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MISSOURI PUBLIC SERVICE COMMISSION

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REBUTTAL TESTIMONY

OF

MICHAEL GOGGIN

SUBMITTED ON BEHALF OF:

CLEAN GRID ALLIANCE

April 19, 2023

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Schedules MG-1 through MG-11

1 **1. INTRODUCTION**

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

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

5 **Q: For whom are you testifying?**

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

7 **Q: Have you previously testified before utility commissions?**

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

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

15 **A:** I testified in several dockets related to Clean Line LLC's petition for a
16 Certificate of Public Convenience and Necessity ("CCN") for the Grain Belt
17 Express transmission line (Illinois Commerce Commission docket nos. 15-
18 0277 and 22-0499, and Missouri PSC Docket nos. EA-2014-0207 and EA-
19 2016-0358).

20 **Q: What is your background and educational experience?**

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

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

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

37 **Q: What is the purpose of your testimony?**

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

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

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

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

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

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

80

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

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

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

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

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

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

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

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

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

120 **A:** As indicated in the wind resource map in Clean Grid Alliance Schedule MG-
121 2, Kansas has high-quality wind resources with high average wind speeds.
122 Importantly, the energy available for wind energy production is proportional
123 to the cube of wind speed, so the difference between the orange and purple
124 areas in the wind speed map in Clean Grid Alliance Schedule MG-2 is quite
125 significant. For example, the 8.5-9 meter/second area of the map, which is
126 the dark purple area that covers significant parts of Kansas, Oklahoma and
127 Nebraska has about 76% more energy available in the wind than the 7.0-
128 7.5 meter/second dark orange area in a few parts of northern and western
129 Missouri, and more than twice as much energy as the 6.5-7 meter/second
130 light orange areas that are more widespread in the northwestern Missouri.

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

133 **A:** Lawrence Berkeley National Laboratory ("LBNL") data show that in 2021,
134 the average capacity factor for Kansas wind projects installed during 2016-
135 2020 was 43.4%, compared to 34.6% for Missouri wind projects installed
136 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.xlsx

137 higher capacity factors if wind curtailment, which is discussed in more detail
138 in the next section, had not reduced their output. SPP wind projects, a large
139 share of which are in Kansas, experienced 6.4% curtailment in 2021, versus
140 4.7% in MISO.² Assuming wind projects in those states experienced
141 curtailment rates in 2021 consistent with those regional averages, without
142 curtailment Kansas wind projects would have operated at a 46.2% capacity
143 factor, versus around 36.2% for Missouri.

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

146 **A:** It is also much higher. As shown in the National Renewable Energy
147 Laboratory (“NREL”) solar resource map in Clean Grid Alliance Schedule
148 MG-3, southwestern Kansas receives around 5-5.25 kWh/m²/day of solar
149 insolation, versus 4.25-4.75 kWh/m²/day in most of Missouri. The 5-25%
150 higher insolation in southwestern Kansas has a roughly proportional impact
151 on capacity factor.

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

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

² *Ibid.*, tab “Curtailment and Penetration”

³ NREL, *Annual Technology Baseline, 2022*, available at:
https://atb.nrel.gov/electricity/2022/utility-scale_pv

158 21% in MISO, for solar projects with tracking equipment.⁴ Notably, the MISO
159 average capacity factor includes projects in MISO South, which have much
160 higher quality solar resources than those in Missouri.

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

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

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

⁴ Lawrence Berkeley National Laboratory, Utility-Scale Solar, available at:
https://emp.lbl.gov/sites/default/files/2022_utility-scale_solar_data_update.xlsx, 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.xlsx

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

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

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

183 **A:** The extension of the wind PTC, and the creation of a solar PTC that solar
184 projects can opt to take instead of a 30% Investment Tax Credit, creates a
185 further premium for locating renewable projects in highly productive areas.
186 Using the LBNL historical wind and solar capacity factors discussed above,
187 a 100 MW solar project in SPP would generate over \$900,000 more PTCs
188 per year than a lower capacity factor solar project in MISO at the current
189 PTC value of \$26/MWh, while a 100 MW wind project in Kansas would
190 generate \$1.75 million more in PTCs annually. For the 6,021 MW of wind
191 and 3,262 MW of solar that GBE Witness Repsher, from PA Consulting,
192 assumes would be connected to the Grain Belt Express Project in Kansas,
193 this translates to around \$135 million more in annual revenue for those wind
194 and solar projects compared to locating those projects in Missouri, or \$1.35
195 billion over the 10-year period that projects receive PTCs.⁷ Revenue from
196 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.

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

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

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

208 **Q: Can storage eliminate the need for transmission?**

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

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

218 **A:** When transmission congestion prevents the delivery of renewable
219 generation, this results in lower Locational Marginal Prices (“LMPs”) on the

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

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

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

241

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

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

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

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

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>

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

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

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

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

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

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.xlsx

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

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

286 **A:** LBNL analysis shown in Schedules MG-5 and MG-6 indicates congestion
287 and curtailment is significantly reducing the value of wind generation in
288 MISO,¹⁴ a finding further corroborated by published academic research by
289 LBNL.¹⁵ In MISO, congestion has reduced the value of wind by 42%, and
290 curtailment by an additional 1%. In the best wind resource areas of MISO,
291 the map shown in Schedule MG-5 reveals that the impacts are even larger,
292 with the value of wind energy reduced to \$5/MWh or less. This indicates
293 that Missouri utilities procuring wind energy from these areas would receive
294 little value in the MISO market for their purchases, which will negatively
295 affect continued development of wind projects in these areas until that
296 congestion is alleviated. The data also show that the value of SPP wind is
297 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](https://www.cell.com/joule/pdfExtended/S2542-4351(21)00244-0)

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

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

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

315 **A:** Yes. A major difficulty in coordinating renewable and transmission
316 development is the mismatch between the relatively short amount of time
317 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

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

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>.

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

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

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

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

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

²² MISO, MVP Report, January 2012, *available at*:
<https://cdn.misoenergy.org/2011%20MVP%20Portfolio%20Analysis%20Full%20Report117059.pdf>
f, 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/>

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

363 The value of interregional transmission, even with strong intra-
364 regional transmission, is confirmed by a number of studies.²⁵ In addition,
365 the history of the MVPs and other pro-actively planned transmission
366 projects is that they are always more than fully subscribed well before they
367 enter service, so regardless of the success of the Tranche 1 projects there
368 will still be large value in the Project delivering low-cost renewable energy
369 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>

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

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

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

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%20jitq%20study%20updated%20white%20paper%2020221220.pdf>

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

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

396 **Q: Please explain.**

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

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

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

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

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

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

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

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

452 **A:** Kansas’ renewable resources delivered via the Project are a lower cost
453 option than resources available in or currently deliverable to Missouri,
454 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>

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

463

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

467 **Q: Please summarize what recent Missouri utility Integrated Resource**
468 **Plans (“IRPs”) indicate about the need for renewable energy and the**
469 **Grain Belt Express Project.**

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

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>.

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

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

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

491 A: Evergy’s IRP notes that “With regards to renewable resources in the
492 southwest Kansas region, it is known that the total current firm transmission
493 service requests to SPP exceed the total transmission service availability
494 which will be provided by transmission construction projects. Until large
495 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

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

501

502 **4. THE GRAIN BELT EXPRESS PROJECT FOSTERS**
503 **ELECTRICITY MARKET COMPETITION THAT REDUCES**
504 **PRICES**

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

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

515 **Q: How does the Project provide these benefits?**

516 **A:** As explained above, the Project provides access to Kansas renewable
517 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>,

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

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

528 **A:** Yes. The impact on energy and capacity market prices tends to be largest
529 near the point at which additional supply is injected, because transmission
530 congestion can limit the flow of those benefits to more distant parts of the
531 MISO footprint. Because the Project's point of injection into MISO is in
532 Missouri, a significant share of the benefits will accrue to Missouri
533 ratepayers. The analysis by PA Consulting³³ quantifies the beneficial
534 impact of the Project on energy and capacity market prices for Missouri
535 consumers. In addition, Missouri utilities will be able to sign PPAs for low-
536 cost renewable generation delivered via the Project, directly reducing their
537 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).

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

540 **A:** Yes. A 2012 report by Synapse Energy Economics found that adding 20 to
541 40 GW of wind energy and the accompanying transmission in the MISO
542 region would save a typical household between \$63 and \$200 per year, as
543 shown in Clean Grid Alliance Schedule MG-8.³⁴ As the report explains,
544 “Since wind energy ‘fuel’ is free, once built, wind power plants displace
545 fossil-fueled generation and lower the price of marginal supply—thus
546 lowering the energy market clearing price.”³⁵

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

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

³⁴ Synapse Energy Economics, Inc., [The Potential Rate Effects of Wind Energy and Transmission in the Midwest ISO Region](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), 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.*

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

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

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

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

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>.

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

582 **Q: How does transmission ensure competitive electricity markets?**

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

588 can have a disincentive to remedy transmission congestion
589 when doing so reduces the value of their generation or
590 otherwise stimulates new entry or greater competition in their
591 area. For example, a transmission provider does not have an
592 incentive to relieve local congestion that restricts the output of
593 a competing merchant generator if doing so will make the
594 transmission provider's own generation less competitive."³⁸
595

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

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

601 **A:** The benefits of a more interconnected power system have been apparent
602 ever since the days of Edison and Westinghouse, when the larger
603 alternating current network championed by Westinghouse was able to
604 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>

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

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

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

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:

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

626 **A:** Yes. The results of my analysis of the value the Project could have offered
627 SPP, MISO, and PJM during December 22-26, 2022, are presented in
628 Schedule MG-9. My analysis examined the difference in hourly electricity
629 prices among the SPP South, MISO Illinois, and PJM ComEd market hubs
630 during Winter Storm Elliott, and evaluated the value a new 2,500 MW link
631 between each pair of those regions would have provided.⁴¹ The results
632 show that each of those links would have provided between \$39 million and
633 \$80 million in value, with large value flowing to each of SPP, MISO, and
634 PJM.

635 **Q: What drives these benefits?**

636 **A:** The Project would have allowed larger power exchanges among SPP,
637 MISO, and PJM during Winter Storm Elliott. Those regions experienced
638 their peak need, as reflected in the power prices shown in Schedule MG-
639 10, at different times as the cold air moved from west to east and north to
640 south across the country. Prices peaked in SPP first, then MISO, and then
641 PJM. The Project would have allowed power to flow east to west as SPP
642 and MISO dealt with the most extreme cold, and then west to east once the

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>

643 extreme cold had moved into PJM. A similar dynamic occurred during the
644 2014 and 2019 Polar Vortex events, as cold weather moved from SPP and
645 MISO into PJM.⁴² The opposite occurred during Winter Storm Uri, when the
646 cold air primarily affected SPP, MISO, and ERCOT in the middle of the
647 country, so imports from PJM were extremely valuable.⁴³ During Elliott and
648 other storms, regions also experienced peak wind output at different times,
649 further increasing the value of inter-regional transmission like the Grain Belt
650 Express Project.

651

652 **6. GRAIN BELT EXPRESS PROJECT REDUCES POLLUTION**
653 **AND FACILITATES COMPLIANCE WITH ENVIRONMENTAL**
654 **REGULATIONS**

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

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

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

662 **A:** Yes, I used the U.S. Environmental Protection Agency’s Avoided Emissions
663 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.*

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

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

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/>.

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

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

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

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

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

705 111 requires the U.S. EPA to regulate emissions that cause or significantly
706 contribute to air pollution that may endanger public health or welfare, and
707 the EPA has determined that carbon dioxide does endanger public health
708 or welfare. While it is not yet known what form EPA's rule for existing power
709 plants will take, the *West Virginia vs. EPA* Supreme Court⁴⁷ ruling in June
710 2022 provides some indications of what paths EPA may take. It is likely
711 that EPA's rule will increase costs for existing fossil-fired power plants by
712 requiring investments or operational changes to reduce emissions of carbon
713 dioxide.

714 Other pending, proposed, and recently finalized EPA⁴⁸ rules are
715 likely to add further costs to the operation of new and existing fossil-fired
716 power plants, including the national soot standard,⁴⁹ national smog
717 standard, the Good Neighbor Rule, the Mercury and Air Toxics Standard,
718 and new rules on coal ash and regional haze. The cuts to nitrogen oxide
719 emissions required of Missouri power plants under the Good Neighbor Plan
720 are the second largest of any state, with 61% reductions in ozone season
721 emissions required by 2027 relative to 2021 emissions.⁵⁰ Combined, these

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¤tPub=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-naags#maps>

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

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

726 **A:** Yes.

727

**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.

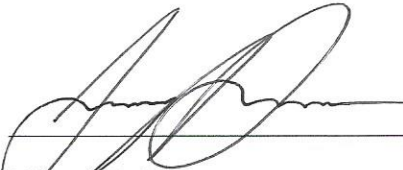
Further, affiant sayeth naught.



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

