STATE OF ILLINOIS

ILLINOIS COMMERCE COMMISSION

Rock Island Clean Line LLC	)	
	)	
Petition for an Order granting Rock Island	)	
Clean Line LLC a Certificate of Public	)	
Convenience and Necessity Pursuant to Section	)	
8-406 of the Public Utilities Act as a	)	**Docket No. 12-____**
Transmission Public Utility and to Construct,	)	
Operate and Maintain an Electric Transmission	)	
Line and Authorizing and Directing Rock Island	)	
Clean Line pursuant to Section 8-503 of the	)	
Public Utilities Act to Construct an Electric	)	
Transmission Line.	)	

DIRECT TESTIMONY OF

GARY MOLAND

ON BEHALF OF

ROCK ISLAND CLEAN LINE LLC

ROCK ISLAND EXHIBIT 3.0

OCTOBER 10, 2012

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Certain capitalized terms in this testimony have the meaning set forth in the Glossary included as **Attachment A** to the Direct Testimony of Michael Skelly, Rock Island Exhibit 1.0.

I. WITNESS INTRODUCTION AND PURPOSE OF TESTIMONY

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

A. My name is Gary Moland. I am the Director of Power Markets & Transmission Analysis at GL Garrad Hassan. My business address is 45 Main Street, Suite 302, Peterborough, New Hampshire 03458.

Q. Please describe your education and professional background.

A. I received a Bachelor of Science degree in Nuclear Engineering from the Georgia Institute of Technology and a Master of Science degree in Mathematics and Computer Science from Emory University in Atlanta, Georgia.

I am currently employed by GL Garrad Hassan ("GL GH"), a global engineering consulting company, owned by Germanischer Lloyd of Hamburg, Germany. I have been employed by GL GH since December 2010. I oversee all analysis performed by GL GH in regards to economic planning and simulation of US energy markets. In this role, I manage consulting engagements that include economic benefit analysis for new transmission projects, congestion studies for generation projects both existing and under development, Locational Marginal Price ("LMP") forecasting studies, curtailment risk studies for wind generators, and analysis of wind integration impacts and costs.

Prior to joining GL GH, I spent 20 years working for Ventyx, the vendor of the PROMOD simulation software used by GL GH and many utilities for economic planning studies. My roles at Ventyx included software developer for PROMOD, client support for PROMOD users (primarily major utilities), Manager of PROMOD technical development, Manager of the PowerBase energy market database project, and Vice President in the

"Ventyx Advisors" consulting group. My full Curriculum Vita is provided in Rock Island Exhibit 3.1.

Q. Please describe your background in performing transmission economic analysis.

A. In my work as a consultant over the past ten years, I have performed numerous studies to assess the economic impact of new transmission projects, including several studies that have formed the basis for testimony before state public service commissions and other regulatory agencies. Specific transmission projects I have studied include:

- Axtell-Spearville-Comanche 345 kV, located in the Southwest Power Pool, Inc. ("SPP") Regional Transmission Organization ("RTO");
- RITELine/Midwest Power transmission project, located in the Midwest Independent Transmission System Operator, Inc. ("MISO") and PJM Interconnection, LLC ("PJM") RTOs;
- CREZ Scenario 2 transmission expansion, located in the Electric Reliability Council of Texas ("ERCOT"); and
- Atlantic Wind Connection offshore high voltage direct current transmission project, located in PJM.

My experience from this study work includes the design and creation of future scenarios to assess the economic impacts of a proposed transmission project across a range of possible market conditions.

Q. What is the purpose of your direct testimony?

A. The purpose of my testimony is to describe the assumptions, methodology, and results of the analysis conducted by GL GH to measure the economic and environmental impacts of operation of the Rock Island Clean Line transmission project ("Rock Island Project" or "Project"). The results of my analysis were provided to Rock Island Clean Line LLC

("Rock Island") witness Dr. Karl McDermott for use in his analysis of the effect of the proposed Project on the wholesale cost of electricity and market competitiveness for Illinois customers. I also provided input data, used within my analysis, to Rock Island witness Mr. Leonard Januzik for use in his analysis of the reliability benefits of the Rock Island Project.

Q. In addition to your prepared direct testimony, Rock Island Exhibit 3.0, are you sponsoring any other exhibits?

A. Yes, I am also sponsoring Rock Island Exhibits 3.1 through 3.4, which were prepared by me or under my supervision and direction.

II. ECONOMIC MARKET STUDY

A. STUDY METHODOLOGY, SCENARIOS AND DATA ASSUMPTIONS

Q. Please summarize the economic study performed by GL GH to analyze the impacts of constructing and operating the Rock Island Project.

A. GL GH used the PROMOD production cost modeling software package to perform simulations of future energy markets for two representative study years, 2016 and 2020, to assess the economic impact of the Rock Island Project on system operations in Illinois. The simulations encompassed RTO 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 most other utility systems in the eastern U.S. 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 Rock Island Project.

Q. Please describe the study methodology for evaluating the economic and environmental benefits of the Rock Island Project.

A. The study methodology used to assess the economic benefits of the Rock Island Project includes the following primary activities:

1) Assumptions and scenario development – Study years and energy market scenarios are selected 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. Scenarios are constructed and tested to ensure that results reflect the intended data parameters.

2) Base Case simulations – A full set of simulations is performed for all study years and scenarios without the Rock Island 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) Rock Island Project simulations – A second set of simulations is performed for all study years and scenarios that include the Rock Island Project along with the wind generation expected to supply energy delivered over the Rock Island Project. An hourly energy profile for the generation in the Resource Area was provided by Rock Island witness Mr. David Berry, which I then modified to account for electrical losses at the two direct current converter stations and during transmission over the line. The added wind capacity is not interconnected into the existing transmission grid and can only be delivered via the Rock Island Project. This benefit study is unique in that the economic feasibility of the Rock Island Project and the new wind generation resources that will utilize it are directly intertwined such that one cannot be reasonably modeled without the

other. The Project serves no purpose without the new wind resources and the new wind resources would not be developed without the transmission access afforded by the Rock Island Project. Quality assurance checks are carried out with a focus on the operation of the Rock Island Project to ensure that the modeled line flow, electrical loss rates, and other results align with design parameters.

4) Benefit Analysis – Rock Island simulations are compared to the corresponding Base Case for each study year and scenario to assess the impact of the Project on system operations, costs, and emissions. The resulting economic and environmental benefits are wholly driven by new wind generation facilitated by the Rock Island Project. This new wind generation offsets production costs (fuel and emission costs) from conventional generation, and the low variable cost of the new wind generation also reduces LMPs in Illinois, lowering demand cost under RTO settlement processes.

Q. What are "LMPs"?

A. LMPs represent the incremental cost of energy at a specific electrical bus (or collection of buses, often referred to as a "hub") at a given point in time. LMPs are calculated by the system operator every five minutes in Illinois, and these prices are used in financial settlement to determine the cost to buy and sell energy on the open market. LMPs include the cost of the next increment of energy needed to meet system-wide demand, the cost of transmission congestion impacts on a specific bus location, and the cost of electrical losses associated with a specific bus location.

Q. Please describe the PROMOD software model used in the analysis.

A. PROMOD is an integrated electric generation and transmission market simulation tool. PROMOD performs hourly chronological commitment and dispatch of generating resources that minimizes system operating costs while simultaneously adhering to a variety of

constraints, including maximum capacity of generation sources, transmission limits, fuel and environmental costs, operating reserve requirements, and customer demand. PROMOD can be used to forecast hourly energy prices (LMPs), unit generation, fuel consumption, emissions output, regional energy interchange, transmission flows and congestion costs based on the input market conditions specified by the user.

Q. What future energy market scenarios were considered in the economic analysis?

A. The economic analysis of the Rock Island 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 Rock Island Exhibit 3.2. The study scenarios include:

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 moderate retirement of coal generation driven by market economics and existing environmental rules.

Slow Growth – 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.

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, PATH (Potomac Appalachian Transmission Highline), and Pioneer transmission projects in the 2020 study year, designed to move energy eastward from Illinois into markets in Indiana and Ohio, then on to the major demand centers near the eastern coast. These projects are generally representative of the anticipated expansion of the transmission grid needed to support robust load growth assumptions and to provide representative value of such expansions regardless of the specific likelihood of the construction of any such specific projects.

Green Economy – Expansion in environmental policy including carbon "cap and trade" legislation 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, PATH, and Pioneer transmission projects in the 2020 study year, designed to move energy eastward from Illinois into markets in Indiana and Ohio, then on to major demand centers near the eastern coast. These projects are generally representative of the anticipated expansion of the transmission grid needed to support a green economy and to provide representative value of such expansions regardless of the specific likelihood of the construction of any such specific projects.

Q. What other data assumptions were used in the economic analysis?

A. In addition to the data assumptions presented in Rock Island Exhibit 3.2 for each of the four study scenarios, GL GH uses many other data assumptions in the study database. Along with the PROMOD simulation model, GL GH licenses the "Simulation-Ready Data" product from Ventyx. This energy market database contains data for forecasted demand, forecasted fuel prices, detailed generating unit characteristics, transmission system

configuration, and other information. GL GH carries out validation activities to verify data accuracy and make enhancements in some areas such as modeling of wind generation and adding recently approved transmission projects. The Ventyx data is used as a starting point for system planners across North America and undergoes rigorous review by a wide variety of product users.

Q. What are the sources of operating and cost data on individual existing and planned generating units and transmission facilities that were used in the scenarios?

A. The bulk of the study data for generators, fuel, electrical demand, and market operating rules is provided by Ventyx, the same company that licenses the PROMOD simulation software. Ventyx compiles electrical system data from public sources and combines it with detailed market research and analysis to provide databases for use in energy market simulation models. Ventyx is a leading data vendor for North America, providing simulation databases to many utilities, transmission and generation planners, consulting organizations, and system operators (including MISO, SPP, PJM, ERCOT, and CAISO). Ventyx provides data updates twice a year to keep databases current with regard to forecasted fuel prices, demand forecasts, and new generation projections. As I noted, the Ventyx data is used as a starting point for system planners across North America and undergoes rigorous review by a wide variety of product users. Transmission assumptions are based on industry-approved transmission powerflow cases published by the North American Electric Reliability Corporation along with information on recently approved major transmission projects provided by transmission planning organizations, such as MISO.

Q. What metrics were developed in the economic analysis?

A. PROMOD simulations provide several key metrics that were used to assess the economic benefits of the Rock Island Project and the new wind generation it supports. These metrics include:

- Demand Cost ($) – The hourly electrical demand (MWh) at each bus multiplied by the hourly LMP ($/MWh) at that bus summed over all Illinois buses for all hours. This represents the total cost to purchase energy to supply total Illinois annual demand under RTO settlement rules.
- Production Cost ($) – Total variable cost of generation to supply energy to meet Illinois annual demand including fuel costs, emission costs, variable operation and maintenance costs, and unit start up costs.
- Locational Marginal Price ($/MWh) – Incremental cost of energy averaged across all electrical load buses in Illinois.
- 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").

B. RESULTS OF THE ECONOMIC ANALYSIS

Q. What were the results of the economic analysis?

A. Rock Island Exhibit 3.3 shows the results of the economic analysis for each scenario and study year in terms of demand costs, LMPs, and variable production costs. Rock Island Exhibit 3.4 shows the emissions and water use reductions as calculated in the analysis.

Q. How were emissions reductions calculated?

The study database licensed from Ventyx includes emission production rates for NOx, SO_2, mercury, and CO_2 for each generator. The total number of 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 modeled 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 is a direct result from the reduced need for conventional, emissions-producing generation due to the addition of new wind resources facilitated by the Rock Island Project.

Q. What information did you supply to Dr. McDermott for use in his economic analysis?

A. GL GH supplied the full results provided in Rock Island Exhibit 3.3 to Dr. McDermott for use in his economic analysis. Additionally, hourly LMP results and unit dispatch order results for selected hours were provided from all scenarios in each of the two years. Finally, transmission flows into and out of Illinois were provided from each scenario in both study years.

Q. What information did you supply to Mr. Januzik for use in his reliability analyses?

A. GL GH supplied maintenance schedules of each generating unit as well as hourly forecasted Illinois electrical demand to Mr. Januzik for use in his reliability analyses.

Q. Please summarize the results of your studies of the Rock Island Project and the interconnected wind generation.

A. (1) The Rock Island Project reduces total demand costs in both the PJM Illinois region and the MISO Illinois region in both study years under each of the four future scenarios.

(2) The Rock Island Project lowers LMPs ($/MWh) in both the PJM Illinois region and the MISO Illinois region in both study years in each of the future scenarios.

(3) The Rock Island Project reduces total variable production costs in the eastern United States in both study years under each of the future scenarios.

(4) The Rock Island Project reduces emissions of NOx, SOx, CO_2, and mercury, and reduces water usage in power generation, in the eastern United States in both study years under each of the future scenarios.

Q. Are your study results for the years 2016 and 2020 representative of the impact of the Rock Island Project and the new wind resources that will be connected to it if the Rock Island Project does not enter commercial operation until 2017?

A. Yes, the study benefits and impacts for the Rock Island Project presented here are representative of the expected results for 2017 since this study considered two simulation years surrounding 2017.

Q. Does this conclude your prepared direct testimony?

A. Yes, it does.

Gary Moland

Energy Consultant

Experienced consultant to the energy industry specializing in economic market analysis, energy price forecasting, congestion risk, and integration of renewable generation. Comprehensive knowledge of study methods and technical approach to assessing wind integration costs, economic impacts of new transmission, generation asset valuation, congestion risk, and other key areas. Has extensive project management experience and has led major consulting engagements including working in a team environment and responding to multiple stakeholders/committee oversight in performance of studies. Has deep technical knowledge of simulation-based modeling of power systems and analytical methods for quantifying the economic impacts of future changes in energy markets. Strong track record in successfully managing a consulting group including heavy engagement in sales and marketing activities, budget development, staff mentoring, setting business strategy, and interfacing with executive management. Has participated as a panelist and speaker at industry-leading conferences and has published articles and provided interviews for energy-related publications.

Career History

GL Garrad Hassan

Director of Power Markets & Transmission Analysis, December 2010 - present

Responsible for starting up a new service area within GL Garrad Hassan to provide services for economic market studies including congestion and curtailment risk assessment for renewable development projects. Wide latitude to pursue strategic studies in new industry markets to broaden the company's client base and penetrate new industry segments. Duties include

- Management of staff and oversight of all departmental consulting engagements
- Development of business plan, including strategic direction to meet revenue growth targets
- Annual budget development for revenue projections and staffing requirements
- Business development activities including writing proposals and technical sales support
- Establish and foster strong client relationships
- Provide expertise to support other service offerings within GL Garrad Hassan
- Expand industry presence through conference speaking engagements and publications

Ventyx

Vice President, 2007 - 2010

- Business Development – Managed all consulting business development activities for renewable companies, transmission development companies, and ISOs including proposal development, providing technical expertise on sales, maintaining strategic action plans for key clients, overseeing marketing activities, attending and speaking at conferences.
- Project Oversight – Held periodic reviews of all active projects, provided technical and project management direction as needed to ensure a successful engagement. Participated in key

project calls, reviewed deliverables, wrote and edited final reports, and followed up with clients after project completion.

- Staff Development – Provide staff mentoring and internal training to ensure that consulting staff skills continue to develop and work quality is maintained at a high level. Responsible for hiring new staff as needed to meet project work load.

Principle Consultant, 2003-2007

- Nodal Market Team Leader – directed staff and participated in sales for nodal market studies.
- Project Manager – Led major project engagements including
    - Wind site congestion and curtailment analysis for over 20 separate project sites
    - Oversaw all Ventyx project work on EWITS and Nebraska wind integration studies funded by NREL (http://www.nrel.gov/wind/systemsintegration/ewits.html) (http://www.nrel.gov/wind/pdfs/47285.pdf)
    - Studied economic benefits of developing the transmission expansion "X" plan in SPP to support public filing by ITC for regulatory approval.
    - Studied ERCOT CREZ expansion to provide quantitative benefits for CREZ Scenario 2 in support of PUC testimony filed by a major wind developer
    - NPPD participation in SPP/MISO – this study was a key factor in NPPD's decision to join the SPP market.
    - Led the Ventyx Cost Benefit Study to assess SPP's move toward adding a day-ahead market with expanded ancillary services and financial Transmission rights (http://www.spp.org/publications/SPP%20Report%20April%20v8.pdf)

PowerBase™ Product Manager (2000 – 2003)

- Product Manager – Provided business plan, staffing levels, cost & revenue forecast, and strategic vision for the PowerBase data product for upper management.
- Market Data – Oversaw the development of simulation-ready data for North American energy markets delivered in the PowerBase database to over 40 clients. This included developing processes for migrating data from Platts database products as well as identifying other data sources and data research activities. Also included the incorporation of detailed powerflow data for full transmission system representation and the development of flowgates and contingencies for modeling congestion.
- Business Analyst – Acted as a business analyst to guide technical product development of new relational database and new user interface. Provided functional specifications, test plans and screen layouts to technical staff for implementation.

PROMOD™ Technical Manager (1997 – 2000)

- Product Version Control – Oversaw all code changes, testing, QA process, and version releases for the PROMOD product. Heavily involved in scoping and design of new program features including Hourly Monte Carlo dispatch under simple transmission, Marketwise convergence

Monte Carlo feature, significant user interface enhancements, and many other program upgrades.

- Staff Development – Directed programming staff on implementation of new program features based on feedback from clients and sales staff. Mentored staff to enhance knowledge of production costing algorithms and coding techniques.

PROMOD™ Support (1990 – 1997)

- Provided technical programming support and direct client support for PROMOD users

Professional Experience

Selected key consulting engagements led by Mr. Moland include:

- *Eastern Wind Integration & Transmission Study* (EWITS, 2009) - Mr. Moland was the project manager for Ventyx, a key study partner responsible for developing the detailed modeling methods for capturing the operational impacts of hourly wind forecast error, hourly spinning/regulating reserve requirements, and other factors. EWITS was the first wind integration study in North America using detailed hourly wind profiles developed on a two kilometer grid, and provides an important benchmark for study methodologies in capturing wind integration costs and impacts. Link to study web site: http://www.nrel.gov/wind/systemsintegration/ewits.html

- *Nebraska State-Wide Wind Integrations Study* - (2009) - Mr. Moland was the overall project manager for the economic modeling work for this important regional wind integration study assessing up to 40% wind penetration within the Southwest Power Pool. Scenarios included assessing the impacts of SPP high voltage transmission expansion to transport wind to load areas. Link to study report: http://www.nrel.gov/docs/fy10osti/47285.pdf

- *Cost Benefit Analysis for Nebraska Utility's Participation in SPP & MISO Market (2008*) –Mr. Moland was the Ventyx project manager for a detailed cost/benefit analysis to support a Nebraska utility's decision to join the Midwest ISO or Southwest Power Pool energy market. PROMOD IV full transmission logic and the Simulation Ready Data were utilized to quantify the operational costs/benefits of MISO's centralized dispatch, MAPP balancing authority dispatch, and SPP EIS market dispatch. Other market design features were analyzed including ancillary services, MISO marginal loss impacts, and transmission congestion rights. Scenarios were developed to assess the impact of other Nebraska utilities joining MISO and whether the benefits of each option were dependent on the decisions of others. An initial view of FTR values for pathways from the client's generators to load hub was also provided to support the MISO participation option. The analysis from this study was used to support the client's decision to join the SPP market.

- *Atlantic Wind Connection Economic Feasibility Study* (*2010*) – Mr. Moland was the project manager for Ventyx's participation in an analysis of the economic and operational benefits associated with the construction of an offshore HVDC looped transmission backbone to facilitate 6000 MW of off shore wind development off the Atlantic coast of the US. The project included detailed modeling of the transmission design including assessing impacts of

electrical losses and comparing a multi-terminal loop with radial connections for delivering wind to shore.

- *Southeastern U.S. Offshore Wind Integration Study (2011*) – Mr. Moland performed a study analyzing production cost and transmission congestion to assess the impacts of 8.5 GW of new offshore wind along the coast of North & South Carolina and Georgia. This public study was performed as part of a DOE grant to the Southern Alliance for Clean Energy. The study utilized databases from the Eastern Wind Integration and Transmission Study (EWITS) to look at a future 20% wind energy scenario for the year 2024. Study results included the fuel and emissions cost savings from offset thermal energy and the impact of energy prices in the Southeastern U.S. Key study scenarios included comparison of independent radial connections for offshore wind versus a looped offshore transmission network that allowed the wind energy to move north and south to reach a preferred landing point. Final report and supporting documents can be found at https://sites.google.com/site/sobreip/home/completed-reports.

Academic History

M.S., Mathematics and Computer Science, Emory University, Atlanta, 1992

B.S., Nuclear Engineering, Georgia Institute of Technology, Atlanta, 1984

Published Articles

Public Utility Fortnightly – May 2008 – "Windpower's Warning"
http://www.fortnightly.com/pubs/05012008_PowerMeasurements.pdf

EXHIBIT 3.2 -- SCENARIO ASSUMPTIONS

Data Assumptions for Study Scenarios (2016)

2016 Assumptions	Business as Usual	Robust Economy	Slow Growth	Green Economy
Nat Gas Prices (Henry Hub Spot, $/MMBTU)	Medium: $4.72	High: Medium + $2	Low: Medium - $2	High: Medium + $2
Forced Coal Retirements (GW)	Medium: MISO - 11.5, PJM - 11.4	Low: MISO - 5.4, PJM - 4.1	Low: MISO - 5.4, PJM - 4.1	High: MISO - 21.8, PJM - 18.4
Carbon Pricing	No	No	No	Yes: $50/ton
NOx, SOx ($/ton)	Medium: NOx - 713, SOx - 1308	Medium: NOx - 713, SOx - 1308	Low: Medium -25%	High: Medium +25%
Load Growth	Medium: 1.4% peak, 1.7% energy	High: 2.1% peak, 2.5% energy	Low: 0.7% peak, 0.8% energy	High: 2.1% peak, 2.5% energy
Wind (Eastern US)	46.8 GW	46.8 GW	46.8 GW	78.2 GW
Transmission expansion	No	No	No	No

Data Assumptions for Study Scenarios (2020)

2020 Assumptions	Business as Usual	Robust Economy	Slow Growth	Green Economy
Nat Gas Prices (Henry Hub Spot, $/MMBTU)	Medium: $6.10	High: Medium + $2	Low: Medium - $2	High: Medium + $2
Forced Coal Retirements (GW)	Medium: MISO - 13.5, PJM - 15.8	Low: MISO - 9.0, PJM - 9.51	Low: MISO - 9.0, PJM - 9.51	High: MISO - 21.8, PJM - 18.4
Carbon Pricing	No	No	No	Yes: $50/ton
NOx, SOx ($/ton)	Medium: NOx - 713, SOx - 1308	Medium: NOx - 713, SOx - 1308	Low: Medium -25%	High: Medium +25%
Load Growth	Medium: 1.4% peak, 1.7% energy	High: 2.1% peak, 2.5% energy	Low: 0.7% peak, 0.8% energy	High: 2.1% peak, 2.5% energy
Wind (Eastern US)	60.8 GW	60.8 GW	60.8 GW	111.6 GW
Transmission expansion	No	Yes – RITE, PATH and Pioneer	No	Yes – RITE, PATH and Pioneer

EXHIBIT 3.3 -- ECONOMIC ANALYSIS OF ROCK ISLAND PROJECT

Demand Cost	**($M)**	**2016**			
		Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Rock Island	PJM Illinois	4,676	3,581	5,831	10,201
Without Rock Island	MISO Illinois	2,247	1,671	2,825	5,912
Without Rock Island	Total	6,923	5,252	8,656	16,113
With Rock Island	PJM Illinois	4,375	3,344	5,380	9,755
With Rock Island	MISO Illinois	2,228	1,658	2,789	5,865
With Rock Island	Total	6,603	5,003	8,168	15,621
Savings	PJM Illinois	301	236	452	446
Savings	MISO Illinois	19	13	36	46
Savings	Total	320	249	488	493

Demand Cost	**($M)**	**2020**			
		Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Rock Island	PJM Illinois	6,233	4,153	9,685	12,579
Without Rock Island	MISO Illinois	2,801	1,808	4,595	6,959
Without Rock Island	Total	9,034	5,961	14,280	19,538
With Rock Island	PJM Illinois	6,014	3,986	9,436	12,496
With Rock Island	MISO Illinois	2,778	1,797	4,555	6,949
With Rock Island	Total	8,792	5,782	13,991	19,445
Savings	PJM Illinois	219	168	249	83
Savings	MISO Illinois	23	11	41	10
Savings	Total	242	179	289	93

EXHIBIT 3.3 -- ECONOMIC ANALYSIS OF ROCK ISLAND PROJECT

Locational Marginal Price ($/MWh) 2016

			Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Rock Island	LMP OnPeakAverage	PJM Illinois	44.22	34.49	56.25	92.37
Without Rock Island	LMP OffPeakAverage	PJM Illinois	29.45	24.21	31.65	64.60
Without Rock Island	LMP Average	PJM Illinois	36.46	29.09	43.33	77.79
Without Rock Island	LMP OnPeakAverage	MISO Illinois	43.55	32.07	54.75	105.69
Without Rock Island	LMP OffPeakAverage	MISO Illinois	29.01	24.54	32.92	79.15
Without Rock Island	LMP Average	MISO Illinois	35.92	28.11	43.29	91.79
With Rock Island	LMP OnPeakAverage	PJM Illinois	42.10	32.88	52.61	89.39
With Rock Island	LMP OffPeakAverage	PJM Illinois	26.50	21.72	27.95	60.37
With Rock Island	LMP Average	PJM Illinois	33.90	27.02	39.65	74.15
With Rock Island	LMP OnPeakAverage	MISO Illinois	43.15	31.92	54.06	104.88
With Rock Island	LMP OffPeakAverage	MISO Illinois	28.84	24.27	32.49	78.75
With Rock Island	LMP Average	MISO Illinois	35.64	27.90	42.74	91.19
LMP Change	LMP OnPeak Change	PJM Illinois	-2.13	-1.61	-3.65	-2.98
LMP Change	LMP OffPeak Change	PJM Illinois	-2.94	-2.48	-3.70	-4.23
LMP Change	LMP Average Change	PJM Illinois	-2.56	-2.07	-3.68	-3.63
LMP Change	LMP OnPeak Change	MISO Illinois	-0.40	-0.15	-0.70	-0.81
LMP Change	LMP OffPeak Change	MISO Illinois	-0.17	-0.27	-0.43	-0.40
LMP Change	LMP Average Change	MISO Illinois	-0.28	-0.21	-0.55	-0.60

Locational Marginal Price ($/MWh) 2020

			Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Rock Island	LMP OnPeakAverage	PJM Illinois	53.85	38.34	81.33	102.65
Without Rock Island	LMP OffPeakAverage	PJM Illinois	37.64	27.46	51.28	71.54
Without Rock Island	LMP Average	PJM Illinois	45.37	32.64	65.60	86.37
Without Rock Island	LMP OnPeakAverage	MISO Illinois	54.40	36.55	87.05	124.15
Without Rock Island	LMP OffPeakAverage	MISO Illinois	36.38	27.34	51.41	88.04
Without Rock Island	LMP Average	MISO Illinois	44.96	31.72	68.37	105.20
With Rock Island	LMP OnPeakAverage	PJM Illinois	52.39	37.08	79.79	102.58
With Rock Island	LMP OffPeakAverage	PJM Illinois	35.74	25.84	49.14	70.32
With Rock Island	LMP Average	PJM Illinois	43.68	31.20	63.74	85.70
With Rock Island	LMP OnPeakAverage	MISO Illinois	54.10	36.43	86.59	123.91
With Rock Island	LMP OffPeakAverage	MISO Illinois	35.96	27.04	50.61	87.79
With Rock Island	LMP Average	MISO Illinois	44.60	31.51	67.73	104.96
LMP Change	LMP OnPeak Change	PJM Illinois	-1.46	-1.26	-1.54	-0.07
LMP Change	LMP OffPeak Change	PJM Illinois	-1.91	-1.62	-2.14	-1.23
LMP Change	LMP Average Change	PJM Illinois	-1.69	-1.44	-1.86	-0.67
LMP Change	LMP OnPeak Change	MISO Illinois	-0.31	-0.12	-0.46	-0.24
LMP Change	LMP OffPeak Change	MISO Illinois	-0.43	-0.30	-0.80	-0.25
LMP Change	LMP Average Change	MISO Illinois	-0.37	-0.21	-0.64	-0.24

EXHIBIT 3.3 -- ECONOMIC ANALYSIS OF ROCK ISLAND PROJECT

Variable Production Cost (Eastern US) ($M) 2016

	Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Rock Island	90,203	71,627	107,129	183,536
With Rock Island	89,713	71,238	106,537	182,438
Savings	490	389	593	1,098

Variable Production Cost (Eastern US) ($M) 2020

	Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Rock Island	114,865	82,182	157,300	233,041
With Rock Island	114,249	81,760	156,385	231,981
Savings	616	423	914	1,060

EXHIBIT 3.4 -- EMISSIONS AND WATER USE REDUCTION FROM ROCK ISLAND PROJECT

Emissions (Eastern US)	**Effluent (Units)**	**2016**			
		Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Rock Island	NOx (tons)	1,423,542	1,124,315	1,629,927	1,062,298
Without Rock Island	SOx (tons)	2,591,748	1,893,032	3,206,526	2,060,349
Without Rock Island	CO2 (tons)	1,800,490,290	1,572,122,063	1,967,101,455	1,525,819,613
Without Rock Island	Hg (lbs)	30,130	21,561	34,350	23,251
Without Rock Island	Water (MGal)	659,366	557,960	717,928	570,069
With Rock Island	NOx (tons)	1,415,212	1,112,644	1,621,564	1,054,737
With Rock Island	SOx (tons)	2,575,593	1,875,196	3,189,278	2,048,449
With Rock Island	CO2 (tons)	1,791,383,235	1,559,796,244	1,957,361,071	1,515,255,833
With Rock Island	Hg (lbs)	29,991	21,398	34,218	23,050
With Rock Island	Water (MGal)	655,820	553,758	714,287	566,157
Reduction	NOx (tons)	8,330	11,671	8,363	7,561
Reduction	SOx (tons)	16,155	17,836	17,248	11,900
Reduction	CO2 (tons)	9,107,054	12,325,819	9,740,384	10,563,780
Reduction	Hg (lbs)	140	163	133	201
Reduction	Water (MGal)	3,546	4,202	3,641	3,912

Emissions (Eastern US)	**Effluent (Units)**	**2020**			
		Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Rock Island	NOx (tons)	1,468,411	1,086,862	1,689,931	1,192,992
Without Rock Island	SOx (tons)	2,649,819	1,754,880	3,429,218	2,308,675
Without Rock Island	CO2 (tons)	1,873,943,746	1,535,452,119	2,086,172,945	1,616,740,696
Without Rock Island	Hg (lbs)	34,866	27,016	38,718	25,195
Without Rock Island	Water (MGal)	697,083	559,767	771,802	630,715
With Rock Island	NOx (tons)	1,462,864	1,077,289	1,686,323	1,185,865
With Rock Island	SOx (tons)	2,633,485	1,740,911	3,420,033	2,293,227
With Rock Island	CO2 (tons)	1,866,869,934	1,524,377,174	2,080,627,252	1,608,882,810
With Rock Island	Hg (lbs)	34,757	26,862	38,659	24,997
With Rock Island	Water (MGal)	693,981	555,754	769,186	627,201
Reduction	NOx (tons)	5,547	9,572	3,608	7,127
Reduction	SOx (tons)	16,334	13,969	9,185	15,448
Reduction	CO2 (tons)	7,073,812	11,074,945	5,545,692	7,857,886
Reduction	Hg (lbs)	109	154	59	198
Reduction	Water (MGal)	3,102	4,013	2,616	3,514

Note: Water is in Millions of Gallons of water consumed (evaporated), not to be confused with total amount of water used in the power plant cooling system.