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REBUTTAL TESTIMONY

OF

MICHAEL GOGGIN

SUBMITTED ON BEHALF OF:

CLEAN GRID ALLIANCE

April 19, 2023

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1. INTRODUCTION

Q: Please state your name and job title.

A: My name is Michael Goggin, and I am a Vice President at Grid Strategies LLC, a consulting firm based in the Washington, D.C. area.

Q: For whom are you testifying?

A: I am testifying on behalf of the Clean Grid Alliance.

Q: Have you previously testified before utility commissions?

A: Yes. I have testified in dozens of proceedings before state utility commissions in Colorado, Georgia, Illinois, Indiana, Iowa, Minnesota, Missouri, Nevada, North Carolina, New Mexico, Ohio, Oklahoma, Virginia, Washington, and Wisconsin, as well as before the Federal Energy Regulatory Commission.

Q: In what proceedings have you testified in front of the Missouri Public Service Commission?

A: I testified in several dockets related to Clean Line LLC's petition for a Certificate of Public Convenience and Necessity ("CCN") for the Grain Belt Express transmission line (Illinois Commerce Commission docket nos. 15-0277 and 22-0499, and Missouri PSC Docket nos. EA-2014-0207 and EA-2016-0358).

Q: What is your background and educational experience?

A: I have worked on renewable energy, transmission, and electricity market issues for over 15 years. At Grid Strategies I serve as an expert on those topics for a range of clean energy industry and environmental clients.

Preceding my tenure with Grid Strategies, I worked at the American Wind Energy Association (now known as the American Clean Power Association) for ten years, where I provided technical analysis and advocacy regarding renewable energy, transmission, and renewable integration into electricity markets, including directing the organization's research and analysis team from 2014-2018. Prior to the American Wind Energy Association, I worked at a firm serving as a consultant to the U.S. Department of Energy.

In the course of that work, I have co-authored nearly one hundred filings with the Federal Energy Regulatory Commission; served as a technical reviewer for over a dozen national laboratory reports, academic articles, and renewable integration studies; and published academic articles and conference presentations on renewable integration, transmission, and policy. I graduated with honors from Harvard University.

Q: What is the purpose of your testimony?

A: I support the petition of Grain Belt Express LLC ("Grain Belt Express") to amend its existing CCN granted in docket EA-2016-0358. I provide facts supporting the finding that the Grain Belt Express transmission line (the "Project" or "Grain Belt Express Project") meets the following three "*Tartan* Factors" the Commission uses to assess CCN applications: 1. There must be a need for the service; 2. The applicant's proposal must be economically feasible; and 3. The service must promote the public interest. I do not address the other two *Tartan* Factors, which are that the applicant must be qualified to provide the proposed service, and that the applicant must have

the financial ability to provide the service, as I do not have anything to add to the testimony of Grain Belt Express demonstrating that it meets those two factors.

The Grain Belt Express Project meets the need for low-cost, reliable, and clean electricity from Missouri utilities, their ratepayers, and other electricity purchasers. The Project will allow greater amounts of low-cost renewable energy resources to be delivered to Missouri consumers, meeting their need for low-cost electricity, making the project economically feasible, and promoting the public interest. By improving electric reliability and resilience, the Project also promotes the public interest and meets the need for reliable electricity from Missouri utilities, ratepayers, and other electricity purchasers. The Project promotes reliability and resilience primarily by increasing the ability to transfer power among the three main grid operators that serve Missouri: the Southwest Power Pool ("SPP"), the Midcontinent ISO ("MISO"), and Associated Electric Cooperative Inc. ("AECI"), and to import power from the PJM grid operator to the east. The delivery of renewable energy via the Project also reduces emissions of a range of pollutants, which benefits the public interest and meets the need for generation resources that reduce the cost of complying with federal regulations that limit emissions of those pollutants.

Q: Please outline your testimony.

A: First, I explain that the Project will deliver low-cost renewable power from Kansas to Missouri, which makes the Project economically feasible while

meeting the public interest and Missouri ratepayers' need for low-cost electricity. In the next section, I document how Missouri utility Integrated Resource Plans ("IRPs") show that large additions of renewable energy, including those delivered via the Project, will reduce electric rates for their customers. In addition, I explain how transmission increases wholesale electricity market competition, which reduces consumers' electricity costs. Next, I discuss the electric reliability and resilience benefits from the Project. Finally, I explain that the renewable energy delivered by the Project provides environmental benefits, which will also help Missouri comply with recently announced and pending federal environmental regulations.

2. THE PROJECT WILL DELIVER LOW-COST RENEWABLE POWER FROM KANSAS TO MISSOURI

Q: What is your understanding of the purpose of the Project?

A: As explained in the direct testimony of Grain Belt Express witness Sane, the Project is an approximately 800 mile 600-kiloVolt (kV) direct current transmission line capable of transmitting up to 5,000 megawatts of electricity from low-cost renewable energy resources in Kansas. The Project will be capable of delivering up to 2,500 MW of power into the MISO and/or the Associated Electric Cooperative, Inc. ("AECI") grids at delivery points in Missouri, and up to 2,500 MW of power into the PJM grid at the Sullivan substation in Indiana, just across the border from Illinois. The primary benefit to Missouri ratepayers and the public interest is that the Project provides access to untapped high-quality renewable energy resources in

Kansas to meet long-term demand for low-cost, reliable, and clean electricity.

Q: Please describe the economic factors that enable the Project to deliver low-cost renewable energy.

A: The wind resources in western Kansas that will be delivered by the Project are some of the best in the United States, while southwestern Kansas's solar resources are among the best in the Eastern U.S.. These renewable resources have high capacity factors. Capacity factor is typically expressed as a percentage indicating the amount of electricity produced by a power plant in a typical year divided by the amount of electricity that that power plant could provide if it ran at 100% of its nameplate capacity for all 8,760 hours in that year.

Higher capacity factors translate directly to lower electricity costs for renewable projects, as a larger amount of electricity production from a renewable project allows the fixed costs to be spread over a larger quantity of MegaWatt-hours ("MWh). Moreover, wind and – with the passage of the Inflation Reduction Act – solar projects are eligible for a Production Tax Credit for each MWh they produce. As a result, high-quality renewable resources are able to offer lower-priced Power Purchase Agreements relative to lower capacity factor renewable resources. The Project is economically feasible because it can deliver lower-cost renewable generation to Missouri. Providing Missouri utilities and other utilities in

MISO with access to these high-quality renewable resources will meet the public interest and Missouri ratepayers' need for low-cost electricity.

Q: Can you quantify the quality of wind resources in the Kansas Resource Area served by the Project?

A: As indicated in the wind resource map in Clean Grid Alliance Schedule MG-2, Kansas has high-quality wind resources with high average wind speeds. Importantly, the energy available for wind energy production is proportional to the cube of wind speed, so the difference between the orange and purple areas in the wind speed map in Clean Grid Alliance Schedule MG-2 is quite significant. For example, the 8.5-9 meter/second area of the map, which is the dark purple area that covers significant parts of Kansas, Oklahoma and Nebraska has about 76% more energy available in the wind than the 7.0-7.5 meter/second dark orange area in a few parts of northern and western Missouri, and more than twice as much energy as the 6.5-7 meter/second light orange areas that are more widespread in the northwestern Missouri.

Q: How does the quality of the wind resource translate to the capacity factor of wind plants that would be developed in the Resource Area?

A: Lawrence Berkeley National Laboratory ("LBNL") data show that in 2021, the average capacity factor for Kansas wind projects installed during 2016-2020 was 43.4%, compared to 34.6% for Missouri wind projects installed during the same period.[1] Kansas wind projects would have seen even

[1] Lawrence Berkeley National Laboratory, Land-Based Wind Market Report: 2022 Edition, datafile, tab "Capacity Factor by State," *available at*: https://emp.lbl.gov/sites/default/files/2022_land_based_wind_market_report_data.xlsm

higher capacity factors if wind curtailment, which is discussed in more detail in the next section, had not reduced their output. SPP wind projects, a large share of which are in Kansas, experienced 6.4% curtailment in 2021, versus 4.7% in MISO.[2] Assuming wind projects in those states experienced curtailment rates in 2021 consistent with those regional averages, without curtailment Kansas wind projects would have operated at a 46.2% capacity factor, versus around 36.2% for Missouri.

Q: How does the quality of solar resources in Kansas compare to that in Missouri and other parts of MISO?

A: It is also much higher. As shown in the National Renewable Energy Laboratory ("NREL") solar resource map in Clean Grid Alliance Schedule MG-3, southwestern Kansas receives around 5-5.25 kWh/m^2/day of solar insolation, versus 4.25-4.75 kWh/m^2/day in most of Missouri. The 5-25% higher insolation in southwestern Kansas has a roughly proportional impact on capacity factor.

Q: How does the capacity factor of SPP solar compare to that in MISO?

A: NREL categorizes southwestern Kansas as class 4 (the fourth highest out of 10 categories), with an average capacity factor of 28.7%, while most of Missouri is class 6 or 7 out of 10, with an average capacity factor of 24.6% or 25.8%.[3] LBNL also reports historical average solar project capacity factors by region, which shows the SPP solar fleet averaging 25.3%, versus

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[2] *Ibid.*, tab "Curtailment and Penetration"
[3] NREL, Annual Technology Baseline, 2022, *available at*: https://atb.nrel.gov/electricity/2022/utility-scale_pv

21% in MISO, for solar projects with tracking equipment.[4] Notably, the MISO average capacity factor includes projects in MISO South, which have much higher quality solar resources than those in Missouri.

Q: How does capacity factor affect the economics of renewable generation?

A: Capacity factor significantly affects the economics of renewable generation because a larger amount of electricity production from a renewable project allows the Project's fixed costs to be spread over a larger quantity of MWh, as noted above. LBNL data shows that wind Power Purchase Agreement ("PPA") prices in SPP averaged $22/MWh in the last four quarters, the lowest in the country. This compares favorably to $32/MWh in MISO.[5]

Similarly, solar PPA prices are significantly lower in SPP than in MISO, as shown in Clean Grid Alliance Schedule MG-4. Specifically, over the last three years solar PPA prices averaged around $25/MWh in SPP, versus around $31/MWh in MISO. NREL also estimates that solar generation in the resource class present in southwestern Kansas has a levelized cost of $25/MWh, versus $27-29/MWh in Missouri.[6] The lower cost of Kansas wind and solar resources makes the Project feasible and

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[4] Lawrence Berkeley National Laboratory, Utility-Scale Solar, *available at*: https://emp.lbl.gov/sites/default/files/2022_utility-scale_solar_data_update.xlsm, tab "CF by region"

[5] Lawrence Berkeley National Laboratory, Land-Based Wind Market Report: 2022 Edition, datafile, tab "Level10 Wind PPA Prices," *available at*: https://emp.lbl.gov/sites/default/files/2022_land_based_wind_market_report_data.xlsm

[6] NREL, Annual Technology Baseline, *available at*: https://data.openei.org/files/5716/2022%20v1%20Annual%20Technology%20Baseline%20Workbook%20Original%206-14-2022.xlsx, tab Solar – Utility PV, Levelized Cost of Energy

also benefits Missouri ratepayers and the public interest. The solar cost and price figures presented above do not account for the Inflation Reduction Act's creation of a solar Production Tax Credit, which greatly reduces the cost and price of higher-quality solar resources like those in Kansas, as explained below.

Q: How does the passage of the Inflation Reduction Act affect the relative economics of Kansas wind and solar versus renewables in Missouri?

A: The extension of the wind PTC, and the creation of a solar PTC that solar projects can opt to take instead of a 30% Investment Tax Credit, creates a further premium for locating renewable projects in highly productive areas. Using the LBNL historical wind and solar capacity factors discussed above, a 100 MW solar project in SPP would generate over $900,000 more PTCs per year than a lower capacity factor solar project in MISO at the current PTC value of $26/MWh, while a 100 MW wind project in Kansas would generate $1.75 million more in PTCs annually. For the 6,021 MW of wind and 3,262 MW of solar that GBE Witness Repsher, from PA Consulting, assumes would be connected to the Grain Belt Express Project in Kansas, this translates to around $135 million more in annual revenue for those wind and solar projects compared to locating those projects in Missouri, or $1.35 billion over the 10-year period that projects receive PTCs.[7] Revenue from federal tax credits directly offsets the costs that a renewable project must

[7] EA-2023-0017, GBE Witness Repsher, PA Consulting, "Missouri Interstate Transmission Need: The Public Benefit of Grain Belt", at 6.

recover through its PPA price, so renewable projects receiving a large amount of tax credits can offer low-priced PPAs to the benefit of utility customers.

Q: What role does transmission expansion play in enabling the development of renewable resources?

A: Transmission is essential, both for allowing renewable resources to be developed and enabling already developed renewable resources to not have their wind energy output curtailed. In areas where transmission constraints prevent renewable energy from being delivered to customers, there is no cost-effective substitute for increasing transmission capacity to alleviate those constraints.

Q: Can storage eliminate the need for transmission?

A: No, as only transmission can move power from areas with high-quality renewable resources to electricity demand centers. Storage can help reduce renewable curtailment and congestion and increase the utilization of transmission by storing renewable production and shifting its output to time periods when transmission capacity is not fully utilized, but transmission is still essential for moving low-cost renewable energy to customers.

Q: How does congestion affect consumers and the economics of renewable development?

A: When transmission congestion prevents the delivery of renewable generation, this results in lower Locational Marginal Prices ("LMPs") on the

renewable-plant side of the transmission constraint and higher LMPs on the load side of the constraint. While the higher LMP harms consumers on the load side of the constraint, the lower LMP on the renewable plant side reduces the value of the renewable generation, which directly harms either the renewable generator or the purchaser of its output.

Importantly, the local LMP clearing price applies to all energy (MWh) sold into and procured from the market in those areas. As a result, the cost of this congestion for renewable generators and consumers can be much higher than just the cost of any renewable generation lost to curtailment, particularly for utilities that are procuring a large amount of electricity in the wholesale market.

In addition, a lack of transmission access will greatly reduce the willingness of a lender or investor to finance a renewable project. Transmission congestion also tends to force wind energy development to occur in lower quality wind energy resource areas with lower wind capacity factors, reducing the total number of wind MWh and increasing the dollars/MWh PPA price because the fixed costs must be spread over fewer MWh. Finally, transmission congestion causes interconnecting renewable generators to incur greater costs for connecting to the grid, through higher network upgrade costs assigned by grid operators like MISO and the need to build longer interconnection tie lines.

Q: What is the trend for interconnection network upgrade costs in MISO?

A: According to recent analysis from LBNL, interconnection costs have been "rapidly growing."[8] Active projects in the MISO queue now face average upgrade costs of $156/kW, which is more than 10% of total project capital costs for a typical wind or solar project. LBNL finds that interconnection costs are higher for wind generators, particularly in high wind resource areas like the Dakotas.

Q: Do wind and solar projects in the MISO interconnection queue face long backlogs?

A: Yes. As LBNL has documented, many generators facing large upgrade costs withdraw from the interconnection queue.[9] Each withdrawal requires a restudy for all projects after that generator in the queue, which can change the interconnection costs assigned to those generators. This uncertainty results in significant shuffling of the interconnection queue, and also drives developers to submit more speculative interconnection applications, further exacerbating the uncertainty and shuffling.[10] Demand for wind and solar interconnection is far greater than available transmission capacity in

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[8] LBNL, "Data from MISO Show Rapidly Growing Interconnection Costs," October 2022, *available at*: https://emp.lbl.gov/news/data-miso-show-rapidly-growing

[9] *Id.*

[10] Americans for a Clean Energy Grid, Disconnected: The Need for a New Generator Interconnection Policy, January 2021, *available at*: https://gridprogress.files.wordpress.com/2021/01/disconnected-the-need-for-a-new-generator-interconnection-policy-1.14.21-1.pdf

MISO.[11] Recently released data show that the MISO queue just ballooned from 118 GW to 289 GW.[12]

Q: What is renewable curtailment, and how common is it in MISO?

A: Renewable energy curtailment occurs when the output of operating projects exceeds the transmission capacity that is locally available to deliver that energy to customers. When this occurs, renewable plants receive a market signal or grid operator instruction to reduce their output to the level that can be carried on the transmission system. Wind turbines can rapidly reduce their output on command by pitching their blades to an angle where they capture less or zero of the energy available in the wind, while the digital controls at solar plants allow even faster response. For the last five years, wind curtailment in MISO has ranged between 4.2% and 5.5%.[13]

Q: How does curtailment affect the economics of renewable generation?

A: Renewable project developers are hesitant or unable to build projects in areas that experience significant curtailment. While historically a large share of curtailment risk was borne by utilities purchasing renewable energy, PPAs increasingly require renewable project owners to take on a significant share of wind energy curtailment risk. The cost of this lost revenue (including PTCs), as well as the risk of experiencing this cost, significantly

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[11] LBNL, "Generation, Storage, and Hybrid Capacity in Interconnection Queues," 2022, *available at*: https://emp.lbl.gov/generation-storage-and-hybrid-capacity

[12] MISO, "Renewable applications continue to surpass other resource types," (September 2022), *available at*: https://www.misoenergy.org/about/media-center/misos-generator-interconnection-queue-cycle-set-new-record/

[13] Lawrence Berkeley National Laboratory, Land-Based Wind Market Report: 2022 Edition, datafile, tab "Curtailment and Penetration," *available at*: https://emp.lbl.gov/sites/default/files/2022_land_based_wind_market_report_data.xlsm

deters renewable energy development and reduces the willingness of lenders or investors to finance renewable energy development in those areas. As most PPAs pass some curtailment cost and risk to the utility, utilities are also hesitant to sign PPAs for renewable projects that they expect will face significant curtailment.

Q: How does congestion and curtailment affect the economic value of renewable generation?

A: LBNL analysis shown in Schedules MG-5 and MG-6 indicates congestion and curtailment is significantly reducing the value of wind generation in MISO,[14] a finding further corroborated by published academic research by LBNL.[15] In MISO, congestion has reduced the value of wind by 42%, and curtailment by an additional 1%. In the best wind resource areas of MISO, the map shown in Schedule MG-5 reveals that the impacts are even larger, with the value of wind energy reduced to $5/MWh or less. This indicates that Missouri utilities procuring wind energy from these areas would receive little value in the MISO market for their purchases, which will negatively affect continued development of wind projects in these areas until that congestion is alleviated. The data also show that the value of SPP wind is currently similarly reduced by congestion and curtailment, though the wind

[14] *Ibid.*, tabs "2021 Market Value by Location" and "Value Relative to Flat Block,"
[15] Millstein et al., "Solar and wind grid system value in the United States: The effect of transmission congestion, generation profiles, and curtailment," (July 2021), *available at*: https://www.cell.com/joule/pdfExtended/S2542-4351(21)00244-0

and solar generation delivered via the Project will not be affected as the entire point of the Project is to alleviate that congestion and curtailment.

Transmission congestion is the primary impediment to the addition of new wind generation in MISO. MISO has released a map showing that essentially all of the high quality wind resource areas in western MISO lack sufficient transmission to add even modest amounts of wind capacity.[16] The map shows first contingency incremental transfer capability ("FCITC"), which is essentially the amount of transmission capacity available for the addition of new generation (contingency refers to the fact that the power system must always be operated with enough spare transmission capacity to remain reliable even with the loss of any one transmission facility). The map indicates that there is essentially zero available transmission capacity to add new wind generation north or northwest of Missouri, and that in many locations more than 5,000 MW of additional transmission capacity would be required to alleviate the congestion.

Q: Is it common for transmission development to precede renewable development?

A: Yes. A major difficulty in coordinating renewable and transmission development is the mismatch between the relatively short amount of time required to develop a renewable project versus the longer time period

[16] MISO, Generator Interconnection Contour Map, *available at*: https://cdn.misoenergy.org/GI-Contour_Map108143.pdf

required to develop a transmission project.[17] Transmission development that pro-actively plans transmission to interconnect areas with high renewable resource areas before projects have been built has been recognized as an essential aspect of bringing renewable energy to market.[18] Examples include the Competitive Renewable Energy Zone lines in Texas,[19] which have been successfully completed, and the Regional Generator Outlet Study in MISO,[20] which developed the plan for the 17 Multi-Value Projects, all but one of which have now been completed. Due to the continued cost reductions and growth of renewable resources. MISO's periodic reviews of the Multi-Value Projects show that the net benefits continue to exceed initial expectations,[21] which already showed highly favorable benefit-to-cost ratios. An optimal amount of transmission pays for itself by accessing more productive renewable resources, reducing the cost of generating capacity additions, as shown in the chart from MISO's MVP Report shown in Clean Grid Alliance Schedule MG-7. MISO found the MVP projects enabled an 11% reduction in the nameplate capacity of wind

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[17] American Wind Energy Association, "Grid Vision," (May 2019), *available at*: https://cleanpower.org/wp-content/uploads/2021/01/Grid-Vision-The-Electric-Highway-to-a-21st-Century-Economy.pdf

[18] *See generally*, FERC, Order 1000, at ¶¶ 2, 3, 6, 29, 38, 45, *available at:* https://www.ferc.gov/sites/default/files/2020-06/Order-1000.pdf

[19] Electric Reliability Council of Texas ("ERCOT"), Competitive Renewable Energy Zones (CREZ) Transmission Optimization Study, (April 2008), attachment as part of ERCOT filing with the Public Utilities Commission of Texas, *available at:* http://pbadupws.nrc.gov/docs/ML0914/ML091420467.pdf.

[20] MISO, Regional Generation Outlet Study, *available at:* https://puc.sd.gov/commission/dockets/electric/2013/EL13-028/appendixb3.pdf

[21] MISO, *MTEP17 MVP Triennial Review*, (September 2017), *available at*: https://cdn.misoenergy.org/MTEP17%20MVP%20Triennial%20Review%20Report117065.pdf.

that must be deployed to meet regional RPS requirements, with a corresponding 11% reduction in wind energy capital costs.[22]

In two studies, the Southwest Power Pool has similarly found large net benefits across a range of categories from its pro-active transmission expansion.[23] More recent examples of pro-active transmission development include the Greenlink Nevada project, the Colorado Power Pathway, and MISO's recent approval of the Tranche 1 set of projects.[24]

Q: How will MISO's Long Range Transmission Plan's Tranche 1 projects affect Missouri's ability to procure low-cost renewable energy?

A: They will help, if the individual transmission projects receive the necessary permits from state regulatory commissions and other authorities. However, the transmission projects are not slated to start coming online until 2028, at the earliest.

The Tranche 1 lines can serve as an important complement to the Grain Belt Express Project, but they cannot substitute for the value the Project provides by allowing renewable energy to be imported from SPP and enabling power flows among SPP, MISO, AECI, and PJM. The Tranche 1 projects were designed to serve MISO load and not serve as

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[22] MISO, MVP Report, January 2012, *available at*: https://cdn.misoenergy.org/2011%20MVP%20Portfolio%20Analysis%20Full%20Report117059.pdf, at 66.
[23] SPP, "The Value of Transmission," January 2016, *available at*: https://www.spp.org/documents/35297/the%20value%20of%20transmission%20report.pdf, and SPP, "The Value of Transmission: 2021 Report," *available at:* https://www.spp.org/documents/67023/2021%20value%20of%20transmission%20report.pdf
[24] Ethan Howland, "MISO board approves $10.3B transmission plan to support 53 GW of renewables," (July 2022), *available at*: https://www.utilitydive.com/news/miso-board-transmission-plan-midcontinent-renewables/628108/

interregional transmission lines. As I explain later in my testimony, interregional transfers become increasingly important at the higher renewable penetration levels that MISO will be reaching once the renewable buildout enabled by the Tranche 1 projects is complete. Without the strong inter-regional transmission ties provided by long-distance transmission lines like the Grain Belt Express Project, renewable generation in MISO North will suffer from congestion and curtailment that reduces the value of renewables across the entire region during periods of renewable abundance, while the region may also struggle to import power during periods of low renewable output. The reliability and resilience benefits of the Project are discussed in more detail later in my testimony.

The value of interregional transmission, even with strong intra-regional transmission, is confirmed by a number of studies.[25] In addition, the history of the MVPs and other pro-actively planned transmission projects is that they are always more than fully subscribed well before they enter service, so regardless of the success of the Tranche 1 projects there will still be large value in the Project delivering low-cost renewable energy from Kansas. This is particularly true because of the long-term extension

[25] For example, see Patrick Brown and Audun Botterud, "The Value of Inter-Regional Coordination and Transmission in Decarbonizing the US Electricity System," Joule, (January 2021), *available at*: https://www.sciencedirect.com/science/article/pii/S2542435120305572; NREL, "The Value of Increased HVDC Capacity Between Eastern and Western U.S. Grids: The Interconnections Seam Study" (September 2021), *available at*: https://ieeexplore.ieee.org/document/9548789; Alexander E. MacDonald, Christopher T.M. Clack, Anneliese Alexander, Adam Dunbar, James Wilczak & Yuanfu Xie, *Future Cost-Competitive Electricity Systems and Their Impact on US CO2 Emissions*, Nature Climate Change 6, *available at*: https://www.nature.com/articles/nclimate2921

and expansion of the renewable tax credits in the IRA, as well as continued increases in the demand for renewable energy.

Q: If the Project is not built, are there other options for delivering low-cost renewable energy from SPP to MISO?

A: Not at this time. SPP's transmission planning policies are structured entirely around planning transmission to meet SPP demand, with no consideration for planning lines to meet export demand. That policy would have to change before SPP would likely even begin planning a transmission line to serve export demand, which means it is extremely unlikely any line of that type would enter service this decade. There are efforts underway to develop a mechanism to allocate the cost for transmission between MISO and SPP, though its prospects are uncertain.[26] Even if an agreement can be reached on cost allocation, proposed transmission projects can be derailed by an inability to obtain permits from state and other regulatory authorities, and at best the development of any transmission would take the better part of this decade. Moreover, more than $800 million of the $1.06 billion in total JTIQ projects are located in Minnesota or the Dakotas,[27] and none of them are designed to alleviate the primary transmission constraints limiting delivery of renewable generation from western Kansas to Missouri.

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[26] Ethan Howland, "SPP, MISO identify 7 cross-seam transmission projects that could unlock up to 53 GW of new generation," (February 2022), *available at*: https://www.utilitydive.com/news/spp-miso-identify-seven-cross-seam-transmission-projects-renewable-wind/618152/

[27] SPP and MISO, SPP-MISO Joint Targeted Interconnection Queue Cost Allocation and Affected System Study Process Changes," at 5 (12/20/2022), *available at*: https://www.spp.org/documents/68518/spp-miso%20jtiq%20study%20updated%20white%20paper%2020221220.pdf

Q: Can SPP resources be accessed through the existing AC grid?

A: There are several challenges to delivering generation from SPP to MISO, including a lack of available transmission capacity. Expanding transmission ties would require transmission planning and cost allocation cooperation that currently does not exist. Even if there were an increase in available transmission capacity, the cost of crossing SPP and into MISO would likely be quite large due to rate pancaking, as described below.

Q: Please explain.

A: First of all, moving power from SPP to MISO requires transmission service across SPP and MISO. Each of these would require a transmission study which would identify needed transmission upgrades, which can be quite expensive and require a long lead time to complete. These costs would likely be added to the cost of transmission service. Each of these studies would be time-consuming as they would in many cases be bundled with other requests for transmission service. These studies are notorious for delays and the need for restudy as those requesting service drop out. Each study must be coordinated in each region. It is often difficult to have these studies align in timing. Thus, a study may be tied up in one RTO while the other RTO is requiring the renewable developer to commit to the transmission service. Committing to transmission service in one RTO while waiting on approval from other RTO can place a significant amount of capital at risk.

There are major challenges blocking effective inter-regional transmission planning and cost allocation. No large-scale inter-regional AC transmission projects have been built recently, largely because there is no framework through which to allocate their costs. FERC's recent Notice of Proposed Rulemaking on transmission planning and cost allocation is focused on transmission within regions and did not attempt to solve the challenges facing inter-regional transmission.

Q: Are there other hurdles that would interfere with access to SPP renewable generation from buyers in MISO?

A: Yes. Transmission service across multiple regions will incur pancaked rates that have significant cost risk for either the generator or end use customer. To deliver electricity from western SPP to MISO there are two main costs -- firm point-to-point transmission and congestion. Firm transmission rates across SPP and MISO are known, however, they are volatile over extended periods of time. For SPP, firm transmission rates have continuously increased since 2005, sometimes dramatically. Since most renewable power purchase agreements are for twenty years, trying to estimate the increase in price of firm transmission rights in two RTOs and still produce a competitive price for your product is extremely difficult. Moreover, there is no mechanism for a generator to hedge its financial exposure to these costs.

The congestion cost is the difference in price between the renewable project and the SPP/MISO border and from the SPP/MISO border to load

in Missouri. As noted above, congestion drastically reduces the value of SPP and MISO wind today. This cost can be hedged by utilizing financial transmission rights ("FTRs"), but usually the nameplate capacity of a project cannot be completely hedged via the free allocation of FTRs that comes with a firm transmission path. A renewable generator will be left with some financial risk exposure with regards to both the unhedged portion and the variable cost of purchasing additional FTRs.[28] Further risk related to congestion is knowing what congestion will look like along the route for the multi-decade duration of a typical power purchase agreement. This changes as new transmission lines are built and new generation interconnects to the system. Like firm transmission rights, the ability to properly assess the potential future costs of congestion is extremely difficult to nearly impossible.

In comparison, the Project removes these uncertainties by providing a known cost for transmission capacity for a fixed term. Therefore, a renewable generator does not need to worry about changes to the firm transmission right or congestion costs.

Q: Can you please summarize the main conclusion of this section?

A: Kansas' renewable resources delivered via the Project are a lower cost option than resources available in or currently deliverable to Missouri, because Kansas resources are more productive (which reduces the

[28] International Assoc. for Energy Economics – The Energy Journal, "Rethinking the Role of Financial Transmission Rights in Wind-Rich Electricity Markets in the Central U.S.", *available at*: https://www.iaee.org/en/publications/download-view.aspx?id=4076

levelized cost of each MWh and generates more PTCs), are less affected by congestion and curtailment, and are not affected by the growing interconnection upgrade costs assigned to generators in MISO. Providing access to low-cost renewable resources makes the project economically feasible and meets the public interest and Missouri ratepayers' need for affordable electricity. Interregional transmission, like the Project, will be needed regardless of the success of building transmission to access renewable energy within MISO.

3. THE RENEWABLE ENERGY DELIVERED VIA THE GRAIN BELT EXPRESS PROJECT IS NEEDED BY MISSOURI ELECTRIC UTILITIES

Q: Please summarize what recent Missouri utility Integrated Resource Plans ("IRPs") indicate about the need for renewable energy and the Grain Belt Express Project.

A: Ameren's 2022 update to its 2020 IRP calls for adding 3,500 MW of renewables by 2030,[29] while Evergy's 2022 update to its 2021 IRP calls for adding 3,540 MW by 2032,[30] for a total of over 7,000 MW of new renewable capacity. These IRPs confirm that large renewable purchases, including via the Project, are the lowest-cost option for supplying Missouri ratepayers.

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[29] Ameren Missouri, "2022 Change in Preferred Plan: Integrated Resources Plan," at 3, *available at:* https://www.ameren.com/-/media/missouri-site/files/environment/irp/2022/preferred-plan.ashx#:~:text=Ameren%20Missouri's%20new%20Preferred%20Resource,generation%2C%20total%20renewable%20generation%20of

[30] Evergy, "2022 IRP Update" at 2 (June 10, 2022), *available at:* https://investors.evergy.com/IRP2022.

Q: Was the Grain Belt Express Project explicitly mentioned in recent Missouri IRPs?

A: Yes, Ameren's 2020 IRP evaluated a scenario with 1,000 MW of wind delivered via the Project. The IRP found the scenario including the Project offered a comparably low cost to its preferred approach, which purchases the same amount of renewable capacity, but it scored the Grain Belt Express plan slightly lower than its preferred plan because it was given a lower score for regulatory certainty.[31] However, since the 2020 IRP, regulatory uncertainty has already been greatly reduced by the Project receiving approvals from Illinios and other states, and any remaining risk will be further reduced if the Missouri Commission approves this amendment to the CCN. Regardless, Ameren's IRP confirms that procuring large amounts of low-cost renewable energy, like that delivered via the Project, is the best option for the utility's ratepayers.

Q: What does Evergy's IRP say about the ability to source renewable energy from southwest Kansas without transmission expansion?

A: Evergy's IRP notes that "With regards to renewable resources in the southwest Kansas region, it is known that the total current firm transmission service requests to SPP exceed the total transmission service availability which will be provided by transmission construction projects. Until large scale investments in transmission upgrades are made, the timing of future

[31] Ameren, "2020 Integrates Resources Plan", Chapter 10, at 11, 22; available at: https://efis.psc.mo.gov/mpsc/commoncomponents/view_itemno_details.asp?caseno=EO-2021-0021&attach_id=2021003713

renewable resource additions in that region will be difficult to determine with certainty. This could lead to output and/or delivery limitations on future renewable resource additions in the southwest Kansas region."[32] This confirms that Project is essential for accessing the low-cost renewable resources available in southwest Kansas.

4. THE GRAIN BELT EXPRESS PROJECT FOSTERS ELECTRICITY MARKET COMPETITION THAT REDUCES PRICES

Q: How does the Grain Belt Express Project increase competition in electricity markets?

A: Transmission has several beneficial impacts on the competitiveness of electricity markets that reduce the price consumers pay for electricity. Specifically, the Project (1) delivers electricity that has a lower cost, including both marginal production cost and long-term Power Purchase Agreement prices, than the electricity in the area to which it is interconnecting; (2) serves as a hedge against volatile fuel prices; (3) reduces prices in MISO's voluntary capacity market; and (4) reduces the potential for generators to exercise market power.

Q: How does the Project provide these benefits?

A: As explained above, the Project provides access to Kansas renewable energy resources that offer a lower cost than is available from renewable

[32] Evergy Metro, "Supply-Side Resource Analysis: Integrated Resource Plan" at 40-41 (April 2021); *available at*: https://www.efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936352823,

resources in Missouri. Kansas renewable resources delivered via the Project offer a lower cost because they are more productive which reduces the levelized cost of each MWh and generates more PTCs, are less affected by congestion and curtailment, and are not affected by the growing interconnection upgrade costs assigned to generators in MISO. The transmission line itself and the renewable generation it delivers also offer capacity value, hedge against fuel price risk, and reduce the potential for the exercise of market power.

Q: Does having the Project interconnect in Missouri increase those benefits?

A: Yes. The impact on energy and capacity market prices tends to be largest near the point at which additional supply is injected, because transmission congestion can limit the flow of those benefits to more distant parts of the MISO footprint. Because the Project's point of injection into MISO is in Missouri, a significant share of the benefits will accrue to Missouri ratepayers. The analysis by PA Consulting[33] quantifies the beneficial impact of the Project on energy and capacity market prices for Missouri consumers. In addition, Missouri utilities will be able to sign PPAs for low-cost renewable generation delivered via the Project, directly reducing their cost to serve their customers.

[33] EA-2023-0017, GBE Witness Repsher, Sched. MR-2, "Missouri Interstate Transmission Need: The Public Benefit of Grain Belt" (August 2022).

Q: Are you aware of any reports that analyze the impact of renewable energy and transmission on electricity prices in MISO?

A: Yes. A 2012 report by Synapse Energy Economics found that adding 20 to 40 GW of wind energy and the accompanying transmission in the MISO region would save a typical household between $63 and $200 per year, as shown in Clean Grid Alliance Schedule MG-8.[34] As the report explains, "Since wind energy 'fuel' is free, once built, wind power plants displace fossil-fueled generation and lower the price of marginal supply—thus lowering the energy market clearing price."[35]

Q: Does transmission help to hedge against uncertainty and protect consumers from risk?

A: Yes. Transmission is an important mechanism to protect consumers against unpredictable volatility in the price of fuels used to produce electricity. Transmission can alleviate the negative impact of fuel price fluctuations on consumers by making it possible to buy power from other regions and move it efficiently on the grid. This increased flexibility helps to modulate swings in fuel price. Utilities are able to respond to price signals by decreasing their use of an expensive fuel and instead importing cheaper power made from other sources. As utilities Xcel and ITC noted in a recently approved application to build a transmission line in Minnesota, "[A] robust regional

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[34] Synapse Energy Economics, Inc., The Potential Rate Effects of Wind Energy and Transmission in the Midwest ISO Region, at page 3 (May 22, 2012), *available at*: https://cleanenergygrid.org/wp-content/uploads/2012/05/Full-Report-The-Potential-Rate-Effects-of-Wind-Energy-and-Transmission-in-the-Midwest-ISO-Region.pdf

[35] *Id.*

transmission system is also key to enabling access to a diverse mix of generation resources, which in turn allows customers to access the least expensive power available at any given time."[36]

Renewable generation itself also provides significant hedging value against fuel price fluctuations, so the hedging benefit of transmission is even larger for transmission that connects new renewable generation, such as the Project. An LBNL report concluded that

> Comparing the wind PPA sample to the range of long-term gas price projections reveals that even in today's low gas price environment, and with the promise of shale gas having driven down future gas price expectations, wind power can still provide long-term protection against many of the higher-priced natural gas scenarios contemplated by the EIA [United States Energy Information Administration].[37]

Going forward, a robust transmission grid can provide valuable protection against a variety of uncertainties in the electricity market. Fluctuations in the price of fossil fuels are likely to continue, particularly as the electric sector becomes more reliant on natural gas and liquefied natural gas exports more closely tether U.S. natural gas prices to world prices. Further price risk associated with the potential enactment of environmental policies place a further premium on the flexibility and choice provided by a robust transmission grid. As a result, transmission should be viewed as a

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[36] Northern States Power Company and ITC Midwest LLC, *Application to the Minnesota Public Utilities Commission for a Certificate of Need for the Huntley-Wilmarth 345 kV Transmission Line Project*, at 8, MPUC Docket No. E-002, (January 2018), *available at*: https://www.huntleywilmarth.com/staticfiles/microsites/hw/HW-Certificate-of-Need-Application.pdf.

[37] 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/lbnl-6103e.pdf.

valuable hedge against uncertainty and future price fluctuations for all consumers.

Q: How does transmission ensure competitive electricity markets?

A: Transmission infrastructure is also a powerful tool for increasing competition in wholesale power markets and reducing the potential for generators to harm consumers by exercising market power. In Order 890, FERC explained how transmission constraints can restrict electricity market competition, discussing how those with incumbent generating assets

> can have a disincentive to remedy transmission congestion when doing so reduces the value of their generation or otherwise stimulates new entry or greater competition in their area. For example, a transmission provider does not have an incentive to relieve local congestion that restricts the output of a competing merchant generator if doing so will make the transmission provider's own generation less competitive."[38]

5. THE GRAIN BELT EXPRESS PROJECT INCREASES ELECTRIC RELIABILITY AND RESILIENCE IN MISSOURI AND ACROSS MISO AND SPP

Q: How does transmission make the power system more reliable and resilient?

A: The benefits of a more interconnected power system have been apparent ever since the days of Edison and Westinghouse, when the larger alternating current network championed by Westinghouse was able to achieve greater reliability at lower cost by aggregating more diverse loads

[38] FERC Order 890 at ¶422, *available at:* http://www.ferc.gov/whats-new/comm-meet/2007/021507/E-1.pdf

and resources. The official report to President Johnson regarding the large-scale 1965 Northeast blackout concluded that "[I]solated systems are not well adapted to modern needs either for purposes of economy or service" and recommended "… an acceleration of the present trend toward stronger transmission networks within each system and stronger interconnections between systems in order to achieve more reliable service at the lowest possible cost."[39]

Q: How does interregional transmission make the power system more resilient to extreme weather?

A: Extreme weather events can have a large impact on electricity demand and supply, both by affecting renewable output and causing forced outages and derates at conventional power plants. Because severe weather affects a limited geographic area, interregional transmission counteracts its impact by linking to neighboring regions that are less affected and therefore have spare electricity supply. As discussed in Mr. Repsher's testimony and report, expanded interregional transmission would have been extremely valuable during recent heat waves and cold snaps. Analysis by LBNL confirms that severe weather events account for about half of the total value of interregional transmission.[40]

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[39] Federal Power Commission, *Report to the President on the Power Failure in the Northeastern United States and the Province of Ontario on November 9-10, 1965*, (December 1965), at 43 (emphasis added);cited in WIRES, "Informing the Transmission Discussion," (January 2020), *available at*: https://www.scottmadden.com/content/uploads/2020/01/ScottMadden_WIRES_Informing-the-Transmission-Discussion_4-Interregional-Considerations_2020_0115.pdf

[40] LBNL, "The Latest Market Data Show that the Potential Savings of New Electric Transmission was Higher Last Year than at Any Point in the Last Decade," (Feb. 2023), *available at:*

Q: Have you analyzed the value the Grain Belt Express Project could have offered during Winter Storm Elliott in December 2022?

A: Yes. The results of my analysis of the value the Project could have offered SPP, MISO, and PJM during December 22-26, 2022, are presented in Schedule MG-9. My analysis examined the difference in hourly electricity prices among the SPP South, MISO Illinois, and PJM ComEd market hubs during Winter Storm Elliott, and evaluated the value a new 2,500 MW link between each pair of those regions would have provided.[41] The results show that each of those links would have provided between $39 million and $80 million in value, with large value flowing to each of SPP, MISO, and PJM.

Q: What drives these benefits?

A: The Project would have allowed larger power exchanges among SPP, MISO, and PJM during Winter Storm Elliott. Those regions experienced their peak need, as reflected in the power prices shown in Schedule MG-10, at different times as the cold air moved from west to east and north to south across the country. Prices peaked in SPP first, then MISO, and then PJM. The Project would have allowed power to flow east to west as SPP and MISO dealt with the most extreme cold, and then west to east once the

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https://eta-publications.lbl.gov/sites/default/files/lbnl-transmissionvalue-fact_sheet-2022update-20230203.pdf

[41] To simplify the analysis, power delivered to both AECI and MISO in Missouri was assumed to receive the price at the MISO Illinois hub, which is the nearest market hub. Other details of the methodology are described on page 10 here, which generally follows the methodology used in the earlier Grid Strategies ACORE study cited in the next footnote and used by the Guidehouse report presented in Mr. Petti's testimony. *Available at*: https://acore.org/wp-content/uploads/2023/02/The-Value-of-Transmission-During-Winter-Storm-Elliott-ACORE.pdf

extreme cold had moved into PJM. A similar dynamic occurred during the 2014 and 2019 Polar Vortex events, as cold weather moved from SPP and MISO into PJM.[42] The opposite occurred during Winter Storm Uri, when the cold air primarily affected SPP, MISO, and ERCOT in the middle of the country, so imports from PJM were extremely valuable.[43] During Elliott and other storms, regions also experienced peak wind output at different times, further increasing the value of inter-regional transmission like the Grain Belt Express Project.

6. GRAIN BELT EXPRESS PROJECT REDUCES POLLUTION AND FACILITATES COMPLIANCE WITH ENVIRONMENTAL REGULATIONS

Q: How does Grain Belt Express affect pollution in Missouri?

A: By delivering low-cost non-emitting energy to Missouri and the broader MISO market, the Project displaces higher-cost emitting generators in Missouri and in nearby states where their pollution also negatively affects Missouri residents.

Q: Were you able to quantify the air emissions reductions attributable to the Project?

A: Yes, I used the U.S. Environmental Protection Agency's Avoided Emissions and Generation Tool ("AVERT") to calculate the emissions reductions that

[42] Michael Goggin, "Transmission Makes The Power System Resilient to Extreme Weather," (July 2021), *available at*: https://acore.org/wp-content/uploads/2021/07/GS_Resilient-Transmission_proof.pdf
[43] *Id.*

would be provided by the roughly 5,000 MW of renewable generation delivered by the Project. The AVERT tool was built by the U.S. Environmental Protection Agency to quantify the impact of renewable energy and other measures on air pollution emissions.[44] This U.S. government tool has been widely used for emissions benefit analysis. The tool statistically estimates which power plants in a region experience reduced emissions of sulfur dioxide, fine particulate matter (under 2.5 micrometer), nitrogen oxides, and carbon dioxide due to the deployment of renewable energy or energy efficiency. The first three pollutants cause environmental degradation, including smog and acid rain, and contribute to cardiopulmonary health problems including asthma, bronchitis, heart attacks, and even death.[45] Carbon dioxide is the primary greenhouse gas that causes global warming and climate change, which has negative effects on human health and the environment.[46] AVERT's "Midwest" and "Mid-Atlantic" regions, which roughly approximate the footprints of MISO+AECI and PJM respectively, were used for this analysis.

The AVERT tool indicates that delivering 2,500 MW of additional renewable generation to each of the Midwest and Mid-Atlantic regions, with

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[44] EPA, *AVoided Emissions and geneRation Tool (AVERT)*, (accessed October 10, 2022), *available at*: https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert.
[45] EPA, *Regulatory Impact Analysis for the Proposed Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program* at 4-18, (August 2018), *available at*: https://www.epa.gov/sites/production/files/2018-08/documents/utilities_ria_proposed_ace_2018-08.pdf.
[46] U.S. Global Change Research Program, *Fourth National Climate Assessment* (November 2018), *available at*: https://nca2018.globalchange.gov/.

overbuilt renewable capacity in a roughly 2:1 wind:solar ratio so the line can operate at a combined capacity factor of 74% to deliver around 16,200,000 MWh/year to each region, would annually displace over 25 million tons of carbon dioxide, nearly 40 million pounds of sulfur dioxide, 28 million pounds of nitrogen oxides, and 3 million pounds of fine particulate matter emissions. These regional results, as well as results for the displacement of air emissions from power plants in Missouri, are summarized in Clean Grid Alliance Schedule MG-11.

Q: How do these benefits compare to those found by PA Consulting?

A: These emissions savings are somewhat higher than those calculated by PA Consulting's analysis, as these results are based on recent historical dispatch of fossil generators while PA Consulting's results are based on modeled future dispatch of fossil generators after many higher-emitting generators retire or reduce their output. Our analysis also accounts for the full amount of renewable energy delivered by the Project, while PA Consulting's analysis focuses on the incremental benefits of expanding the Project from delivering 500 MW to MISO to a total of 5,000 MW to both MISO and PJM.

Q: If new federal environmental regulations are enacted, how would that affect the value of and need for renewable energy resources?

A: It would increase. The U.S. EPA is currently developing new rules to regulate carbon dioxide emissions from existing and new power plants under sections 111(d) and 111(b) of the Clean Air Act, respectively. Section

111 requires the U.S. EPA to regulate emissions that cause or significantly contribute to air pollution that may endanger public health or welfare, and the EPA has determined that carbon dioxide does endanger public health or welfare. While it is not yet known what form EPA's rule for existing power plants will take, the *West Virginia vs. EPA* Supreme Court[47] ruling in June 2022 provides some indications of what paths EPA may take. It is likely that EPA's rule will increase costs for existing fossil-fired power plants by requiring investments or operational changes to reduce emissions of carbon dioxide.

Other pending, proposed, and recently finalized EPA[48] rules are likely to add further costs to the operation of new and existing fossil-fired power plants, including the national soot standard,[49] national smog standard, the Good Neighbor Rule, the Mercury and Air Toxics Standard, and new rules on coal ash and regional haze. The cuts to nitrogen oxide emissions required of Missouri power plants under the Good Neighbor Plan are the second largest of any state, with 61% reductions in ozone season emissions required by 2027 relative to 2021 emissions.[50] Combined, these

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[47] U.S. Supreme Court, "*West Virginia vs. EPA*," (June 2022), *available at*: https://www.supremecourt.gov/opinions/21pdf/20-1530_n758.pdf

[48] OIRA, "Agency Rule List - Fall 2022: Environmental Protection Agency," *available at*: https://www.reginfo.gov/public/do/eAgendaMain?operation=OPERATION_GET_AGENCY_RULE_LIST&currentPub=true&agencyCode=&showStage=active&agencyCd=2000&csrf_token=348176055B315014FAB9C6698A25D57A155D419664A71FCBF93D52396C9E982C035071D32AA6612F51A2FA35789F064078C6

[49] U.S. E.P.A., "EPA Proposes to Strengthen Air Quality Standards to Protect the Public from Harmful Effects of Soot," (Jan. 6, 2023), *available at*: https://www.epa.gov/newsreleases/epa-proposes-strengthen-air-quality-standards-protect-public-harmful-effects-soot

[50] https://www.epa.gov/csapr/good-neighbor-plan-2015-ozone-naaqs#maps

rules are likely to drive the retirement, or at least reduced utilization, of these fossil-fired power plants, creating a need for replacement generation and capacity from non-emitting resources.

Q: Does this conclude your testimony?

A: Yes.

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Application of Grain Belt Express LLC		
For an Amendment to its Certificate of Convenience	)	
and Necessity Authorizing it to Construct,	)	
Own, Operate, Control, Manage, and Maintain	)	Case No. EA-2023-0017
a High Voltage, Direct Current Transmission Line	)	
and Associated Converter Station	)	

AFFIDAVIT OF MICHAEL GOGGIN

I, Michael Goggin, being duly sworn, declare under oath as follows:

1. My name is Michael Goggin. I am a Vice President at Grid Strategies LLC, a consulting firm based in the Washington, D.C. area. I make this affidavit in support of testimony being submitted in the above captioned docket before the Missouri Public Service Commission on behalf of Clean Grid Alliance.

2. Attached hereto is my Rebuttal Testimony, labeled as *Rebuttal Testimony of Michael Goggin on Behalf of: Clean Grid Alliance*, that consists of a cover page, a table of contents and 36 pages of questions and answers, and schedules MG-1 through MG- 11.

3. The aforementioned documents were prepared by me or under my direction and control.

4. I have personal knowledge of the facts set forth in those documents.

5. If I were asked under oath the same questions posed therein, including my schedules, I would provide the same answers contained therein.

6. The answers provided in the attached testimony, including my schedules, are true and correct to the best of my knowledge and belief.

Further, affiant sayeth naught.

Michael Goggin

STATE OF Washington, DC

COUNTY OF District of Columbia

Subscribed and Sworn or Affirmed before me

this 18 day of April 2023.

Notary Public

My Commission expires: 12/14/2025