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Issues: Production Cost Modeling;
Economic Benefits
Witness: Robert Cleveland
Sponsoring Party: Grain Belt Express
Clean Line LLC
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MISSOURI PUBLIC SERVICE COMMISSION

CASE NO. EA-2014-0207

SURREBUTTAL TESTIMONY OF

ROBERT CLEVELAND

ON BEHALF OF

GRAIN BELT EXPRESS CLEAN LINE LLC

October 14, 2014

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I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Robert Cleveland. My business address is 9665 Chesapeake Drive, Suite 435, San Diego, CA 92123.

Q. What is the purpose of this surrebuttal testimony?

A. I am responding issues raised in the rebuttal testimonies of other parties in this proceeding, including witnesses representing Commission Staff, the Missouri Landowners Alliance ("MLA"), and the Eastern Missouri Landowners Alliance, d/b/a Show Me Concerned Landowners ("Show Me").

Q. Do you intend to adopt the direct testimony of Gary Moland offered in this case?

A. Yes, I do. Mr. Moland resigned his employment at DNV GL in order to accept a new job leading the transmission consulting group at Leidos Engineering.

Q. Are you familiar with the testimony filed by Mr. Moland and the underlying transmission analysis supporting the results in that testimony?

A. Yes. I assisted Mr. Moland in the preparation of his testimony and reviewed all of the model results reported in his testimony. I was deeply involved in the design and review of all model scenarios and results reported in Mr. Moland's direct testimony.

Q. By whom are you employed and in what capacity?

A. I am employed by DNV GL as a Senior Project Manager. DNV GL is a leading global engineering consulting company headquartered in Norway. I have been employed by DNV GL since June 2011. I manage projects for DNV GL clients related to the economic planning and simulation of U.S. electricity markets. In this role, I manage consulting engagements including economic benefit analyses for new transmission projects, locational marginal price ("LMP") forecasting studies, congestion and curtailment risk studies for wind generators, and wind integration studies. I also recently led a project on behalf of an investor owned utility using adjusted production cost ("APC") analysis to determine the benefits of joining a regional transmission organization ("RTO").

Prior to joining DNV, GL I spent fourteen years working for Ventyx, the vendor of the PROMOD software used by Grain Belt Express in this proceeding. My full Curriculum Vitae is provided in Schedule RC-1 to this testimony.

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

A. In my work as a consultant over the last six years, I have performed numerous studies to determine the economic and rate impact of new transmission lines, including projects in MISO, SPP, and PJM. In these studies, I designed and created future scenarios to assess the economic impact of a proposed transmission project or other changes to market fundamentals across a range of market conditions.

Q. Please summarize your surrebuttal testimony.

A. Section II updates the production cost model results presented in Mr. Moland's direct testimony and presents an additional evaluation metric called adjusted production cost, or APC. Commission Staff witness Sarah Kliethermes recommended that Grain Belt Express provide this additional analysis in order to more completely understand the Project's impact on electric rates in Missouri. The APC results show that the Project produces a benefit for the state, even when accounting for the potential impact of lower wholesale electric prices on utility revenues.

Section III responds to Show Me witness Dr. Michael Proctor, who suggests that locating wind elsewhere in the Midcontinent Independent System Operator ("MISO") could produce the same benefits to Missouri as the Project. I ran a PROMOD sensitivity to compare the benefits of the Project's 500 MW wind energy injection in Missouri with locating an equivalent amount of wind generation elsewhere in MISO. The Project yields more benefits to the Missouri than locating wind generation elsewhere.

Section IV then responds to other issues raised in intervenor rebuttal testimony.

II. UPDATED PROMOD RESULTS INCLUDING ADJUSTED PRODUCTION COST (APC) METRICS

Q. At page 9 of her rebuttal testimony, Staff witness Sarah Kliethermes states that Grain Belt Express should provide additional production cost modeling to include the effects on generators owned by Missouri utilities. Have you prepared such an analysis?

A. Yes. Using the same assumptions and scenarios described in Mr. Moland's direct testimony, I reran the model simulations to include additional reporting metrics that take into account the wholesale power market revenues received by Missouri utilities. Specifically, I added an APC metric, which is also the metric that Show Me witness Michael Proctor suggested Grain Belt Express should use on pages 39 and 40 of his rebuttal testimony. APC includes the off-system sales margins of Missouri utilities that are discussed by Ms. Kliethermes in her rebuttal testimony at pages 10 and 11.

Q. How is APC defined for the purpose of your analysis?

A. APC is defined in the same way as Dr. Proctor defines it on page 40 of his rebuttal testimony. Specifically, APC is defined as (1) the total variable cost of generation minus (2) the cost of energy purchases plus (3) revenue from off-system sales. This is a standard way of defining APC similar to the metric used by both MISO and Southwest

Power Pool ("SPP").

Total variable cost of generation is equal to the total cost of consumed fuel, variable operation and maintenance cost, and emissions costs (if applicable). Purchase and sale volumes and accounting are calculated on an hourly basis. For each hour of the year, if a Missouri utility generates more energy than it needs to serve load, the excess is sold at the market price and included in the "revenue from off system sales" in the APC metric. On the other hand, if a Missouri utility generates less energy than it needs to serve load, the utility purchases the deficit at the market price and the payment is included in the "cost of energy purchases."

When defining the APC metric, I included all of the generation owned by the Missouri utility in question. For example, I considered the fact that Missouri regulated utilities own generation in other states that they use, in part, to serve their Kansas load.

Q. Have you made any other adjustments to the production cost model used in Mr. Moland's direct testimony?

A. No. I did not change the model year, transmission topology, or any other assumptions. I did make a correction to the way the Missouri benefits were reported. The previous results, presented in Mr. Moland's testimony, did not include 29 Kansas City Power & Light Company load buses that were incorrectly assumed to be located in Kansas. Actually, these load buses are located in Missouri. This change does not affect the way the underlying model runs or the generator dispatch.

Q. What results were affected by the change described above?

A. The change reported above affects the Missouri-specific benefits reporting as related to LMP and demand cost changes. The production cost and emissions reductions were not affected since these were reported for the entire eastern interconnection.

Q. How much does including the additional KCPL load buses in the model affect the Missouri LMP and demand cost?

A. The change in LMP reduction does not materially change the results. In the Business-as-Usual scenario, the original results showed reduction of Missouri Load Hub average annual LMP of $0.24, from $33.64/MWh to $33.40/MWh (Schedule GM-2). The revised results show a reduction of $0.22.

When the additional load buses are incorporated, annual demand cost savings increased by about $1 million. In the Business-as-Usual scenario, the Project's original demand cost benefit was $21.8 million in the originally filed results. The benefit increases to $22million when the additional buses are added to the reporting. A full set of model results, including APC, that take account of the additional KCPL buses is attached to this testimony as Schedule RC-2.

Q. What do the APC metrics conclude about the benefits of the Project to the State of Missouri?

A. The additional APC results confirm that the Project provided a net benefit to Missouri, even accounting for lower off system sales revenues by Missouri utilities. In the Business-as-Usual scenario, the total adjusted production cost savings to Missouri is $2.6 million in 2019. All four scenarios show a lower APC with the Project than without.

I also calculated APC results specifically for Ameren Missouri and provided the results in Schedule RC-2. The results show a $1.0 million decrease in adjusted production cost in 2019 in the Business-as-Usual scenario, with the Project online. All four scenarios show a lower APC with the Project than without for Ameren Missouri as well.

Q. What do the APC results from your model indicate about the Project's rate impacts on Missouri?

A. The APC results show that the Project will decrease cost-of-service rates for incumbent utilities that own their own generation.

III. PROJECT BENEFITS COMPARED TO MISO WIND ALTERNATIVE

Q. At page 41 of his rebuttal, Dr. Proctor states that the benefits from the Project, described in Mr. Moland's testimony, could occur if the same amount of wind generation is built elsewhere in MISO. What is your response?

A. I prepared an additional production cost model sensitivity using the Business as Usual assumptions. Instead of the Project's 500 MW high capacity factor wind energy injection in Missouri, I added an equivalent amount of wind energy in MISO locations with a high capacity factor wind resource. To model the MISO wind alternative, I chose the five highest capacity factor wind profiles from the Eastern Wind Interconnection Study (EWITS) library that were located in Minnesota, Iowa or North Dakota. The five MISO wind farms are located on high voltage 345 kV buses near the high wind capacity sites. In other words, I assumed the appropriate interconnection upgrades were in place for these wind farms to reach the MISO 345 kV system.

Q. What did your additional model sensitivity show about the benefits to Missouri?

A. It showed that the benefits to the State of Missouri were higher with the Grain Belt Express Project for all the three benefit metrics specific to Missouri. Demand Cost reduction for the state of Missouri was only $4 million savings in the MISO wind alternative, compared to $22 million savings with Grain Belt Express Project. Locational

Marginal Price impact was also much lower with the MISO wind alternative, with the Missouri Load Hub dropping $0.04/MWh on annual average, compared to a $0.22/MWh drop with Grain Belt Express. The Adjusted Production Cost benefit to Missouri in the MISO wind alternative was $0.48 million, compared to $2.6 million with Grain Belt Express.

IV. OTHER ISSUES

Q. At page 5 of her rebuttal testimony, Ms. Kliethermes states that Grain Belt Express has only modeled the day-ahead power market. Is that an accurate description of the model results presented in Mr. Moland's direct testimony and your surrebuttal testimony?

A. No, it is not. PROMOD is more sophisticated than Ms. Kliethermes describes. PROMOD produces one set of LMPs that reflects day-ahead and real-time market processes, the economic inefficiency due to re-dispatch between the two markets, and the impact of operating reserves. The benefits presented in this study are based upon these realistic LMPs, not on simple day-ahead LMPs.

In the first phase of its dispatch, PROMOD mimics the day-ahead market over a study week with a security-constrained unit commitment process. The methodology incorporates a combined linear program and mixed-integer program to mimic the decisions made by each balancing area to commit generation to meet the next day's energy demand and operating reserve requirements, given generator bids, generator operational constraints, and transmission system constraints. The economics of the commitment decision are based upon day-ahead forecast LMPs derived within the process.

In the next phase, PROMOD applies the day-ahead commitment solution to an hour-by-hour real-time security constrained economic dispatch of the system solved by a linear program. Each balancing area dispatches generation against energy demand and operating reserve requirements. The least-cost dispatch decision is driven by LMPs within the linear program solution for the given hour. Generator re-dispatch and real-time unit commitments occur during this real-time dispatch phase, and the LMPs within the real-time dispatch are different than forecasted LMPs used in the day-ahead unit commitment process.

Q. At page 5 of her testimony, Kliethermes states that Grain Belt Express modeled the entire Eastern Interconnection as a single market. Is that an accurate description of the model results presented in Mr. Moland's direct testimony and your surrebuttal testimony?

A. No, this is not accurate. PROMOD models each RTO separately as its own balancing area and market, similar to how the electric system operates. Electric systems that are not part of an RTO are typically grouped within a regional representation of a larger balancing area. There are fourteen balancing areas modeled in the simulations discussed in this testimony, with each balancing area committing its own generation to meet its own load and operating reserve requirements. Interchange between balancing areas occurs when two neighboring regions have a price differential larger than an economic hurdle rate specified in $/MWh. The physical transmission flows supporting this interchange are subject to transmission constraints in the day-ahead commitment and real-time dispatch solutions.

Q. Is the PROMOD simulation software used in the industry to study economic impacts of new transmission projects?

A. Yes, PROMOD is widely accepted and used as a software tool to study the economic benefit of new transmission projects. MISO, SPP, PJM use the software utilize the software within economic transmission planning processes to evaluate the impact of candidate transmission projects in regional transmission plans. Many electric utilities use the software for making similar decisions regarding new transmission projects. MISO also uses PROMOD to produce some of the economic benefits in its annual Value Proposition study presented to members.

Q. At page 18 of her rebuttal testimony, Ms. Kliethermes states that Grain Belt Express has not provided any information regarding the cost efficiency and fuel efficiency of the Eastern Interconnection with and without the Project. What is your response?

A. The cost efficiency and fuel efficiency of generation across the Eastern Interconnection change very little when Grain Belt Express is included. The average annual variable cost of thermal generation in $/MWh is a standard measure of cost efficiency. This metric changes from $23.31/MWh to $23.28/MWh when including Grain Belt Express in the Business-as-Usual scenario, a reduction of $0.03/MWh. This trend continues across the other three scenarios when adding the Project, dropping $0.30/MWh in the Green Economy scenario, $0.11/MWh in the Robust Economy scenario, and $0.04/MWh in the Slow Growth scenario.

Fuel efficiency is measured by average heat rate in MMBtu/MWh. Across the four scenarios, the change to average heat rate due to the Project is very small, from a

0.008 decrease to a 0.001 increase. These very small differences in fuel efficiency across a very large area would not appreciably impact Missouri rates, especially when compared against the larger impact of the Project reducing wholesale prices and Adjusted Production Cost.

Q. In discussing Grain Belt Express response to Staff Data Request 37 on page 20 of her rebuttal, Ms. Kliethermes states that the Callaway and Iatan plants were excluded from Grain Belt Express' reporting. Why is that the case?

A. Staff Data Request 37 asked for the change in generator output as a result of the addition of the Project. Neither the Callaway and Iatan plants experienced any change in output when the Project was added to the simulation, and therefore were not included in the information provided. The exclusion of these plants does not affect Ms. Kliethermes' calculations about the decrease in Missouri utilities' generation since there was no decrease at these plants.

Q. On page 17 of her rebuttal, Ms. Kliethermes states that Grain Belt Express' model results indicate that increased congestion will occur in Missouri. Is this correct?

A. No. Congestion costs, measured at the location of Missouri load, decrease with the addition of the Project. It is inaccurate to interpret decreased congestion costs to load as an increase in overall system congestion.

For a utility that is a member of MISO or SPP, net congestion cost is a function of the congestion cost paid to the RTO for demand and congestion revenue paid to the utility for generation. Congestion cost is measured directly as the portion of demand cost attributable to the congestion component of the LMP. Congestion revenue is measured as the portion of generator revenues attributable to the congestion component of the LMP.

The congestion cost minus congestion revenue represents a utility's net congestion cost. In the Business-as-Usual scenario results, Ameren Missouri has a net congestion cost of $224,065 without the Project and a net congestion cost of -$149,510 with the Project, a reduction of $373,575 specific to congestion. For KCP&L and KCP&L Greater Missouri Operations, the net congestion cost reduction is $185,166 with the Project.

Q. At pages 25-26 of her rebuttal, Ms. Kliethermes points out that a number of fossil generation plants did not produce at all when the Project is added to the PROMOD simulation. What can be concluded from this observation?

A. All of the plants Ms. Kliethermes lists are simple cycle oil or gas plants that, even without the Project, generate less than 400 MWh per year. The fact that the Grain Belt Express Project displaces some of these plants shows that the Project delivers a substantial amount energy during peak hours when the most inefficient plants (i.e., those with the highest fuel cost) are called on to generate power. Just because the plants do not run in one simulated model year does not mean they are unneeded or would be retired.

Q. At page 13 and 14 of his rebuttal testimony, MLA witness Jeffery Gray states that it is unreasonable to assume that the PATH transmission line is constructed in the PROMOD scenario with higher than forecasted load growth. What is your response?

A. As Show Me witness Dr. Michael Proctor correctly states at page 39 of his rebuttal testimony, "the addition of the PATH transmission project … in the robust economy future appears to make sense as it was cancelled because of low load growth." If load growth in the PJM is higher than expected, it is reasonable to assume the PATH line is included in future PJM transmission plans and approved for construction.

Q. Does this conclude your prepared surrebuttal testimony?

A. Yes, it does.

BEFORE THE PUBLIC SERVICE COMMISSION OF THE STATE OF MISSOURI

In the Matter of the Application of Grain Belt Express Clean Line LLC for a Certificate of Convenience and Necessity Authorizing it to Construct, Own, Operate, Control, Manage and Maintain a High Voltage, Direct Current Transmission Line and an Associated Converter Station Providing an Interconnection on the Maywood 345 kV transmission line.	))))))))	Case No. EA-2014-0207

AFFIDAVIT OF ROBERT CLEVELAND

STATE OF Georgia)
) ss
COUNTY OF DeKalb)

Robert Cleveland, being first duly sworn on his oath, states:

1. My name is Robert Cleveland. I am employed by DNV GL (formerly GL Garrad Hassan).

2. Attached hereto and made a part hereof for all purposes is my Surrebuttal Testimony on behalf of Grain Belt Express Clean Line, LLC consisting of 12 pages, having been prepared in written form for introduction into evidence in the above-captioned docket.

3. I have knowledge of the matters set forth therein. I hereby swear and affirm that my answers contained in the attached testimony to the questions therein propounded, including any attachments thereto, are true and accurate to the best of my knowledge, information and belief.

Robert Cleveland

Robert Cleveland

Subscribed and sworn to before me this 14 day of October, 2014.

Angela M. Claybrooks

Notary Public

My Commission Expires: April 9, 2017

Angela M Claybrooks
Notary Public
State of Georgia
County of Gwinnett
Comm Exp April 9, 2017

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Rob Cleveland

Senior Project Manager, Power Markets & Transmission Analysis
DNV GL

Mr. Cleveland is an energy industry consultant with more than 17 years of experience analyzing the economics and impacts of electric generation and power systems. His expertise in power markets modeling, strategic analysis, and project management are keys to his successful consulting engagements. He is recognized as an expert in nodal market modeling and fundamental price forecasting. His current areas of focus are wind curtailment and integration, power market price forecasting, generation and load strategy, FTR and ARR valuation and strategy, and economic transmission analysis.

Career History

GL Garrad Hassan/ DNV GL

Senior Project Manager, Power Markets & Transmission Analysis, June 2011 - present

Leader in the new PMTA group, focused on managing consulting projects and supporting business development activities:

- Direct and deliver successful PMTA projects
- Participate in PMTA business development, including marketing and proposals
- Establish and maintain mutually beneficial client relationships

Ventyx

Director, 2009 - 2011

- Leader – managed staff of 15 consultants in consulting and software services group, including nodal analysis and resource planning areas.
- Business Development – led business development activities for consulting with utility companies, including proposal development and interface with core sales staff.
- Strategic Consulting – Managed key projects in the nodal markets practice: price forecasting, FTR analysis, economic transmission planning, curtailment analysis, and ISO cost-benefit assessment.

Product Manager, 2006 – 2009

- Responsible for analytics software portfolio, including PROMOD IV, MarketPower, Strategist, and Powerbase.

PROMOD IV Service and Development, 1998 – 2006

- Advisory Service – Provided strategic advice and training to PROMOD IV clients, responsible for specific client accounts.
- Development – managed software development agenda, software releases, and staff; designed break-through enhancements in PROMOD IV security-constrained unit commitment logic

Professional Experience

Selected key consulting engagements led by Mr. Cleveland include:

- *Wind Curtailment Risk Studies* (2011 - 2013) – In two years Mr. Cleveland conducted curtailment risk studies for over twenty wind projects in SPP, MISO, WECC, PJM, ISO-NE, ERCOT, IESO, and Maui. Studies quantified and characterized the risk of congestion-related curtailment based on market simulation results, historical data and contracts, and market research.

- *Analysis of Cleco Participation in MISO Market* (2011 - 2012) – Mr. Cleveland consulted with Cleco to provide an independent assessment of the benefits and impacts of joining the MISO energy market. Mr. Cleveland provided testimony on Cleco's behalf filed with the Louisiana Public Service Commission. Previous FERC study results were assessed and additional scenarios constructed to analyze the impact of various market conditions on study benefit results. Additional work included analysis and strategic advice related to joining an RTO: 1) a study of the production cost benefit and potential cost allocation of proposed regional transmission projects, 2) guidance and strategic advice regarding the additional transmission cost and compliance cost associated with FERC Order 1000, 3) assessing the impacts of joining an RTO on future wholesale load and capacity growth, including congestion cost forecasts and potential FTR activities, and 4) assessing RFP bids operating within a MISO market.

- *Economic Benefit Study for Rock Island Clean Line Project* (2012-13) – Mr. Cleveland performed the modeling and analytical work to assess the environmental and economic impacts of a new HVDC transmission project to transport energy from wind projects in high wind resource areas in western Iowa into the Chicago area in Illinois. The analysis included the development of four different future economic scenarios with detailed nodal simulations performed for 2016 and 2020. The study results were included in expert witness testimony supplied by GL GH in support of Clean Line Energy's October 2012 filing. The full study report is posted on the Clean Line Energy website at: http://www.rockislandcleanline.com/site/page/environmental-studies

- *Fleet Congestion Study for an electric utility in Wisconsin* (2012) – Mr. Cleveland performed a comprehensive congestion study for a Wisconsin-based utility to assess the impacts of future conditions on congestion costs. Simulations were performed for 2013, 2017, and 2020 under four different future market scenarios, along with multiple sensitivities for each case examining impacts of unit retirements. A validation task was performed for the 2013 study year to align the model with recent congestion patterns and benchmark the model to historical unit operations. Study results focused on LMP values and congestion costs between generators and delivery points, including calculation of FTR values as a possible means of hedging congestion costs.

Academic History

M.S., Public Policy, Georgia Institute of Technology, Atlanta, 1996

B.S., Mechanical Engineering, Georgia Institute of Technology, Atlanta, 1991

Full Economic Benefit Results for Grain Belt Express

Demand Cost*	($M)	2019			
		Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Grain Belt	Missouri	3,221	2,239	5,324	9,067
With Grain Belt	Missouri	3,199	2,228	5,255	9,035
Savings	Missouri	22	11	69	32

Locational Marginal Price ($/MWh)*			2019			
			Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Grain Belt	LMP OnPeak Avg	Missouri	38.77	26.66	63.65	98.56
Without Grain Belt	LMP OffPeak Avg	Missouri	28.41	20.85	37.62	77.00
Without Grain Belt	LMP Average	Missouri	33.35	23.62	50.03	87.28
With Grain Belt	LMP OnPeak Avg	Missouri	38.45	26.53	62.87	98.11
With Grain Belt	LMP OffPeak Avg	Missouri	28.27	20.76	37.06	76.84
With Grain Belt	LMP Average	Missouri	33.13	23.51	49.36	86.98
LMP Change	LMP OnPeak Delta	Missouri	-0.32	-0.13	-0.78	-0.45
LMP Change	LMP OffPeak Delta	Missouri	-0.14	-0.09	-0.56	-0.16
LMP Change	LMP Average Delta	Missouri	-0.22	-0.11	-0.67	-0.30

Variable Production Cost (Eastern US)		($M)	2019	
	Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Grain Belt	75,906	52,959	100,798	150,015
With Grain Belt	75,331	52,572	99,931	148,780
Savings	574	387	867	1,236

***Result has been updated after adding 29 KCPL load buses to the Missouri Load Hub definition**

Emissions and Water Use Reduction Results for Grain Belt Express

Emissions (Eastern US) 2019

		Business as Usual	Slow Growth	Robust Economy	Green Economy
Without Grain Belt	NOx (tons)	902,580	596,858	1,084,855	615,122
Without Grain Belt	SOx (tons)	2,196,005	971,702	2,618,321	1,426,626
Without Grain Belt	CO2 (tons)	1,541,471,608	1,171,768,238	1,768,831,993	1,140,810,137
Without Grain Belt	Hg (lbs)	28,091	13,352	32,614	18,238
Without Grain Belt	Water (MGal)	424,612	502,802	457,766	478,173
With Grain Belt	NOx (tons)	895,469	588,908	1,080,168	609,014
With Grain Belt	SOx (tons)	2,176,216	955,125	2,608,824	1,405,774
With Grain Belt	CO2 (tons)	1,531,458,478	1,160,202,768	1,761,300,314	1,130,027,471
With Grain Belt	Hg (lbs)	27,955	13,235	32,545	18,095
With Grain Belt	Water (MGal)	420,331	500,018	452,873	474,222
Reduction	NOx (tons)	7,111	7,950	4,687	6,109
Reduction	SOx (tons)	19,788	16,578	9,497	20,852
Reduction	CO2 (tons)	10,013,130	11,565,469	7,531,679	10,782,667
Reduction	Hg (lbs)	135	117	69	143
Reduction	Water (MGal)	4,281	2,783	4,893	3,952

Adjusted Production Cost Results for State of Missouri with Grain Belt Express

Business as Usual

		Without Grain Belt	With Grain Belt	Difference
Energy (GWh)	Generation	87,889	87,653	(235)
	Purchases	9,074	9,268	195
	Sales	(891)	(850)	41
	Net	96,071	96,071	(0)
Cost (M$)	Generation	2,082.9	2,074.7	(8.1)
	Purchases	349.0	353.5	4.3
	Sales	(23.2)	(22.1)	0.9
	Net	2,408.7	2,406.1	(2.6)

Slow Growth

		Without Grain Belt	With Grain Belt	Difference
Energy GWh	Generation	77,545	76,618	(927)
	Purchases	17,733	18,651	918
	Sales	(31)	(22)	9
	Net	95,247	95,247	0
Cost (M$)	Generation	1,565.0	1,541.3	(23.7)
	Purchases	405.2	423.5	18.3
	Sales	(0.9)	(0.6)	0.2
	Net	1,969.3	1,964.1	(5.2)

Robust Economy

		Without Grain Belt	With Grain Belt	Difference
Energy GWh	Generation	92,468	92,114	(354)
	Purchases	11,655	11,979	324
	Sales	(569)	(539)	30
	Net	103,554	103,554	-
Cost (M$)	Generation	2,518.7	2,497.0	(21.7)
	Purchases	700.8	709.5	8.6
	Sales	(17.1)	(16.0)	1.0
	Net	3,202.5	3,190.5	(12.1)

Green Economy

		Without Grain Belt	With Grain Belt	Difference
Energy GWh	Generation	68,207	68,052	(155)
	Purchases	35,348	35,503	155
	Sales	-	-	-
	Net	103,554	103,554	-
Cost (M$)	Generation	4,458.3	4,445.1	(13.2)
	Purchases	3,159.8	3,162.2	2.4
	Sales	-	-	-
	Net	7,618.0	7,607.3	(10.7)

Adjusted Production Cost Results for Ameren Missouri with Grain Belt Express

Business as Usual

		Without Grain Belt	With Grain Belt	Difference
Energy (GWh)	Generation	45,953	45,844	(109)
	Purchases	4,108	4,160	51
	Sales	(2,954)	(2,897)	58
	Net	47,107	47,107	(0)
Cost (M$)	Generation	995.2	991.7	(3.5)
	Purchases	163.8	164.3	0.5
	Sales	(82.0)	(79.9)	2.0
	Net	1,077.0	1,076.0	(1.0)

Slow Growth

		Without Grain Belt	With Grain Belt	Difference
Energy GWh	Generation	38,689	37,931	(758)
	Purchases	8,468	9,168	700
	Sales	(297)	(239)	58
	Net	46,860	46,860	0
Cost (M$)	Generation	837.8	817.5	(20.2)
	Purchases	206.6	221.5	14.9
	Sales	(7.9)	(6.4)	1.5
	Net	1,036.5	1,032.6	(3.9)

Robust Economy

		Without Grain Belt	With Grain Belt	Difference
Energy GWh	Generation	46,697	46,658	(39)
	Purchases	6,039	6,066	26
	Sales	(1,790)	(1,778)	12
	Net	50,946	50,946	-
Cost (M$)	Generation	1,093.9	1,088.7	(5.2)
	Purchases	368.3	365.1	(3.2
	Sales	(57.3)	(56.3)	1.0
	Net	1,404.8	1,397.5	(7.4)

Green Economy

		Without Grain Belt	With Grain Belt	Difference
Energy	Generation	24,658	24,555	(104)
GWh	Purchases	26,288	26,392	104
	Sales	-	-	-
	Net	50,946	50,946	-
Cost	Generation	1,295.7	1,285.7	(10.0)
(M$)	Purchases	2,485.7	2,481.4	(4.3)
	Sales	-	-	-
	Net	3,781.5	3,767.1	(14.4)

Full Economic Benefit Results for MISO Wind Alternative Scenario

Demand Cost	($M)	2019
		Business as Usual
Without MISO Wind	Missouri	3,221
With MISO Wind	Missouri	3,217
Savings	Missouri	4

Locational Marginal Price ($/MWh)			2019
			Business as Usual
Without MISO Wind	LMP OnPeak Avg	Missouri	38.77
Without MISO Wind	LMP OffPeak Avg	Missouri	28.41
Without MISO Wind	LMP Average	Missouri	33.35
With MISO Wind	LMP OnPeak Avg	Missouri	38.71
With MISO Wind	LMP OffPeak Avg	Missouri	28.39
With MISO Wind	LMP Average	Missouri	33.31
LMP Change	LMP OnPeak Delta	Missouri	-0.06
LMP Change	LMP OffPeak Delta	Missouri	-0.02
LMP Change	LMP Average Delta	Missouri	-0.04

Variable Production Cost (Eastern US) ($M) 2019

	Business as Usual
Without MISO Wind	75,906
With MISO Wind	75,839
Savings	67

Emissions and Water Use Reduction Results for MISO Wind Alternative Scenario

Emissions (Eastern US) 2019

		Business as Usual
Without MISO Wind	NOx (tons)	902,580
Without MISO Wind	SOx (tons)	2,196,005
Without MISO Wind	CO2 (tons)	1,541,471,608
Without MISO Wind	Hg (lbs)	28,091
Without MISO Wind	Water (MGal)	424,612
With MISO Wind	NOx (tons)	901,901
With MISO Wind	SOx (tons)	2,194,129
With MISO Wind	CO2 (tons)	1,539,897,167
With MISO Wind	Hg (lbs)	28,052
With MISO Wind	Water (MGal)	424,128
Reduction	NOx (tons)	679
Reduction	SOx (tons)	1,867
Reduction	CO2 (tons)	1,574,441
Reduction	Hg (lbs)	39
Reduction	Water (MGal)	484

Adjusted Production Cost Results for State of Missouri with MISO Wind Alternative

Business as Usual

MISO Wind Alternative

		Without MISO Wind	With MISO Wind	Difference
Energy GWh	Generation	87,871	87,913	42
	Purchases	9,089	9,065	(24)
	Sales	(888)	(906)	(12)
	Net	96,071	96,071	-
Cost (M$)	Generation	2,082.9	2,083.9	1.0
	Purchases	349.7	348.5	(1.2)
	Sales	(23.4)	(23.6)	(0.2)
	Net	2,409.24	2,408.75	(0.48)

Adjusted Production Cost Results for Ameren Missouri with MISO Wind Alternative

Business as Usual

MISO Wind Alternative

		Without MISO Wind	With MISO Wind	Difference
Energy GWh	Generation	45,953	45,946	(7)
	Purchases	4,108	4,113	4
	Sales	(2,954)	(2,952)	3
	Net	47,107	47,107	-
Cost (M$)	Generation	995.2	994.9	(0.3)
	Purchases	163.8	163.6	(0.1)
	Sales	(82.0)	(81.9)	0.1
	Net	1,077.0	1,076.7	(0.3)