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BEFORE THE STATE CORPORATION COMMISSION

OF THE STATE OF KANSAS

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In the Matter of the Application of Grain Belt Express Clean Line LLC for a Siting Permit for the Construction of a High Voltage Direct Current Transmission Line in Ford, Hodgeman, Edwards, Pawnee, Barton, Russell, Osborne, Mitchell, Cloud, Washington, Marshall, Nemaha, Brown, and Doniphan Counties Pursuant to K.S.A.66-1,177, *et seq.*	)	**Docket No. 13-GBEE-803-MIS**

DIRECT TESTIMONY OF

DAVID A. BERRY

ON BEHALF OF

GRAIN BELT EXPRESS CLEAN LINE LLC

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*Certain capitalized terms in this testimony have the meaning set forth in the Glossary included as **Exhibit C** to the Application.*

I. INTRODUCTION AND PURPOSE OF TESTIMONY

Q. Please state your name, present position and business address.

A. My name is David Berry. I am Executive Vice President – Strategy and Finance of Clean Line Energy Partners LLC ("Clean Line"). Clean Line is the ultimate parent company of Grain Belt Express Clean Line LLC ("Grain Belt Express" or "Company"),[1] the Petitioner in this proceeding. My business address is 1001 McKinney Street, Suite 700, Houston, Texas 77002.

Q. What are your duties and responsibilities as Executive Vice President – Strategy and Finance of Clean Line?

A. I am responsible for Clean Line's overall strategy and business plan. I also oversee and am responsible for the financing activities, accounting, transaction structuring and market analysis for Clean Line and its subsidiaries, including Grain Belt Express. I am responsible for developing the transmission capacity products offered to potential customers and furthering relationships with those customers.

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[1] In the Kansas certification docket for Grain Belt Express Clean Line LLC entitled *In the Matter of the Application of Grain Belt Express Clean Line LLC for a Limited Certificate of Public Convenience to Transact the Business of a Public Utility in the State of Kansas*, Docket No. 11-GBEE-624-COC ("624 Docket"), Grain Belt Express Clean Line LLC was referred to in shorthand as "Clean Line", whereas in this Application it is referred to in shorthand as "Grain Belt Express".

Q. What is the purpose of your direct testimony?

A. I am testifying in support of Grain Belt Express' request for a siting permit to begin construction of the Grain Belt Express Clean Line transmission project ("Grain Belt Project" or "Project"). The body of my testimony is divided into two sections. In the first section, I will summarize and update the information presented in the 624 Docket upon which the Commission made its finding that Grain Belt Express promotes the public convenience and is in the interest of the public in the State of Kansas. In the second section, I will review the current estimated cost of the Project, discuss how that cost will be recovered, and provide updated information on Grain Belt Express' financing plan in light of National Grid USA's investment in Clean Line.

Q. Please describe your education and professional background.

A. I received a Bachelor of Arts degree *summa cum laude* from Rice University with a major in economics and a second major in history. Prior to joining Clean Line Energy Partners, I was employed by Horizon Wind Energy as Finance Director. At Horizon Wind Energy, I was responsible for financing transactions, investment analysis, power purchase agreement pricing and acquisitions. I worked on and led over $2 billion of project finance transactions, including a non-recourse debt financing that was named North American Renewables Deal of the Year by *Project Finance*, and several structured equity transactions for projects in development, construction, and operations.

Q. Have you previously testified in regulatory proceedings?

A. Yes. I have testified previously before the Illinois Commerce Commission, the Indiana Utility Regulatory Commission, and the Kansas Corporation Commission (the "Commission.")

II. WHY GRAIN BELT EXPRESS PROMOTES THE PUBLIC INTEREST

Q. Has the Kansas Corporation Commission previously considered whether the Grain Belt Project is in the public interest?

A. Yes. In the 624 Docket, the Commission granted Grain Belt Express a limited certificate of public convenience to transact the business of a public utility in the State of Kansas. The Commission found the public convenience to be the "primary concern" in the case.[2] The Commission affirmed that it was in the public interest to approve the settlement agreement presented by the majority of the parties in the 624 Docket, including Grain Belt Express' authority to site, own, operate and maintain the Grain Belt Project.[3]

Q. What evidence supported the Commission's finding in the 624 Order?

A. The Commission's order cited evidence presented in Grain Belt Express' application and by Grain Belt Express' witnesses in the proceeding. The Commission also cited evidence presented by other interveners in the 624 Docket, including evidence presented in the testimony of Commission staff. The evidence that supported the Commission's finding addressed the nature of the Project, benefits arising from the Project, Clean Line's staff and capabilities, and Grain Belt Express' business model.

Q. Has any of the evidence presented by Grain Belt Express in the 624 Docket changed as the Company pursued development of the Grain Belt Project?

A. Yes, certain aspects of the Grain Belt Project have changed since the 624 Docket. Like any complex infrastructure project, the Grain Belt Project has evolved as we have

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[2] 624 Docket, Order Approving Stipulation and Agreement and Granting Certificate, December 7, 2011 (the "624 Order"), ¶ 42.

[3] *Ibid.*, ¶ 53.

completed additional public outreach, routing and technical studies, customer discussions, and financings. Additionally, where we have new studies and information available, we are now able to further elaborate on certain public benefits.

Q. Do any of the changes in the evidence decrease the public benefits created by the Project?

A. In my opinion, no. The changes to the evidence since the 624 Docket reflect a natural and incremental evolution, not a fundamental change in the purpose or consequences of the Project. I believe the changes either increase or do not alter the benefits to the Kansas public and the public convenience.

Q. On what basis did you form this opinion?

A. I reviewed the Commission Order as well as the testimony of Commission staff in the 624 Docket. Where the Commission or staff determined a project benefit or made a conclusion relevant to the public convenience, I reviewed the supporting evidence filed by Grain Belt Express. With respect to each factor below, it is my judgment that no changes in the Project or new facts since the 624 Docket diminish the basis upon which the Commission previously found that the Project promoted the public convenience. In the remainder of this section of my testimony, I discuss my reasoning and provide any relevant updates to the evidence.

a. Duplication of Service

Q. Does the service offered by Grain Belt Express duplicate the service of any other Kansas utility?

A. No. As Grain Belt Express previously stated before the Commission, the Grain Belt

Project is not duplicative of any current or planned transmission lines.[4] The Commission's Order acknowledged this fact, stating "[Clean Line's] service is not being provided by any other Kansas utility."[5] To the best of my knowledge, Grain Belt Express remains the only Kansas utility, or company of any kind, developing an HVDC transmission line. As addressed extensively in the 624 Docket, HVDC is the best, most economic technology to move large amounts of power a long distance. Moreover, Grain Belt Express remains the only Kansas utility whose primary purpose is to develop transmission solutions to enable the export of wind energy. Grain Belt Express is also the only Kansas utility using a merchant business model, where direct users of the line, not transmission users in general, pay for the cost of the Project.

b. Facilitating Wind Exports

Q. Will the Grain Belt Project facilitate the export of Kansas wind generation?

A. Yes. This Commission previously found that:

> [t]he need for long-distance, multi-state transmission projects such as the Grain Belt Express proposed by Clean Line in this proceeding will promote the development of wind generation facilities in Kansas, which will provide benefits to Kansas and other areas of the country. These benefits are certainly in the public's interest and Kansas' interest, especially since Clean Line's merchant model for cost recovery does not charge Kansas ratepayers to execute the proposed Project.[6]

As Mr. Skelly previously testified, the Grain Belt Project will deliver 3,500 megawatts ("MW") of power to markets farther east, enabling over 4,000 MW of new wind-powered projects in Kansas.[7] The Commission's finding and Mr. Skelly's testimony

[4] 624 Docket, Direct Testimony of Michael P. Skelly at 20-21.

[5] 624 Order at ¶ 42.

[6] 624 Order at ¶ 50.

[7] 624 Docket, Skelly Direct Testimony at 5.

remain accurate. Enabling new wind generation is the primary purpose of the Grain Belt Project. The Project's western HVDC converter is located in Ford County, Kansas, near a large, high quality wind resource area. The potential of this resource area vastly exceeds Kansas' own demand for wind power. According to one estimate by the National Renewable Energy Laboratory, the high capacity factor wind potential in Kansas as a whole could produce an amount of energy (3.0 million GWh)[8] approximately 75 times larger than the state's electricity demand (40,000 GWh).[9] Only by connecting this resource area to export markets can the state reach its full potential in wind power development.

Since the 624 Docket, the Grain Belt Project has extended its route farther east to Illinois and Indiana to interconnect at the Sullivan 765 kilovolt substation, owned by Indiana Michigan Power Company, a subsidiary of American Electric Power ("AEP"). Grain Belt Express will install an HVDC converter with a delivery capacity of 3,500 MW near the Sullivan substation. Grain Belt Express also intends to install a smaller midpoint HVDC converter in Missouri, connecting to Ameren Missouri's transmission system and the MidContinent Independent Transmission System Operator, Inc. ("MISO").

The addition of a third converter in PJM Interconnection, Inc. ("PJM") was already under consideration during the 624 Docket and was also explicitly contemplated

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[8] National Renewable Energy Laboratory and AWS, "Estimates of Windy Land Area and Wind Energy Potential, by State." (2010). Available at http://www.windpoweringamerica.gov/windmaps/resource_potential.asp. Last accessed June 21, 2013.

[9] Energy Information Administration. "State Electricity Profiles" (2012). Available at: http://www.eia.gov/electricity/state/. Last accessed June 21, 2013.

in the Commission Order.[10] Commission staff witness Andrew Fry also addressed the third converter in the 624 Docket. Mr. Fry stated that the addition of the third HVDC terminal adds more markets for the energy transmitted by the Grain Belt Project but did not change the Project's purpose. He ultimately recommended approval of Grain Belt Express' application based on his technical review.[11]

The new configuration of the Project with a delivery point in MISO and another in PJM will allow for at least as much export of Kansas wind power as the previous configuration with a single 3,500 MW delivery point in MISO. As I detail later in this testimony, the additional converter in PJM accesses a large wholesale electricity market where there is a growing demand for renewable energy. By delivering to both MISO and PJM, the new project configuration increases the number of potential buyers for the power generated by western Kansas wind farms connected to the Grain Belt Project.

Q. Have you observed an increasing demand for transmission service to export wind energy from western Kansas?

A. Yes. One way to measure this increase in demand is to look at the increased number of requests to the Southwest Power Pool ("SPP") for long-term, point-to-point transmission service. I reviewed SPP's open access same time information system ("OASIS") and determined the increased number of requests with a point of receipt in the Sunflower Electric Power Corporation balancing authority and a point of delivery in a balancing authority to the east. Sunflower Electric Corporation's balancing authority encompasses much of western Kansas, including the Grain Belt Express western converter station.

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[10] See Cover Letter for Data Response 1-22 from Cafer Law Office, dated July 28, 2011 and Response to KCC Data Request 51, attached hereto as **Exhibit DAB-1a and DAB-1b**. See also 624 Order, ¶ 1.

[11] 624 Docket, Direct Testimony of Andrew Fry at 8 and 12.

During 2004-2009, there were only 165 MW of such requests. During 2010-2013, there have been over 6,750MW of these requests. This represents an increase of over forty times. While there may be some level of duplicate requests from the same generators and not all of these requests are specific to wind plants, I am confident that the increased level of transmission requests indicates strong interest among wind generators in procuring transmission service to export their product.

c. <u>Economic Development</u>

Q. Did the Commission previously find that the Grain Belt Project would further economic development in Kansas?

A. Yes. The Commission concluded that:

> Clean Line demonstrated that construction of its project in Kansas will promote economic development and provide benefits to local communities, which include: construction of wind farms that could not otherwise be built due to insufficient transmission, construction and permanent maintenance jobs, and growth of turbine and related manufacturing employment.[12]

The Commission also noted that the Project will generate additional state and local tax revenues in Kansas and will generate additional royalties for landowners where wind turbines are located. As the 624 Order states, "[t]he Commission finds that it is in the public's interest to promote the development of wind energy resources, which is vital to economic growth in the state." [13]

Q. Did Grain Belt Express previously present any estimates of the economic impact of the Grain Belt Project?

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[12] 624 Order, ¶ 51.

[13] Id, ¶ 52 and 53.

A. Yes, we did. My colleague Michael Skelly sponsored estimates prepared by Development Strategies, an economic consulting firm. Using input-output economic models, Development Strategies estimated the employment and fiscal benefits of constructing and operating the Grain Belt Project as well as the associated wind farms.[14]

Q. Have you updated your study of economic impacts?

A. Yes, we have. Earlier this year, the Company engaged Strategic Economic Research to update the economic impact study. The principal of Strategic Economic Research, Dr. David Loomis, is a well-known expert on energy economics in general and wind energy in particular. Dr. Loomis worked with his colleague Dr. Lon Carlson, now retired from Illinois State University, to update the economic impact analysis based on the latest Project cost estimate and the latest economic data. I supervised and reviewed the preparation and writing of the study.

Q. Why did Grain Belt Express decide to update the economic impact study?

A. Many of the inputs into an economic impact study change with time, such as estimated cost of construction and economic data used to determine fiscal impacts and "multiplier" effects of increased spending. In addition, the economic impact study submitted in the 624 Docket did not include the Project's segments in Illinois and Indiana. The updated study (attached as **Exhibit DAB-2**) reflects the latest available cost estimates, economic data and project design.

Q. How does the methodology of the updated economic impact study compare to the study prepared for the 624 Docket?

[14] 624 Docket, Skelly Direct Testimony at 7.

A. Both studies use the same models and similar methods. To estimate the economic impacts of the construction and operation of the wind farms, both studies used the Jobs and Economic Development Impacts ("JEDI") Wind Energy Model developed by the National Renewable Energy Laboratory ("NREL"). The JEDI Wind Energy Model estimates the employment, income and economic output that result from the location-specific construction and operation of wind energy projects of a certain size and cost.

To estimate the economic impacts of the construction and operation of the transmission line, both studies used the IMPLAN model. Like JEDI, IMPLAN is an input-output model. Using location and sector-specific expenditures for the transmission line as inputs, IMPLAN generates as outputs the resulting employment, income, economic output and fiscal impacts.

Q. Please summarize the economic impacts of constructing the wind farms in Kansas.

A. Using JEDI, Strategic Economic Research estimated the economic benefits of constructing 4,000 MW of wind farms enabled by the Grain Belt Project and the related supply chain benefits from manufacturing turbine equipment in Kansas. Because there is some uncertainty about how much of the wind turbine equipment will be manufactured in Kansas, I asked Strategic Economic Research to run two scenarios. In the first scenario, Kansas produces 15% percent of wind turbine equipment (as measured in dollars), whereas in the second scenario the percentage increases to 45%. Given the location of multiple turbine component manufacturers in Kansas, I consider this a reasonable range of assumptions.

Based on this range of in-state manufacturing, the construction of wind farms is expected to generate between 15,542 and 19,656 jobs in Kansas. These jobs are expected to result in between $779 million and $1.026 billion of earnings for workers in the states of Kansas. Meanwhile, the impact on Kansas economic output is forecasted to be between $2.284 billion and $3.268 billion.[15]

Q. Please summarize the economic impacts of operating the wind farms in Kansas.

A. Operating and maintaining the wind farms is expected to generate 528 jobs, $25 million in earnings and $73 million in output on an annual basis.

Q. Please summarize the economic impacts of constructing the Grain Belt Project in Kansas.

A. The average annual economic impact from constructing the Grain Belt Project in Kansas is expected to be 2,340 jobs, $131.5 million in earnings and $371.0 million in economic output. Because construction is expected to take three years, the total impacts from construction would be three times the annual impacts.

Q. Please summarize the economic impacts of operating the Grain Belt Project in Kansas.

A. Once it is placed in service, the annual economic impact from operating and maintaining the Grain Belt Project in Kansas is estimated to be 135 jobs, $7.6 million of earnings and $17.7 million of economic output.

Q. How do these results compare to the impacts estimated by the economic impact study in the 624 Docket?

A. They are comparable. Development Strategies previously estimated a total employment benefit of 21,200 full-time equivalent job-years from the construction of the Grain Belt

[15] Both the earnings and the output estimates are expressed in 2013 dollars, as are all dollar figures in the remainder of my testimony discussing the updated economic impact study. All jobs figures are expressed in full-time equivalents based on a 2,080 hour work year.

Project and the associated wind farms in Kansas. (A job-year is equal to one full-time employee for one year, and allows the comparison of employment impacts over different periods.) The updated estimates in **Exhibit DAB-2** range from 22,562 to 26,676 job-years, depending on the level of in-state manufacturing assumed.

d. Impacts on the Environment and on Wholesale Market Competition

Q. What environmental benefits will the Grain Belt Project provide?

A. The Commission previously found that the renewable energy enabled by the Grain Belt Project will reduce emissions of carbon dioxide, nitrous oxides, and sulfur dioxide, and also will reduce water usage for cooling thermal power plants.[16] While these environmental benefits are a result of the generation enabled by the Project, not the Project itself, the generation and the transmission are highly linked. Without new transmission capacity, the construction of new wind energy projects in western Kansas will be limited. The dependency also works in the other direction. Grain Belt Express will require transmission service contracts with wind generators or their power purchasers prior to obtaining financing. Consequently, it is extremely unlikely that the Project will be built without the associated wind generation. There is a direct contractual and causal link between Grain Belt Express' new transmission capacity and the construction of new wind generation. So the environmental benefits of wind generation do very much proceed from new transmission construction.

Q. How will the Grain Belt Project promote wholesale market competition?

A. First, the Project will increase competition in the supply of transmission service. Currently, wind farms and other generators in Kansas who wish to move their power farther east must request service on the SPP system and bear the costs of any necessary

[16] 624 Order, ¶57.

upgrades.[17] The Grain Belt Project will provide generators and other transmissions service customers another option to move their product to a market where it can be sold.

Second, as the Commission has found previously, the Project will enable new low-cost generation that will increase competition among generators in the wholesale electric market.[18] The Project will enable Kansas wind generators to compete against other generation sources that serve the MISO and PJM wholesale electricity markets.

Q. Has anything about the Project changed that would affect the finding that the Grain Belt Project increases competition?

A. No, it has not. The Project still provides additional paths to market for Kansas wind generators. The purpose of the Project is still to enable more than 4,000 MW of the lowest cost wind generation, which will increase generation supply and provide over 15 million megawatt-hours ("MWh") per year of renewable energy.

Q. Is it possible to estimate the environmental and wholesale market benefits of the Project?

A. Yes, it is. Grain Belt Express engaged the consultancy Germanischer Lloyd Garrad Hassan ("GL GH") to perform an analysis of the electric generation and transmission system of the U.S. Eastern Interconnection using PROMOD, a commonly used simulation software package. I reviewed and supervised the analysis for and the writing of a report that is attached to my testimony as **Exhibit DAB-3.** The analysis was carried out for one representative year, 2019. GL GH used a scenario-based approach in order to ensure a robust analysis for a variety of plausible future conditions. Each of four scenarios was analyzed with and without the Grain Belt Project, and the corresponding

[17] 624 Docket, Skelly Direct Testimony at 8.
[18] 624 Order, ¶ 57.

outputs were compared to determine the Project's effects. We measured the level of emissions and the cost to produce wholesale electricity with and without the Project.

Q. Please describe the PROMOD software package used for this analysis.

A. PROMOD is a leading package used to forecast hourly energy prices, unit generation, fuel consumption, emissions output, regional energy interchange, transmission flows and congestion costs, based on the input market conditions specified by the user. PROMOD is a standard software tool used by the utility industry, including MISO and PJM. PROMOD allows the ability to model the complete generation fleet in the Eastern Interconnection and, for each hour studied, develops the cost for each generator to run. This cost is a function of several factors, including: fuel inputs, emissions cost, if any, and variable and fixed operations costs. PROMOD dispatches generation resources in a manner that minimizes system cost, while adhering to generation and load balancing, transmission constraints, and operational reserve requirements. This security-constrained economic dispatch based on generator marginal costs mimics the way regional transmission organizations dispatch their generation fleets based on costs bid by generators.

Q. How does PROMOD estimate the environmental impacts that will result from the construction and operation of the Grain Belt Project?

A. GL GH used a common database of inputs for use within the PROMOD software. This database is produced by Ventyx and includes the Nitrous Oxide ("NO_x"), Sulfur Dioxide ("SO_2"), mercury, and Carbon Dioxide ("CO_2") emission production rates associated with each generator in the model. PROMOD multiplies the relevant emission production rate by the energy output of each plant and sums the emissions to find the total emissions for each scenario. PROMOD does not have plant-specific water consumption rates; instead, water consumption rates for each type of generator (coal, combined cycle, combustion turbine) are used in the same fashion as described for emissions calculations. By comparing the emissions for the simulations run with and without the Grain Belt Project, we can estimate the emissions and water usage reductions that result from the construction and operation of the Project.

Q. Please describe the study methodology.

A: The first steps of the analysis were the development of the four scenarios and the selection of the study year. 2019 was selected as the study year, as the Grain Belt Project is expected to achieve commercial operation in 2018. For each of the four scenarios, a set of specific assumptions for future gas prices, coal retirements, public policies, emissions pricing, load growth rate, wind capacity additions, and transmission build out was developed and built into the model. The assumptions were based on industry knowledge, research, and GL GH's past modeling experience.

After each of the scenarios was developed, the model was run for 2019 without the inclusion of the Grain Belt Project. These runs are referred to as Base Case simulations. The outputs of the analysis are locational marginal prices ("LMPs"), production cost, demand cost, and emissions production for each of the scenarios with and without the Grain Belt Project. I explain the relevance of each of these output metrics below.

Next, each scenario was rerun with the Grain Belt Project and the wind generation the Project will deliver. It is important to note that these wind generators could not be integrated into the MISO and PJM systems without the construction of the

Grain Belt Project, and the Project would not be constructed without commitments from the wind generators, so neither the wind generators nor the transmission line can be reasonably modeled without the other.

Finally, the metrics of the Grain Belt Project simulations are compared to those of the Base Case simulations to determine how the Project impacts LMPs, demand costs, production costs, and emissions production. The change in values is the estimated net benefit of the Project.

Q. What are LMPs?

A. LMPs reflect the location-specific cost of procuring the next increment of energy needed to meet system-wide demand. LMPs are comprised of three components – the cost of energy production, the cost related to transmission congestion and the cost of electric losses across the system. LMPs are a relevant metric because they determine the cost of buying and selling energy on the wholesale electricity market.

Q. What is demand cost?

A. Demand cost is calculated by summing across all hours in the simulation year, the product of the LMP at each load point or "node" times the electric demand at that node. It represents the amount paid by load serving entities for electricity, assuming all load serving entities buy generation from the market. Because it estimates the cost of procuring electricity on behalf of customers, demand cost is used by transmission planning bodies, such as MISO and PJM, in measuring the benefits from new transmission lines to consumers.

Q. What is production cost?

A. Production cost is calculated by summing across all hours in the simulation year the total variable cost of electricity production. Production cost is different from demand cost because it measures the cost to generators of producing the electricity demanded, while demand cost measures the cost of procuring that electricity on the wholesale market.

Q. Please explain the assumptions in each of the four scenarios modeled.

A. The economic analysis of the Grain Belt Project considered four different future scenarios. A high-level description of each scenario is provided below, and detailed data assumptions for each scenario can be found in the GL GH report, attached as **Exhibit DAB-3**

1. Business As Usual – Energy demand grows under a moderate economic recovery with no major changes to existing environmental policy, generating technologies, fuel commodity prices, or other key energy market assumptions. Expansion of renewable generation is driven by current state mandates with the moderate retirement of coal generation driven by market economics and existing environmental rules.
2. Slow Growth – Continuation of depressed economic conditions characterized by slow demand growth, continued low fuel commodity prices, and minimal transmission and generation expansion. Renewable generation expansion is driven by current state mandates, with moderate retirement of coal generation driven by existing environmental rules.
3. Robust Economy – Strong recovery in economic activity characterized by accelerated growth in electrical demand, higher fuel prices and emission allowances prices, and increased activity in new generation and transmission projects.

Expansion of renewable generation is based on current state mandates with the moderate retirement of coal generation driven by existing environmental rules. This scenario includes the addition of the RITELine, Pioneer, and the Potomac Appalachian Transmission Highline ("PATH") transmission projects as representative of the type of transmission projects that would be needed under a robust economy to move energy eastward from Illinois and Indiana.

4. Green Economy – Expansion in environmental policy including carbon regulation and a federal renewable portfolio standard. This scenario includes high-demand growth and increases in fuel prices and emission allowance prices (including carbon). Expansion of renewable generation is significantly higher than current state mandates with accelerated coal retirements driven by new emissions costs. This scenario includes the addition of the RITELine and PATH transmission projects as representative of the type of transmission projects that would be needed under a robust economy to move energy eastward from Illinois and Indiana.

Q. Please summarize the results of the GL GH analysis of the Grain Belt Project's impact on production cost.

A. Total annual production cost savings in the Eastern Interconnection averages $521 million across the four scenarios. This cost decline results from Kansas wind generators displacing the most expensive marginal unit providing power to the grid in the relevant delivery markets, subject to reliability constraints.

Q. Please summarize the results of the GL GH analysis of the Grain Belt Project's environmental benefits.

A. Based on average results across the four scenarios, the Grain Belt Project reduces annual carbon dioxide emissions by 7.2 million tons, annual NOx emissions by 4,963 tons, annual SO_2 emissions by 8,453 tons, and annual mercury emissions by 84 pounds. Additionally, the Grain Belt Project reduces losses due to water evaporation by an average of 3.1 billion gallons per year.

The full results of all four scenarios of the PROMOD modeling, along with additional discussion, are found in the GL GH report attached to my testimony as **Exhibit DAB-3.**

e. Regional Benefits

Q. Are the environmental and market benefits described above relevant to the public convenience in Kansas?

A. Yes, they are for several reasons. First, many pollutants have regional or global effects. For example, pollutants in upwind states can travel to downwind states and contribute to air quality problems. Carbon dioxide is a truly global emission, since it mixes almost completely throughout the atmosphere, making the location of its original release unimportant. Second, improving air quality in downwind states can reduce the likelihood that Kansas is affected by federal pollution regulation. The Clean Air Act requires that all upwind states reduce emissions if they make a significant contribution to downwind states' non-attainment of National Ambient Air Quality Standards ("NAAQS"). Allowing downwind states to reduce their emissions by incorporating Kansas wind energy can help them meet air quality standards, reducing the likelihood that Kansas must abate pollution because it contributes to downwind non-compliance. Third, the markets for fossil fuels used in electricity generation such as coal and natural gas are regional, national and sometimes even global in nature. Making affordable Kansas wind power available to other states diversifies the electric generation portfolio and reduces the potential for rising or volatile fuel prices, which would affect Kansas consumers. Fourth and finally, I understand that the Commission previously has considered regional benefits of transmission lines in assessing whether they promote the public convenience.[19] In approving Grain Belt Express' utility certificate, the Commission referenced regional benefit, stating, "Granting Clean Line a certificate of public convenience allows Kansas to both receive benefits and to provide benefits to other areas of the country at no cost to Kansas ratepayers."[20]

Q. Are there any other regional benefits of the Grain Belt Project?

A. Yes. The economic benefits from the construction and operation of the transmission line and the manufacturing of wind turbine components are not limited to Kansas. The economic impact study attached as **Exhibit DAB-2** estimates these economic benefits that occur in Missouri, Illinois, Indiana and nationwide. Moreover, the Grain Belt Project will play a key role in helping states in MISO and PJM footprints meet their renewable portfolio standards.

Q. Please describe these Renewable Portfolio Standards ("RPS").

A. Within the PJM footprint, the District of Columbia, Delaware, Maryland, New Jersey, West Virginia, North Carolina, Ohio, Pennsylvania, and Virginia all have enacted RPSs, goals, or targets, as have Indiana, Illinois, and Michigan, which have service territories

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[19] 624 Order, ¶ 56 (citing to the Order in Docket No. 08-KMOE-028-COC, August 12, 2008, ¶ 4).

[20] 624 Order, ¶ 48.

in MISO as well as PJM.[21] Several additional states in the MISO footprint—Iowa, Minnesota, Missouri, Montana, North Dakota, and Wisconsin—also have RPS requirements.

Q. Based on state renewable energy standards and goals, what is the total demand for renewable energy in the MISO and PJM region?

A. I estimate that the demand for renewable energy from states in the PJM and MISO footprint will be 99.7 million MWh in 2015, 157.3 million MWh in 2020, and 194.8 million MWh in 2025. These figures were obtained by using the statutory requirements or goals and applying them to the load forecasts from the Energy Information Administration's ("EIA's") 2013 Annual Energy Outlook.[22] The calculations to obtain these figures are provided in **Exhibit DAB-4.**

Q. How does this total volume of renewable energy demand compare with existing supply?

A. According to data published by the EIA, total renewable energy generation in the PJM and MISO states during 2010 was about 83.1 million MWh.[23] This figure likely overestimates RPS eligible supply, since it includes conventional hydro generation, which is not eligible to meet many state RPSs. Regardless, the current level of supply in the PJM and MISO states falls far short of the projected demand over the next 12 years based on state RPS requirements and renewable goals.

[21] Indiana and Virginia have voluntary renewable energy goals.

[22] EIA, "Annual Energy Outlook 2013." Available online at http://www.eia.gov/oiaf/aeo/. Last accessed June 21, 2013.

[23] Includes energy generation from hydro wind, solar thermal and photovoltaic, wood and wood-derived fuels and other biomass. EIA, "Renewable Electricity State Profiles." Available at http://www.eia.gov/renewable/state/ (last visited June 21, 2013).

Q. What will be the consequences of not building adequate transmission to meet PJM and MISO renewable energy standards?

A. If adequate supply is not available, renewable energy credit ("REC") prices will increase, increasing the costs of complying with RPS. In addition, some states require alternative compliance payments from load serving entities that are unable to meet their RPS requirements.

f. Impacts on Kansas Ratepayers

Q. Has the Commission previously considered the effects of the Project on Kansas ratepayers?

A. Yes, it has. The Commission found that Grain Belt Express will not recover Project costs from Kansas ratepayers.[24] As part of its Settlement Agreement in the 624 Docket, Grain Belt Express agreed not to recover Project costs from Kansas ratepayers or the SPP cost allocation process.[25] Consequently, as the Commission noted in its 624 Order, the Grain Belt Project will provide economic benefits to Kansas and to other areas of the United States with no cost to Kansas ratepayers.[26]

Q. Will the Grain Belt Project have any negative effects on Kansas ratepayers?

A. Grain Belt Express' business model has not changed since the Commission previously evaluated the impact on Kansas ratepayers. Grain Belt Express will seek negotiated rate authority from the Federal Energy Regulatory Commission ("FERC") to charge

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[24] 624 Order, ¶ 46

[25] Stipulation and Agreement among parties to the 624 Docket at ¶ 10.

[26] 624 Order, ¶ 48 and Direct Testimony of Staff witness, Mr. Thomas DeBaun, pg 17.

transmission service rates to direct users of the Project. These direct users could include wind generators in the Kansas Resource Area and load serving entities in MISO and PJM with RPS obligations or a demand for low-cost renewable energy.

The Grain Belt Project actually has the potential to reduce costs to Kansas ratepayers. By reducing the strain on the existing alternating current ("AC") system, the Grain Belt Project can reduce the congestion and electric losses on transmission lines in the SPP system, which could benefit Kansas ratepayers. Lower congestion could reduce the risk that Kansas ratepayers are required to pay for additional transmission service upgrades necessary to remove congestion caused by an excess of wind projects and too little transmission. Such upgrades could be required by FERC's Order 890 and Order 1000, which requires regional transmission organizations like SPP to plan and cost allocate transmission lines to eliminate and reduce electric congestion.[27]

Q. Please summarize how and why the Grain Belt Project will promote the public convenience in Kansas.

A. Consistent with the Commission's previous findings, the Grain Belt Project promotes the public convenience for the following reasons:

- The Project will offer a unique transmission product not currently offered by any Kansas utility, and Grain Belt Express will not duplicate the service provided by ant other Kansas utility.
- The Project will enable the export of more than 4,000 MW of new wind power generation in western Kansas that could not otherwise be built due to the constraints of the existing transmission grid.
- The Project will promote economic development in Kansas through the construction of wind farms; the long-term operation of these wind farms;

[27] 624 Docket, Skelly direct testimony, pg 8.

additional royalties to landowners for the enabled wind farms; the construction of the transmission line; the growth of turbine and related manufacturing; and the additional state and local tax revenue generated by these activities.

- Based on detailed modeling and scenario analysis for 2019, the Grain Belt Project reduces annual carbon dioxide emissions by 7.2 million tons, annual NOx emissions by 4,963 tons, annual SO_2 emissions by 8,453 tons, and annual mercury emissions by 84 pounds. Additionally, the Grain Belt Project reduces losses due to water evaporation by an average of 3.1 billion gallons per year.

- Based on the same detailed modeling and scenario analysis, the Grain Belt Project promotes wholesale competition in the generation sector, resulting in estimated decrease in production cost of $521 million in 2019. Additionally, the Grain Belt Project promotes competition in the transmission sector by providing Kansas generators with an alternative to requesting service on the existing AC grid.

- Beyond benefits in the State of Kansas, the Project provides regional benefits in the form of cost-effective renewable energy, improved air quality, reduced water consumption and additional economic activity from construction and manufacturing.

- The Project has no negative effect and imposes no costs on Kansas ratepayers.

Based on my review, all of these benefits were included in the Commission's findings in Grain Belt Express' 624 Docket, and I do not believe any new evidence has called into question any of these benefits.

Q. **What about some of the public comments the Commission has received that claim the Project will not benefit Kansas because the line will not serve the areas it traverses?**

A. As I have explained in detail above, there are many benefits to Kansas even though the line does not actually deliver power to customers in Kansas. It is important to remember that the primary purpose of the Grain Belt Express is not to deliver power in Kansas, but rather, to allow Kansas to export its rich and vast wind resource.

Q. What about the public comment alleging that the power on the Project will not necessarily be wind energy?

A. The Project will be required to develop and file with FERC an open access transmission tariff ("OATT.) As an open access transmission provider, the Project cannot deny service based on how electricity is generated. That said, the Project is designed to transport wind energy. It begins in an outstanding wind resource area. Besides wind generation, no other type of generation resource has the same geographic advantage in western Kansas. So it is reasonable to expect that most or all of the Project's customers will be wind farms or their power purchasers.

III. UPDATES TO FINANCING PLAN

Q. Has the Project cost increased since the 624 Docket?

A. Yes. The Project cost has increased as a result of extending the Project's route to the Sullivan substation near the Illinois-Indiana border, adding about 200 miles to the Project's length. The eastern HVDC converter is similar in size and scope to the one originally contemplated to be installed in Missouri. However, the Project will now also have a midpoint converter in Missouri. Together, these changes have resulted in an increase in estimated Project cost of about $500 million. In the 624 Docket, Grain Belt Express estimated the Project cost to be $1.7 billion. We now estimate the Project cost to be $2.2 billion.

Q. How will Grain Belt Express recover the increased cost of the Project?

A. Grain Belt Express' business model is to sell transmission capacity to wind generators and purchasers of wind power. As a result of the increased Project cost, the Grain Belt

Express transmission tariff will increase. This increased charge will allow Grain Belt Express to recover the increased costs of the Project.

Q. Has Grain Belt Express made any changes to its corporate organization since the 624 Docket?

A. Grain Belt Express' basic ownership structure remains largely unchanged. Grain Belt Express is 100% owned by a holding company, Grain Belt Express Holding LLC, which in turn is owned 100% by Clean Line. ZAM Ventures LP, through a subsidiary, Clean Line Investor Corp, remains the majority shareholder in Clean Line. Michael Zilkha as well as certain Clean Line employees continues to be minority shareholders in Clean Line. The only major addition to Clean Line's shareholder group is National Grid USA.

Q. Please describe the investment by National Grid USA.

A. On November 6, 2012, National Grid USA, through its wholly owned subsidiary GridAmerica Holdings Inc., agreed to become an additional equity investor and to make a $40 million investment in Clean Line. This investment by National Grid USA will allow Clean Line to advance the development of its transmission lines, including the Grain Belt Project. Notice of the investment by National Grid USA was filed with the Commission on November 27, 2012.

Q. What is the business of National Grid USA and its affiliates?

A. National Grid USA is a wholly owned U.S. subsidiary of National Grid plc. National Grid plc is a major multinational holding company whose principal business is to own and operate networks for the transmission and distribution of electricity and natural gas. In the United Kingdom, a subsidiary of National Grid plc, National Grid Electricity Transmission plc, owns and operates the high voltage electric transmission system in

England and Wales, comprising approximately 4,500 miles of overhead transmission lines among other assets, and operates the high voltage electricity transmission system in Scotland. National Grid Electricity Transmission plc is also the operator and part owner of a 2,000 MW HVDC link to France and a 1,000 MW HVDC link to the Netherlands, and is developing an HVDC facility to link Scotland with England and Wales. Another subsidiary of National Grid plc, National Grid Gas plc, owns and operates the gas transportation system, comprising approximately 4,700 miles of high pressure pipe, and a majority of the gas distribution system, in Great Britain, serving over 11 million homes and businesses.

In the United States, National Grid USA, through its regulated subsidiaries, operates electric transmission and distribution facilities that deliver electricity to approximately 3.2 million customers in New York, Massachusetts, and Rhode Island and manages the electricity network on Long Island under an agreement with the Long Island Power Authority. Regulated subsidiaries of National Grid USA also operate natural gas distribution systems serving approximately 3.3 million customers in New York, Massachusetts and Rhode Island. National Grid USA's regulated operating subsidiaries include New England Power Company, Massachusetts Electric Company, Nantucket Electric, Narragansett Electric Company, Niagara Mohawk Power Corporation, KeySpan Gas East Corporation, Boston Gas Company, Colonial Gas Company, and The Brooklyn Union Gas Company.

Q. Please describe the financial strength of National Grid plc and National Grid USA.

A. For the year ended March 31, 2013, National Grid plc reported, under International Financial Reporting Standards ("IFRS"), consolidated revenues of £14,359 million and consolidated net income of £2,296 million. For the six months ended September 30, 2012, National Grid USA reported, under United States GAAP, consolidated revenues of $4,888 million and consolidated net income of $116 million. As of September 30, 2012, National Grid USA had total assets of $38,451 million and consolidated net worth of $14,358 million. As of the date hereof, National Grid USA's long term, unsecured debt is rated Baa1 by Moody's and A- by Standard & Poor's.

Q. Does National Grid USA have operations in the Midwest, including in the Resource Area for the Grain Belt Project or in PJM and MISO, where the Grain Belt Project will deliver power?

A. No. Like Clean Line's other investors, National Grid USA has no such operations.

Q. With National Grid USA as an equity investor, will ZAM Ventures continue to be the majority owner of Grain Belt Express?

A. Subject to certain conditions precedent, National Grid USA, through GridAmerica Holdings Inc., will hold approximately 40% of the voting units in Grain Belt Express. Assuming no other changes to Grain Belt Express' equity ownership, ZAM Ventures would still hold over 50% of the voting units in Clean Line.

Q. Do National Grid USA, and ZAM Ventures have an active role in the day-to-day management of Clean Line, Grain Belt Express, and Clean Line's other subsidiaries?

A. No. National Grid USA is entitled to name two members of Clean Line's five-member board of directors (equal to 40% voting control), as will ZAM Ventures. The fifth member of the board is Mr. Skelly, the President and CEO of Clean Line. In addition, Michael Zilkha will be an observer to the board of directors and National Grid USA will be entitled to name one observer to the board. Certain major actions will require super-majority (80%) approval by the Board.

Although National Grid USA, GridAmerica Holdings Inc., and ZAM Ventures are not involved in day-to-day management, they provide oversight, participate in the approval of major actions, monitor the activities of Clean Line Energy Partners and its subsidiaries, and provide advice.

Q. Are there benefits to Clean Line and Grain Belt Express from having National Grid USA as an additional investor in Clean Line?

A. Yes. First, National Grid USA's equity investment will provide additional equity capital that can be used in the development stages of our projects until permanent financings can be put in place. Second, National Grid USA and its subsidiaries are major participants in the electricity and natural gas transmission and distribution sectors in the U.S., and National Grid USA is a financially strong company with substantial assets and revenues. National Grid USA's participation as an equity investor in Clean Line provides additional credibility in the capital markets for Clean Line's projects, financing plans, and financial capabilities. Third, although, as I have stated, National Grid USA and Grid America Holdings Inc., will not be actively involved in the day-to-day operations of Clean Line and its subsidiaries, National Grid USA is experienced in constructing and operating electric transmission facilities, particularly HVDC facilities. Clean Line and its subsidiaries, including Grain Belt Express, can draw on this expertise when necessary in connection with the planning, construction and operation of their electric transmission projects.

At the same time, however, National Grid USA does not own electric generation or transmission facilities or serve customers in the areas in which Grain Belt Express will be operating or in the Resource Area. Therefore, there will be no conflicts between Grain Belt Express' goals and objectives and the needs of its customers and those of National Grid USA in the operation of the Grain Belt Project.

Q. Have there been other structural changes in the Company?

A. Yes. On February 6, 2012, Grain Belt Express changed its state of incorporation from Delaware to Indiana. We effected this change because of regulatory requirements imposed by the Indiana Utility Regulatory Commission, which took the view that to be an Indiana utility, Grain Belt Express must be incorporated in Indiana. We determined that the simplest way to comply was to convert Grain Belt Express from a Delaware limited liability company to an Indiana limited liability company. In May 2013, Grain Belt Express received a certificate to operate as a utility in the State of Indiana.

Q. Does the conversion to an Indiana corporation have any effect on the Grain Belt Project?

A. No, it should not have any effect. The ownership of Grain Belt Express was not affected by the conversion, and the required changes to the Clean Line Energy Partners LLC Agreement were minor. The conversion will not affect Grain Belt Express' development, construction, or financing plans for the Grain Belt Project.

Q. Has the Clean Line's financing plan changed from the plan you described in the 624 Docket?

A. No, our plan has not changed. As I described in the 624 Docket, Clean Line's current investors are providing capital to enable Clean Line to undertake the initial development and permitting work for its transmission line projects, including the Grain Belt Project. This capital will enable Clean Line and its subsidiaries to bring the Grain Belt Project, and the other transmission line projects being developed by other subsidiaries of Clean Line, to a point at which Clean Line and its subsidiaries can enter into project-specific financing arrangements with lenders and with equity investors and/or other partners. These arrangements will allow Grain Belt Express to construct the Grain Belt Project. Clean Line's equity investors could participate in the project financings by making debt or additional equity investments, along with new lenders, investors and/or partners.

Q. How has the addition of National Grid USA as an investor in Clean Line Energy Partners affected Grain Belt Express' financing plan?

A. As I mentioned above, the basic plan has not changed. However, in my opinion, the addition of National Grid USA adds credibility to the Grain Belt Project and will make it easier to execute our financing plan. National Grid USA and its affiliates are deeply experienced in constructing both HVDC projects and large, networked infrastructure projects. Moreover, the financial strength of National Grid USA and its parent company, National Grid plc, allow National Grid USA the option to make substantial additional investments in the future. I note that the Grain Belt Project, at an estimated cost of $2.2 billion, would represent less than six percent of the current consolidated assets of National Grid USA.

Q. Are you aware of public comments received by the Commission that are critical of the fact that the Grain Belt Express is a private corporation?

A. Yes, I know there are three or four such comments. Grain Belt Express is still a public utility that will be serving the public interest by meeting a public need. Whether the company is owned by individuals in a private business structure or by individual stockholders of a publicly traded entity, as is the case with many Kansas utilities, it does not alter this fact. The financing of a company is separate from its business purpose. I would also point out that the risk of the Project is being borne by the owners of Grain Belt Express, while many of the benefits of the Project are public in nature. In this way, the private ownership of the company is a positive for Kansans, who receive benefits from wind development without footing the bill for transmission.

Q. Does this conclude your prepared direct testimony?

A. Yes, it does.

VERIFICATION

STATE OF TEXAS)
)
COUNTY OF HARRIS)

The undersigned, David Berry, upon oath first duly sworn, states that he is the Executive Vice President - Strategy and Finance of Clean Line Energy Partners LLC, that he has reviewed the foregoing Testimony, that he is familiar with the contents thereof, and that the statements contained therein are true and correct to the best of his knowledge and belief.

David Berry
Executive Vice President – Strategy and Finance
Clean Line Energy Partners LLC

Subscribed and sworn to before me this 8th day of July, 2013.

Notary Public

My appointment expires: July 22, 2015

JUDY BLANKENSHIP
Notary Public, State of Texas
My Commission Expires
July 22, 2015

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July 28, 2011

Dr. Michael Schmidt
Kansas Corporation Commission
1500 SW Arrowhead Road
Topeka, Kansas 66604

Dr. Schmidt:

Attached please find Grain Belt Express Clean Line LLC's (Clean Line) responses to Staff data requests (DR) 1-22.

At the time Clean Line filed its Application on March 7, 2011, Grain Belt Express Clean Line anticipated that it would interconnect with the AC grid at the St. Francois substation in southeast Missouri. However, the preliminary analysis from MISO regarding interconnection at this location suggests extensive upgrades will be required to the MISO system. As a result, we are now considering delivering a smaller quantity of power in Missouri and then continuing our line to an interconnection with PJM . You will see the reference to this development in DR responses 12 and 17.

This variation does not impact our Application as it applies to Kansas, but we want to keep Staff apprised of any potential modifications as the project evolves. Please let us know if you need further information.

Sincerely,

Terri Pemberton

DAB-1a

Kansas Corporation Commission
Information Request

Request No: **51**

Company Name	Grain Belt Express Clean Line LLC
Docket Number	11-GBEE-624-COC
Request Date	August 6, 2011
Date Information Needed	August 15, 2011

RE: 11-GBEE-624-COC

Please Provide the Following:

a. Does Clean Line intend to have a 3rd Converter Station on the Grain Belt Express?
b. If so, will this addition Converter Station fall within Kansas?
c. What purpose does this 3rd Converter Station serve? Does it benefit the operation of the line? If so, how?
d. Specifically what is the technology within the Converter Station which bisects the line that allows for 3 points of interconnection?

Submitted By	Andy Fry
Submitted To	Michael Skelly
Prepared By	Wayne Galli

(a) A multi-terminal HVDC system is currently under consideration by Clean Line for the Grain Belt Express project.

(b) No, the plans currently under consideration include one converter in Kansas, one in Missouri, and one in the PJM footprint.

(c) The converter in Kansas will act primarily as a rectifier to pick up power generated in Kansas and move that power to points further east. The Missouri and PJM converters will act as inverters that will deliver the power to their respective markets. The addition of a third terminal is neither beneficial nor detrimental to the operation of the line from a physics perspective. It does, however, offer flexibility in terms of the deliverability of power.

DAB-1b

(d) At this point in time, Clean Line is considering a range of technology options for the converters. Ultimately the converters will either be based on thyristors or Insulated Gate BipolarTransistors. For the midpoint converter, the voltage source converter (VSC) technology seems promising.[1]

If for some reason, the above information cannot be provided by the date requested, please provide a written explanation of those reasons.

[1] An IGBT is the power electronic device that is used as the electronic switch inside a voltage source converter (VSC).

Verification of Response

I have read the foregoing Information Request and answer(s) thereto and find answer(s) to be true, accurate, full and complete and contain no material misrepresentations or omissions to the best of my knowledge and belief; and I will disclose to the Commission Staff any matter subsequently discovered which affects the accuracy or completeness of the answer(s) to this Information Request.

Signed: ______________________

Date: 8/11/2011

Economic Impact Study of the Proposed Grain Belt Express Clean Line Project

June 10, 2013

Photo by Jeff Cowell of Wichita, Kansas

Prepared For: Grain Belt Express Clean Line LLC

By

David G. Loomis, Ph.D.

J. Lon Carlson, Ph.D.

Strategic Economic Research, LLC

1323 Lismore Lane
Normal, IL 61761
309-242-4690

EXHIBIT
DAB-2

Table of Contents

Executive Summary

Grain Belt Express Clean Line LLC ("Clean Line") is proposing to build the Grain Belt Express Clean Line, an approximately 700-mile, high voltage direct current transmission line that will connect wind resources in Kansas with energy demand centers in Missouri, Illinois, Indiana and states farther east. The construction of the proposed transmission line is expected to stimulate the construction of approximately 4,000 MW of additional wind farms in Kansas. This report summarizes the estimated impacts[1] of both the transmission line and the additional wind generation capacity.

We estimate that the construction of the Grain Belt Express Clean Line itself will – when we include the manufacturing of inputs to the line such as structures, wire, and real estate services – result in the creation of approximately 2,340 jobs per year for three years in Kansas, approximately 1,315 jobs per year for three years in Missouri, approximately 1,450 jobs per year for three years in Illinois, and approximately 38 jobs per year for three years in Indiana. In addition, the Grain Belt Express Clean Line will result in the creation of an estimated 296 permanent jobs stemming from operations and maintenance of the line, including 135 jobs in Kansas, 70 jobs in Missouri, 88 jobs in Illinois, and 3 jobs in Indiana. Fiscal impacts would also be substantial. During the three-year construction phase, individual income tax receipts, corporate income tax receipts, and sale tax receipts could average a combined total of $6.76 million per year in Kansas, $3.74 million per year in Missouri, $3.93 million per year in Illinois, and $74 thousand per year in Indiana.

Regarding the new wind farms that would serve the line, we estimate that the Grain Belt Express Clean Line could support as many as 33,618 manufacturing supply chain jobs in Kansas, Missouri, Illinois and Indiana ("the four-state region") during the construction phase and would result in the creation of approximately 528 permanent operations and maintenance jobs at those associated wind farms in Kansas. At the national level, economic impacts resulting from the construction of 4,000 MW of new wind generation capacity would include approximately 71,075 jobs during the construction phase and 3,360 jobs annually during the operating years.

Economic Impacts of Construction of the Grain Belt Express Clean Line

Construction

As seen in Table ES-1, when assuming 50 percent of manufacturing (structures and wire) and 100 percent of construction-related activities for the transmission line are completed by in-state firms in the four-state region, the potential total employment impact over the projected period would amount to approximately 5,143 jobs per year for three years. Projected income impacts are substantial as well; the total labor income impact over the projected period would amount to approximately $311.5 million per year for three years.

Table ES-1: Estimated Annual[1] Impacts of Construction of the Grain Belt Express Clean Line in 4-State Region

	Kansas	Missouri	Illinois	Indiana
Change in Final Demand[2]	$220.4	$118.1	$140.1	$3.3
Employment[3]	2,340	1,315	1,450	38
Labor Income	$131.5	$77.0	$100.8	$2.2
Output	$371.0	$206.0	$251.1	$5.7

1. Construction period = 3 years.
2. All spending and $ impacts are in millions of 2013 $ and are rounded.
3. All employment figures are full time equivalents.

[1] The impacts of construction and operation of the transmission line, including fiscal impacts—personal and corporate tax revenues—for Kansas, Missouri, Illinois, and Indiana presented here were estimated using the IMPLAN model. The labor, turbine, and supply chain impacts of construction and operation of the new wind farms that could result from construction of the proposed transmission line were estimated using the JEDI model.

Operation and Maintenance (O&M)

Clean Line estimates that annual operation and maintenance (O&M) costs, which will be incurred when the line is up and running, will amount to approximately one percent of total construction costs. In Kansas, this will result in $10.0 million in O&M expenditures each year. The corresponding amounts for Missouri, Illinois, and Indiana are $5.0 million, $7.0 million, and $0.2 million, respectively. As shown in Table ES-2, the total impacts of annual O&M expenditures in the four-state region are substantial. The potential total employment impact over the projected period would amount to approximately 296 jobs per year. The total labor income impact over the projected period would amount to approximately $18 million per year

Table ES-2: Estimated Annual O&M-Related Impacts of the Grain Belt Express Clean Line in 4-State Region

	Kansas	Missouri	Illinois	Indiana
Employment[1]	135	70	88	3
Labor Income[2]	$7.6	$4.1	$6.1	$0.19
Output	$17.7	$9.2	$13.1	$0.43

1. All employment figures are full time equivalents.
2. All monetary impacts are in millions of 2013 $ and are rounded.

Fiscal Impacts of the Grain Belt Express Clean Line

The IMPLAN model was used to estimate certain tax-related impacts of the projected increases in final demand in Kansas, Missouri, Illinois and Indiana. The tax impacts considered here include individual income tax, corporate income tax, and sales tax receipts. Referring to Table ES-3, it is estimated that in Kansas individual income tax receipts, corporate income tax receipts, and sale tax receipts could average a combined total of $6.76 million per year over the three-year construction period. In Missouri, Illinois, and Indiana the corresponding amounts are $3.74 million, $3.93 million, and $74 thousand per year over the three-year construction period.

Table ES-3: Estimated Fiscal Impacts of Construction of Grain Belt Express Clean Line in 4-State Region

	Kansas	Missouri	Illinois	Indiana
Individual Income Tax[1]	$8.47	$4.19	$4.18	$0.143
Corporate Income Tax	$1.17	$0.28	$1.12	$0.015
Sales Tax	$10.64	$6.75	$6.48	$0.063
Total	$20.28	$11.22	$11.78	$0.221
Annual Average[2]	$6.76	$3.74	$3.93	$0.074

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. Construction period = 3 years.

As was previously noted, once the transmission line is built and is in operation, O&M costs will contribute additional spending to the Kansas, Missouri, Illinois, and Indiana economies each year. Referring to Table ES-4, in Kansas individual income tax receipts, corporate income tax receipts, and sale tax receipts resulting from O&M expenditures are predicted to amount to approximately $379 thousand per year. In Missouri, Illinois, and Indiana the same revenue sources are predicted to yield approximately $189 thousand, $247 thousand, and $9 thousand per year, respectively.

Table ES-4: Summary of Estimated Annual Fiscal Impacts of O&M Expenditures

	Kansas	Missouri	Illinois	Indiana
Individual Income Tax[1]	$0.162	$0.074	$0.084	$0.004
Corporate Income Tax	$0.016	$0.004	$0.017	$0.000
Sales Tax	$0.201	$0.111	$0.146	$0.005
Total	$0.379	$0.189	$0.247	$0.009

1. All monetary impacts are in millions of 2013 $ and are rounded.

Economic Impacts of Additional Wind Generation Capacity

The construction of the Grain Belt Express Clean Line is expected to stimulate the development of approximately 4,000 MW of wind farms in Kansas. In order to model the economic impacts, it is assumed that the transmission line will connect eight new 500 MW wind farms to the transmission grid. All eight of the new wind farms will be located in Kansas. The JEDI model, which was used to estimate the economic impacts of the wind farms, contains default values for how these construction and operations and maintenance costs are allocated to the component parts. These default values, however, were not used to estimate the local content of the manufacture of the larger components of a wind turbine – the nacelle, tower, blades, and transportation. Instead, we based the allocation on the American Wind Energy

Association's *Wind Power Outlook 2012* conclusion that the domestic content of wind farms built in the United States rose to 67 percent in 2011. Using 67 percent domestic content as a guideline, we estimated that 55 percent of the nacelles, 90 percent of the blades, and 90 percent of the structures used to construct wind farms would be manufactured in the United States.[2]

The assumed increase in wind development will yield economic benefits throughout the four-state region as a result of both direct expenditures on the construction of the wind farms and supply chain impacts resulting from the increased demand for the required inputs. To estimate the state-level economic impacts of the new wind generation capacity it was necessary to estimate the percentage of the wind turbine components that would be produced in each state. We constructed two different scenarios in which the four-state region provides either 30 percent or 90 percent of the domestic content. In each scenario, Kansas is assumed to provide half of the major wind turbine parts if the state is home to a current manufacturer of that component. The exact percentages by state and by component are reported in Table 4.5 on page 32.

Kansas

The total economic impact of the wind farms for the state of Kansas consists of two parts – (1) the economic impacts of the direct expenditures made in the state to build the 4,000 MW of wind farms located there, and (2) the supply chain impacts of the total 4,000 MW of wind farms that will be built in Kansas. Table ES-5 shows the total economic impact during the construction period in Kansas under the 30 percent and 90 percent scenarios. The total employment impacts during construction range from 15,542 to 19,656 jobs, and earnings range between $778.8 million and $1.026 billion. It is estimated that when the wind farms built in Kansas are up and running, they will generate 528 jobs and $25 million in earnings annually.

Table ES-5: Economic Impacts of Wind Farm Construction and Operation in Kansas

	Employment[1]	Earnings[2]	Output
Construction: 30% Scenario	15,542	$778.8	$2,283.5
Construction: 90% Scenario	19,656	$1,026.1	$3,267.7
Annual Operations: All Scenarios	528	$25.0	$73.3

1. All employment figures are full time equivalents.
2. All monetary impacts are in millions of 2013 $ and are rounded.

Missouri

The total economic impacts in Missouri of the wind farms constructed in Kansas include supply chain impacts and associated indirect effects. Table ES-6 shows the total economic impact during the construction period in Missouri under the 30 percent and 90 percent scenarios. The total employment impacts during construction range from 1,311 to 3,933 jobs, and earnings range between $79.8 million and $239.5 million under the 30 percent and 90 percent scenarios, respectively.

Table ES-6: Economic Impacts of Wind Farm Construction in Missouri

	Employment[1]	Earnings[2]	Output
30% Scenario	1,311	$79.8	$329.0
90% Scenario	3,933	$239.5	$986.9

1. All employment figures are full time equivalents.
2. All monetary impacts are in millions of 2013 $ and are rounded.

Illinois

The total economic impacts in Illinois of the wind farms constructed in Kansas include supply chain impacts and associated indirect effects. Table ES-7 shows the total economic impact during the construction period in Illinois under the 30 percent and 90 percent scenarios. The total

Table ES-7: Economic Impacts of Wind Farm Construction in Illinois

	Employment[1]	Earnings[2]	Output
30% Scenario	1,471	$104.0	$381.1
90% Scenario	4,412	$311.9	$1,143.4

1. All employment figures are full time equivalents.
2. All monetary impacts are in millions of 2013 $ and are rounded.

[2] See p.30 for a more detailed discussion of the estimation process that was used.

employment impacts during construction range from 1,471 to 4,412 jobs, and earnings range between $104.0 million and $311.9 million under the 30 percent and 90 percent scenarios, respectively.

Indiana

The total economic impacts in Indiana of the wind farms constructed in Kansas include supply chain impacts and associated indirect effects. Table ES-8 shows the total economic impact during the construction period in Indiana under the 30 percent and 90 percent scenarios. The total employment impacts during construction range from 1,872 to 5,617 jobs, and earnings range between $113.5 million and $340.6 million under the 30 percent and 90 percent scenarios, respectively.

Table ES-8: Economic Impacts of Wind Farm Construction in Indiana

	Employment[1]	Earnings[2]	Output
30% Scenario	1,872	$113.5	$472.5
90% Scenario	5,617	$340.6	$1,417.5

1. All employment figures are full time equivalents.
2. All monetary impacts are in millions of 2013 $ and are rounded.

United States

The total economic impact of the wind farms for the United States consist of two parts – (1) the economic benefit of the direct expenditures made in Kansas to build the 4,000 MW of wind farms, and (2) the supply chain impacts. Table ES-9 shows the total economic impact during the construction period in the United States assuming 55 percent of the nacelles, 90 percent of the blades, and 90 percent of the structures used to construct wind farms are manufactured in the United States. The total employment impacts during construction amount to 71,105 jobs; earnings increase by $4.4 billion. It is estimated that when the wind farms built are up and running, they will generate 3,360 U.S. jobs and $191 million in earnings annually.

Table ES-9: Economic Impacts of Wind Farm Construction and Operation in the United States

	Employment[1]	Earnings[2]	Output
Total Construction Impact	71,075	$4,421.7	$15,160.5
Total Annual Operating Impacts: All Scenarios	3,360	$190.7	$981.4

1. All employment figures are full time equivalents.
2. All monetary impacts are in millions of 2013 $ and are rounded.

1 Background

Grain Belt Express Clean Line LLC ("Clean Line") is proposing to build the Grain Belt Express Clean Line, an approximately 700-mile, high voltage direct current transmission line that will connect approximately 4,000 MW of wind generation in Kansas with energy demand centers in Missouri, Illinois, Indiana and states east. This report summarizes the estimated economic impacts of the Grain Belt Express Clean Line, including both the impacts of construction and operation of the transmission line and manufacturing of inputs to the line – e.g., structures, wire, real estate services – and the impacts of construction and operation of the wind farms this transmission line would enable.

Transmission Line Impacts

The impacts of construction and operation of the transmission line were modeled using the IMPLAN model.[3] The specific impacts analyzed include direct, indirect, and induced effects on employment, income, and output, as well as fiscal impacts – personal and corporate tax revenues and sales tax receipts – for Kansas, Missouri, Illinois, and Indiana. All impacts are reported at the state level for Kansas, Missouri, Illinois, and Indiana. In addition, national estimates of the employment, income, and output impacts of increased spending in the four-state region are reported. All estimated impacts are based on cost of construction and cost of operation and maintenance estimates provided by Clean Line.

Wind Farm Impacts

The construction of the proposed transmission line is also expected to stimulate the construction of additional wind farms in Kansas. The impacts of construction and operation of these new wind farms were estimated using the JEDI model[4], and include direct, indirect, and induced effects for both Kansas and Illinois. All impacts are reported at the state level for Kansas, Missouri, Illinois, and Indiana. All estimated impacts are based on estimates of the number of new wind farms, location (state) of each wind farm, number of turbines, and size of turbines (MW) provided by Clean Line Energy Partners. Wind farm cost estimates for the construction costs and operation and maintenance costs were based on the JEDI model estimates. The local share of turbines, component parts, materials and personnel were based on JEDI model estimates and information provided by Clean Line.

1.1 Limitations of the Study

It is also important to note what the analysis of the impacts of construction and operation of the transmission line and new wind farms does not include, specifically,

- The *net effects* of the proposed project, i.e., the potential impacts on existing power generation facilities resulting from the development of the wind farms associated with the Grain Belt Express Clean Line;
- The economic costs of any pass-through rates or taxes that electric customers could be required to pay by utility companies purchasing energy from the Grain Belt Express Clean Line or the proposed wind farms;
- Any environmental impacts, costs, or benefits;
- The potential impacts on electric prices and generation costs or fuel prices;
- The potential impacts of regulations associated with renewable energy, and

[3] IMPLAN is a PC-based program that allows construction of regional input-output models for areas as small as a county. The model allows aggregation of individual county databases for multicounty analysis. IMPLAN was originally developed for the US Department of Agriculture and is maintained and supported by the Minnesota IMPLAN Group, Inc. Stillwater, Minnesota. IMPLAN is a widely recognized and respected tool for economic impact analysis.

[4] The JEDI model was developed by Marshall Goldberg, Ph.D. for the National Renewable Energy Laboratory and calculates the number of jobs and the amount of money spent on salaries and economic activities generated in a specific location from the construction and operation of a wind power plant. Because the JEDI model is based upon the IMPLAN model multipliers, the two methods of analysis are compatible. The JEDI model is used by most modelers of wind farm economic impacts.

- The *net effects* of increased demand for the components of the transmission line, construction of the line, operation and maintenance expenditures, and the construction and operations of new wind farms on employment, income, and output in the affected regions.

2 Methodology

The impacts of construction and operation of the transmission line were estimated using the IMPLAN model. The specific impacts analyzed include direct, indirect, and induced effects on employment, labor income, and output, as well as fiscal impacts – personal and corporate tax revenues and sales tax receipts – for Kansas, Missouri, Illinois, and Indiana. The construction of the proposed transmission line is also expected to stimulate the construction of additional wind farms in Kansas. The impacts of construction and operation of these new wind farms were estimated using the JEDI model, and include direct, indirect, and induced effects for the four-state region.

2.1 IMPLAN

The economic impacts of the manufacture of the required components, construction of the line, and operation and maintenance expenses were estimated using the IMPLAN model and 2011 data for Kansas, Missouri, Illinois, and Indiana. Stated briefly, the model is used to estimate the total impacts of an increase in spending in a particular industry. IMPLAN is a micro-computer-based program that allows construction of regional input-output models for areas ranging in size from a single zip code region to the entire United States. The model allows aggregation of individual regional, e.g., county, databases for multi-region analysis.

Total impacts are calculated as the sum of direct, indirect, and induced effects. *Direct effects* are production changes associated with the immediate effects of final demand changes, such as an increase in spending for the manufacture of new structures that will be used to support a new transmission line. *Indirect effects* are production changes in backward-linked industries caused by the changing input needs of the directly affected industry, e.g., additional purchases to produce additional output such as the steel used in the construction of the new transmission structures. *Induced effects* are the changes in regional household spending patterns caused by changes in household income generated from the direct and indirect effects. An example of the latter is the increased spending of the incomes earned by newly hired steel workers.

The analysis summarized here focuses on the impacts of increased manufacturing of the different components of the transmission line, as well as construction of the line, on employment, employee compensation, and total expenditures (output). Employment includes total wage and salary employees as well as self-employed jobs in the region of interest. All of the employment figures reported here are full-time equivalents[5] (FTE). Employee compensation represents income, including benefits, paid to workers by employers, as well as income earned by sole proprietors. Total output represents sales (including additions to inventory), i.e., it is a measure of the value of output produced. Impacts are estimated on a state-wide basis for Kansas, Missouri, Illinois, and Indiana, as well as for the United States as a whole.

2.2 JEDI

The economic analysis of wind power development presented here utilizes the National Renewable Energy Laboratory's (NREL's) latest (release number W1.10.03) Jobs and Economic Development Impacts (JEDI) Wind Energy Model. The JEDI Wind Energy Model is an input-output model that measures the spending patterns and location-specific economic structures that reflect expenditures supporting varying levels of employment, income, and output. For example, JEDI reveals how purchases

[5] IMPLAN jobs include all full-time, part time, and temporary positions. When employment is counted as full and part-time, one cannot tell from the data the number of hours worked or the proportion that is full or part-time. A full-time-employed (FTE) worker is assumed to work 2,080 hours (= 52 weeks x 40 hours/week) in a standard year. Employment impacts have been rescaled to reflect the change in the number of FTEs.

of wind project materials not only benefit local turbine manufacturers but also the local industries that supply the concrete, rebar, and other materials. The JEDI model uses construction cost data, operating cost data, and data relating to the percentage of goods and services acquired in the state to calculate jobs, earnings, and economic activities that are associated with this information. The results are broken down into the construction period and the operation period of the wind project. Within each period, impacts are further divided into direct, indirect, and induced impacts.

Direct impacts during the construction period refer to the changes that occur in the onsite construction industries in which the direct final demand (i.e., spending on construction labor and services) change is made. The initial spending on the construction and operation of the wind farm creates a second layer of "indirect" impacts. *Indirect impacts* during the construction period consist of the changes in inter-industry purchases resulting from the direct final demand changes, and include construction spending on materials and wind farm equipment and other purchases of goods and offsite services. Concrete that is used in turbine foundations increases the demand for gravel, sand, and cement. Turbine parts/component manufacturers such as bearing producers, steel producers, and gear producers are also in this same category. Indirect impacts during operating years refer to the changes in inter-industry purchases resulting from the direct final demand changes. All land lease payments and property taxes show up in the operating-years portion of the results because these payments do not support the day-to-day operations and maintenance of the wind farm but instead are more of a latent effect that results from the wind farm being present. *Induced impacts* during construction refer to the changes that occur in household spending as household income increases or decreases as a result of the direct and indirect effects of final demand changes. Induced impacts during operating years refer to the changes that occur in household spending as household income increases or decreases as a result of the direct and indirect effects from final demand changes.

3 Economic Impacts of the Grain Belt Express Clean Line

3.1 Relevant Economic Sectors

In this section we describe the sectors in which direct spending will increase as a result of construction of the proposed transmission line. These sectors include those engaged in the manufacture of structures and wire, those engaged in the actual construction of the transmission line and the installation of converters, the real estate sector, and financial and architectural services.

Clean Line estimates that purchasing the necessary inputs (e.g., structures, wire, and converters) and construction of the proposed transmission line will cost approximately $2.2 billion. Expenditures are expected to be spread roughly evenly over a three-year period. Table 3.1 summarizes the estimated costs of each of the major components of the line – structures, wire, and converters – as well as the costs of constructing the line, including the cost of acquiring the right-of-way for the line's location and expenditures on financial and architectural services and electric power. While construction of the line constitutes the single largest component of the total cost (32.5 percent), the costs of manufacturing the structures and wire and installation of the converters are significant as well.

Table 3.1: Distribution of Transmission Line Construction Expenditures by IMPLAN Sector

Component	IMPLAN Sector #	IMPLAN Sector Title	Direct Spending[1]	Percent of Total Expenditures
Installation of Structures	36	Construction of other new nonresidential structures	$723.1	32.5%
Manufacture of Structures	186	Plate work and fabricated structural product manufacturing	$381.2	17.1%
Manufacture of Wire	272	Communication and energy wire and cable manufacturing	$211.0	9.5%
Architectural Services	369	Architectural, engineering, and related services	$74.5	3.3%
Right of Way	360	Real estate	$75.2	3.4%
Financial	359	Funds, trusts, and other financial vehicles	$24.6	1.1%
Electric Power	31	Electric power generation, transmission, and distribution	$14.4	0.6%
Manufacture of Transformer	244	Electronic capacitor, resistor, coil, transformer, and other inductor manufacturing	$13.4	0.6%
Installation of Converter/Transformer	36	Construction of other nonresidential structures	$237.6	10.7%
Converters[2]			$469.0	21.1%
Total			$2,224.0	100%

1. All spending is in millions of 2013 $ and rounded.
2. Because the converters are produced overseas, IMPLAN sector information is not relevant, i.e., there are no domestic impacts from construction of the converters.

As indicated in the notes accompanying Table 3.1, the project's converters will be produced overseas. It is therefore not appropriate to include the actual purchase price of the converters in the estimate of economic impacts that are reported here. The installation of converters in Kansas, Missouri, and Illinois, as well as a transformer in Indiana, however, does constitute increased spending in each of the four states and is therefore appropriately included when estimating the impacts of spending on the proposed line.[6]

[6] The economic impact study assumes all structures and conductor are manufactured domestically. The United States does have substantial capacity to manufacture structures and conductor. However, increasing investment in electric transmission in the United States raises the possibility that some companies may not have the ability to fulfill demand for some equipment, especially structures. The study does not address this scenario, as Clean Line will first seek to purchase from domestic manufacturers where possible.

Table 3.2 includes information from Table 3.1 and summarizes the allocation of the input and construction costs among the four states. The allocation of construction costs among the four-state region and the inputs to the transmission line reflects several important assumptions. First, it is assumed that costs will vary across states based on the percentage of total line length located in each state. Second, it is assumed that 50 percent of the costs of manufacturing the structures and wire required for the portion of line constructed in each state will be incurred in-state, while the remaining 50 percent of those costs will be incurred elsewhere in the United States (and outside of the four-state region). The 50 percent limitation reflects the fact that productive capacity in each of the affected sectors is much more constrained at the state level than it is at the national level. It is intended to avoid overstating the potential employment, income, and output impacts attributable to manufacturing-related activities in each of the four states where the proposed line would be built. Third, it is assumed that the cost of manufacturing the transformer that will be installed in Indiana will be incurred outside of the four-state region.

Table 3.2: Grain Belt Express Clean Line Inputs for IMPLAN

			Construction Budget				
Component	IMPLAN Sector	Direct Spending[1]	Kansas	Missouri	Illinois	Indiana	United States
Construction							
Installation of Structures	36	$723.1	$336.6	$192.3	$192.3	$1.9	$723.1
Manufacture of Structures[2]	186	$381.2	$88.7	$50.7	$50.7	$0.5	$381.2
Manufacture of Wire[2]	272	$211.0	$49.1	$28.1	$28.1	$0.3	$211.0
Architectural Services	369	$74.5	$34.7	$19.8	$19.8	$0.2	$74.5
Right of Way	360	$75.2	$35.0	$20.0	$20.0	$0.2	$75.2
Financial	359	$24.6	$11.4	$6.5	$6.5	$0.1	$24.6
Electric Power	31	$14.4	$6.7	$3.8	$3.8	$0.0	$14.4
Manufacture of Transformer	244	$13.4	$0.0	$0.0	$0.0	$0.0	$13.4
Installation of Converters/ Transformers	36	$237.6	$99.0	$33.0	$99.0	$6.6	$237.6
Subtotal		$1,755.0	$661.2	$354.2	$420.2	$9.8	$1,755.0
Converters		$469.0	$201.0	$67.0	$201.0	$13.4	$0.0
Total Cost of Construction		$2,224.0	$862.2	$421.2	$621.2	$23.2	$1,755.0
Average Annual O&M	39	$22.2	$10.0	$5.0	$7.0	$0.2	$22.2

1. All spending is in millions of 2013 $ and rounded.
2. Assumes 50 percent in-state share of manufacturing.

According to Clean Line's estimates, excluding the cost of the converters (which will be purchased overseas), the total costs of building the proposed line, $1,755 million, are distributed among the four states and the remainder of the United States as follows: approximately $661.2 million (37.7 percent) in Kansas, $354.2 million (20.2 percent) in Missouri, $420.2 million (23.9 percent) in Illinois, and $9.8 million (0.6 percent) in Indiana. The remaining $309.6 million (17.6 percent) of spending, which consists of 50 percent of the spending on the manufacture of the structures and wire and 100 percent of the costs of a transformer, will be incurred outside the four-state region. It is assumed that annual Operation and Maintenance (O&M) expenses (incurred when the line is up and running) will amount to approximately 1 percent of the total costs of construction, including in-state manufacturing and construction costs, manufacturing costs incurred outside the four-state region, and the cost of the converter or transformer installed in each state. Estimated annual O&M costs incurred in each state are shown in the last row of Table 3.2.

3.2 Manufacturing and Construction Impacts at the State Level

To estimate the economic impacts of construction of the transmission line, changes in final demand (i.e., the projected increase in total spending attributable to the manufacture and construction of the proposed transmission line) in each of the relevant sectors were analyzed using the IMPLAN model. Impacts were then aggregated across the different components and types of impacts. Impacts were estimated separately for each the segments of the line that will be located in Kansas, Missouri, Illinois, and Indiana. In addition, impacts were estimated at both the state and national levels. In the former, indirect and induced impacts are limited by spending associated with the construction of the line that occurs in other states. Estimating the impacts at the national level captures the majority of this "out-of-state" spending, resulting in larger indirect and induced impacts than those associated with in-state spending.

3.2.1 Kansas

Table 3.3 summarizes the direct, indirect, induced, and total impacts of increases in final demand for the components –wire, structures – of the new transmission line, installation of the converters, construction of the line, and architectural, financial, energy, and right-of-way requirements associated with the segment of the line constructed in Kansas.

Table 3.3: Estimated State-Level Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Kansas

Component	Change in Final Demand[1]	Impact	Direct	Indirect	Induced	Total	Annual Average[4]
Installation of Structures	$336.6	*Employment*[2]	2,657	536	956	4,149	1,383
		Labor Income[3]	$159.8	$32.7	$42.6	$235.1	$78.4
		Output	$336.6	$117.6	$140.4	$594.6	$198.2
Manufacture Structures	$88.7	*Employment*	299	144	149	592	197
		Labor Income	$21.9	$7.9	$6.6	$36.5	$12.2
		Output	$88.7	$23.4	$21.9	$134.0	$44.7
Manufacture Wire	$49.1	*Employment*	78	49	51	178	59
		Labor Income	$6.8	$3.2	$2.3	$12.2	$4.1
		Output	$49.1	$11.0	$7.5	$67.5	$22.5
Architectural Services	$34.7	*Employment*	248	71	119	438	146
		Labor Income	$20.3	$3.6	$5.3	$29.2	$9.7
		Output	$34.7	$9.5	$17.4	$61.6	$20.5
Right of Way	$35.0	*Employment*	232	54	28	313	104
		Labor Income	$3.1	$2.4	$1.2	$6.8	$2.3
		Output	$35.0	$8.6	$4.1	$47.7	$15.9
Financial	$11.4	*Employment*	38	54	16	108	36
		Labor Income	$0.7	$2.3	$0.7	$3.7	$1.2
		Output	$11.4	$9.0	$2.3	$22.8	$7.6
Electric Power	$6.7	*Employment*	6	9	7	23	8
		Labor Income	$1.0	$0.5	$0.3	$1.8	$0.6
		Output	$6.7	$2.1	$1.1	$9.9	$3.3
Installation of Converters/ Transformers	$99.0	*Employment*	782	158	281	1,221	407
		Labor Income	$47.0	$9.6	$12.5	$69.2	$23.1
		Output	$99.0	$34.6	$41.3	$174.9	$58.3
Totals	$661.2	*Employment*	4,340	1,075	1,607	7,021	2,340
		Labor Income	$260.7	$62.2	$71.5	$394.4	$131.5
		Output	$661.2	$215.9	$235.9	$1,113.0	$371.0

1. All spending and $ impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.
4. Assumes a three-year construction period.

Referring to Table 3.3, assuming 50 percent of all manufacturing-related activities (structures and wire) and 100 percent of all construction-related activities directly tied to the transmission line are completed by in-state firms, manufacturing of structures and wire; construction of the transmission line; installation of a converter; the payment of fees for the required right-of-way, architectural, and financial services; and the purchase of electric power would generate substantial economic impacts in Kansas. In total, it is estimated that approximately 2,340 jobs would be created in each year of the three-year period during which the line is being constructed. More than 61 percent (886) of the total *direct* jobs (1,447) created in each of the three years would result from the construction of the proposed line. Labor income impacts would also be substantial with $86.9 million per year in direct impacts. Factoring in indirect and induced income impacts increases the annual average labor income impact to $131.5.

3.2.2 Missouri

Table 3.4 summarizes the direct, indirect, induced, and total impacts of increases in final demand for the components –wire, structures – of the new transmission line, installation of the converters, construction of the line, and architectural, financial, energy, and right-of-way requirements associated with the segment of the line constructed in Missouri.

Table 3.4: Estimated State-Level Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Missouri

Component	Change in Final Demand[1]	Impact	Direct	Indirect	Induced	Total	Annual Average[4]
Installation of Structures	$192.3	*Employment*[2]	1,490	355	657	2,502	834
		Labor Income[3]	$93.0	$23.2	$31.5	$147.7	$49.2
		Output	$192.3	$60.6	$96.4	$349.4	$116.5
Manufacture Structures	$50.7	*Employment*	171	102	106	379	126
		Labor Income	$12.5	$6.2	$5.1	$23.8	$7.9
		Output	$50.7	$16.9	$15.6	$83.2	$27.7
Manufacture Wire	$28.1	*Employment*	46	33	33	112	37
		Labor Income	$3.4	$2.3	$1.6	$7.3	$2.4
		Output	$28.1	$6.9	$4.9	$39.9	$13.3
Architectural Services	$19.8	*Employment*	138	47	82	267	89
		Labor Income	$11.8	$2.6	$3.9	$18.4	$6.1
		Output	$19.8	$6.4	$12.0	$38.2	$12.7
Right of Way	$20.0	*Employment*	126	36	20	182	61
		Labor Income	$1.8	$1.8	$1.0	$4.6	$1.5
		Output	$20.0	$5.6	$3.0	$28.6	$9.5
Financial	$6.5	*Employment*	19	28	13	60	20
		Labor Income	$0.6	$1.5	$0.6	$2.7	$0.9
		Output	$6.5	$5.0	$1.9	$13.4	$4.5
Electric Power	$3.8	*Employment*	4	6	5	15	5
		Labor Income	$0.6	$0.3	$0.2	$1.1	$0.4
		Output	$3.8	$1.0	$0.7	$5.6	$1.9
Installation of Converters/ Transformers	$33.0	*Employment*	256	61	113	429	143
		Labor Income	$16.0	$4.0	$5.4	$25.3	$8.4
		Output	$33.0	$10.4	$16.5	$59.9	$20.0
Totals	$354.2	*Employment*	2,250	667	1,030	3,946	1,315
		Labor Income	$139.7	$41.9	$49.4	$231.0	$77.0
		Output	$354.2	$112.8	$151.1	$618.1	$206.0

1. All spending and $ impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.
4. Assumes a three-year construction period.

Referring to Table 3.4, assuming 50 percent of all manufacturing-related activities (structures and wire) and 100 percent of all construction-related activities and directly tied to the transmission line are completed by in-state firms, manufacturing of structures and wire; construction of the transmission line; installation of a converter; the payment of fees for the required right-of-way, architectural, and financial services; and the purchase of electric power would generate substantial economic impacts in Missouri. In total, it is estimated that approximately 1,315 jobs would be created in each year of the three-year period during which the line is being constructed. More than 66 percent (497) of the total direct jobs (750) created in each of the three years would result from the construction of the proposed line. Labor income impacts would also be substantial with $46.6 million per year in direct impacts. Factoring in indirect and induced income impacts increases the annual average labor income impact to $77 million.

3.2.3 Illinois

Table 3.5 summarizes the direct, indirect, induced, and total impacts of increases in final demand for the components –wire, structures – of the new transmission line, installation of the converters, construction of the line, and architectural, financial, energy, and right-of-way requirements associated with the segment of the line constructed in Illinois.

Table 3.5: Estimated State-Level Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Illinois

Component	Change in Final Demand[1]	Impact	Direct	Indirect	Induced	Total	Annual Average[4]
Installation of Structures	$192.3	*Employment*[2]	1,355	299	619	2,273	758
		Labor Income[3]	$101.0	$22.6	$34.0	$157.7	$52.6
		Output	$192.3	$65.4	$101.2	$358.9	$119.6
Manufacture Structures	$50.7	*Employment*	161	88	103	352	117
		Labor Income	$14.2	$6.3	$5.7	$26.1	$8.7
		Output	$50.7	$16.7	$16.9	$84.3	$28.1
Manufacture Wire	$28.1	*Employment*	41	28	39	107	36
		Labor Income	$5.3	$2.3	$2.2	$9.8	$3.3
		Output	$28.1	$6.8	$6.4	$41.3	$13.8
Architectural Services	$19.8	*Employment*	135	42	74	252	84
		Labor Income	$12.0	$2.9	$4.1	$18.9	$6.3
		Output	$19.8	$6.6	$12.2	$38.6	$12.9
Right of Way	$20.0	*Employment*	93	22	17	132	44
		Labor Income	$2.0	$1.3	$0.9	$4.3	$1.4
		Output	$20.0	$4.0	$2.8	$26.8	$8.9
Financial	$6.5	*Employment*	18	22	13	52	17
		Labor Income	$0.8	$1.7	$0.7	$3.1	$1.0
		Output	$6.5	$4.4	$2.1	$13.0	$4.3
Electric Power	$3.8	*Employment*	3	4	5	12	4
		Labor Income	$0.6	$0.3	$0.3	$1.2	$0.4
		Output	$3.8	$1.0	$0.8	$5.6	$1.9
Installation of Converters/ Transformers	$99.0	*Employment*	697	154	319	1,170	390
		Labor Income	$52.0	$11.7	$17.5	$81.2	$27.1
		Output	$99.0	$33.7	$52.1	$184.8	$61.6
Totals	$420.2	*Employment*	2,502	659	1,189	4,350	1,450
		Labor Income	$188.0	$49.1	$65.3	$302.3	$100.8
		Output	$420.2	$138.7	$194.3	$753.3	$251.1

1. All spending and $ impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.
4. Assumes a three-year construction period.

Referring to Table 3.5, assuming 50 percent of all manufacturing-related activities (structures and wire) and 100 percent of all construction-related activities and directly tied to the transmission line are completed by in-state firms, manufacturing of structures and wire; construction of the transmission line; installation of a converter; the payment of fees for the required right-of-way, architectural, and financial services; and the purchase of electric power would generate substantial economic impacts in Illinois. In total, it is estimated that approximately 1,450 jobs would be created in each year of the three-year period during which the line is being constructed. More than 54 percent (452) of the total direct jobs (834) created in each of the three years would result from the construction of the proposed line. Labor income impacts would also be substantial with $62.7 million per year in direct impacts. Factoring in indirect and induced income impacts increases the annual average labor income impact to $100.8 million.

3.2.4 Indiana

Table 3.6 summarizes the direct, indirect, induced, and total impacts of increases in final demand for the components –wire, structures – of the new transmission line, installation of the converters, construction of the line, and architectural, financial, energy, and right-of-way requirements associated with the segment of the line constructed in Indiana.

Table 3.6: Estimated State-Level Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Indiana

Component	Change in Final Demand[1]	Impact	Direct	Indirect	Induced	Total	Annual Average[4]
Installation of Structures	$1.9	*Employment*[2]	15	3	6	23	8
		Labor Income[3]	$0.95	$0.16	$0.26	$1.37	$0.46
		Output	$1.92	$0.60	$0.87	$3.39	$1.13
Manufacture Structures	$0.5	*Employment*	2	1	1	3	1
		Labor Income	$0.13	$0.05	$0.04	$0.22	$0.07
		Output	$0.51	$0.15	$0.14	$0.80	$0.27
Manufacture Wire	$0.3	*Employment*	0	0	0	1	0
		Labor Income	$0.04	$0.02	$0.01	$0.07	$0.02
		Output	$0.28	$0.06	$0.05	$0.39	$0.13
Architectural Services	$0.2	*Employment*	2	0	1	3	1
		Labor Income	$0.11	$0.02	$0.03	$0.16	$0.05
		Output	$0.20	$0.06	$0.10	$0.36	$0.12
Right of Way	$0.2	*Employment*	1	0	0	2	1
		Labor Income	$0.02	$0.01	$0.01	$0.04	$0.01
		Output	$0.20	$0.05	$0.02	$0.27	$0.09
Financial	$0.1	*Employment*	0	0	0	0	0
		Labor Income	$0.01	$0.01	$0.00	$0.02	$0.01
		Output	$0.07	$0.04	$0.01	$0.11	$0.04
Electric Power	$0.04	*Employment*	0	0	0	0	0
		Labor Income	$0.01	$0.00	$0.00	$0.01	$0.00
		Output	$0.04	$0.01	$0.01	$0.05	$0.02
Installation of Converters/ Transformers	$6.6	*Employment*	50	9	20	80	27
		Labor Income	$3.26	$0.55	$0.90	$4.70	$1.57
		Output	$6.60	$2.07	$2.97	$11.64	$3.88
Totals	$9.8	*Employment*	70	14	28	113	38
		Labor Income	$4.51	$0.82	$1.26	$6.59	$2.20
		Output	$9.81	$3.04	$4.16	$17.02	$5.67

1. All spending and $ impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.
4. Assumes a three-year construction period.

Referring to Table 3.6, assuming 50 percent of all manufacturing-related activities (structures and wire) and 100 percent of all construction-related activities and directly tied to the transmission line are completed by in-state firms, manufacturing of structures and wire; construction of the transmission line; installation of a transformer; the payment of fees for the required right-of-way, architectural, and financial services; and the purchase of electric power would generate measurable economic impacts in Indiana. In total, it is estimated that approximately 38 jobs would be created in each year of the three-year period during which the line is being constructed. Approximately 74 percent (17) of the total direct jobs (23) created in each of the three years would result from the installation of the transformer. Labor income impacts would amount to $1.5 million per year in direct impacts. Factoring in indirect and induced income impacts increases the annual average to $2.2 million.

3.2.5 Assessment of Estimated State-Level Impacts

We have already stated that the impacts reported in Tables 3.3 – 3.6 reflect the assumption that 50 percent of manufacturing-related activities and 100 percent of construction-related activities would be completed by in-state firms; however, this assumption warrants further consideration. In particular, we need to examine whether it is *reasonable* to expect that industries in each state would be able to handle the projected increase in demand.

The reasonableness of the approach employed here can be addressed, to a first approximation, by examining the potential for existing industries in each state to accommodate the projected increases in demand considered here. Table 3.7 summarizes employment levels in each of the affected industries in Kansas, Missouri, Illinois, and Indiana in 2011, as well as the projected annual increases in employment in each of the seven directly impacted sectors (*Construction of other new nonresidential structures; Plate work and fabricated structural product manufacturing; Communication and energy wire and cable manufacturing; Architectural, engineering, and related services; Real estate; Funds, trusts, and other financial vehicles; and Electric power generation, transmission, and distribution*) in both absolute and percentage terms.

Table 3.7: Comparison of Baseline Employment to Projected Annual Impacts in Kansas, Missouri, Illinois, and Indiana

Component	Employment[1]	Kansas	Missouri	Illinois	Indiana
Installation of Structures	*Current*	26,081	53,411	78,598	53,875
	Projected Increase	1383	834	758	8
	% Change	5.3%	1.6%	1.0%	0.0%
Manufacture Structures	*Current*	2,256	2,716	6,987	4,734
	Projected Increase	197	126	117	1
	% Change	8.7%	4.7%	1.7%	0.0%
Manufacture Wire	*Current*	575	239	684	304
	Projected Increase	59	37	36	0
	% Change	10.3%	15.7%	5.2%	0.0%
Architectural Services	*Current*	18,462	29,017	61,275	27,611
	Projected Increase	146	89	84	1
	% Change	0.8%	0.3%	0.1%	0.0%
Right of Way	*Current*	50,647	121,734	240,916	109,293
	Projected Increase	104	61	44	1
	% change	0.2%	0.0%	0.0%	0.0%
Financial	*Current*	3,105	8,587	22,989	3,105
	Projected Increase	36	20	17	0
	% Change	1.2%	0.2%	0.1%	0.0%
Electric Power	*Current*	6,040	8,636	18,595	11,203
	Projected Increase	8	5	4	0
	% Change	0.1%	0.1%	0.0%	0.0%
Installation of Converters/ Transformers	*Current*	26,081	53,411	78,598	53,875
	Projected Increase	407	143	390	27
	% Change	1.6%	0.3%	0.5%	0.1%
Totals	*Employment*				
	Labor Income				
	Output	$9,999.9	$9,999.9	$9,999.9	$9,999.9

1. All employment figures are full time equivalents.
2. Assumes a three-year construction period.

Referring to Table 3.7, in Illinois and Indiana, all seven of the affected sectors should be able to absorb the increased demand associated with manufacturing of the required components and construction of the proposed transmission line. The only possible exception is manufacturing of the required wire in Illinois. The *Communications and energy wire and cable manufacturing* sector would experience an estimated 5.2 percent increase in employment in Illinois. Considering, however, the current state of the economy in

Illinois (the unemployment is currently 9 percent), and the fact that the predicted increase in jobs is 36 FTE positions, there is likely sufficient excess capacity within the industry in Illinois to absorb the projected increase.

Turning to Missouri, six of the seven affected sectors should be able to absorb the increased demand associated with manufacturing of the required components and construction of the proposed transmission line. Referring to Table 3.7, the only possible exception is manufacturing of the needed wire. The *Communications and energy wire and cable manufacturing* sector would experience an estimated 15.7 percent increase in employment in Missouri. As was the case in Illinois, however, the current state of the economy in Missouri (the unemployment is currently 6.5 percent), and the fact that the predicted increase in jobs is 37 FTE positions, there is likely sufficient excess capacity within the industry in Missouri to absorb the projected increase.

Finally, considering Kansas, it is reasonable to expect that five of the seven sectors should be able to absorb the increased demand associated with manufacturing of the required components and construction of the proposed transmission line. The only possible exceptions include manufacturing of the wire and structures required for that portion of the line that will be constructed in Kansas. As shown in Table 3.7, the *Communications and energy wire and cable manufacturing* sector would experience an estimated 10.3 percent increase in employment, while the *Plate work and fabricated structural product manufacturing* sector would experience an estimated 8.7 percent increase in employment in Kansas. With an unemployment rate currently at 5.5 percent, some might argue that Kansas is nearing full employment overall. That being said, the predicted increase in FTE positions in each sector – 197 in *Plate work* and 59 in *Communications and energy wire* – do not appear to be excessively large.[7]

[7] If we were to take the position that neither sector would be able to absorb more than a 6% increase in employment, the effect would be to reduce the total number of additional jobs associated with the manufacturing of the required components and construction of the proposed transmission line in Kansas by 87 FTE jobs, or less than 4%, in each year of the assumed three-year construction period.

3.3 Manufacturing and Construction Impacts at the National Level

The state-level impacts reported in Tables 3.3 – 3.6 summarize the estimated impacts of the increased spending that is assumed to occur *within* each state's respective boundaries. It is important to recognize, however, that some of the spending associated with the manufacture and construction of the proposed transmission line in each state will actually occur outside of the state. For example, it is assumed that 50 percent of the direct spending on the manufacturing of the wire that will be used in the portion of the transmission line located in a particular state will be paid to one or more wire manufacturers located in that state. In fact, however, it is reasonable to expect that some of the materials the in-state manufacturers use to produce the wire in question may come from vendors located *outside* of the particular state. The spending on materials produced out-of-state is viewed as a "leakage" from the particular state insofar as it will yield no subsequent indirect or induced spending within that state. This "leakage" will, however, lead to indirect and induced spending elsewhere. To the extent that this spending occurs elsewhere in the United States, one or more of the remaining states will benefit from the construction, operation, and maintenance of the proposed transmission line as well. In addition, recall that 50 percent of the manufacturing of structures and wire associated with that portion of the transmission line that would be built in each state, as well as the transformer that would be installed in Indiana, are assumed to occur elsewhere in the United States.

To capture the indirect and induced impacts of the sources of additional spending described in the preceding paragraph (i.e., "leakages," the 50 percent of direct spending on the manufacture of structures and wire explicitly assumed to occur outside of each state, and the manufacture of the transformer to be installed in Indiana), additional analysis was conducted. To be specific, the impacts of the state-specific expenditures summarized in Tables 3.3 – 3.6 were re-estimated for the region consisting of the entire United States. To hold constant the characteristics of each industry that is assumed to experience the initial increase in final demand in each state (e.g., 50 percent in-state manufacture of structures and wire in Kansas), the national model was recalibrated to reflect the industry-specific characteristics in each sector (IMPLAN sectors 36, 186, 244, 272, 359, 360, 369) and state in which final demand would initially increase. If the specific U.S. industry relationships (output per worker, ratio of employee compensation to output, etc.) were not revised to reflect the relevant state-specific (i.e., Kansas, Missouri, Illinois, Indiana) relationships, the differences reported in Tables 3.8 – 3.11 would be due not only to internalizing trade flows at the national level, but to differences in the industry at the state versus national level as well.

The results of the estimation of national-level impacts of spending on the manufacture and construction of the proposed transmission line are reported in Tables 3.8 – 3.11. It is important to note that the *direct impacts* reported in Tables 3.8 – 3.11 match those reported in Tables 3.3 – 3.6, respectively. This is due to the recalibration described above. Inspection of the indirect and induced impacts shows that these effects are larger at the national level than they are at the state level. Once again, this reflects the capture of indirect and induced spending that would occur outside of the four-state region.

3.3.1 Kansas – US

The national-level impacts of increases in final demand for the components – wire, structures – of the new transmission line, installation of the converters, construction of the line, and right-of-way requirements associated with the segment of the line constructed in Kansas are summarized in Table 3.8.

Table 3.8: Estimated National-Level Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Kansas

Component	Change in Final Demand[1]	Impact	Direct	Indirect	Induced	Total	Annual Average[4]
Installation of Structures	$336.6	*Employment*[2]	2,657	1,125	1,907	5,689	1,896
		Labor Income[3]	$159.8	$81.5	$106.3	$347.6	$115.9
		Output	$336.6	$273.4	$339.6	$949.5	$316.5
Manufacture Structures	$88.7	*Employment*	299	384	391	1,074	358
		Labor Income	$21.9	$26.9	$21.8	$70.7	$23.6
		Output	$88.7	$100.6	$69.6	$258.9	$86.3
Manufacture Wire	$49.1	*Employment*	78	162	158	399	133
		Labor Income	$6.8	$12.6	$8.8	$28.2	$9.4
		Output	$49.1	$70.9	$28.2	$148.2	$49.4
Architectural Services	$34.7	*Employment*	248	119	220	587	196
		Labor Income	$20.3	$7.5	$12.3	$40.1	$13.4
		Output	$34.7	$19.5	$39.2	$93.3	$31.1
Right of Way	$35.0	*Employment*	232	86	63	381	127
		Labor Income	$3.2	$4.7	$3.5	$11.4	$3.8
		Output	$35.0	$15.0	$11.0	$61.0	$20.3
Financial	$11.4	*Employment*	38	82	55	175	58
		Labor Income	$0.7	$6.0	$3.1	$9.8	$3.3
		Output	$11.4	$16.6	$9.8	$37.9	$12.6
Electric Power	$6.7	*Employment*	6	14	16	36	12
		Labor Income	$1.0	$1.0	$0.9	$2.9	$1.0
		Output	$6.7	$3.5	$2.9	$13.1	$4.4
Installation of Converters/ Transformers	$99.0	*Employment*	782	331	561	1,673	558
		Labor Income	$47.0	$24.0	$31.3	$102.2	$34.1
		Output	$99.0	$80.4	$99.9	$279.3	$93.1
Totals	$661.2	*Employment*	4,340	2,304	3,371	10,015	3,338
		Labor Income	$260.7	$164.2	$187.9	$612.8	$204.3
		Output	$661.2	$579.8	$600.1	$1,841.2	$613.7

1. All spending and $ impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.
4. Assumes a three-year construction period.

According to Table 3.8, assuming 50 percent of all manufacturing-related activities (structures and wire) and 100 percent of all construction-related activities directly tied to the transmission line are completed by in-state firms, the indirect and induced impacts of spending on manufacturing of structures and wire; construction of the transmission line; installation of a converter; the payment of fees for the required right-of-way, architectural, and financial services; and the purchase of electric power associated with that segment of the proposed transmission line located in Kansas increase substantially when the scope of the analysis is expanded to the national level. Total employment impacts increase by approximately 998[8] jobs per year, to approximately 3,338 full-time equivalent jobs per year over the three-year construction period. Total labor income increases by $72.8 million per year, to $204.3 million per year for three years.

[8] The difference in FTE jobs and labor income is calculated by comparing the relevant values in Tables 3.8 and 3.3. The same approach is employed in discussing the results in Tables 3.9-3.11.

3.3.2 Missouri – US

The national-level impacts of increases in final demand for the components –wire, structures – of the new transmission line, installation of the converters, construction of the line, and right-of-way requirements associated with the segment of the line constructed in Missouri are summarized in Table 3.9.

Table 3.9: Estimated National-Level Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Missouri

Component	Change in Final Demand[1]	Impact	Direct	Indirect	Induced	Total	Annual Average[4]
Installation of Structures	$192.3	*Employment*[2]	1,490	631	1,095	3,216	1,072
		Labor Income[3]	$93.0	$45.7	$61.0	$199.7	$66.6
		Output	$192.3	$153.3	$194.9	$540.6	$180.2
Manufacture Structures	$50.7	*Employment*	171	219	223	614	205
		Labor Income	$12.5	$15.4	$12.5	$40.4	$13.5
		Output	$50.7	$57.4	$39.8	$147.9	$49.3
Manufacture Wire	$28.1	*Employment*	46	96	88	230	77
		Labor Income	$3.4	$7.4	$4.9	$15.7	$5.2
		Output	$28.1	$41.8	$15.7	$85.5	$28.5
Architectural Services	$19.8	*Employment*	138	66	126	331	110
		Labor Income	$11.8	$4.2	$7.0	$23.0	$7.7
		Output	$19.8	$10.9	$22.5	$53.2	$17.7
Right of Way	$20.0	*Employment*	126	47	35	208	69
		Labor Income	$1.8	$2.6	$2.0	$6.4	$2.1
		Output	$20.0	$8.3	$6.2	$34.5	$11.5
Financial	$6.5	*Employment*	19	42	30	91	30
		Labor Income	$0.6	$3.1	$1.7	$5.4	$1.8
		Output	$6.5	$8.4	$5.4	$20.4	$6.8
Electric Power	$3.8	*Employment*	4	8	9	21	7
		Labor Income	$0.6	$0.6	$0.5	$1.7	$0.6
		Output	$3.8	$2.1	$1.6	$7.5	$2.5
Installation of Converters/ Transformers	$33.0	*Employment*	256	108	188	552	184
		Labor Income	$16.0	$7.8	$10.5	$34.3	$11.4
		Output	$33.0	$26.3	$33.4	$92.8	$30.9
Totals	$354.2	*Employment*	2,250	1,218	1,795	5,263	1,754
		Labor Income	$139.7	$86.8	$100.1	$326.5	$108.8
		Output	$354.2	$308.5	$319.7	$982.4	$327.5

1. All spending and $ impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.
4. Assumes a three-year construction period.

According to Table 3.9, assuming 50 percent of all manufacturing-related activities (structures and wire) and 100 percent of all construction-related activities directly tied to the transmission line are completed by in-state firms, the indirect and induced impacts of spending on manufacturing of structures and wire; construction of the transmission line; installation of a converter; the payment of fees for the required right-of-way, architectural, and financial services; and the purchase of electric power associated with that segment of the proposed transmission line located in Missouri increase substantially when the scope of the analysis is expanded to the national level. Total employment impacts increase by approximately 439 jobs per year, to approximately 1,754 full-time equivalent jobs per year over the three-year construction period. Total labor income increases by $31.8 million per year, to $108.8 million per year for three years.

3.3.3 Illinois – US

The national-level impacts of increases in final demand for the components –wire, structures – of the new transmission line, installation of the converters, construction of the line, and right-of-way requirements associated with the segment of the line constructed in Illinois are summarized in Table 3.10.

Table 3.10: Estimated National-Level Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Illinois

Component	Change in Final Demand[1]	Impact	Direct	Indirect	Induced	Total	Annual Average[4]
Installation of Structures	$192.3	*Employment*[2]	1,355	574	1,122	3,051	1,017
		Labor Income[3]	$101.0	$41.5	$62.6	$205.1	$68.4
		Output	$192.3	$139.4	$199.9	$531.6	$177.2
Manufacture Structures	$50.7	*Employment*	161	206	230	596	199
		Labor Income	$14.2	$14.5	$12.8	$41.5	$13.8
		Output	$50.7	$54.1	$40.9	$145.6	$48.5
Manufacture Wire	$28.1	*Employment*	41	84	97	222	74
		Labor Income	$5.3	$6.6	$5.4	$17.4	$5.8
		Output	$28.1	$37.0	$17.3	$82.3	$27.4
Architectural Services	$19.8	*Employment*	135	65	127	326	109
		Labor Income	$12.0	$4.1	$7.1	$23.2	$7.7
		Output	$19.8	$10.6	$22.6	$53.0	$17.7
Right of Way	$20.0	*Employment*	93	34	31	158	53
		Labor Income	$2.0	$1.9	$1.7	$5.7	$1.9
		Output	$20.0	$6.3	$5.6	$31.8	$10.6
Financial	$6.5	*Employment*	18	38	29	85	28
		Labor Income	$0.8	$2.8	$1.6	$5.2	$1.7
		Output	$6.5	$7.7	$5.2	$19.5	$6.5
Electric Power	$3.8	*Employment*	3	7	9	19	6
		Labor Income	$0.6	$0.5	$0.5	$1.6	$0.5
		Output	$3.8	$1.8	$1.6	$7.2	$2.4
Installation of Converters/ Transformers	$99.0	*Employment*	697	295	578	1,570	523
		Labor Income	$52.0	$21.4	$32.2	$105.6	$35.2
		Output	$99.0	$71.8	$102.9	$273.6	$91.2
Totals	$420.2	*Employment*	2,502	1,303	2,223	6,028	2,009
		Labor Income	$188.0	$93.4	$123.9	$405.3	$135.1
		Output	$420.2	$328.6	$396.0	$1,144.8	$381.6

1. All spending and $ impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.
4. Assumes a three-year construction period.

According to Table 3.10, assuming 50 percent of all manufacturing-related activities (structures and wire) and 100 percent of all construction-related activities directly tied to the transmission line are completed by in-state firms, the indirect and induced impacts of spending on manufacturing of structures and wire; construction of the transmission line; installation of a converter; the payment of fees for the required right-of-way, architectural, and financial services; and the purchase of electric power associated with that segment of the proposed transmission line located in Illinois increase substantially when the scope of the analysis is expanded to the national level. Total employment impacts increase by approximately 559 jobs per year, to approximately 2,009 full-time equivalent jobs per year over the three-year construction period. Total labor income increases by $34.3 million per year, to $135.1 million per year for three years.

3.3.4 Indiana – US

The national-level impacts of increases in final demand for the components –wire, structures – of the new transmission line, installation of the converters, construction of the line, and right-of-way requirements associated with the segment of the line constructed in Indiana are summarized in Table 3.11.

Table 3.11: Estimated National-Level Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Indiana

Component	Change in Final Demand[1]	Impact	Direct	Indirect	Induced	Total	Annual Average[4]
Installation of Structures	$1.9	*Employment*[2]	15	6	11	32	11
		Labor Income[3]	$0.95	$0.45	$0.61	$2.01	$0.67
		Output	$1.92	$1.50	$1.96	$5.39	$1.80
Manufacture Structures	$0.5	*Employment*	2	2	2	6	2
		Labor Income	$0.13	$0.15	$0.13	$0.41	$0.14
		Output	$0.51	$0.56	$0.40	$1.47	$0.49
Manufacture Wire	$0.3	*Employment*	0	1	1	2	1
		Labor Income	$0.04	$0.07	$0.05	$0.16	$0.1
		Output	$0.28	$0.40	$0.16	$0.85	$0.3
Architectural Services	$0.2	*Employment*	2	1	1	4	1
		Labor Income	$0.11	$0.05	$0.07	$0.23	$0.08
		Output	$0.20	$0.12	$0.22	$0.54	$0.18
Right of Way	$0.2	*Employment*	1	1	0	2	1
		Labor Income	$0.02	$0.03	$0.02	$0.07	$0.02
		Output	$0.20	$0.09	$0.06	$0.35	$0.12
Financial	$0.1	*Employment*	0	0	0	1	0
		Labor Income	$0.01	$0.03	$0.02	$0.05	$0.02
		Output	$0.07	$0.08	$0.05	$0.20	$0.07
Electric Power	$0.04	*Employment*	0	0	0	0	0
		Labor Income	$0.01	$0.01	$0.01	$0.02	$0.01
		Output	$0.04	$0.02	$0.02	$0.08	$0.03
Installation of Converters/ Transformers	$6.6	*Employment*	50	21	38	109	36
		Labor Income	$3.26	$1.54	$2.11	$6.90	$2.30
		Output	$6.60	$5.15	$6.74	$18.49	$6.16
Totals	$9.8	*Employment*	70	32	54	156	52
		Labor Income	$4.51	$2.32	$3.01	$9.84	$3.28
		Output	$9.81	$7.93	$9.61	$27.36	$9.12

1. All spending and $ impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.
4. Assumes a three-year construction period.

According to Table 3.11, assuming 50 percent of all manufacturing-related activities (structures and wire) and 100 percent of all construction-related activities directly tied to the transmission line are completed by in-state firms, the indirect and induced impacts of spending on manufacturing of structures and wire; construction of the transmission line; installation of a transformer; the payment of fees for the required right-of-way, architectural, and financial services; and the purchase of electric power associated with that segment of the proposed transmission line located in Indiana increase substantially when the scope of the analysis is expanded to the national level. Total employment impacts increase by approximately 14 jobs per year, to approximately 52 full-time equivalent jobs per year over the three-year construction period. Total labor income increases by $1.08 million per year, to $3.28 million per year for three years.

3.3.5 Manufacturing Outside of the Four-State Region

It was also necessary to estimate the impacts of the 50 percent of manufacturing of structures and wire required for the transmission line that was assumed to occur outside of the four-state region, as well as the transformer that will be installed in Indiana. Those results are reported in Table 3.12.

Table 3.12: Estimated National-Level Impacts of Manufacturing 50 percent of Structures and Wire, and Transformers Outside of Four-State Region

Component	Change in Final Demand[1]	Impact	Direct	Indirect	Induced	Total	Annual Average[4]
Manufacture Structures	$190.6	*Employment[2]*	630	808	848	2,286	762
		Labor Income[3]	$49.3	$56.8	$47.3	$153.3	$51.1
		Output	$190.6	$211.6	$151.0	$553.2	$184.4
Manufacture Wire	$105.5	*Employment*	161	335	351	847	282
		Labor Income	$16.9	$26.1	$19.5	$62.6	$20.9
		Output	$105.5	$146.6	$62.5	$314.5	$104.8
Manufacture of Transformers	$13.4	*Employment*	57	49	62	168	56
		Labor Income	$3.8	$3.9	$3.5	$11.2	$3.7
		Output	$13.4	$13.3	$11.1	$37.8	$12.6
Totals	$309.5	*Employment*	848	1,192	1,261	3,301	1,100
		Labor Income	$70.0	$86.8	$70.3	$227.1	$75.7
		Output	$309.5	$371.5	$224.6	$905.6	$301.9

1. All spending and $ impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.
4. Assumes a three-year construction period.

Referring to Table 3.12, the 50 percent of manufacturing of structures and wire required for the transmission line that is assumed to occur outside of the four-state region, as well as the transformer that would be installed in Indiana would generate substantial economic impacts at the national level. In total, approximately 1,100 jobs would be created in each year of the three-year period during which the line is being constructed. Labor income impacts would also be substantial with $23.3 million per year in direct impacts. Factoring in indirect and induced income impacts increases the annual average to $75.7 million.

3.4 Operations and Maintenance Impacts at the State Level

Clean Line estimates that annual operation and maintenance (O&M) costs, which would be incurred when the line is up and running, would amount to approximately one percent of total construction costs. In Kansas, this amounts to $10.0 million of additional spending each year. The corresponding amounts for Missouri, Illinois, and Indiana are $5.0 million, $7.0 million, and $0.2 million, respectively. The estimated impacts of annual O&M expenditures in each state are summarized in Tables 3.13 – 3.16.

3.4.1 Kansas

As shown in Table 3.13, the direct effects of annual O&M expenditures in Kansas include 88 jobs and $5.3 million in labor income. These impacts increase to 135 jobs and $7.6 million of labor income when indirect and induced impacts are factored in.

Table 3.13: Estimated Impacts of Annual O&M-Related Expenditures on Grain Belt Express Clean Line in Kansas (Total annual spending = $10.0 million)

Impact[1]	Direct	Indirect	Induced	Total
Employment[2]	88	16	31	135
Labor Income[3]	$5.3	$0.9	$1.4	$7.6
Output	$10.0	$3.2	$4.5	$17.7

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.

3.4.2 Missouri

As shown in Table 3.14, the direct effects of annual O&M expenditures in Missouri include 43 jobs and $2.7 million in labor income. These impacts increase to 70 jobs and $4.1 million of labor income when indirect and induced impacts are factored in.

Table 3.14: Estimated Impacts of Annual O&M-Related Expenditures on Grain Belt Express Clean Line in Missouri (Total annual spending = $5.0 million)

Impact[1]	Direct	Indirect	Induced	Total
Employment[2]	43	9	18	70
Labor Income[3]	$2.7	$0.5	$0.9	$4.1
Output	$5.0	$1.5	$2.7	$9.2

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.

3.4.3 Illinois

As shown in Table 3.15, the direct effects of annual O&M expenditures in Illinois include 54 jobs and $4.1 million in labor income. These impacts increase to 88 jobs and $6.1 million of labor income when indirect and induced impacts are factored in.

Table 3.15: Estimated Impacts of Annual O&M-Related Expenditures on Grain Belt Express Clean Line in Illinois (Total annual spending = $7.0 million)

Impact[1]	Direct	Indirect	Induced	Total
Employment[2]	54	10	24	88
Labor Income[3]	$4.1	$0.7	$1.3	$6.1
Output	$7.0	$2.1	$3.9	$13.1

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.

3.4.4 Indiana

As shown in Table 3.16, the direct effects of annual O&M expenditures in Indiana include 2 jobs and $130 thousand in labor income. These impacts increase to 3 jobs and $190 thousand of labor income when indirect and induced impacts are factored in.

Table 3.16: Estimated Impacts of Annual O&M-Related Expenditures on Grain Belt Express Clean Line in Indiana (Total annual spending = $0.2 million)

Impact[1]	Direct	Indirect	Induced	Total
Employment[2]	2	0	1	3
Labor Income[3]	$0.13	$0.02	$0.04	$0.19
Output	$0.24	$0.07	$0.12	$0.43

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.

3.5 Operations and Maintenance Impacts at the National Level

As was the case with state-level manufacturing and construction-related impacts, to capture the indirect and induced effects of leakages from state-level spending at the national level, the impacts of the state-specific O&M-related expenditures summarized in Tables 3.13 – 3.16 were re-estimated for the region consisting of the entire United States. The results are reported in Tables 3.17 – 3.20.

3.5.1 Kansas – US

As shown in Table 3.17, the indirect and induced impacts of O&M-related expenditures associated with that segment of the proposed transmission line located in Kansas increase when the scope of the analysis is expanded to the national level. Total employment impacts increase by 42, to 177 full-time equivalent jobs. Total labor income increases by $3.1 million, to $10.7 million.

Table 3.17: Estimated National-Level Impacts of Annual O&M-Related Expenditures on Grain Belt Express Clean Line in Kansas (Total annual spending = $10.0 million)

Impact[1]	Direct	Indirect	Induced	Total
Employment[2]	88	30	58	177
Labor Income[3]	$5.3	$2.1	$3.3	$10.7
Output	$10.0	$7.2	$10.4	$27.6

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.

3.5.2 Missouri – US

As shown in Table 3.18, the indirect and induced impacts of O&M-related expenditures associated with that segment of the proposed transmission line located in Missouri increase when the scope of the analysis is expanded to the national level. Total employment impacts increase by 18, to 88 full-time equivalent jobs. Total labor income increases by $1.2 million, to $5.3 million.

Table 3.18: Estimated National-Level Impacts of Annual O&M-Related Expenditures on Grain Belt Express Clean Line in Missouri (Total annual spending = $5.0 million)

Impact[1]	Direct	Indirect	Induced	Total
Employment[2]	43	15	29	88
Labor Income[3]	$2.7	$1.0	$1.6	$5.3
Output	$5.0	$3.5	$5.2	$13.8

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.

3.5.3 Illinois – US

As shown in Table 3.19, the indirect and induced impacts of O&M-related expenditures associated with that segment of the proposed transmission line located in Illinois increase when the scope of the analysis is expanded to the national level. Total employment impacts increase by 27, to 115 full-time equivalent jobs. Total labor income increases by $1.6 million, to $7.7 million.

Table 3.19: Estimated National-Level Impacts of Annual O&M-Related Expenditures on Grain Belt Express Clean Line in Illinois (Total annual spending = $7.0 million)

Impact[1]	Direct	Indirect	Induced	Total
Employment[2]	54	19	42	115
Labor Income[3]	4.1	1.3	2.4	7.7
Output	$7.0	$4.4	$7.5	$19.0

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.

3.5.4 Indiana – US

As shown in Table 3.20, the indirect and induced impacts of O&M-related expenditures associated with that segment of the proposed transmission line located in Indiana increase when the scope of the analysis is expanded to the national level. Total employment impacts increase by 1, to 4 full-time equivalent jobs. Total labor income increases by $70 thousand, to $260 thousand.

Table 3.20: Estimated National-Level Impacts of Annual O&M-Related Expenditures on Grain Belt Express Clean Line in Indiana (Total annual spending = $0.2 million)

Impact[1]	Direct	Indirect	Induced	Total
Employment[2]	2	1	1	4
Labor Income[3]	$0.13	$0.05	$0.08	$0.26
Output	$0.24	$0.17	$0.25	$0.66

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.

3.6 Summary of Estimated Manufacturing and Construction and O&M-Related Impacts

This section provides an aggregate view of the various impacts reported in Tables 3.3 – 3.6 and Tables 3.8 – 3.20.

3.6.1 Manufacturing and Construction

Table 3.21 summarizes the average annual impacts of manufacture of the inputs to, and construction of, the proposed transmission line at the state and national levels that would occur in each year of the three year construction period.

Table 3.21: Estimated Average Annual Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Kansas, Missouri, Illinois, Indiana, the Four-State Region, and the United States

		Kansas	Missouri	Illinois	Indiana	Four-State Region	United States
Component	**Impacts**[1]	**Annual Avg.**[4]	**Annual Avg.**	**Annual Avg.**	**Annual Avg.**	**Annual Avg.**	**Annual Avg.**
Installation of Structures	*Employment*[2]	1,383	834	758	8	2,982	3,996
	Labor Income[3]	$78.4	$49.2	$52.6	$0.46	$180.6	$251.5
	Output	$198.2	$116.5	$119.6	$1.13	$435.4	$675.7
Manufacture Structures	*Employment*	197	126	117	1	442	1525
	Labor Income	$12.2	$7.9	$8.7	$0.07	$28.9	$102.1
	Output	$44.7	$27.7	$28.1	$0.27	$100.7	$369.0
Manufacture Wire	*Employment*	59	37	36	0	133	566
	Labor Income	$4.1	$2.4	$3.3	$0.02	$9.8	$41.3
	Output	$22.5	$13.3	$13.8	$0.13	$49.7	$210.5
Architectural Services	*Employment*	146	89	84	1	320	416
	Labor Income	$9.7	$6.1	$6.3	$0.05	$22.2	$28.8
	Output	$20.5	$12.7	$12.9	$0.12	$46.3	$66.7
Right of Way	*Employment*	104	61	44	1	210	250
	Labor Income	$2.3	$1.5	$1.4	$0.01	$5.2	$7.9
	Output	$15.9	$9.5	$8.9	$0.09	$34.4	$42.6
Financial	*Employment*	36	20	17	0	73	118
	Labor Income	$1.2	$0.9	$1.0	$0.01	$3.2	$6.8
	Output	$7.6	$4.5	$4.3	$0.04	$16.4	$26.0
Electric Power	*Employment*	8	5	4	0	17	26
	Labor Income	$0.6	$0.4	$0.4	$0.00	$1.4	$2.1
	Output	$3.3	$1.9	$1.9	$0.02	$7.0	$9.3
Installation of Converters/ Transformers	*Employment*	407	143	390	27	966	1302
	Labor Income	$23.1	$8.4	$27.1	$1.57	$60.1	$83.0
	Output	$58.3	$20.0	$61.6	$3.88	$143.7	$221.4
Manufacture Transformer	*Employment*	0	0	0	0	0	56
	Labor Income	$0.0	$0.0	$0.0	$0.0	$0.0	$3.7
	Output	$0.0	$0.0	$0.0	$0.0	$0.0	$12.6
Totals	*Employment*	2,340	1,315	1,450	38	5,143	8,255
	Labor Income	$131.5	$77.0	$100.8	$2.2	$311.4	$527.2
	Output	$371.0	$206.0	$251.1	$5.7	$833.8	$1,633.8

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.
4. Assumes a three-year construction period.

The various figures reported in Table 3.21 for Kansas, Missouri, Illinois, Indiana, and the four-state region can be viewed as an upper bound on the impacts in question. Thus, for example, assuming 50 percent of all manufacturing-related activities (structures and wire) and 100 percent of all construction-related activities directly tied to the transmission line are completed by in-state firms in Kansas, Missouri, Illinois, and Indiana, over the projected period the employment impact in the four-state region could potentially average approximately 5,143 jobs per year for three years. As shown in the last column of Table 3.21, when spending that occurs outside of the four-state region is accounted for, average employment impacts would increase to 8,255 jobs per year. Projected income impacts would be substantial as well. Assuming, once again, that 50 percent of manufacturing-related activities and 100 percent of construction-related activities are completed by in-state firms in each of the four states, over the projected period the labor income impact in the four-state region would average approximately $311.4 million per year for three years. When spending occurring in the remainder of the country is accounted for, average labor income impacts would increase to $527.2 million per year for three years.

3.6.2 Operations and Maintenance

Table 3.22 summarizes the annual impacts of operations and maintenance of the proposed transmission line at the state and national levels. Unlike the construction-related impacts, which would cease after the three-year construction period, the O&M impacts would be sustained for the foreseeable future as these recur on an annual basis.

Table 3.22: Estimated Annual O&M-Related Impacts[1] of the Grain Belt Express Clean Line in Kansas, Missouri, Illinois, Indiana, the Four-State Region, and the United States

Impact[1]	Kansas	Missouri	Illinois	Indiana	Four-State Region	U.S.
Employment[2]	135	70	88	3	296	383
Labor Income[3]	$7.6	$4.1	$6.1	$0.19	$18.0	$24.0
Output	$17.7	$9.2	$13.1	$0.43	$40.4	$61.0

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.
3. Labor Income = Employee compensation + Proprietor income.

4 Economic Impacts of Associated Wind Farms

It is estimated that the Grain Belt Express Clean Line will connect approximately 4,000 MW of new wind farm capacity to the transmission grid. For this analysis, we assumed that the 4,000 MW will be built in western Kansas and comprise eight new wind farms. We further assumed that each wind farm will be 500 MW in size and entail construction costs of $1,700 per kW and operation and maintenance costs of $20 per kW. The JEDI model, which was used to estimate the economic impacts of construction of the new wind farms, contains default values that are used to allocate the construction and operation and maintenance costs to their component parts.

To estimate the economic impacts of the construction of the wind farms and the manufacture of the related components at the national and state levels, it is necessary to estimate the share of the wind turbine components that will be manufactured in the United States for the national impacts and the share of the components that will be manufactured in Kansas, Missouri, Illinois, and Indiana for the state analyses. The default values within the JEDI model were used for the local share of the operations and maintenance costs and the balance of plant costs. However, these default values were not used to estimate the local share of the manufacture of the larger components of a wind turbine – the nacelle, structure, blades, and transportation – which comprise 75% of the construction costs. Instead, we based the allocation on the American Wind Energy Association's *Wind Power Outlook 2012* conclusion that the domestic content of wind equipment (turbines, blades and structures) built in the United States rose to 67 percent in 2011. Blades and towers are easier to source and build domestically so it is reasonable to assume that a higher percentage of those components will be sourced domestically. Using 67 percent domestic content as a guideline, we assumed that 55 percent of the nacelles, 90 percent of the blades, and 90 percent of the structures will be produced in the United States. This yielded an overall cost-weighted average of domestic content of 66.56 percent. We assumed that 100 percent of the transportation is sourced within the United States.

To estimate the state-level economic impacts it was necessary to estimate the percentage of components that would be produced in each state. As is shown in Tables 4.1– 4.4, and is discussed more generally in the American Wind Energy Association's *Wind Power Outlook 2012*, all four states have robust supply chains. Because it is impossible to know the identity and geographic location of the companies that will build the components for the proposed wind farms until they are actually built, we estimated the potential economic impacts of construction of the eight new wind farms using two different scenarios. Given the overall domestic content from the national model, we assumed that the four-state region would produce either 30 percent of the domestic content (low scenario) or 90 percent of the domestic content (high scenario) of the components that would go into construction of the new wind farms.

Table 4.1 : Major Kansas Wind Turbine Component Manufacturers

Company	Component
Atkinson Industries, Pittsburgh, KS	Machining/Fabrication
Electromech Technologies, Wichita, KS	Distributed Wind Turbines Drive Train
Enertech Manufacturing, Newton, KS	Distributed Wind Turbines
J.R. Custom Metal Production, Wichita, KS	Power Transmission - Machining/ Fabrication
Jupiter Group, Junction City, KS	Material- Composites
Draka, Hutchinson, KS	Electrical Power Transmission
Siemens, Hutchinson, KS	Turbines

Table 4.2: Major Missouri Wind Turbine Component Manufacturers

Company	Component
ABB Inc., St. Louis, MO & Jefferson City, MO	Electrical
Able Manufacturing, Joplin, MO	Machining/Fabrication
AZZ Central Electric, Fulton, MO	Electrical Power Converter
CG Power Systems, Washington, MO	Power Transmission
Continental Disc Corporation, Liberty, MO	Power Transmission Brakes
FAG Bearings, Joplin, MO	Bearings
Lincoln Industrial, St. Louis, MO	Machinery
Nordic Wind Power, Kansas City, MO	Turbines
Schaeffler Group, Joplin, MO	Bearings
Sika Corporation, Grandview, MO	Material - Composites
Vest- Fiber, Moberly, MO	Nacelle Components
Zoltek, St. Peters, MO	Composites

Table 4.3: Major Illinois Wind Turbine Component Manufacturers

Company	Component
Afton Chemical, Sauget, IL	Power Transmission/Lubricants
Aldridge Electric, Chicago, IL	Electrical/Power Transmission
Amico, Bourbonnais, IL	Power Transmission Machining/Fabrication
Armacell, Chicago, IL	Material Composites
Brad Foote Gear Works, Cicero, IL	Power Transmission Gears
Castrol, Naperville, IL	Power Transmission Lubricants
Centa Corp., Aurora, IL	Power Transmission Couplings
Chicago Industrial Fasteners Sugar Grove, Aurora, IL	Structural Fasteners
Coleman Cable, Waukegan, IL	Electrical Power Transmission
Deublin Company, Waukegan, IL	Electrical Generator Components
Earle M. Jorgenson Company, Schaumburg, IL	Material Steel
Excel Gear, Roscoe. IL	Power Transmission Gears
Finkl and Sons, Chicago, IL	Structural Castings
G&W Electrical, Bolingbrook, IL	Electrical Power Transmission
Gleason, Rockford, IL	Equipment Manufacturing Machinery
Harger Lightning and Grounding, Grays Lake, IL	Equipment Other Equipment
Harting Inc., Elgin, IL	Electrical Power Transmission
Hydac, Glendale Height, IL	Power Transmission Hydraulics
Ingersoll Cutting Tools, Rockford, IL	Equipment Manufacturing Machinery
Ingersoll Machine Tools, Rockford, IL	Power Transmission Machining/Fabrication
NTN Bearings, Macomb, IL	Power Transmission Bearings
S&C Electric Company, Chicago, IL	Electrical Power Converter
Smalley Steel Ring Company, Lake Zurich, IL	Power Transmission Bearings
Southwire Company, Flora, IL	Wire & Cable
Specialty Metal Fabricators, Minonk, IL	Structural Steel Products
Stanley Machining & Tool, Hampshire, IL	Power Transmission Machining/Fabrication
Stanley Machining & Tool, Carpentersville, IL	Power Transmission Machining/Fabrication
Titan Tool Works, Carol, Stream, IL	Equipment, Construction
Trinity Structural Towers, Clinton, IL	Towers
Universal Steel, Crete, IL	Material Steel
Winergy, Elgin, IL	Gearboxes

Table 4.4: Major Indiana Wind Turbine Component Manufacturers

Company	Component
Ambassador Steel Corp., Auburn, IN	Material Steel
AOC LLC, Valparaso, IN	Composites
ATI Casting Service, La Porte, IN	Structural Castings
Bedford Machine & Tool, Bedford, IN	Power transmission Machining/Fabrication
Brevini Wind, Yorktown, IN	Gearboxes
Carlisle Industrial Brake and Friction, Bloomington, IN	Power transmission Brakes
Coleman Cable, Lafayette, IN	Electrical power transmission
Draka, Kouts, IN	Electrical
Global Blade Technology, Evansville, IN	Blades
Industrial Steel Construction, Gary, IN	Equipment Manufacturing machinery
Industrial Steel Construction, Heidtman Steel Products, IN	raw material supplier
KTR Corporation, Michigan City, IN	Power Transmission - coupling
NSK Americas, Franklin, IN	Power transmission - bearings
Oerlikon Fairfield, Lafayette, IN	gears
O'Neal Steel, Indianapolis, IN	steel products
Standard Locknut, Westfield, IN	Bearings
Transhield Inc., Elkhart, IN	Protective covers
Universal Steel America, Gary, IN	Structural/steel

In general, because the eight new wind farms will be located in Kansas, it is reasonable to assume that half of the domestically-sourced content would be produced in Kansas and that the remainder of the domestically sourced content would be evenly divided among the remaining three states. Combining this assumption with the assumed percentages of the different components that would be produced domestically and the 30 percent and 90 percent scenarios described above yields the percentages reported in Table 4.5, which summarizes the different scenarios that were estimated and the percentage of wind turbine components assumed to be produced in each state. For example, as shown in Table 4.5,under the 30 percent scenario, Kansas would produce 8.25 percent of the turbines (one half of 55 percent times 30 percent), while each of the remaining states would produce 2.75 percent of the turbines (one third of one half of 55 percent times 30 percent). However, certain states do not currently host a tower or blade manufacturer. Although it is possible that a manufacturer might build a new facility in such a state, we assumed no new facilities would be built in the relevant time frame. Currently, Kansas has no blade or tower manufacturers; Illinois has no blade manufacturer; and Missouri has no tower manufacturer. In each of these cases, we held the assumed four-state region supply share constant and shifted the assumed share from a state that had no manufacturer for that component to the remaining states in the region. Because the wind turbine nacelle has numerous component parts, we chose to keep the allocation the same even if a nacelle assembly plant was not located in a particular state.

Table 4.5: Baseline Scenarios for Location of Wind Turbine Components

		Kansas		Missouri		Illinois		Indiana	
Component	U.S.	30%	90%	30%	90%	30%	90%	30%	90%
Turbines	55%	8.25%	24.75%	2.75%	8.25%	2.75%	8.25%	2.75%	8.25%
Blades	90%	0.00%	0.00%	13.50%	40.50%	0.00%	0.00%	13.50%	40.50%
Structures	90%	0.00%	0.00%	0.00%	0.00%	13.50%	40.50%	13.50%	40.50%
Transportation	100%	15.0%	45.0%	5.00%	15.00%	5.00%	15.00%	5.00%	15.00%

4.1 Kansas

The economic impact in Kansas has two parts: the direct impact of the construction of the wind farms that are built in Kansas (4,000 MW) and the indirect and induced impacts that include the supply chain impacts. Table 4.6 displays the direct expenditure estimates from the JEDI model under the two scenarios outlined earlier for the 4,000 MW of wind farms built in Kansas. The only change that occurs among the scenarios is the amount of installed project costs that are spent in Kansas. Spending in Kansas is $1.5 billion in the 30 percent scenario and $2.2 billion in the 90 percent scenario. The JEDI model estimates annual operational expenses for the 4,000 MW of Kansas wind farms at $1.1 billion. Total direct operating and maintenance costs amount to $80 million, with $21 million spent in Kansas. Taxes, financing costs, land leases and other expenses amount to $1,046 million, with $24 million spent in Kansas. The local spending in Kansas is determined by the JEDI model using its default values. These annual costs stay the same in the 30 percent and 90 percent scenario because the source of the equipment does not have an effect on the operations and maintenance costs.

Table 4.6: Kansas Direct Expenditure Estimates from JEDI Model for 4,000 MW of Kansas Wind Farms

	30% Scenario	90% Scenario
Installed Project Cost[1]	$6,800	$6,800
Local (Kansas) Spending	$1,522	$2,194
Total Annual Operational Expenses (O&M, financing costs, lease payments, and taxes)	$1,126	$1,126
Direct Operating and Maintenance Costs	$80	$80
Local (Kansas) Spending	$21	$21
Other Annual Costs (Taxes, financing costs, land leases, etc.)	$1,046	$1,046
Local (Kansas) Spending	$24	$24

1. All spending is in millions of 2013 $ and is rounded.

As shown in Table 4.7, in the 30 percent scenario, employment impacts during construction include 1,989 jobs for project development and on-site labor, 10,863 jobs due to turbine and supply chain impacts, and 2,690 jobs from induced impacts, for a total of 15,542 jobs. During the operating years, 181 on-site jobs will be created, local revenue and supply chain impacts will result in 242 jobs, and induced impacts will contribute another 104 jobs, resulting in a total of 528 new jobs. During construction, earnings will increase by a total of $779 million and total output will increase by approximately $2.3 billion. During the operating years, earnings will increase by $25 million and total output will increase by $73 million annually. As shown in Table 4.8, impacts increase to 19,656 new jobs and $3.3 billion in output during construction under the 90 percent scenario.

Table 4.7: Kansas Wind Farms Economic Impacts from JEDI Model for 4,000 MW of Kansas Wind Farms – Summary Results for 30 Percent Scenario

Impacts[1]	Employment[2]	Earnings	Output
During Construction Period			
Project Development and Onsite Labor Impacts	1,989	$103.5	$122.7
Turbine and Supply Chain Impacts	10,863	$563.9	$1,805.4
Induced Impacts	2,690	$111.3	$355.4
Total	15,542	$778.8	$2,283.5
During Operating Years (annual)			
Onsite Labor Impacts	181	$9.3	$9.3
Local Revenue and Supply Chain Impacts	242	$11.3	$50.2
Induced Impacts	104	$4.3	$13.7
Total	528	$25.0	$73.3

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

Table 4.8: Kansas Wind Farms Economic Impacts from JEDI Model for 4,000 MW of Kansas Wind Farms – Summary Results for 90 Percent Scenario

Impacts[1]	Employment[2]	Earnings	Output
During Construction Period			
Project Development and Onsite Labor Impacts	1,989	$103.5	$122.7
Turbine and Supply Chain Impacts	14,034	$772.2	$2,665.1
Induced Impacts	3,633	$150.3	$480.0
Total Impacts	19,656	$1,026.1	$3,267.7
During Operating Years (annual)			
Onsite Labor Impacts	181	$9.3	$9.3
Local Revenue and Supply Chain Impacts	242	$11.3	$50.2
Induced Impacts	104	$4.3	$13.7
Total Impacts	528	$25.0	$73.3

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

Sections 4.2 – 4.4 describe the estimated impacts on the Missouri, Illinois, and Indiana economies that are attributable to the wind farms we assume would be built in Kansas as a result of the Grain Belt Express Clean Line transmission line. Because all of the wind farms are assumed to be built in Kansas, we consider only the supply chain aspects of the new wind farm capacity for Missouri, Illinois, and Indiana. The total direct expenditure estimates for the two scenarios (30 percent and 90 percent) are the same direct expenditures reported in Table 4.6. Once again, the only difference between the two scenarios is the amount of the project costs that are assumed to be spent in each of the three remaining states.

4.2 Missouri

As shown in Table 4.5, we assume that 2.75 percent of the turbine components, 13.5 percent of the blades and 5 percent of the transportation would be sourced from Missouri under the 30 percent scenario. In the 90 percent scenario, 8.25 percent of the turbine components, 40.5 percent of the blades, and 15 percent of the transportation would be sourced from Missouri. Referring to Table 4.9, total spending in Missouri would range from $209 million under the 30 percent scenario to $627 million under the 90 percent scenario.

Table 4.9: Missouri Direct Expenditure Estimates from JEDI Model for 4,000 MW of Wind Farms Built in Kansas

Expenditures[1]	30% Scenario	90% Scenario
Installed Project Cost	$6,800	$6,800
Local (Missouri) Spending	$209	$627
Total Annual Operational Expenses (O&M, financing costs, lease payments, and taxes)	$1,134	$1,134
Direct Operating and Maintenance Costs	$80	$80
Local (Missouri) Spending	$0	$0
Other Annual Costs (Taxes, financing costs, land leases, etc.)	$1,054	$1,054
Local (Missouri) Spending	$0	$0

1. All spending is in millions of 2013 $ and is rounded.

Tables 4.10 and 4.11 summarize the estimated impacts in Missouri under the 30 percent and 90 percent scenarios. Estimated employment impacts range from approximately 1,311 to 3,933 jobs, and output impacts range from $329 million to $987 million. There are no operating year impacts because the wind farms are assumed to be located outside of Missouri.

Table 4.10: Missouri Supply Chain Economic Impacts from JEDI Model for 4,000 MW of Wind Farms Built in Kansas – Summary Results for 30 Percent Scenario

Impacts[1]	Employment[2]	Earnings	Output
During Construction Period			
Project Development and Onsite Labor Impacts	0	$0	$0
Turbine and Supply Chain Impacts	980	$65.3	$284.3
Induced Impacts	331	$14.5	$44.7
Total Impacts	1,311	$79.8	$329.0

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

Table 4.11: Missouri Supply Chain Economic Impacts from JEDI Model for 4,000 MW of Wind Farms Built in Kansas – Summary Results for 90 Percent Scenario

Impacts[1]	Employment[2]	Earnings	Output
During Construction Period			
Project Development and Onsite Labor Impacts	0	$0	$0
Turbine and Supply Chain Impacts	2,939	$196.0	$852.9
Induced Impacts	994	$43.5	$134.0
Total Impacts	3,933	$239.5	$986.9

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

4.3 Illinois

As shown in Table 4.5, we assume that 2.75 percent of the turbine components, 13.5 percent of the structures, and 5 percent of the transportation would be sourced from Illinois under the 30 percent scenario. For the 90 percent scenario, 8.25 percent of the turbine components, 40.5 percent of the structures, and 15 percent of the transportation would be sourced in Illinois. Referring to Table 4.12, total spending in Illinois in each of these scenarios would range from $218 million under the 30 percent scenario to $654 million under the 90 percent scenario.

Table 4.12: Illinois Direct Expenditure Estimates from JEDI Model for 4,000 MW of Wind Farms Built in Kansas

Expenditures[1]	30% Scenario	90% Scenario
Installed Project Cost	$6,800	$6,800
Local (Illinois) Spending	$218	$654
Total Annual Operational Expenses (O&M, financing costs, lease payments, and taxes)	$1,142	$1,142
Direct Operating and Maintenance Costs	$80	$80
Local (Illinois) Spending	$0	$0
Other Annual Costs (Taxes, financing costs, land leases, etc.)	$1,062	$1,062
Local (Illinois) Spending	$0	$0

1. All spending is in millions of 2013 $ and is rounded.

Tables 4.13 and 4.14 summarize the estimated impacts in Illinois under the 30 percent and 90 percent scenarios. Estimated employment impacts range from approximately 1,471 to 4,412 jobs, and output impacts range from $381 million to $1.14 billion. There are no operating year impacts because the wind farms are assumed to be located outside of Illinois.

Table 4.13: Illinois Supply Chain Economic Impacts from JEDI Model for 4,000 MW of Wind Farms Built in Kansas – Summary Results for 30 Percent Scenario

Impacts[1]	Employment[2]	Earnings	Output
During Construction Period			
Project Development and Onsite Labor Impacts	0	$0	$0
Turbine and Supply Chain Impacts	1,061	$81.6	$315.4
Induced Impacts	410	$22.4	$65.7
Total Impacts	1,471	$104.0	$381.1

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

Table 4.14: Illinois Supply Chain Economic Impacts from JEDI Model for 4,000 MW of Wind Farms Built in Kansas – Summary Results for 90 Percent Scenario

Impacts[1]	Employment[2]	Earnings	Output
During Construction Period			
Project Development and Onsite Labor Impacts	0	$0	$0
Turbine and Supply Chain Impacts	3,182	$244.7	$946.3
Induced Impacts	1,230	$67.2	$197.1
Total Impacts	4,412	$311.9	$1,143.4

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

4.4 Indiana

As shown in Table 4.5, we assume that 2.75 percent of the turbine components, 13.5 percent of the blades, 13.5 percent of the structures, and 5 percent of the transportation would be sourced from Indiana under the 30 percent scenario. In the 90 percent scenario, 8.25 percent of the turbine components, 40.5 percent of the blades, 40.5 percent of the structures, and 15 percent of the transportation would be sourced from Indiana. Referring to Table 4.15, total spending in Indiana in each of these scenarios would range from $316 million under the 30 percent scenario to $949 million under the 90 percent scenario.

Table 4.15: Indiana Direct Expenditure Estimates from JEDI Model for 4,000 MW of Wind Farms Built in Kansas

Expenditures[1]	30% Scenario	90% Scenario
Installed Project Cost	$6,800	$6,800
Local (Indiana) Spending	$316	$949
Total Annual Operational Expenses (O&M, financing costs, lease payments, and taxes)	$1,178	$1,178
Direct Operating and Maintenance Costs	$80	$80
Local (Indiana) Spending	$0	$0
Other Annual Costs (Taxes, financing costs, land leases, etc.)	$1,098	$1,098
Local (Indiana) Spending	$0	$0

1. All spending is in millions of 2013 $ and is rounded.

Tables 4.16 and 4.17 summarize the estimated impacts in Indiana under the 30 percent and 90 percent scenarios. Estimated employment impacts range from approximately 1,872 to 5,617 jobs, and output impacts range from $472 million to $1.42 billion. There are no operating year impacts because the wind farms are assumed to be located outside of Indiana.

Table 4.16: Indiana Supply Chain Economic Impacts from JEDI Model for 4,000 MW of Wind Farms Built in Kansas – Summary Results for 30 Percent Scenario

Impacts[1]	Employment[2]	Earnings	Output
During Construction Period			
Project Development and Onsite Labor Impacts	0	$0	$0
Turbine and Supply Chain Impacts	1,398	$94.3	$412.2
Induced Impacts	475	$19.2	$60.3
Total Impacts	1,872	$113.5	$472.5

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

Table 4.17: Indiana Supply Chain Economic Impacts from JEDI Model for 4,000 MW of Wind Farms Built in Kansas – Summary Results for 90 percent Scenario

Impacts[1]	Employment[2]	Earnings	Output
During Construction Period			
Project Development and Onsite Labor Impacts	0	$0	$0
Turbine and Supply Chain Impacts	4,193	$283.0	$1,236.7
Induced Impacts	1,424	$57.5	$180.8
Total Impacts	5,617	$340.6	$1,417.5

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

4.5 United States

To estimate impacts at the national level, we assumed that 55 percent of the nacelles, 90 percent of the blades, and 90 percent of the structures would be manufactured in the United States along with 100 percent of the transportation for all 4,000 MW of new generating capacity. Table 4.18 summarizes the resulting direct expenditure estimates.

Table 4.18: United States Direct Expenditure Estimates from JEDI Model of 4,000 MW of Wind Farms

Expenditure[1]	Amount
Installed Project Cost	$6,800
Local (U.S.) Spending	$5,269
Total Annual Operational Expenses (O&M, financing costs, lease payments, and taxes)	$1,144
Direct Operating and Maintenance Costs	$80
Local (U.S.) Spending	$52
Other Annual Costs (Taxes, financing costs, land leases, etc.)	$1,064
Local (U.S.) Spending	$1,064

1. All spending is in millions of 2013 $ and is rounded.

Table 4.19 summarizes the national economic impacts resulting from the 4,000 MW of wind farms. During construction, approximately 71,075 jobs will be created and during the operating years, 3,360 jobs will be created. Total output is predicted to increase by approximately $15.1 billion during construction and $981 million during operation.

Table 4.19: United States Direct Expenditure Estimates from JEDI Model of 4,000 MW of Wind Farms – Summary Results

Impacts[1]	Employment[2]	Earnings	Output
During Construction Period			
Project Development and Onsite Labor Impacts	3,157	$219.5	$271.7
Turbine and Supply Chain Impacts	39,524	$2,691.7	$10,024.3
Induced Impacts	28,394	$1,510.5	$4,864.6
Total Impacts	71,075	$4,421.7	$15,160.5
During Operating Years (annual)			
Onsite Labor Impacts	200	$11.3	$11.3
Local Revenue and Supply Chain Impacts	1,342	$82.7	$658.5
Induced Impacts	1,818	$96.7	$311.5
Total Impacts	3,360	$190.7	$981.4

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

5 Fiscal Impacts: Transmission Line Construction and Operations

The IMPLAN model was also used to estimate various tax-related impacts of a projected increase in final demand in the economy. The tax impacts considered here include individual income tax, corporate income tax, and sales tax revenues in Kansas, Missouri, Illinois, and Indiana attributable to the manufacture of required components and construction of that segment of the Grain Belt Express Clean Line that will be located in each state. The impacts reported here do not reflect any specific tax-related incentives that any one of the states might offer to Clean Line.

5.1 Manufacturing and Construction

Projected increases in tax revenues in Kansas, Missouri, Illinois, and Indiana attributable to increased spending on manufacturing of structures and wire; construction of the transmission line; installation of a transformer; the payment of fees for the required right-of-way, architectural, and financial services; and the purchase of electric power associated with the line are summarized in Tables 5.1 – 5.4.

5.1.1 Kansas

As shown in Table 5.1, it is estimated that the direct, indirect, and induced impacts resulting from the manufacturing and construction of that segment of the Grain Belt Express Clean Line located in Kansas would yield $8.47 million in income taxes paid by individuals, $1.17 million in corporate income taxes, and $10.64 million in sales tax revenues over the three-year construction period. This translates to an average annual increase in tax revenues attributable to these three revenue streams of $6.76 million per year over the three-year period.

Table 5.1: Estimated Fiscal Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Kansas

Component	Individual Income Tax[1]	Corporate Income Tax	Sales Tax	Total	Annual Average[2]
Installation of Structures	$5.06	$0.53	$6.23	$11.82	$3.94
Manufacture Structures	$0.78	$0.13	$1.15	$2.06	$0.69
Manufacture Wire	$0.26	$0.06	$0.38	$0.70	$0.23
Architectural Services	$0.62	$0.05	$0.65	$1.32	$0.44
Right of Way	$0.15	$0.20	$1.59	$1.94	$0.65
Financial	$0.08	$0.02	$0.18	$0.28	$0.09
Electric Power	$0.04	$0.03	$0.45	$0.52	$0.17
Installation of Converter	$1.49	$0.16	$0.00[3]	$1.64	$0.55
Totals	$8.47	$1.17	$10.64	$20.28	$6.76

1. All impacts are in millions of 2013 $ and are rounded.
2. Assumes a three-year construction period.
3. Sales taxes from converter installation are set at 0 on the assumption that the converter stations might qualify for a tax relief exemption.

5.1.2 Missouri

As shown in Table 5.2, it is estimated that the direct, indirect, and induced impacts resulting from the manufacturing and construction of that segment of the Grain Belt Express Clean Line located in Missouri would yield $4.19 million in income taxes paid by individuals, $280 thousand in corporate income taxes, and $6.75 million in sales tax revenues over the three-year construction period. This translates to an average annual increase in tax revenues attributable to these three revenue streams of $3.74 million per year over the three-year period.

Table 5.2: Estimated Fiscal Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Missouri

Component	Individual Income Tax[1]	Corporate Income Tax	Sales Tax	Total	Annual Average[2]
Installation of Structures	$2.68	$0.13	$3.96	$6.77	$2.26
Manufacture Structures	$0.43	$0.03	$0.78	$1.24	$0.41
Manufacture Wire	$0.13	$0.01	$0.25	$0.40	$0.13
Architectural Services	$0.33	$0.01	$0.43	$0.78	$0.26
Right of Way	$0.08	$0.05	$0.94	$1.07	$0.36
Financial	$0.05	$0.01	$0.14	$0.20	$0.07
Electric Power	$0.02	$0.01	$0.25	$0.28	$0.09
Installation of Converter	$0.46	$0.02	$0.00	$0.48	$0.16
Totals	$4.19	$0.28	$6.75	$11.22	$3.74

1. All impacts are in millions of 2013 $ and are rounded.
2. Assumes a three-year construction period.
3. Sales taxes from converter installation are set at 0 on the assumption that the converter stations might qualify for a tax relief exemption.

5.1.3 Illinois

As shown in Table 5.3, it is estimated that the direct, indirect, and induced impacts resulting from the manufacturing and construction of that segment of the Grain Belt Express Clean Line located in Illinois would yield $4.18 million in income taxes paid by individuals, $1.12 million in corporate income taxes, and $6.48 million in sales tax revenues over the three-year construction period. This translates to an average annual increase in tax revenues attributable to these three revenue streams of $3.93 million per year over the three-year period.

Table 5.3: Estimated Fiscal Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Illinois

Component	Individual Income Tax[1]	Corporate Income Tax	Sales Tax	Total	Annual Average[2]
Installation of Structures	$2.18	$0.45	$3.78	$6.41	$2.14
Manufacture Structures	$0.36	$0.12	$0.76	$1.24	$0.41
Manufacture Wire	$0.14	$0.06	$0.25	$0.45	$0.15
Architectural Services	$0.26	$0.05	$0.41	$0.71	$0.24
Right of Way	$0.06	$0.16	$0.90	$1.12	$0.37
Financial	$0.04	$0.03	$0.14	$0.21	$0.07
Electric Power	$0.02	$0.02	$0.25	$0.28	$0.09
Installation of Converter	$1.12	$0.23	$0.00	$1.35	$0.45
Totals	$4.18	$1.12	$6.48	$11.78	$3.93

1. All impacts are in millions of 2013 $ and are rounded.
2. Assumes a three-year construction period.
3. Sales taxes from converter installation are set at 0 on the assumption that the converter stations might qualify for a tax relief exemption.

5.1.4 Indiana

As shown in Table 5.4, it is estimated that the direct, indirect, and induced impacts resulting from the manufacturing and construction of that segment of the Grain Belt Express Clean Line located in Indiana would yield $143 thousand in income taxes paid by individuals, $15 thousand in corporate income taxes, and $63 thousand in sales tax revenues over the three-year construction period. This translates to an average annual increase in tax revenues attributable to these three revenue streams of $74 thousand per year over the three-year period.

Table 5.4: Estimated Fiscal Impacts of Manufacturing and Construction of Grain Belt Express Clean Line in Indiana

Component	Individual Income Tax[1]	Corporate Income Tax	Sales Tax	Total	Annual Average[2]
Installation of Structures	$0.030	$0.003	$0.037	$0.069	$0.023
Manufacture Structures	$0.005	$0.001	$0.007	$0.012	$0.004
Manufacture Wire	$0.002	$0.000	$0.002	$0.004	$0.001
Architectural Services	$0.004	$0.000	$0.004	$0.008	$0.003
Right of Way	$0.001	$0.001	$0.009	$0.011	$0.004
Financial	$0.000	$0.000	$0.001	$0.002	$0.001
Electric Power	$0.000	$0.000	$0.003	$0.003	$0.001
Installation of Transformer	$0.102	$0.010	$0.000	$0.112	$0.037
Totals	$0.143	$0.015	$0.063	$0.221	$0.074

1. All impacts are in millions of 2013 $ and are rounded.
2. Assumes a three-year construction period.
3. Sales taxes from transformer installation are set at 0 on the assumption that the transformer station might qualify for a tax relief exemption.

5.2 Operations and Maintenance

As we discussed in Section 3, once the transmission line is built and is in operation, O&M costs will contribute $10.0 million of additional spending to the Kansas economy each year. The corresponding amounts for Missouri, Illinois, and Indiana are $5.0 million, $7.0 million, and $0.2 million, respectively. The estimated tax-related impacts of annual O&M expenditures in each state are summarized in Tables 5.5 – 5.8.

Table 5.5: Estimated Annual Fiscal Impacts of Grain Belt Express Clean Line O&M Expenditures in Kansas

Impact[1]	Total
Individual Income Tax	$0.162
Corporate Income Tax	$0.016
Sales Tax	$0.201
Total	$0.379

1. All impacts are in millions of 2013 $ and are rounded.

5.2.1 Kansas

Referring to Table 5.5, in Kansas annual individual income tax revenues, corporate income taxes, and sales tax revenues are predicted to amount to $162 thousand, $16 thousand, and $201 thousand per year, respectively. The combined total is $379 thousand in additional tax revenues each year.

Table 5.6: Estimated Annual Fiscal Impacts of Grain Belt Express Clean Line O&M Expenditures in Missouri

Impact[1]	Total
Individual Income Tax	$0.074
Corporate Income Tax	$0.004
Sales Tax	$0.111
Total	$0.189

1. All impacts are in millions of 2013 $ and are rounded.

5.2.2 Missouri

Referring to Table 5.6, in Missouri annual individual income tax revenues, corporate income taxes, and sales tax revenues are predicted to amount to $74 thousand, $4 thousand, and $111 thousand per year, respectively. The combined total is $189 thousand in additional tax revenues each year.

Table 5.7: Estimated Annual Fiscal Impacts of Grain Belt Express Clean Line O&M Expenditures in Illinois

Impact[1]	Total
Individual Income Tax	$0.084
Corporate Income Tax	$0.017
Sales Tax	$0.146
Total	$0.247

1. All impacts are in millions of 2013 $ and are rounded.

5.2.3 Illinois

Referring to Table 5.7, in Illinois annual individual income tax revenues, corporate income taxes, and sales tax revenues are predicted to amount to $84 thousand, $17 thousand, and $146 thousand per year, respectively. The combined total is $247 thousand in additional tax revenues each year.

5.2.1 Indiana

Referring to Table 5.8, in Indiana annual individual income tax revenues and sales tax revenues are predicted to amount to $4 thousand and $5 thousand per year, respectively. The combined total is $9 thousand in additional tax revenues each year.

Table 5.8: Estimated Annual Fiscal Impacts of Grain Belt Express Clean Line O&M Expenditures in Indiana

Impact[1]	Total
Individual Income Tax	$0.004
Corporate Income Tax	$0.000
Sales Tax	$0.005
Total	$0.009

1. All impacts are in millions of 2013 $ and are rounded.

6 Summary of Economic Impacts

The construction of the proposed Grain Belt Express Clean Line has the potential to yield substantial economic impacts in Kansas, Missouri, Illinois, Indiana, and the nation over the projected three-year construction period. Referring to Table 6.1, manufacturing of structures and wire and construction of the line could potentially increase employment by approximately 2,340 jobs in Kansas, 1,315 jobs in Missouri, 1,450 jobs in Illinois, and 38 jobs in Indiana in each year of the three-year construction period. Labor income would increase $131.5 million per year in Kansas, $77 million in Missouri, $100.8 million in Illinois, and $2.2 million in Indiana during the same time frame.

Table 6.1: Estimated Annual Average Manufacturing- and Construction-Related Impacts of the Grain Belt Express Clean Line in Kansas, Missouri, Illinois, Indiana, and the United States

Impact[1, 2]	Kansas	Missouri	Illinois	Indiana	U.S.
Employment	2,340	1,315	1,450	38	8,255
Labor Income	$131.5	$77.0	$100.8	$2.2	$527.2
Output	$371.0	$206.0	$251.1	$5.7	$1,633.8

1. All impacts are in millions of 2013 $ and are rounded.
2. Assumes a three-year construction period

Table 6.2: Estimated Annual O&M-Related Impacts[1] of the Grain Belt Express Clean Line in Kansas, Missouri, Illinois, Indiana, and the United States

Impact[1]	Kansas	Missouri	Illinois	Indiana	U.S.
Employment[2]	135	70	88	3	383
Labor Income[3]	$7.6	$4.1	$6.1	$0.19	$24.0
Output	$17.7	$9.2	$13.1	$0.43	$61.0

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents
3. Labor Income = Employee compensation + Proprietor income

Once completed, operation and maintenance of the line would continue to yield economic benefits to each state. Referring to Table 6.2, potential annual employment impacts in Kansas include 143 jobs and $6 million in labor income. Missouri could see an additional 70 jobs and $4.1 million of labor income each year. The corresponding totals in Illinois are 88 jobs and $6.1 million in additional labor income. In Indiana, there would be 3 additional jobs and $190 thousand in additional labor income.

Table 6.3: Estimated Annual[1] Fiscal Impacts[2] of Construction of Grain Belt Express Clean Line in 4-State Region

Impact	Kansas	Missouri	Illinois	Indiana
Individual Income Tax	$2.82	$1.40	$1.39	$0.048
Corporate Income Tax	$0.39	$0.09	$0.37	$0.005
Sales Tax	$3.55	$2.25	$2.16	$0.021
Total	$6.76	$3.74	$3.93	$0.074

1. Construction period = 3 years
2. All monetary impacts are in millions of 2013 $ and are rounded.

Table 6.3 lists fiscal impacts attributable to manufacture and construction of the transmission line. Tax revenues from the sources listed there could amount to $6.76 million in Kansas, $3.74 million in Missouri, $3.93 million in Illinois, and $74 thousand in Indiana each year of the three-year period.

Table 6.4: Summary of Estimated Annual Fiscal Impacts[1] of O&M Expenditures

	Kansas	Missouri	Illinois	Indiana
Individual Income Tax	$0.162	$0.074	$0.084	$0.004
Corporate Income Tax	$0.016	$0.004	$0.017	$0.000
Sales Tax	$0.201	$0.111	$0.146	$0.005
Total	$0.379	$0.189	$0.247	$0.009

1. All monetary impacts are in millions of 2013 $ and are rounded.

Finally, as shown in Table 6.4, annual tax revenues from the sources listed there resulting from operation and maintenance of the line could amount to $379 thousand in Kansas, $189 thousand in Missouri, $247 thousand in Illinois, and 9 thousand in Indiana.

Table 6.5: Kansas Wind Farms Economic Impacts

Impacts[1]	Employment[2]	Earnings	Output
Total Construction Impacts 30% Scenario	15,542	$778.8	$2,283.5
Total Construction Impacts 90% Scenario	19,656	$1,026.1	$3,267.7
Total Operating Year Impacts – All Scenarios	528	$25.0	$73.3

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

The construction of additional wind farms which the proposed transmission line is expected to stimulate has the potential to result in significant economic impacts as well. Table 6.5 summarizes the estimated total economic impacts during the construction period in Kansas under the 30 percent and 90 percent scenarios. The potential total employment impacts during construction range from 15,542 to 19,656 jobs, with output expanding by $2.2 billion to $3.3 billion under the 30 percent and 90 percent scenarios, respectively. We also estimate that during operations, the wind farms built in Kansas would result in 528 jobs, $25 million in earnings, and $73 million in output annually.

Table 6.6: Missouri, Illinois, and Indiana Wind Farms Economic Impacts

State	Total Construction Impacts[1]	Employment[2]	Earnings	Output
Missouri	30% Scenario	1,311	$79.8	$329.0
	90 % Scenario	3,933	$239.5	$986.9
Illinois	30% Scenario	1,471	$104.0	$381.1
	90 % Scenario	4,412	$311.9	$1,143.4
Indiana	30% Scenario	1,872	$113.5	$472.5
	90 % Scenario	5,617	$340.6	$1,417.5

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

While Missouri, Illinois and Indiana would experience smaller overall impacts than Kansas because the new wind farms would not be built in those states, substantial economic benefits would still accrue to those states. As shown in Table 6.6, the total employment impacts of supply chain effects during construction would range from 1,311 to 3,933 jobs in Missouri, from 1,471 to 4,412 in Illinois and from 1,872 to 5,617 in Indiana.

Table 6.7: National Economic Impacts of Wind Farm Construction and Operation

Total Impacts[1]	Employment[2]	Earnings	Output
Construction Impacts	71,075	$4,421.7	$15,160.5
Annual Operating Impacts	3,360	$190.7	$981.4

1. All monetary impacts are in millions of 2013 $ and are rounded.
2. All employment figures are full time equivalents.

Finally, the economic impacts of the wind farms on the United States as a whole are summarized in Table 6.7. Construction of the wind farms could result in 71,075 jobs, $4.4 billion in earnings, and $15.2 billion in output. Operation of the new wind farms could generate approximately 3,360 jobs, $191million in earnings, and $981 million in output annually.

APPENDIX

Qualifications

Dr. David G. Loomis

Dr. David G. Loomis is president of Strategic Economic Research, LLC and Professor of Economics at Illinois State University where he teaches in the Master's Degree program in electricity, natural gas and telecommunications economics. Dr. Loomis is Director of the Center for Renewable Energy and Executive Director of the Institute for Regulatory Policy Studies. As part of his duties, he leads the Illinois Wind Working Group under the U.S. Department of Energy. Dr. Loomis is part of a team of faculty that has designed a new undergraduate curriculum in renewable energy at Illinois State University. Dr. Loomis earned his Ph.D. in economics at Temple University.

Dr. Loomis co-authored several industry reports relevant to this report, including *The Economic Impact of Wind Energy in Illinois* (co-authored with Sarah Noll and Jared Hayden, 2012) and *The Economic Impact of the Wind Turbine Supply Chain in Illinois* (co-authored with J. Lon Carlson and James E. Payne, 2010).

Prior to joining the faculty at Illinois State University, Dr. Loomis worked at Bell Atlantic (Verizon) for 11 years. He has published articles in the *Energy Policy, Energy Economics, Electricity Journal, Review of Industrial Organization, Utilities Policy, Information Economics and Policy, International Journal of Forecasting, International Journal of Business Research, Business Economics* and the *Journal of Economics Education.*

Dr. J. Lon Carlson

Dr. J. Lon Carlson is an independent consultant who recently retired as an Associate Professor in the Department of Economics at Illinois State University and Director of Outreach for the Institute for Regulatory Policy Studies. His research on energy issues and environmental economics has appeared in several outlets, including *The Electricity Journal, Energy Policy, Natural Resources Journal, the Boston College Environmental Affairs Law Review, the Journal of the Air and Waste Management Association, and the Journal of Applied Economics Letters.*

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GL Garrad Hassan

GRAIN BELT EXPRESS PROJECT
Benefits Study

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1 EXECUTIVE SUMMARY

GL Garrad Hassan ("GL GH") was engaged by Clean Line Energy Partners to perform a benefit study for the Grain Belt Express Clean Line ("Grain Belt Express Project" or the "Project"), a new HVDC transmission line designed to deliver wind energy from western Kansas into Missouri and Indiana. The study methodology is based on analysis of market simulations for a representative future year, capturing the operational impacts of building the Grain Belt Express Project. This report provides a quantitative analysis of benefits and impacts of the new transmission line under a variety of possible futures.

Overview of Methodology & Assumptions

GL GH utilizes Ventyx's PROMOD software, a detailed economic market model, to conduct analysis of energy market system operations under a defined set of future conditions. The analysis is based on a detailed simulation for all hours of each study year covering a broad range of load, outage, wind, and other system conditions. The software captures detailed transmission powerflow constraints and nodal market operation under security constrained economic commitment and dispatch.

Simulations of future energy markets for representative study year 2019 were performed to assess the economic impact of the Grain Belt Express Project on system operations in Indiana and surrounding regions. The simulations encompassed energy markets and transmission grids throughout the eastern United States including PJM, MISO, SPP, the New York Independent System Operator, the Ontario Independent Electricity System Operator, Entergy, and Tennessee Valley Authority, as well as other utility systems in the southeastern U.S. that are not currently participating in RTOs.

In order to develop a robust view of impacts and benefits, simulations were performed across several possible future market scenarios. Each scenario was evaluated both with and without the Grain Belt Express Project and system operations were compared in order to identify benefits resulting specifically from the inclusion of the Grain Belt Express Project. Study scenarios were defined as follows:

Business As Usual – Energy demand grows under a moderate economic recovery with no major changes to existing environmental policy, generating technologies, fuel commodity prices, or other key energy market assumptions.

Slow Growth – Continuation of depressed economic conditions characterized by slow demand growth, continued low fuel commodity prices, and minimal transmission/generation expansion.

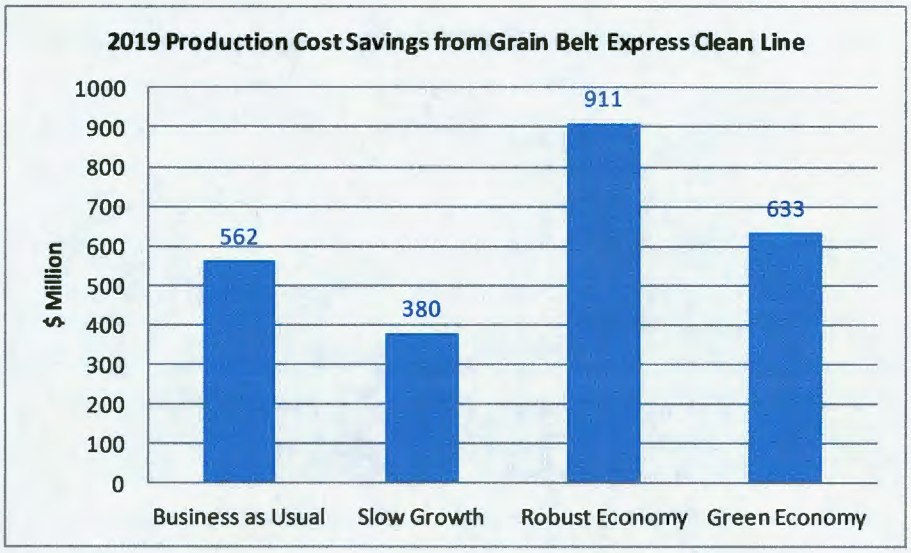
Robust Economy – Strong recovery in economic activity characterized by accelerated growth in electrical demand, higher fuel prices and emission allowances prices, and increased activity in new generation and transmission projects.

Green Economy – Expansion in environmental policy including carbon regulation and a federal renewable portfolio standard under robust economic conditions including high demand growth, an increase in fuel prices, and increased activity in new generation and transmission projects.

Summary of Results

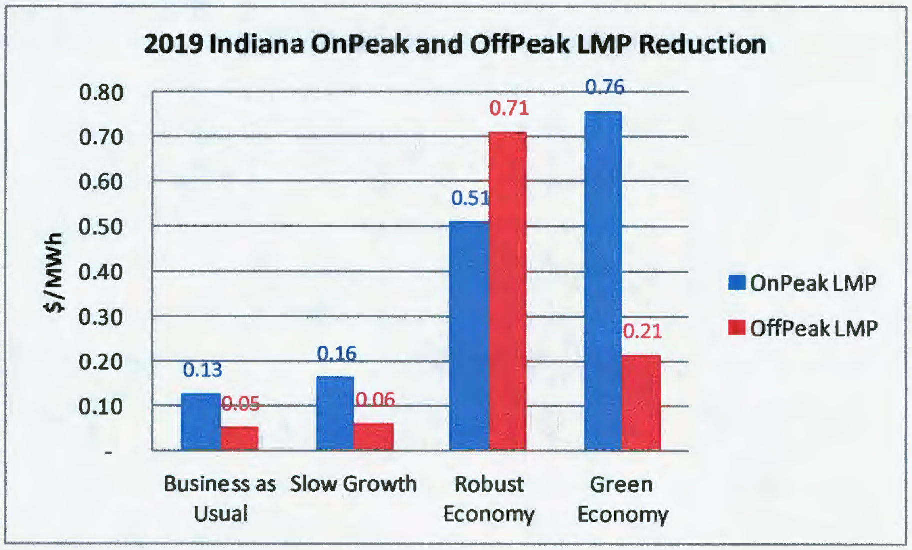
The Grain Belt Express Project reduces total variable production costs in the eastern United States under each of the future scenarios, as shown in Figure 1-1.

Figure 1-1: Production Cost Savings by Scenario



The Grain Belt Express Project also lowers LMP ($/MWh) in both the On Peak period and Off Peak period in Indiana in each of the future scenarios. Figure 1-2 illustrates the impact of the Grain Belt Express Project on Indiana load LMPs for the on-peak and off-peak periods.

Figure 1-2: Change in 2019 Indiana LMP Due to Grain Belt Express Project



Demand cost represents the cost to supply load to end-use customers in a region and is calculated by multiplying the average load-weighted LMP times the demand in each hour of the study year. The demand cost in each hour is then summed across the year to arrive at an annual demand cost value.

The LMP for Indiana is driven lower by the addition of the Grain Belt Express Project and the associated wind energy injection, so it follows that the demand cost will likewise be reduced. The surrounding areas in MISO and PJM also benefit by reduced demand costs. Table 1-1 below shows the impact of the Grain Belt Express Project on Indiana Demand Cost and on MISO and PJM overall Demand Cost for 2019.

Table 1-1: 2019 Demand Cost Savings by Scenario

2019 Demand Cost Savings in $ Million				
Area / Region	**Business as Usual**	**Slow Growth**	**Robust Economy**	**Green Economy**
Indiana	13	14	79	88
PJM	421	310	830	379
Midwest ISO	119	30	370	78

The Grain Belt Express Project reduces emissions of NOx, SO_2, CO_2, and mercury, and also reduces water usage in power generation in the eastern United States under each of the future scenarios as shown in Table 1-2.

Table 1-2: Environmental Benefits of Grain Belt Express Project

	Business as Usual	**Slow Growth**	**Robust Economy**	**Green Economy**
Reduction in NOx (tons)	5,538	7,254	3,504	3,556
Reduction in SOx (tons)	9,868	9,730	6,374	7,841
Reduction in CO2 (tons)	7,434,958	10,345,743	5,704,144	5,402,264
Reduction in Hg (lbs)	83	110	46	96
Reduction in Water (MGal)	3,150	3,915	2,556	2,800

The emissions and water usage reductions are direct results of the reduced need for conventional, emissions-producing generation due to the addition of new wind resources facilitated by the Grain Belt Express Project.

2 METHODOLOGY

GL Garrad Hassan has extensive experience in performing transmission benefits studies and utilizes industry best practices in establishing study design and assumptions. This section provides an overview of the key elements and processes employed to assess benefits for the Grain Belt Express Project, including GL GH's approach to long-term transmission analysis.

2.1 Study Design

The PROMOD production cost model was used to perform simulations of future energy markets for the representative study year 2019, to assess the economic impact of the Grain Belt Express Project on system operations in Indiana and across the eastern United States. The simulations encompassed energy markets and transmission grids throughout the eastern United States including PJM, MISO, SPP, the New York Independent System Operator, the Ontario Independent Electricity System Operator, Entergy, and Tennessee Valley Authority, as well as other utility systems in the southeastern U.S. and elsewhere that are not currently participating in RTOs. In order to develop a robust view of impacts and benefits, simulations were performed across several possible future market scenarios both with and without the Grain Belt Express Project.

The study methodology used to assess the economic benefits of the Grain Belt Express Project includes the following primary activities:

1. Assumptions and scenario development – Study years and energy market scenarios are constructed to provide several plausible futures under which to evaluate the economic and environmental benefits of the project. A scenario-based approach is critical to ensure that economic results are robust across a variety of future conditions. For each scenario, specific assumptions are developed for modeling inputs such as future demand, future gas prices, new wind generation, and other key assumptions based on research and past modeling experience.

2. Base Case simulations - A full set of simulations is performed for all scenarios without the Grain Belt Express Project included. Extensive quality assurance checks are carried out on these Base Case results to validate data accuracy through a general comparison of results against historical operations.

3. Grain Belt Express Project simulations – A second set of simulations is performed for all scenarios that includes the Grain Belt Express Project along with the wind generation supplying the power to be delivered over the Grain Belt Express Project. The added wind capacity is not interconnected into the existing transmission grid and therefore can only be delivered via the Grain Belt Express Project. Quality assurance checks are carried out with a focus on operation of the Grain Belt Express Project to ensure that the modeled line flow, electrical losses, and other results align with design parameters.

4. Benefit Analysis – Simulations with and without the Grain Belt Express Project are compared for each scenario to assess the impact of the Project on system operations, costs, and emissions. The resulting economic and environmental benefits are driven by new wind generation facilitated by the Grain Belt Express Project. This new wind generation offsets production costs (fuel and emission costs) from conventional generation and the zero variable cost of the new wind resources reduces LMP in Indiana, lowering demand cost (defined below).

2.2 Assumptions

GL GH maintains assumptions for expected future market conditions used to perform forward-looking planning studies. Basic market data for generators, demand forecasts, and fuel are provided by Ventyx under a data licensing agreement and reviewed by GL GH for accuracy and appropriateness. This section outlines the major data used in the assessment of benefits for the Grain Belt Express Project.

Study Period – The time horizon for this study is calendar year 2019, which is a study year for which the Grain Belt Express Project can reasonably be considered operational.

Study Scenarios – The economic analysis of the Grain Belt Express Project considered four different future scenarios. A high-level description of each scenario is provided below, and detailed data assumptions for each scenario can be found in Tables 2-1 and 2-2. The study scenarios include:

<u>Business As Usual</u> – Energy demand grows under a moderate economic recovery with no major changes to existing environmental policy, generating technologies, fuel commodity prices, or other key energy market assumptions. Expansion of renewable generation is driven by current state mandates with moderate retirement of coal generation driven by market economics and existing environmental rules.

<u>Slow Growth</u> – Continuation of depressed economic conditions characterized by slow demand growth, continued low fuel commodity prices, and minimal transmission/generation expansion. Addition of new renewable generation expansion is driven by current state mandates with moderate retirement of coal generation driven by existing environmental rules.

<u>Robust Economy</u> – Strong recovery in economic activity characterized by accelerated growth in electrical demand, higher fuel prices and emission allowances prices, and increased activity in new generation and transmission projects. Expansion of renewable generation is based on current state mandates with moderate retirement of coal generation driven by existing environmental rules. This scenario includes the addition of the RITELine and the Pioneer Transmission projects, as well as a surrogate representation of the PATH (Potomac Appalachian Transmission Highline). PATH has been removed as a required Backbone project in the PJM Regional Transmission Expansion Plan (RTEP), but a similar need for PATH would arise again under the assumptions of this scenario. All of these projects are representative of the anticipated expansion of the transmission grid needed to support robust load growth assumptions.

<u>Green Economy</u> – Expansion in environmental policy including carbon regulation and a federal renewable portfolio standard. This scenario includes high demand growth and increases in fuel prices and emission allowance prices (including carbon). Expansion of renewable generation is significantly higher than current state mandates with accelerated coal retirements driven by new emissions costs. This scenario also includes the addition of the RITELine, Pioneer, and PATH transmission projects.

Table 2-1: 2019 Data Assumptions for Study Scenarios

2019 Assumptions	Business as Usual	Slow Growth	Robust Economy	Green Economy
Natural Gas Prices (Henry Hub Spot Avg $/MMBtu)	Medium: $5.50	Low: Medium - $3	High: Medium + $3	High: Medium + $3
Forced Coal Retirements (GW)	Medium: 13.5 GW in MISO, 15.8 GW in PJM	Low: 9 GW in MISO, 9.5 GW in PJM	Low: 9 GW in MISO, 9.5 GW in PJM	High: 25.7 GW in MISO, 21.7 GW in PJM
Carbon Pricing	No	No	No	Yes: $50/ton
NOx, SOx prices ($/ton)	Medium: NOx 713, SOx 1308	Low: Medium - 25%	Medium: NOx 713, SOx 1308	High: Medium + 25%
Load Growth	Medium: 1.4% peak, 1.7% energy	Low: 0.7% peak, 0.8% energy	High: 2.1% peak, 2.5% energy	High: 2.1% peak, 2.5% energy
Installed Wind Capacity (Eastern Interconnect)	60.8GW	60.8GW	60.8GW	111.6GW
Transmission Expansion	Baseline	Baseline	Baseline + RITE, Pioneer, and PATH surrogate	Baseline + RITE, Pioneer, and PATH surrogate

Transmission – GL GH utilizes powerflow cases provided by the North American Electric Reliability Corporation's (NERC) Eastern Interconnect Reliability Assessment Group (ERAG) and Multiregional Modeling Working Group (MMWG) in compiling these cases. This study utilizes the 2011 series 2017 Summer Peak case released in November 2011 for the underlying transmission topology. The study area topology was updated to reflect significant transmission upgrades from recent transmission planning processes, such as the MISO Transmission Expansion Plan (MTEP), MISO Multi-Value Projects (MVPs), SPP Balanced Portfolio and Priority Projects, and the PJM Regional Transmission Plan (RTEP). Transmission contingency event data are derived from public sources including the NERC Book of Flowgates, ISO/RTO published congestion reports, and previous study experience in modeling North American markets. Also, as previously outlined, for the Robust Economy and Green Economy scenarios in 2019, additional EHV transmission projects were modeled.

Grain Belt Express Project – The 3,500 MW Grain Belt Express Clean Line HVDC transmission line interconnects to the Palmyra Tap 345kV bus near Palmyra, Missouri (MISO) as well as the Sullivan 765 kV bus near Sullivan, Indiana (PJM).

Wind energy delivered via the Grain Belt Express Project utilizes an hourly profile derived from data published in the National Renewable Energy Laboratory's Eastern Wind Integration and Transmission Study (EWITS). EWITS wind profiles are used to maintain consistent time series data correlated with profiles on other wind farms in the region based on 2006 meteorological data. The hourly generation profile for the Grain Belt Express Project injection is based on 3,500 MW maximum capacity delivered at the load ends of the line which results in 4,349 MW of wind capacity feeding the line.

The excess wind capacity (above 3,500 MW) accounts for losses of the converter stations and transmission and also allows for higher utilization of the transmission line with recognition that geographic diversity in the wind resource across the supplying wind farms makes it unlikely that the total delivered wind power will exceed the 3,500 MW Grain Belt Express Project capacity during a significant number of hours. The wind capacity supplying the Grain Belt Express Project is not otherwise connected to the transmission grid and must utilize the HVDC line to be delivered.

3 RESULTS

PROMOD simulations provide several key metrics that were used to assess the economic and emissions reduction benefits of the Grain Belt Express Project and the new wind generation it supports. These metrics include:

- Production Cost ($) – Total variable cost of generation to supply energy to meet annual demand including fuel costs, emission costs, variable operation and maintenance costs, and unit start-up costs

- Locational Marginal Price ($/MWh) – Incremental cost of energy including impacts of transmission congestion and system electrical losses, averaged across all electrical load buses in a given region/state..

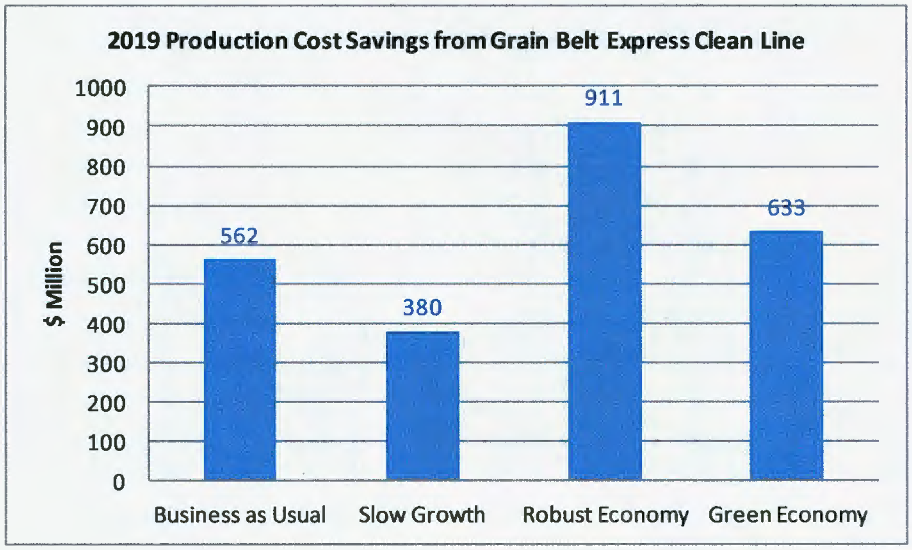
- Demand Cost ($) – The hourly electrical demand (MWh) at each bus multiplied by the hourly LMP ($/MWh) at that bus summed over all buses within a given region (e.g. Indiana or PJM/MISO) for all hours. This represents the total cost to purchase energy to supply total annual demand under RTO settlement rules

- Emissions Production (tons) – Total volume of emissions produced by generation units for sulphur dioxide ("SO_2"), nitrogen oxide ("NO_x"), mercury, and carbon dioxide ("CO_2")

3.1 Production Cost Benefits

The Grain Belt Express Project reduces total variable production costs in the eastern United States under each of the future scenarios, as shown in Figure 3-1.

Figure 3-1: Production Cost Savings by Scenario



Total variable production cost includes the cost of fuel, variable operating & maintenance (VOM) costs, and the cost of emissions for NOx and SO_2 based on current emissions allowance markets. The Grain Belt Express Project facilitates the development of over 4,000 MW of new wind capacity in Kansas which is delivered into the Midwest ISO and PJM high voltage systems at the Palmyra Tap 345kV bus in Missouri and the Sullivan 765kV bus in Indiana. This new wind energy has zero variable cost and displaces higher cost conventional generation from gas and coal resources under ISO centralized economic dispatch rules, resulting in the cost savings shown in Table 3-1.

Table 3-1: Total Variable Production Costs of Eastern United States

2019 Production Cost and Savings in $ Million				
	Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Grain Belt	82,144	60,380	111,550	168,838
With Grain Belt	81,581	60,001	110,639	168,205
Savings	562	380	911	633

Table 3-2 below further breaks out the production cost savings from the Grain Belt Express Project by generation type.

Table 3-2: Production Cost Savings by Type of Generation Reduction

2019 Production Cost Savings by Power Plant Type in $ Million				
Generator Type	Business as Usual	Slow Growth	Robust Economy	Green Economy
Coal	131	209	75	421
Combined Cycle	380	131	719	358
Combustion Turbine	41	38	93	-120
Steam Turbine (Gas / Oil)	8	1	21	-37

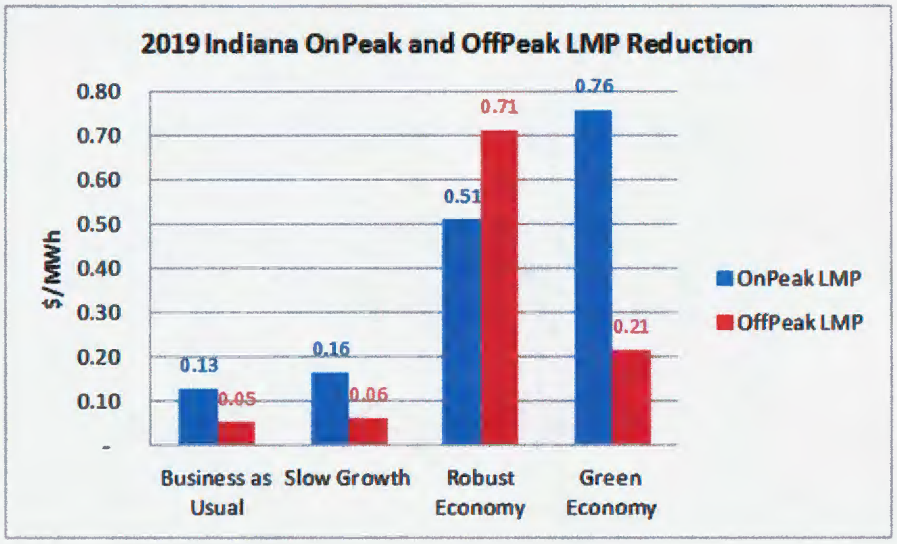
The wind energy delivered over the Grain Belt Express Project tends to offset marginal generation assets, which vary significantly across the scenarios. In the "Business as Usual" and "Robust Economy" cases, more of the cost savings comes from combined-cycle units followed by coal resources. This is reflective of the expected breakdown of marginal resources under moderate to aggressive load and resource expansion. Also note that this table represents cost rather than energy volume (MWh), and wind displacing gas in an hour may result in more cost savings than an hour with wind displacing coal.

In the "Slow Growth" and "Green Economy" scenarios, this order is reversed with most of the cost savings coming from coal followed by combined-cycle. The "Slow Growth" case reflects the higher prevalence of coal as a marginal resource under conditions that include lower demand and reduced generation expansion. Savings in the Green Economy scenario are driven by the addition of a carbon cost assumption which makes coal more expensive relative to natural gas resources. Increases in combustion turbine and steam turbine costs in the Green Economy scenario are overwhelmed by the much more significant coal and combined-cycle costs.

3.2 LMP and Demand Cost Benefits

The Grain Belt Express Project lowers LMP ($/MWh) in Indiana in each of the future scenarios. Figure 3-2 shows the impact of the Grain Belt Express Project on Indiana load-weighted LMP in 2019.

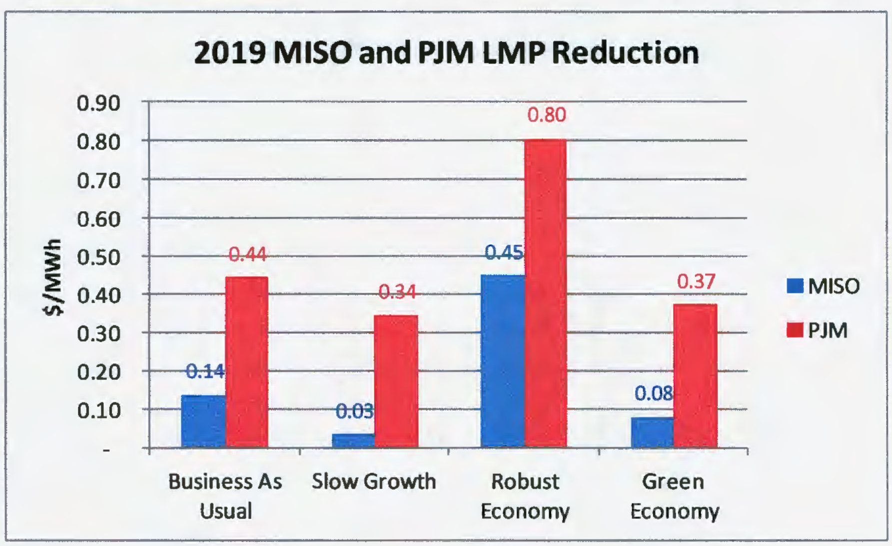
Figure 3-2: Change in 2019 Indiana LMP Due to Grain Belt Express Project



The impact on LMP is much greater in the Robust Economy and Green Economy scenarios because the LMP levels are much higher to start with, due to higher demand and higher fuel costs. The difference in impact in the on-peak versus off-peak period is related to a number of factors, most notably the amount of energy the Grain Belt Express Project is delivering during that time of day in Indiana, the value of the energy in that period in Indiana, and the ability to integrate the energy into the transmission system in that period in Indiana.

MISO and PJM LMP reduction in MISO and PJM regions due to the Grain Belt Express Project is shown in Figure 3-3.

Figure 3-3: Change in 2019 MISO and PJM LMP Due to Grain Belt Express Project



The Grain Belt Express Project interconnects in Indiana at AEP's Sullivan 765kV bus in the PJM region, and PJM LMPs are typically higher than MISO LMPs, so the greater impact on PJM LMPs than MISO LMPs is not surprising.

Demand cost represents the cost to supply the load of end-use customers in a region and is calculated by multiplying the average load-weighted LMP times the demand in each hour of the study year. The demand cost in each hour is then summed across the year to arrive at an annual demand cost value. Since the LMPs in Indiana are driven lower by the addition of the Grain Belt Express Project and the associated wind energy injection, it follows that demand cost will likewise be reduced. Benefits of the Grain Belt Express Project extend to other states and regions, and the overall demand cost and reduction due to the Project were also measured for the MISO and PJM regions.

Table 3-3 below shows the impact of the Grain Belt Express Project on demand cost for Indiana, PJM RTO, and Midwest ISO RTO.

Table 3-3: Demand Cost Savings by Scenario

Demand Cost and Savings in $ Million					
	State or RTO	Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Grain Belt	Indiana	5,694	3,651	11,600	9,225
With Grain Belt	Indiana	5,682	3,637	11,522	9,137
Savings	Indiana	12.6	13.7	78.6	87.8
Without Grain Belt	PJM	49,446	31,568	78,342	96,900
With Grain Belt	PJM	49,025	31,258	77,512	96,521
Savings	PJM	421.0	310.0	830.0	379.0
Without Grain Belt	Midwest ISO	30,594	19,230	50,504	65,682
With Grain Belt	Midwest ISO	30,475	19,200	50,134	65,604
Savings	Midwest ISO	119.0	30.0	370.0	78.0

Table 3-4 provides a detailed view of Indiana LMP impacts due to the Grain Belt Express Project, for the on-peak and off-peak periods.

Table 3-4: Detailed Indiana LMP Impacts from Grain Belt Express Project

2019 Locational Marginal Price and Change by Scenario in $/MWh					
		Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Grain Belt	OnPeak Avg	49.50	33.35	78.43	93.12
Without Grain Belt	OffPeak Avg	36.10	25.51	51.51	72.66
Without Grain Belt	Overall Avg	42.50	29.24	64.35	82.42
With Grain Belt	OnPeak Avg	49.38	33.18	77.92	92.36
With Grain Belt	OffPeak Avg	36.05	25.45	50.80	72.45
With Grain Belt	Overall Avg	42.41	29.14	63.74	81.95
LMP Change	OnPeak Change	0.13	0.16	0.51	0.76
LMP Change	OffPeak Change	0.05	0.06	0.71	0.21
LMP Change	Overall Change	0.09	0.11	0.61	0.47

3.3 Environmental Benefits

The Grain Belt Express Project reduces emissions of NO_X, SO_2, CO_2, and mercury, and also reduces water usage in power generation in the eastern United States under each of the future scenarios as shown in Table 3-5.

Table 3-5: Environmental Benefits to Eastern U.S. Due to Grain Belt Express Project

2019 Emissions and Water Production and Reduction by Scenario					
		Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Grain Belt	NOx (tons)	1,199,010	865,623	1,316,600	837,253
Without Grain Belt	SOx (tons)	2,721,032	1,688,548	3,066,280	1,876,459
Without Grain Belt	CO2 (tons)	1,621,376,308	1,303,428,281	1,746,657,870	1,240,056,428
Without Grain Belt	Hg (lbs)	29,192	20,419	31,760	20,052
Without Grain Belt	Water (MGal)	614,743	486,175	662,721	512,222
With Grain Belt	NOx (tons)	1,193,472	858,369	1,313,096	833,697
With Grain Belt	SOx (tons)	2,711,164	1,678,818	3,059,907	1,868,618
With Grain Belt	CO2 (tons)	1,613,941,350	1,293,082,538	1,740,953,726	1,234,654,164
With Grain Belt	Hg (lbs)	29,109	20,308	31,714	19,956
With Grain Belt	Water (MGal)	611,593	482,259	660,166	509,422
Reduction	NOx (tons)	5,538	7,254	3,504	3,556
Reduction	SOx (tons)	9,868	9,730	6,374	7,841
Reduction	CO2 (tons)	7,434,958	10,345,743	5,704,144	5,402,264
Reduction	Hg (lbs)	83	110	46	96
Reduction	Water (MGal)	3,150	3,915	2,556	2,800

The total tons produced for each of these effluents is calculated by PROMOD during the simulation of each scenario by multiplying the hourly output of each generator times the appropriate emissions production rate. Reductions in mercury were calculated after completion of the PROMOD runs by multiplying unit-specific production rates for mercury times the annual energy production for each coal plant modelled in the study. Reductions in water usage (evaporation) were estimated using general water consumption rates for each unit type (coal, combined cycle, combustion turbine, etc.) combined with annual generation results from the PROMOD simulations. Reduction of each of these emissions and the water-use reduction is a direct result of the reduced need for conventional generation due to the addition of new wind resources facilitated by the Grain Belt Express Project.

Calculating the Total Demand for Renewable Energy in the PJM and MISO Footprints

In order to estimate the demand for renewable energy in PJM and MISO, we first researched the statutory renewable energy requirements and goals for states in the PJM and MISO footprints. The state-by-state annual renewables percentage requirements are shown below. They exclude carve-outs for non-wind resources (e.g. solar carve-outs in New Jersey).

PJM RPS requirement by state
% (excluding RPS for non-wind power sources)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Delaware	13.0%	14.5%	16.0%	17.5%	19.0%	20.0%	21.0%	22.0%	23.0%	24.0%	25.0%
Illinois	9.1%	10.5%	11.8%	13.2%	14.5%	15.9%	17.3%	18.6%	20.0%	21.4%	22.7%
Indiana	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Kentucky	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Maryland	13.0%	15.2%	15.6%	18.3%	17.4%	18.0%	18.7%	20.0%	20.0%	20.0%	20.0%
Michigan	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
New Jersey	13.7%	14.8%	16.9%	19.1%	21.3%	23.6%	24.1%	24.8%	25.4%	26.2%	27.0%
North Carolina	6.0%	6.0%	6.0%	10.0%	10.0%	10.0%	12.5%	12.5%	12.5%	12.5%	12.5%
Ohio	3.1%	4.0%	4.9%	5.7%	6.6%	7.5%	8.4%	9.3%	10.2%	11.1%	11.1%
Pennsylvania	13.3%	13.8%	14.3%	14.8%	15.3%	17.5%	17.5%	17.5%	17.5%	17.5%	17.5%
Tennessee	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Virginia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
West Virginia	9.9%	9.9%	9.9%	9.9%	9.9%	14.9%	14.9%	14.9%	14.9%	14.9%	24.8%
DC	12.0%	13.5%	15.0%	16.5%	18.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%

MISO RPS requirement by state
% (excluding RPS for non-wind power sources)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Iowa	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Minnesota	14.8%	20.7%	20.7%	20.7%	20.7%	24.7%	24.7%	24.7%	24.7%	24.7%	27.3%
Missouri	3.5%	3.5%	3.5%	7.0%	7.0%	7.0%	10.4%	10.4%	10.4%	10.4%	10.4%
Montana	10.2%	10.2%	10.2%	10.2%	10.2%	10.2%	10.2%	10.2%	10.2%	10.2%	10.2%
North Dakota	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
South Dakota	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wisconsin	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%

Next, we compiled the projected electric load for each state from the Energy Information Agency's (EIA) *Annual Energy Outlook 2013.* We used 2010 EIA data on the split of electric sales between investor-owned utilities, cooperatives, etc. to determine how much of future load will be subject to RPS requirements. These RPS-eligible load projections are shown below.

PJM total load
GWh

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Delaware	11,080	11,188	11,267	11,380	11,474	11,583	11,628	11,704	11,797	11,864	11,922
Illinois	138,385	139,740	140,699	141,821	142,847	144,168	144,862	145,771	146,826	147,586	148,300
Indiana	104,683	106,291	107,247	108,345	109,155	110,149	110,659	111,287	112,043	112,473	112,849
Kentucky	88,652	90,636	91,943	93,422	94,735	96,257	97,240	98,216	99,370	100,327	101,207
Maryland	61,364	61,964	62,402	63,027	63,550	64,150	64,400	64,824	65,337	65,709	66,029
Michigan	103,729	104,943	105,641	106,398	106,966	107,748	108,135	108,636	109,227	109,566	109,883
New Jersey	74,158	74,883	75,412	76,168	76,799	77,525	77,827	78,340	78,959	79,408	79,796
North Carolina	127,746	129,591	131,139	133,110	135,025	137,263	138,798	140,498	142,391	144,123	145,823
Ohio	153,087	155,438	156,836	158,441	159,626	161,079	161,825	162,744	163,849	164,479	165,028
Pennsylvania	143,528	144,932	145,956	147,418	148,640	150,044	150,630	151,621	152,821	153,690	154,439
Tennessee	99,736	101,968	103,439	105,103	106,580	108,292	109,398	110,495	111,794	112,871	113,861
Virginia	107,420	108,972	110,274	111,931	113,542	115,423	116,714	118,143	119,736	121,192	122,621
West Virginia	30,904	31,378	31,661	31,985	32,224	32,517	32,668	32,853	33,076	33,203	33,314
DC	11,156	11,265	11,344	11,458	11,553	11,662	11,708	11,785	11,878	11,945	12,004

MISO total load
GWh

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Iowa	44,382	44,991	45,421	45,904	46,317	46,811	47,126	47,488	47,895	48,168	48,410
Minnesota	66,622	67,536	68,182	68,906	69,526	70,268	70,741	71,284	71,896	72,305	72,669
Missouri	81,601	82,400	82,965	83,627	84,232	85,011	85,420	85,956	86,579	87,027	87,448
Montana	13,838	14,091	14,289	14,522	14,709	14,955	15,074	15,218	15,406	15,568	15,727
North Dakota	13,354	13,537	13,667	13,812	13,936	14,085	14,180	14,289	14,411	14,493	14,566
South Dakota	11,354	11,510	11,620	11,743	11,849	11,975	12,056	12,149	12,253	12,323	12,384
Wisconsin	68,473	69,539	70,160	70,832	71,299	71,884	72,218	72,603	73,049	73,273	73,464

Next, we multiplied the renewable energy percentage requirement by the total eligible load for a given state in a given year to form the table below. We summed the renewable generation requirements to determine the total demand in PJM and in MISO.

PJM renewables requirement
GWh

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Delaware	1,440	1,622	1,803	1,991	2,180	2,317	2,442	2,575	2,713	2,847	2,980
Illinois	12,578	14,606	16,625	18,691	20,773	22,931	25,016	27,161	29,359	31,523	33,698
Indiana	-	-	-	-	-	-	-	-	-	-	-
Kentucky	-	-	-	-	-	-	-	-	-	-	-
Maryland	7,977	9,419	9,735	11,534	11,058	11,547	12,043	12,965	13,067	13,142	13,206
Michigan	10,373	10,494	10,564	10,640	10,697	10,775	10,814	10,864	10,923	10,957	10,988
New Jersey	10,159	11,081	12,771	14,559	16,394	18,318	18,789	19,399	20,081	20,793	21,578
North Carolina	7,665	7,775	7,868	13,311	13,503	13,726	17,350	17,562	17,799	18,015	18,228
Ohio	4,738	6,185	7,628	9,107	10,587	12,108	13,595	15,111	16,663	18,181	18,242
Pennsylvania	19,107	19,998	20,848	21,773	22,676	26,244	26,346	26,519	26,729	26,881	27,012
Tennessee	-	-	-	-	-	-	-	-	-	-	-
Virginia	-	-	-	-	-	-	-	-	-	-	-
West Virginia	3,072	3,119	3,147	3,179	3,203	4,848	4,870	4,898	4,931	4,950	8,278
DC	1,339	1,521	1,702	1,891	2,080	2,332	2,342	2,357	2,376	2,389	2,401
	78,448	85,820	92,690	106,676	113,150	125,145	133,606	139,410	144,641	149,679	156,611

MISO renewables requirement
GWh

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Iowa	276	276	276	276	276	276	276	276	276	276	276
Minnesota	9,861	14,004	14,138	14,288	14,417	17,335	17,452	17,586	17,737	17,838	19,864
Missouri	2,840	2,868	2,887	5,820	5,863	5,917	8,918	8,974	9,039	9,086	9,130
Montana	1,409	1,435	1,455	1,479	1,498	1,523	1,535	1,550	1,569	1,586	1,602
North Dakota	-	-	-	-	-	-	-	-	-	-	-
South Dakota	-	-	-	-	-	-	-	-	-	-	-
Wisconsin	6,847	6,954	7,016	7,083	7,130	7,188	7,222	7,260	7,305	7,327	7,346
	21,234	25,537	25,773	28,947	29,183	32,239	35,403	35,646	35,926	36,112	38,218

Finally, we summed the MISO and PJM renewables requirements to find the total demand in both footprints.

PJM and MISO renewables requirement
GWh

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total	99,681	111,357	118,463	135,623	142,333	157,384	169,008	175,056	180,567	185,791	194,829