

# ANALYSIS SUMMARY: IMPACT OF GRAIN BELT EXPRESS ON MIDWEST ENERGY CONSUMER COSTS AND EMISSIONS

## ABOUT GRAIN BELT EXPRESS

Grain Belt Express is an approximately 800-mile, overhead, multi-terminal +600 kilovolt (kV), 5,000 megawatt (MW) HVDC transmission line that is primarily designed to deliver low-cost renewable energy from dedicated, new solar and wind resources in Southwestern Kansas to customers in the Midwest and other regions. The transmission line and renewable generation it is expected to enable (collectively referred to in this analysis summary as “Grain Belt Express”) are projected to create significant cost and emissions savings for energy consumers in Kansas, Missouri, and Illinois (collectively the “Route States”), as well as across broader regions of the U.S. electrical system, namely the Southwest Power Pool (SPP), the Midcontinent Independent System Operator (MISO), Associated Electric Cooperative Inc. (AECI), and PJM Interconnection (PJM).

## PA CONSULTING SAVINGS ANALYSIS

Using a modeling process widely deployed by electric utilities, power market regulators, state commissions, independent system operators, and other market consultants, PA Consulting Group (“PA”) evaluated the energy, capacity, and emissions savings resulting from Grain Belt Express.<sup>1</sup>

PA first conducted a forward-looking, hourly, long-term chronological production simulation of the Eastern Interconnection under a baseline (status quo) scenario, using the Aurora model in both zonal and nodal configuration<sup>2</sup>. The baseline scenario is built around PA’s proprietary “base case” market assumptions (e.g., fuel prices, newbuild costs, demand, etc.), with the exception of federal carbon

**PA Consulting projects that Grain Belt Express will reduce energy and capacity costs for Kansas, Missouri, and Illinois energy consumers by approximately \$11.3 billion over 15 years, with total power cost savings across SPP, MISO, and PJM of \$51.9 billion over 15 years. *Additionally*, Grain Belt Express provides \$61.4 billion in incremental societal benefits from avoided emissions across broader regions over 40 years, including 490 million tons of avoided carbon dioxide emissions.**

<sup>1</sup> Reports produced by PA Consulting and filed in Illinois and Missouri aimed to provide regulators a view of how the proposed expansion and increased local delivery of Grain Belt Express (~5,000 MW) compared to the prior Project configuration (~500 MW), which had been reviewed previously by both Commissions. This report now establishes the full scope of benefits for the approximately 5,000-megawatt Grain Belt Express Project design, versus the status quo of no Grain Belt Express.

<sup>2</sup> Aurora is licensed to PA by Energy Exemplar.



pricing.<sup>3</sup> Next, PA assessed the wholesale market impacts of the incremental resource (~5,000 MW Grain Belt Express<sup>4</sup>) entering service in 2027. In order to isolate the wholesale market impacts from including the incremental resources transmitted by Grain Belt Express, PA held all other assumptions constant between the two scenarios. Importantly, PA's analysis did not alter future resource planning decisions between the baseline and incremental resource scenarios, thereby controlling for potential impacts from confounding variables. To ensure "firm" delivery of renewables – and maximize output from complementary variable energy sources – the dedicated solar and wind resources in Southwestern Kansas were "oversized" (i.e., totaling approximately 9,300 MW) relative to Grain Belt Express's HVDC capacity (i.e., approximately 5,000 MW).

Then, PA analyzed how the addition of the incremental Grain Belt Express resource would impact energy and capacity prices, and thus power supply costs to energy consumers. To determine the impact to customers in specific states, PA identified the relevant wholesale transmission and capacity zones and then allocated their demand, load shapes, and reserve requirements accordingly to produce state-specific benefits for Kansas, Missouri, and Illinois. Finally, PA calculated the associated emissions savings across the broader SPP, MISO, and PJM regions as a result of Grain Belt Express's renewables delivery displacing higher emitting resources off the supply stack.

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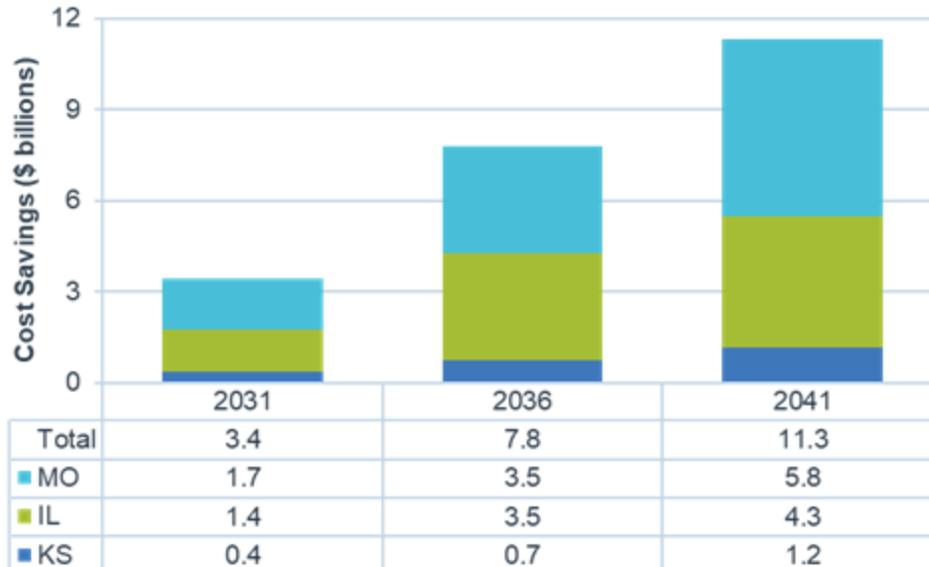
<sup>3</sup> Carbon regime implemented starting 2026 at a \$24.55/short ton price (nominal terms) that tracks inflation, increasing 2.2% annually. The assumption of a carbon pricing regime is a relatively common practice in utility and ISO planning processes. Carbon pricing can be reflected as a broad 'shadow cost' within fundamental market models to satisfy regulatory dictates (footnote continues on p. 3). It being used as a modeling variable and is not necessarily tied to/dependent on/predictive of actual legislative outcomes at the federal level. The use of an alternative carbon price assumption (either higher or lower) will still result in directionally consistent outcomes (i.e., consumer energy cost- and emissions-savings), albeit with differences in specific benefits values.

<sup>4</sup> Specifically, solar and wind resources from western Kansas would be transmitted to the (i) Ameren Missouri (AMMO) service territory in Missouri (1,500 MW); (ii) Associated Electric Cooperative, Inc. (AECI) service territory in Missouri (1,018 MW); and (iii) American Electric Power Indiana (AEP-Indiana) service territory in Indiana (2,500 MW), with PJM deliveries beginning in 2030.

## GRAIN BELT EXPRESS BENEFITS ENERGY CONSUMERS IN ROUTE STATES

PA's analysis found that **Grain Belt Express is projected to reduce energy & capacity costs across Kansas, Missouri, and Illinois by approximately \$11.3 billion between 2027 and 2041** – rising to a cumulative total of \$35.5 billion over the 40-year period of 2027-2066. As shown in the figure below, benefits are projected to be enjoyed across all Route States, with energy consumers in **Kansas, Missouri, and Illinois saving \$1.2 billion, \$5.8 billion, and \$4.3 billion through 2041, respectively**. Total consumer power cost savings of \$51.9 billion are estimated across the broader SPP, MISO, and PJM region over 15 years.

Projected Cumulative Energy & Capacity Savings due to Grain Belt Express





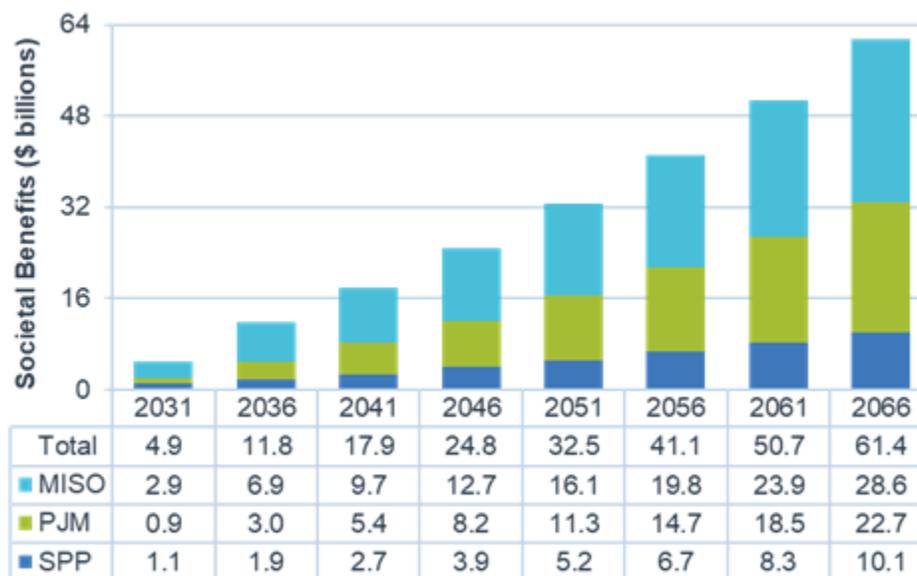
## GRAIN BELT REDUCES REGIONAL EMISSIONS

In addition to economic savings for energy consumers, Grain Belt Express delivers substantial emissions reductions and environmental justice benefits. These benefits are particularly relevant in light of national and state clean energy goals as well as decarbonization targets set by a broad range of market actors – from utilities to corporate and industrial energy users to government agencies including, for example, the Department of Defense.

Across the Midwest and Eastern U.S. over a 40-year study period, **Grain Belt Express enables substantial emissions reductions, with emissions avoided across SPP, MISO, and PJM totaling 490 million short tons of carbon dioxide, 205,000 short tons of sulphur dioxide, and 171,000 short tons of nitrogen oxides. These emissions reductions result in incremental societal benefits of \$61.4 billion from 2027 through 2066.**

PA Consulting notes that Grain Belt Express’s average annual displacement of 12.25 million tons of carbon dioxide over 40 years is equivalent to offsetting annual power sector carbon dioxide emissions in Montana and South Dakota combined, making it among the largest GHG-reducing infrastructure projects currently proposed. Further, Grain Belt Express’s annual displacement of 12.25 million tons of carbon dioxide over 40 years approximately equals the average annual carbon sequestration benefit of the entire Conservation Reserve Program administered by the U.S. Department of Agriculture.

Projected Cumulative Societal Benefits from Emissions Reductions due to Grain Belt Express

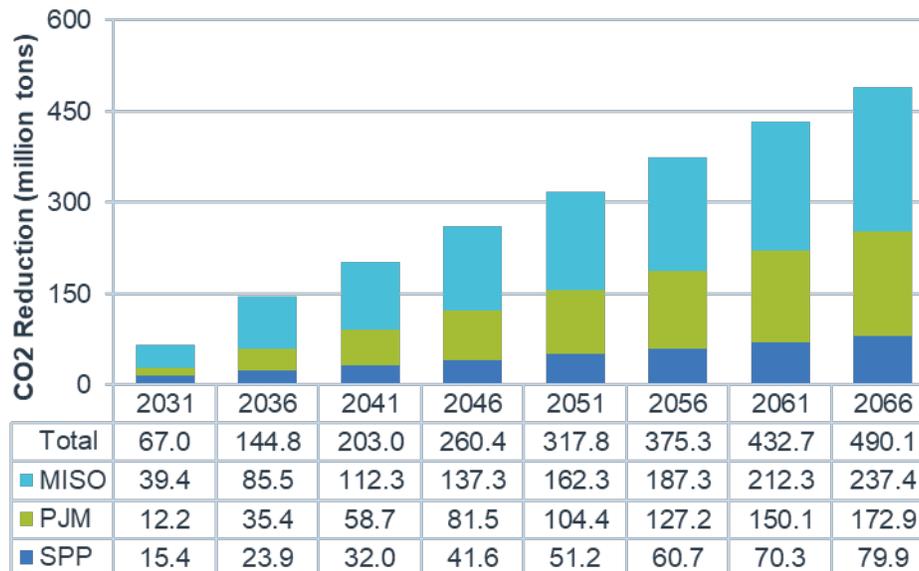


While carbon emissions are a global issue, Grain Belt Express also significantly reduces emissions of criteria pollutants – such as sulphur dioxide and nitrogen oxides – providing even more tangible benefits to local residents in the form of reduced air pollution (and therefore reduced respiratory illness and distress, saving lives and healthcare costs). The table below quantifies the 2027-2066 emissions reductions and benefits for Kansas, Missouri, and Illinois, in addition to the broader region.

### Emissions Reductions and Savings due to Grain Belt Express (40 Years)

Benefit	Kansas	Missouri	Illinois	Route States Total	Regional Total
CO <sub>2</sub> avoided (million tons)	3.3	93.2	33.0	<b>129.5</b>	<b>490.1</b>
SO <sub>2</sub> avoided (tons)	639	87,511	3,187	<b>91,338</b>	<b>205,256</b>
NO <sub>x</sub> avoided (tons)	818	50,479	11,571	<b>62,867</b>	<b>171,498</b>
Societal benefit (billions)	\$0.3	\$10.6	\$4.2	<b>\$15.0</b>	<b>\$61.4</b>

### Projected Cumulative Carbon Dioxide Emissions Reductions due to Grain Belt Express





## GRAIN BELT ENHANCES GRID RELIABILITY AND RESILIENCE

All else equal, adding transmission capacity to the power grid improves reliability by creating more numerous and robust energy pathways from sources to loads, allowing more economic flow as well as enabling more capacity availability in the case of transmission and/or generator outages. In particular, HVDC lines (like Grain Belt Express) are considerably more efficient in transporting energy over long distances and can be controlled by system operators to improve system stability.

Transmission lines that enable inter-regional transfer capability are especially useful, particularly in increasingly decarbonized grids, as they allow access to a greater diversity of resources and unlock a greater degree of renewables penetration on the grid. This diversity of resources can be both temporal (crossing time zones, which is especially helpful to meet peak hour demand) as well as spatial – different generation sources are built in different locations due to a variety of factors including proximity to load, siting and land availability, and resource quality. For example, Grain Belt Express gives the rest of the Midwest access to very high-capacity factor wind generation in Kansas, which is especially useful during evening peak hours (when demand is strong, but solar generation is receding for the day).

Additionally, the complementarity in production profiles of the solar and wind facilities expected to feed Grain Belt Express further enhances resource diversification and supports grid resilience.

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*The methodology, analysis, and findings expressed in this report are current as of January 2023. They were prepared by PA Consulting Group, Inc. (“PA”) at the request of Grain Belt Express LLC. PA is not responsible for any loss or damage to any third party as a result of their use or reliance (direct or otherwise) on PA’s analysis and this report.*