BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of Ameren Missouri's	)	
2017 Utility Resource Filing Pursuant to	)	Case No. EO-2018-0038
4 CSR 240 - Chapter 12	)	

WIND ON THE WIRES' COMMENTS IDENTIFYING DEFICIENCIES IN THE 2017 INTEGRATED RESOURCE PLAN OF AMEREN MISSOURI

Dated: February 28, 2018

COMES NOW Wind on the Wires, by its counsel, respectfully submitting the attached comments pursuant to 4 CSR 240-22.080 that identify deficiencies in Ameren Missouri's 2017 Integrated Resource Plan.

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Introduction

It is encouraging to see Ameren Missouri (Ameren) proposes to primarily add renewable resources to its resource mix by 2028. Ameren states that it is working to accelerate the transition of its fleet to a "cleaner and more diverse portfolio in a responsible fashion." **Wind on the Wires supports this focus and its plan, however, deficiencies exist in the following IRP sections: Load Analysis and Forecasting, Supply-Side Resources, and Risk Analysis and Strategy Selection.**

Understanding that the purpose of the IRP process is for Ameren to objectively and systematically analyze all potential resources to meet future customer electricity needs and to

determine the optimal mix of resources that would result in the lowest present value of revenue requirements (PVRR) over the next 20 years, Wind on the Wires presents information on factors that could affect load forecasting, wind and solar cost assumptions, and timing for wind energy procurement.[1] First, Ameren should assume and plan for additional expected customer demand for wind energy in the near term from large customers and impending electrification. Second, the inputs used to estimate the levelized cost of energy (LCOE) for wind and solar resources need to be updated to account for recent technological advancements, cost competition in wind and solar markets. Third, it would be prudent for Ameren to procure wind resources as soon as possible to capture the benefit of the federal wind Production Tax Credit (PTC) while it is available.

The wind and solar subject matter experts that have contributed to Wind on the Wires' comments are Hannah Hunt, Deputy Director of Electricity Policy and Demand for the American Wind Energy Association, and Sam Kliewer, Policy Manager of Eastern Markets for Cypress Creek Renewables.

4 CSR 240-22.030 Load Analysis and Forecasting

DEFICIENCY #1: Ameren Fails to Assume and Plan for Additional Expected Customer Demand for Wind Energy in the Near Term from Large Customers and Impending Electrification

Summary

Ameren proposes to add at least 700 MW of wind generation to its resource mix by 2020. In addition, it plans to add 50 MW of solar generation by 2025, with a total increase of 100 MW by 2027. The plan reflects Renewable Energy Standard (RES) compliance analysis, which determines the quantity of renewable energy needed to be compliant without exceeding an average 1% revenue requirement increase over the next 10 years. Specifically, Ameren expects only a

[1] 240 CSR 240-22.010.

0.069% revenue requirement increase over the next 10 years with the selected plan.

Wind on the Wires acknowledges and applauds Ameren's pursuit of RES compliance via its own generation resources, rather than through the purchase of unbundled renewable energy credits (REC) on the market. This provides greater value and stability to both Ameren and the wind project owner. As discussed below, it is also commendable for Ameren to focus on procuring low-cost wind resources in the near-term to capture the benefit of the PTC. However, Ameren should assume and systematically plan for additional demand for renewable energy beyond what is required by the RES in the near term. Ameren itself states in its IRP that "it is … possible that additional wind resources beyond those included in our plan could be beneficial to customers"[2] and that it "will continue to explore renewable investments beyond the IRP that are in the long-term best interest of customers – especially given advancing technologies and lower costs."[3] Beyond improvements in wind turbine technology and the decreasing costs of wind, Ameren should assume and plan for additional customer demand for renewable energy, including but not limited to renewable energy initiatives with large customers and impending electrification.

Suggested Remedy

In recent years, the wind industry has seen a large increase in demand for direct purchase of renewable energy by large electricity customers, many of whom prefer direct energy purchases relative to buying RECs alone. Ameren Missouri President and Chairman Michael Moehn recently acknowledged that access to renewable energy is "becoming an increasingly important factor for a lot of these corporate customers," including companies that consider relocating to Missouri.[4] To illustrate the scope of large customers wanting to procure renewable energy, 125 companies to

[2] 2017 IRP, Ch. 10 at 10.
[3] Ibid, Ch. 1 at 3-4.
[4] Bryce Gray, "Ameren Missouri to spend $1 billion on wind generation projects," (Sep 25 2017), *available at* http://www.stltoday.com/business/local/ameren-missouri-to-spend-billion-on-wind-generation-projects/article_08660e51-31e1-5ba3-a156-fb26769b75d6.html.

date have signed the RE100 commitment to procure 100% renewable energy to power their operations, including Missouri employers Anheuser-Busch InBev, Unilever, Walmart, and others.[5] In a January 2018 letter to the Missouri State Governor, seven Missouri companies including Cargill, General Mills, General Motors H&M, Procter & Gamble, Unilever, and Walmart, collectively representing hundreds of facilities and tens of thousands of employees in Missouri, stated goals to increase their use of renewable energy and that they consider access to renewable energy a factor in choosing to do business in Missouri. In addition, the availability of wind energy has become an important factor for many corporate customers in deciding where to site large facilities like data centers. For example, Facebook recently chose to site a $1 billion data center in Texas and not Ohio because favorable policies provided more access to wind energy in Texas than in Ohio.[6] Beyond corporate customers, the city of Saint Louis also committed last year to transitioning to 100 percent renewable energy by 2035.[7] These customers are not just stating goals to procure renewable energy, they're executing significant deals. Since 2012, more than 10 GW of renewable energy have been contracted across the country by corporate customers through PPAs, green power purchases, direct project ownership, and green tariffs.[8]

One method by which Ameren could satisfy this impending customer demand is to offer a well-designed green tariff program, or a program that allows eligible customers to buy the bundled energy and RECs from specific renewable energy projects through its utility. The renewable energy that would be procured for such a program would be in addition to the 800 MW in planned wind and solar capacity. Ameren filed a proposed green tariff in November, pending approval with

[5] RE100, "Companies: 125 RE100 Companies have made a commitment to go '100% renewable," (2017), *available at* http://there100.org/companies.
[6] NRDC, "Facebook Unfriends Ohio in Favor of Texas," (July 8, 2015), *available at* https://www.nrdc.org/media/2015/150708-0.
[7] U.S. News, "St. Louis Sets 100 Percent Renewable Energy Goal; Now at 5," (Oct. 27 2018). https://www.usnews.com/news/best-states/missouri/articles/2017-10-27/st-louis-to-transition-to-100-percent-renewable-energy.
[8] Business Renewables Center, "Deal Tracker," (2017). http://businessrenewables.org/corporate-transactions/.

the Missouri Public Service Commission.[9] Although green tariffs are relatively recent programs being offered by utilities, customers have signaled significant interest to participate. The World Resources Institute (WRI) cites that large non-residential utility customers have procured a total of 1,100 MW of renewable energy via green tariff programs to date, with an additional 558 MW currently under negotiation.[10] This represents significant recent interest, as 97% of the 1,100 MW were signed since the beginning of 2015 alone. It is expected that the 1,100 MW signed to date will grow significantly in the future as more green tariff programs are implemented and program designs are improved to best serve customers. 70 companies representing over 53 million MWh of annual energy demand, including Missouri employers Anheuser-Busch InBev, Unilever, Walmart, and others, articulate in the Corporate Renewable Energy Buyers' Principles that they "welcome the opportunity to work with local utilities to design and develop innovative programs and products that meet our needs."[11] These companies are specifically investing in new energy generation facilities and prefer procuring renewable energy that is "within reasonable proximity to their facilities," specifically on the same grid so that their efforts "benefit local economies and communities as well as enhance the resilience and security of the local grid." General Motors, in particular, shared in its blueprint "Accelerating and Scaling Corporate Renewable Energy" that they view green tariffs "as a significant part" of their renewable energy procurement strategy moving forward.[12] Ameren should align with these corporate strategies and procure more wind energy in anticipation of this demand, acting with urgency to procure inexpensive PTC-qualified

[9] Ameren Missouri, PSC Docket No. ET-2018-0063 "Application of Union Electric Company d/b/a Ameren Missouri for Approval of its Renewable Choice Program and for Accounting Authority," (Nov. 27, 2017), *available at* https://www.efis.psc.mo.gov/mpsc/commoncomponents/view_itemno_details.asp?caseno=ET-2018-0063&attach_id=2018007110.

[10] World Resources Institute, "Grid Transformation: Green Tariff Deals," (2018), *available at* http://www.wri.org/resources/charts-graphs/grid-transformation-green-tariff-deals.

[11] Corporate Renewable Energy Buyers' Principles, "The Principles," (2017), *available at* http://buyersprinciples.org/principles/.

[12] General Motors, "Accelerating and Scaling Corporate Renewable Energy," at 4 (Nov. 14, 2017), *available at www.generalmotors.green/dld/.../us/.../GM_renewable_energy_blueprint.pdf.*

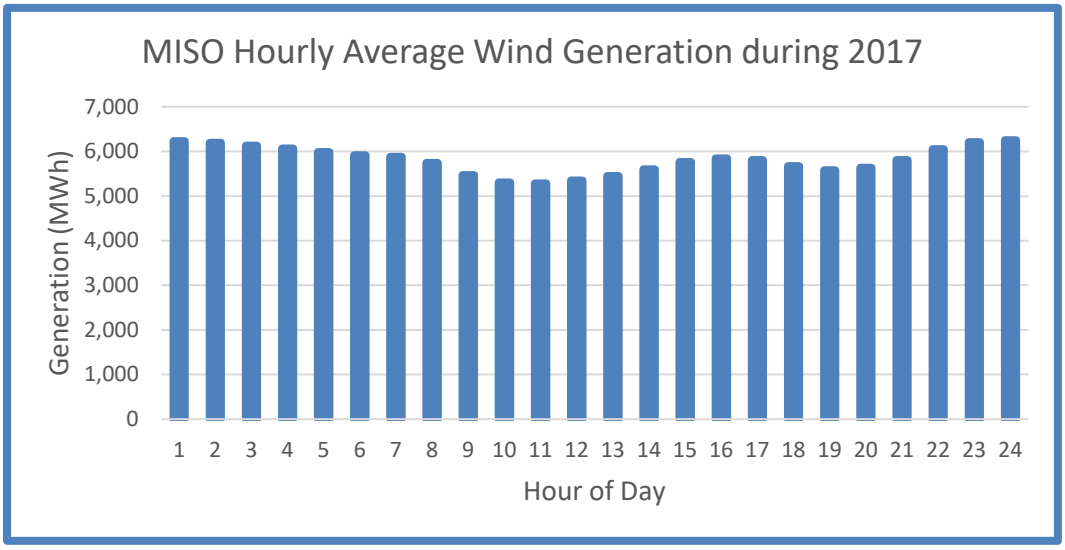
wind projects.

Another impending source of additional renewable energy demand is electrification, or the shift towards powering machines and processes with electricity rather than oil, natural gas, or other energy sources. The 2017 IRP states that electrification will expand in the near term in the transportation sector, and in heating, agricultural, and industrial processes. NREL's Electrification Futures Study confirms substantial electricity demand and timing changes could occur across the country due to the adoption of light-duty plug-in hybrid electric vehicles (PEV), battery electric vehicles (BEV), heat pump water heaters, and other technologies.[13] The base case load forecast in the 2017 IRP estimates that approximately 1,000 GWh in annual energy sales will go to serve electrification by 2037, including 335 GWh for PEVs. Expected demand from electrification represents approximately 3% of Ameren's expected annual energy sales by 2037. Importantly, a complementary relationship exists between electrification and wind generation and Ameren should consider the benefits of this pairing, particularly as it focuses on reducing its carbon footprint and addresses the potential for a future national carbon price.

Wind generation aligns well with expected demand from EVs. Global firm DNV-GL has stated that EV users tend to charge their vehicles most often late at night, even without time-of-use (TOU) policies in place, or policies created to encourage customers to shift consumption to off-peak periods.[14] In turn, charging EVs at night has a significant effect on individual household energy consumption. OPower evaluated data from 2,000 households charging EVs at night and found that energy usage quadrupled in the early morning hours compared to a typical household.[15] Importantly, EV charging patterns align well with time periods when wind generation is at its

[13] NREL, "Electrification Futures Study: End-Use Electric Technology Cost and Performance Projections through 2050," at 1 (2017), *available at* https://www.nrel.gov/docs/fy18osti/70485.pdf.
[14] DNV-GL, "Energy Transition Outlook 2017" at 45 (2017), *available at* https://eto.dnvgl.com/2017#The-future-of-your-industry.
[15] Inside EVs, "Average Hourly Electricity Usage – EV Households Versus Non EV Households." https://insideevs.com/average-hourly-electric-usage-ev-households-versus-non-ev-households/.

strongest in the MISO footprint. MISO wind generation tends to be somewhat higher during the late night and early morning hours that currently have lower electricity demand. Specifically during 2017, wind energy provided on average, at least 5,000 MWh of energy at every hour of the day; however, wind output generally peaked late at night in the hours directly before and after midnight.[16] EVs therefore increase the value of wind generation relative to other forms of generation in Ameren's fleet.



[17]

Ameren could better align wind generation and electrification, including EV charging, heat pump water heater use, and other forms of electrification that occur at night, through the application of time-of-use (TOU) or real-time-pricing (RTP) retail rate policies. Multiple utilities have successfully implemented these policies. A Department of Energy report evaluating six utilities with EV charging station programs found that customers took advantage of TOU policies in order to save on overnight charging expenses.[18] Indianapolis Power and Light Company (IPL)

[16] MISO, "Historical Hourly Wind Data," (2018), *available at* https://www.misoenergy.org/markets-and-operations/market-reports/#t=10&p=0.
[17] MISO, "Historical Hourly Wind Data," (2018), *available at* https://www.misoenergy.org/markets-and-operations/market-reports/#t=10&p=0.
[18] U.S. Department of Energy, "Evaluating Electric Vehicle Charging Impacts and Customer Charging Behaviors" at 11 (Dec. 2014), *available at* https://energy.gov/sites/prod/files/2014/12/f19/SGIG-EvaluatingEVcharging-Dec2014.pdf.

found that approximately 76% of the electricity used for charging EVs occurred during off-peak periods with a TOU policy in place. A pilot study in San Diego also concluded that TOU policies were effective at encouraging customers to charge during off-peak periods, with up to 90 percent of customers choosing to charge during "super off-peak" periods including between 12:00 - 6:00 AM on weekdays, the time period when wind output generally peaks.[19]

Ameren should model renewable energy additions beyond RES compliance through its alternative resource plans that inform the IRP process. It is clear that other utilities are recognizing and planning for additional customer demand for renewable energy above and beyond business as usual. The Public Service Company of New Mexico (PNM) plans to procure renewable energy specifically to satisfy customer demand in its 2017 IRP.[20] Beyond procuring renewables just to comply with the New Mexico Renewable Portfolio Standard (RPS), PNM also plans to procure a mix of wind and solar resources to match a customer's data center energy use in its service territory. Puget Sound Energy (PSE) also recently executed a 20-year power purchase agreement (PPA) for the output of the Skookumchuck wind project directly to serve customers subscribed to its green tariff program.[21] Regardless of the method by which Ameren accounts for additional energy demand at night, it is prudent for Ameren to incorporate these expectations into its IRP processes.

[19] Synapse Energy, "A Plug for Effective EV Rates" at 3 (Mar. 2017), *available at* http://www.synapse-energy.com/sites/default/files/A-Plug-for-Effective-EV-Rates-S66-020.pdf.
[20] Public Service Company of New Mexico, "PNM 2017-20136 Integrated Resource Plan," at 65, Table 22 (July 2017), *available at* https://www.pnm.com/documents/396023/396193/PNM+2017+IRP+Final.pdf/eae4efd7-3de5-47b4-b686-1ab37641b4ed.
[21] Puget Sound Energy, "2017 PSE Integrated Resource Plan," Appendix D: Electric Resources at D-14 (Nov. 2017), *available at* https://pse.com/aboutpse/EnergySupply/Documents/25_2017_PSE_IRP_Appendices_book_compressed_110817.pdf.

4 CSR 240-22.040 New Supply-Side Resources

DEFICIENCY #2: Inputs Used to Estimate the Levelized Cost of Wind Energy Need to be Updated

Summary

In its evaluation of potential wind resources, Ameren evaluated two wind resource options - wind resources within Missouri and those located in either Illinois or Iowa ("Regional Wind").

Table 6.16 Potential Wind Resources

Resource Option	Plant Output (MW)	Project Cost with Owner's Cost, Excluding AFUDC ($/kW)	First Year Fixed O&M Cost, ($/kW)	First Year Variable O&M Cost, ($/MWh)	Assumed Annual Capcity Factor (%)	LCOE without Incentives (¢/kWh)
Missouri Wind	700	$1,859	$26	$0	40.0%	5.80
Regional Wind	1000	$1,866	$26	$0	45.0%	5.17

The installed Project Cost Ameren uses for potential wind projects in Missouri is $1,859/kW and the installed cost for potential Regional Wind projects is $1,866/kW. Installed Project Costs include both the cost to purchase the materials and construct the wind plant and the owner's costs, excluding allowance for funds used during construction (AFUDC) costs. For both wind resource options, Ameren uses a $26/kW first year fixed operations and maintenance (O&M) cost and a $0/kW first year variable O&M cost. Ameren annually escalates fixed O&M costs at a 2% rate, however, it is unclear whether or not Ameren proposes to use an escalator on installed Project Costs. Missouri wind projects were assumed to have 40% annual capacity factors and Regional Wind projects were assumed to have 45% annual capacity factors. Given these inputs, Ameren calculated the levelized cost of energy (LCOE) without incentives for Missouri wind projects to be $58/MWh, and the LCOE without incentives for Regional Wind projects to be $51.70/MWh.[22] Ameren defines Regional Wind projects to be outside the state of Missouri, but in the Midwest and

[22] 2017 IRP, Ch. 6 at 22, Table 6.16.

preferably in the Midcontinent Independent System Operator (MISO) footprint. In response to a Wind on the Wires' data request, Ameren staff confirmed that all cost assumptions were based on responses to an Ameren RFP issued in December 2015. Missouri cost assumptions were based on Missouri project proposals and Regional Wind cost assumptions were based on Iowa and Illinois project proposals.[23] In total, Ameren received responses from seven developers representing 13 wind projects. Of those responses, it is not known how many wind projects were located in Missouri and how many were located in Iowa and Illinois. It is commendable for Ameren to revise its cost and operational characteristics based on its 2015 RFP results, however, considering recent technological advancements and current market dynamics, the 2015 RFP information is likely to be out of date and therefore inaccurate.

Suggested Remedy

The *2016 Lawrence Berkeley National Laboratory* ("LBNL") *Annual Wind Technologies Market Report* identifies a comparatively lower $1,531/kW average installed cost for wind projects completed during 2016 in the Interior region, the region that includes Missouri and Iowa.[24] It also identifies a $1,711/kW average installed cost for Great Lakes wind projects, the region that includes Illinois. Wind projects built in the Interior region of the country, followed by the Great Lakes region, were cheaper than any other region. LBNL based its estimates on a sample size of 41 projects representing 6,558 MW for both regions combined.

[23] WOW Data Request 1.01(a).
[24] Lawrence Berkeley National Laboratory, "2016 Wind Technologies Market Report" at 52 (August 2017), *available at* https://emp.lbl.gov/sites/default/files/2016_wind_technologies_market_report_final_optimized.pdf.

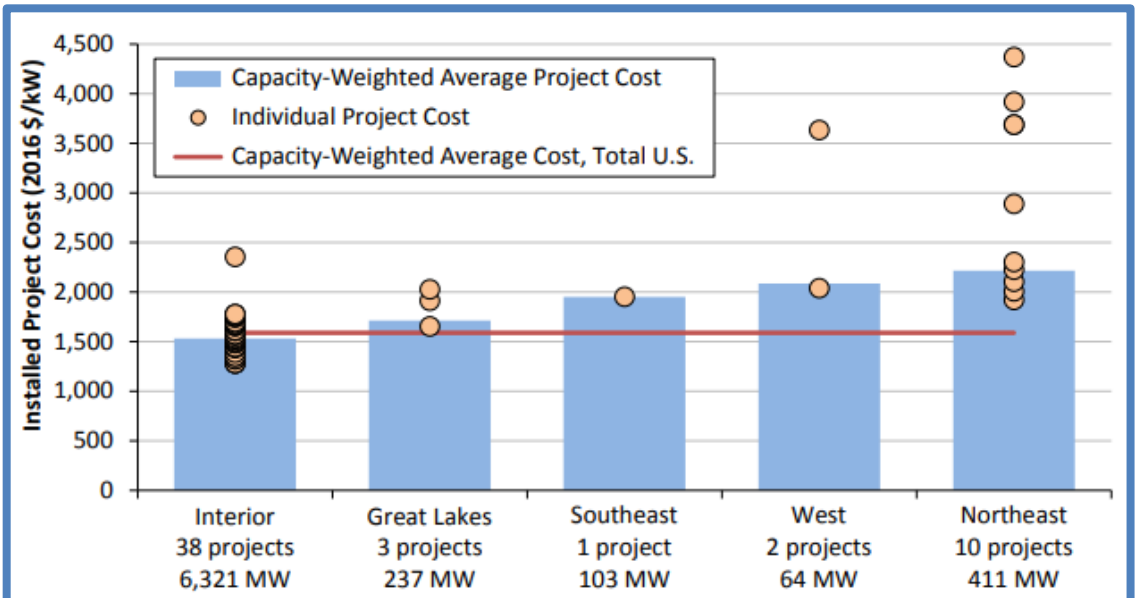


Figure 44. Installed wind power project costs by region: 2016 projects

The *National Renewable Energy Laboratory* ("NREL") *2017 Annual Technology Baseline* also reported a lower national installed cost range of $1,573-$1,713/kW for 2017.[25] This range compares favorably to all other energy source costs included in NREL's analysis, including natural gas combined cycle, nuclear, and solar photovoltaic (PV). Given the strong wind resources in Illinois, Iowa, and Missouri, it can be inferred that Missouri and Regional Wind projects would reside in the lower end of the cost range. In addition, the *Energy Information Administration's* ("EIA") *2018 Annual Energy Outlook* reports a $1,548/kW national average installed cost for wind projects expected to come online in 2018.[26] Importantly, installed costs for wind are expected to decline over time. The *NREL Annual Technology Baseline* expects continued capital cost reductions through 2030.[27] MISO agrees in its Transmission Expansion Plan process that the

[25] National Renewable Energy Laboratory, "2017 ATB," at "Land-Based Wind" tab (2017), *available at* https://atb.nrel.gov/electricity/data.html.
[26] U.S. Energy Information Administration, "Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2018," at 2 (Feb. 2018), *available at* https://www.eia.gov/outlooks/aeo/assumptions/pdf/table_8.2.pdf.
[27] Ibid.

capital cost curve for wind will continue a downward trend over the next decade.[28] A recent DOE survey also showed that wind energy experts expect land-based wind capital costs to decline by an additional 12% by 2030 relative to a 2014 baseline.[29] Market competition between turbine manufacturers and technological advancements in turbine components work together to reduce turbine prices to competitive levels. These forces ensure continued installed cost declines. Ameren's assumptions should incorporate expected cost declines over time.

Ameren's baseline O&M cost assumptions are consistent with current market data. The *2016 LBNL Annual Wind Technologies Market Report* shows a $27/kW average annual O&M cost for U.S. wind projects built since 2010.[30] MAKE Consulting reports a similar $28/kW average O&M cost for U.S. wind projects installed in 2016.[31] Similar to how installed costs are expected to decrease over time, MAKE Consulting and others expect to see O&M costs continue to decrease in all regions of the country as operational efficiencies improve and project operators adopt a hybrid approach of self-service and OEM service agreements. Wind energy experts surveyed by DOE agree that O&M costs will continue to decline through 2030.[32] Therefore, Ameren should assume in its planning process that O&M costs will decrease over time.

In a similar manner, Ameren's capacity factor assumptions are accurate and consistent with

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[28] MISO, "MTEP17," Appendix E2, at 23, Figure 18 (Dec. 2017) *available at* https://www.misoenergy.org/api/documents/getbymediaid/97343; a*lso being considered for* MISO, "MTEP18 Futures," at slide 19 (June 14, 2017), *available at* https://cdn.misoenergy.org/20170614%20PAC%20Item%2002a%20MTEP18%20Futures89864.pdf; a*lso being considered for* MISO, "MTEP19 Futures Development," slide 13 (Feb, 14, 2018), *available at* https://cdn.misoenergy.org/20180214%20PAC%20Item%2003a%20MTEP19%20Futures%20Development125886.pdf.

[29] LBNL, "Forecasting Wind Energy Costs and Cost Drivers," at 20 (June 2016), *available at* https://emp.lbl.gov/sites/all/files/lbnl-1005717.pdf.

[30] Lawrence Berkeley National Laboratory, "2016 Wind Technologies Market Report" at 54, *available at* https://emp.lbl.gov/sites/default/files/2016_wind_technologies_market_report_final_optimized.pdf.

[31] Gerdes, J, "Repowering North America's Aging Wind Turbines is a $25 Billion Opportunity," Greentech Media (Dec. 1, 2017), *available at* https://www.greentechmedia.com/articles/read/could-repowering-be-the-solution-for-north-americas-aging-wind-turbines#gs.K9snNNw.

[32] LBNL, "Forecasting Wind Energy Costs and Cost Drivers," at 20 (June 2016), *available at* https://emp.lbl.gov/sites/all/files/lbnl-1005717.pdf.

current market data. Importantly, recent improvements in wind turbine performance demonstrate that 40% and 45% capacity factor assumptions are reasonable. The *2016 LBNL Annual Wind Technologies Market Report* details a 42.6% average national capacity factor in 2016 for projects built in 2014 and 2015, compared to an average of 32.1% for projects built from 2004-2011, and 25.4% for projects built from 1998-2001.[33] Average capacity factors were highest in the Interior region at 43.7%, followed by the Great Lakes region. Recent capacity factor improvements are primarily due to declines in wind turbine average specific power and increases in hub heights, among other factors. A wind turbine's specific power decreases as longer blades are used on turbines with the same nameplate capacity rating. Declines in specific power will necessarily increase capacity factors, as increases in turbine swept area directly correlate with increases in energy capture.

If Ameren updates its installed Project Cost and escalator assumptions for Missouri wind projects and Regional Wind projects, then the LCOE for those projects will be lower than what is identified in Table 6.16 – in the range of 5.1 to 5.4 cents per kWh for Missouri wind and 4.6 to 4.8 cents per kWh for Regional Wind.[34] The Wall Street firm Lazard reports a $30-50/MWh LCOE without incentives for Midwest wind projects brought online in 2017, tied with Texas for cheapest in the country and comparatively lower than Ameren's $58/MWh assumption for Missouri wind projects and $52/MWh assumption for regional wind projects.[35] From a national perspective, Lazard reports a $30-60/MWh LCOE range, the lowest cost source of new generation compared to natural gas combined cycle at $42-78/MWh, utility-scale solar at $46-53/MWh, and nuclear at $112-183/MWh. In 2016, Macquarie Research projected wind costs in 2023 to be approximately

[33] Lawrence Berkeley National Laboratory, "2016 Wind Technologies Market Report" at 39, *available at* https://emp.lbl.gov/sites/default/files/2016_wind_technologies_market_report_final_optimized.pdf.
[34] LCOE calculated using the NREL Levelized Cost of Energy calculator, *available at* https://www.nrel.gov/analysis/tech-lcoe.html.
[35] Lazard, "Lazard's Levelized Cost of Energy Analysis – Version 11.0." 2017. https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf, 2.

$42/MWh after the PTC has lapsed.[36] EIA's 2018 Annual Energy Outlook also estimates land-based wind LCOE without incentives at $42-46/MWh for resource areas within the 40-45% capacity factor range.[37]

DEFICIENCY #3: Inputs Used to Estimate the Levelized Cost of Potential Solar Energy Resources Need to be Updated

In its evaluation of potential solar resources, Ameren updated a study prepared by Black and Veatch in 2013 and a GTM Research report prepared in 2015.[38] The key factors influencing the levelized cost of electricity without incentives for potential resources were summarized in Table 6.14 of the 2017 IRP:

Table 6.14 Potential Solar Resource

Resource Option	Plant Output (MW)	Project Cost with Owner's Cost, Excluding AFUDC ($/kW)	First Year Fixed O&M Cost, ($/kW)	First Year Variable O&M Cost, ($/MWh)	Assumed Annual Capcity Factor (%)	Forced Outage Rate (%)	LCOE without Incentives (¢/kWh)
Solar	13.2	$1,863	$16	$0	19.0%	1%	11.34

While Ameren updated the 2013 report to revise its cost and operational characteristics of a solar resource, a few of the key factors do not match current market data, probably due to changes in technology and market dynamics since 2013. In addition, Ameren proposes to use a declining maturity curve for its solar costs – decreasing at 4% to 5% per year over the next five years. This trend line is based on the 2015 GTM report and its forecasted prices for 2016 through 2018, but Ameren used the observed 2015 project costs instead of the forecasted 2018 prices in Table 6.15 or more recent actual market prices. The inaccuracy of these key factors results in Ameren using a

[36] Bandyk, M, "Unsubsidized Wind Poised to Become Cost-Competitive Soon, Report Says." SNL. 12 July 2016. https://www.snl.com/web/client?auth=inherit#news/article?id=37071925&KeyProductLinkType=4.
[37] Ibid.
[38] 2017 IRP, Ch. 6 at 20, Tables 6.14 and 6.15.

levelized cost of energy in its analyses that is too high.

Suggested Remedy

There are two factors that need to be updated and if all are made they would result in a significant reduction of the LCOE without incentives to approximately 5.9 cents per kWh. This would be a LCOE without incentives comparable to what is forecasted by Lazard – 4.6 to 5.3 cents per kWh.[39] Wind on the Wires recommends the following two changes: update the installed project cost, and update the capacity factor and adopt a maturity curve that declines greater than 5% per year. These changes also capture the cost competitiveness of the utility-scale solar market, in which independent power producers make money by reducing costs.

Wind on the Wires attempted to calculate the LCOE without incentives and could not duplicate Ameren's result of 11.34 cents per kWh. Using the factors above, Wind on the Wires calculated an LCOE without incentives[40] in the range of 11.7 cents per kWh.

The installed project cost used in Ameren's analysis should be updated to $1,100/kW for projects installed in 2018. This is consistent with the low end of the range of costs forecasted by Lazard[41] and *NREL – 2017 Annual Technology Baseline* forecast[42] and is supported by a solar PPA signed by the City of Columbia, Missouri in January 2018.

The capacity factor for solar cost should be increased to 23% according NREL's PVWatts tool.[43] The solar capacity factor in the Midwest is in the 18% to 20% range.[44] Because Missouri is South of the Great Lakes the capacity factor is likely to be higher than that of the Midwest. When

[39] Lazard, "Lazard's Levelized Cost of Energy Analysis – Version 11.0," at 10 (Nov. 2017), *available at* https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf.
[40] Using the NREL Levelized Cost of Energy calculator, *available at* https://www.nrel.gov/analysis/tech-lcoe.html.
[41] Lazard, "Lazard's Levelized Cost of Energy Analysis – Version 11.0," at 2 (Nov. 2017), *available at* https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf.
[42] NREL, Annual Technology Baseline spreadsheet, "Solar – Utility PV" tab, (2017), *available at* https://atb.nrel.gov/.
[43] Modeling using PVWatts, for a 13.2 MW system, at Lambert Airport, single axis tracking, thin film panels, 98% inverter efficiency and 1% system losses.
[44] Lazard, "Lazard's Levelized Cost of Energy Analysis – Version 11.0," at 9 n.6 (Nov. 2017), *available at* https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf.

combined with updated capital costs of $1,100 ($/kw), a capacity factor of 23% would yield a price of 5.9 cents per kWh.[45] Adding the federal ITC would lower that to approximately 4.53 cents per kWh. That is close to a recent power purchase agreement entered into by the City of Columbia, Missouri. In January the City of Columbia approved a power purchase agreement with Cypress Creek Renewables for solar energy at 4.48 cents per kWh. [46]

Ameren suggests that on average the cost of solar will continue to decline by approximately 4-5% over the next 5 years without supporting analysis. The actual rate of cost decline is, of course, unknown but this rate of decline seems conservative and does not account for cost competitiveness of energy from independent power producers. If the project cost and LCOE used in the 2017 IRP are updated per the suggestions above, the LCOE used by Ameren to select resources will more accurately reflect the cost competitiveness of utility-scale solar energy sourced from independent power producers. Independent owners of solar generation invest private money and private investors bear the burden of risk of cost overruns and project delays. It follows that independent power producers make money by reducing costs whereas traditional utilities invest capital knowing a rate of return is guaranteed and ratepayers carry the risk of cost overruns and delays. As a point of reference, utility-scale solar resources have declined in cost approximately 86% from 2009 to 2017[47], which is approximately 10.75% per year.

[45] LCOE calculated using the NREL Levelized Cost of Energy calculator, *available at* https://www.nrel.gov/analysis/tech-lcoe.html.
[46] Columbia Daily Tribune, " New Solar Power Contract to Come Before City Council" (Jan. 3, 2018), *available at* http://www.columbiatribune.com/news/20180103/new-solar-power-contract-to-come-before-city-council
[47] Lazard, "Lazard's Levelized Cost of Energy Analysis – Version 11.0," at 10 (Nov. 2017), *available at* https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf.

Below is a table summarizing Wind on the Wires recommended changes:

Resource Option	Plant Output (MW)	Project Cost with Owner's Cost, Excluding AFUDC ($/kW)	First Year Fixed O&M Cost, ($/kW)	First Year Variable O&M Cost, ($/MWh)	Assumed Annual Capacity Factor (%)	Forced Outage Rate (%)	LCOE without Incentives (¢/kWh)
Solar	13.2	~~$1863~~ $1,100	$16	$0	~~19%~~ 23%	1%	~~11.34~~ 5.9

4 CSR 240-22.070 Risk Analysis and Strategy Selection

DEFICIENCY #4: Procure Wind Resources as Soon as Possible to Receive Greatest Benefit from Federal Production Tax Credit (PTC)

Summary

Ameren proposes to add at least 700 MW of wind generation to its resource mix by 2020, stating there is opportunity to add more wind generation in the coming years as a result of improving technology and economics.[48] The 2017 IRP does not provide an explicit timeline for evaluating this additional wind generation. It is prudent for Ameren to continue to procure wind resources in the near-term to capture the benefit of the federal wind Production Tax Credit (PTC). Doing so ensures Ameren makes use of reduced wind prices available under the PTC extension.

Suggested Remedy

Congress instituted a phase down of the federal PTC so that wind projects that began construction by the end of 2016 qualify for the full value of the PTC. Projects that begin construction by the end of 2017 qualify for 80% of the full value of the PTC, 2018 projects receive 60%, and 2019 projects receive 40%. The full value of the PTC is $24/MWh, which is received for

[48] 2017 IRP, Ch. 1 at 2.

all megawatt-hours produced over the first ten years a wind project is operational with periodic increases in the value of the credit to account for inflation. There is no expectation for Congressional action in the near-term to revisit the terms of the PTC phase down.

The Internal Revenue Service ("IRS") issued a guidance document in May 2016 outlining the requirements for PTC qualification according to its "start construction" language. Under the widely-used "safe harbor" approach, a project must spend at least 5% of total project costs by the qualification deadline. This is typically satisfied by placing a deposit with a wind turbine manufacturer for the turbines that will be used in the project. The other route for qualification involves "continuous program of construction," which can be satisfied by starting "physical construction of a significant nature" before the qualification deadline and then continuing that work until the project is completed. Under either approach, a wind project developer has to make significant financial commitments to qualify for the PTC.

The IRS guidance for the "safe harbor" compliance pathway provides four years for a project to come online post-qualification, so projects that qualified for the full value PTC by the end of 2016 have until the end of 2020 to commence commercial operations, projects that qualified for the 80% PTC have until the end of 2021, and so on. Developers took steps to qualify significant wind capacity for both the 100% PTC and the 80% PTC. MAKE Consulting reports that project developers qualified approximately 71 GW of wind project capacity for either 100% or 80% PTC value through the end of 2017, with the majority of that total qualifying for the 100% PTC.[49] Developers are now seeking PPAs or build-own-transfer agreements with potential purchasers for these projects and their output. Utilities and corporate purchasers signed 5,496 MW of wind PPAs during 2017 alone, and utilities announced plans to pursue a total of 8,841 MW in

[49] MAKE Consulting, "U.S. Developers Safe Harbor 10 GW of Wind Turbine Equipment in 2017," (Jan. 2018).

rate-based wind capacity since the beginning of 2016.[50] For example, American Electric Power's ("AEP") two Oklahoma utilities announced plans in 2017 to build and rate-base 2,000 MW of full PTC-value wind capacity.[51] Alliant Energy in Iowa also recently announced plans to procure 500 MW of wind, in addition to an earlier commitment for 500 MW.[52] In addition, Xcel Energy announced in September that it will execute a build-transfer agreement for a 300 MW wind project that qualifies for 80% of the full value of the PTC in South Dakota.[53] Kansas City Power and Light announced a 500 MW wind PPA last year, noting "this tax credit allows KCP&L to pass savings along to customers, keeping rates lower than would otherwise be possible."[54] Iowa's MidAmerican Energy also recently announced a $3.6 billion, 2,000 MW investment in wind, explaining that "investments of this scale are viable because federal PTCs are at their highest level."[55] The quantity of wind projects that qualified for the 100% and 80% PTC is limited, and time is of the essence for purchasers to lock in the lowest wind energy pricing seen to date.

If Ameren misses the opportunity to sign wind PPAs or pursue direct ownership with qualifying wind projects, it may have to procure relatively more expensive wind energy. Exactly how much the price of wind energy will increase without the PTC depends on the wind project and its ownership status. To illustrate in the following NREL chart, the solid lines show the record-low pricing currently available from wind projects qualifying for the PTC.[56] Ameren could lock in

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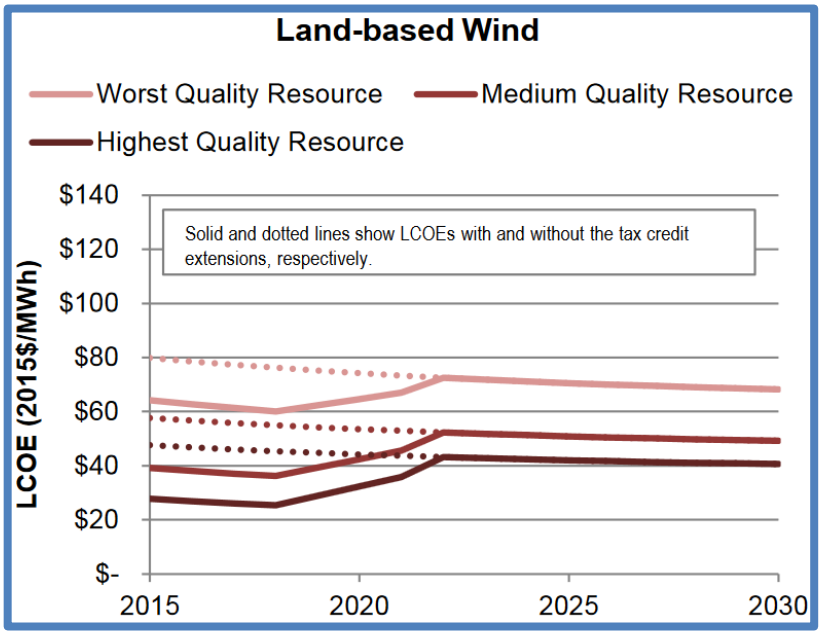
[50] AWEA, "U.S. Wind Industry Fourth Quarter 2017 Market Report," at 13 (Jan. 2018), *available at* https://awea.ebiz.uapps.net/PersonifyEbusiness/Default.aspx?TabID=251&productId=15584567.
[51] American Electric Power, "AEP Announces $4.5 Billion Investment in 2,000-Megawatt Wind Farm and Dedicated Power Line to Benefit Customers in Four States," (July 26, 2017) *available at* https://www.aep.com/newsroom/newsreleases/?ID=1997.
[52] Alliant Energy, "Iowa Wind Expansion." (2017), *available at* https://www.alliantenergy.com/InnovativeEnergySolutions/SustainableEnergyChoices/WindGeneration/IowaWindExpansion.
[53] Weston, D, "Xcel Energy plans 300 MW at lower PTC rate." Windpower Monthly (Sep. 28, 2017), *available at* https://www.windpowermonthly.com/article/1445858/xcel-energy-plans-300mw-lower-ptc-rate.
[54] American Wind Energy Association, "Wind power investment grows during the second quarter, delivering what voters want." (July 26, 2016), *available at* https://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=9106.
[55] Ibid.
[56] National Renewable Energy Laboratory, "Impacts of Federal Tax Credit Extensions on Renewable Deployment and Power Sector Emissions," at 27 (Feb. 2016), *available at* http://www.nrel.gov/docs/fy16osti/65571.pdf.

prices at the lowest point on the V-shaped price curve, prices that reflect the value of the PTC combined with recent cost reductions.



Notably, analysis by the Southern Wind Energy Association ("SWEA") found that if Georgia Power loses 20% of the full value of the PTC by procuring output from wind projects that qualified in 2017 instead of 2016, it could lose up to $104 million in ratepayer savings on a 425 MW wind purchase over ten years.[57] For 2,000 MW of wind energy, the loss would total approximately $490 million in the first ten years. Ameren should add wind generation to it generation portfolio as soon as possible; waiting for projects that qualified for the PTC in 2018 would double all of the losses above, while waiting for 2019 projects would approximately triple them due to further decline in PTC value.

[57] Southern Wind Energy Association, "Electric Utilities Could Lose Billions of Dollars in Wind Energy Savings," (April 20, 2016), *available at* http://www.southernwind.org/blog/electric-utilities-could-lose-billions-of-dollars-in-wind-energy-savings.

Wherefore, Wind on the Wires requests the deficiencies and concerns described herein be adopted by Ameren Missouri.

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned certifies that this Motion was electronically served upon all parties to this case on February 28, 2018.

/s/ Sean R. Brady_____
Sean R. Brady

Attorney for Wind on the Wires