1.pdf](http://energy.gov/sites/prod/files/2014/08/f18/2013%20Wind%20Technologies%20Market%20Report_1.pdf)



Source: Berkeley Lab, Ventyx, IntercontinentalExchange

## Schedule MG-8

Existing wind PPA prices, in real terms, versus increasing gas fuel costs, from Lawrence Berkeley National Laboratories, 2013 Wind Technologies Report, at page 62 (August 2014), [http://energy.gov/sites/prod/files/2014/08/f18/2013%20Wind%20Technologies%20Market%20Report\\_1.pdf](http://energy.gov/sites/prod/files/2014/08/f18/2013%20Wind%20Technologies%20Market%20Report_1.pdf)



Source: Berkeley Lab, EIA

## Schedule MG-9

Table showing SPP analysis of wind's accredited capacity under updated methods, from December 4, 2013 presentation, "Wind Capacity"

<b>Top 10% load Hours</b>			
	Average % of Nameplate rating	Minimum % of Nameplate rating	Maximum % of Nameplate rating
85% Confidence	1%	0%	3%
50% Confidence	16%	9%	26%
Average	21%	14%	28%
<b>Top 5% load Hours</b>			
85% Confidence	1%	0%	4%
50% Confidence	14%	7%	26%
Average	19%	12%	29%
<b>Top 3% load Hours</b>			
85% Confidence	2%	0%	7%
50% Confidence	14%	6%	33%
Average	19%	11%	34%