Final Report

Analysis of the Benefits of the Proposed Plains and Eastern Clean Line

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Submitted to:

Clean Line Energy Partners

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Table of Contents

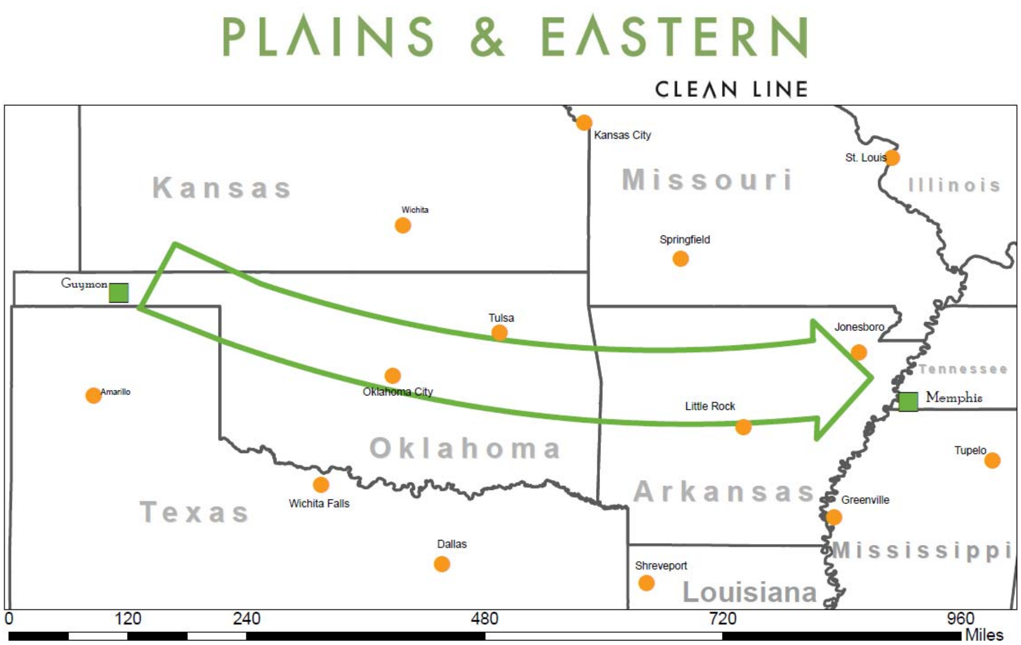
Chapter I
Analysis of the Benefits of the Proposed Plains and Eastern Clean Line

I.1 Introduction to the Project

ICF International ("ICF") was retained by Clean Line Energy Partners ("Clean Line") to provide an assessment of the potential benefits of the Plains and Eastern Clean Line transmission project (the "Project" or the "Clean Line Project"). By way of background, Clean Line is an independent transmission company dedicated to pursuing inter-regional, long-distance electricity transmission projects to support wind power plant development and renewable power delivery to distant load centers.

The Clean Line Project will consist of twin, ±500 or ±600 kilo-volt ("kV"), overhead, HVDC transmission lines, with capacity up to 7,000 MW. The project will extend from western Oklahoma to the southeastern U.S., with possible delivery points near Memphis, Tennessee or elsewhere in the southeastern U.S. It will deliver power generated by wind power plants in western SPP to power purchasers in the southeastern U.S., potentially including the Tennessee Valley Authority ("TVA"). The route of the Project and the sale of transmission capacity have not been finalized. Exhibit I-1 shows an illustrative path for the Project.

Exhibit I-1: Illustrative Path of the HVDC Clean Line Project



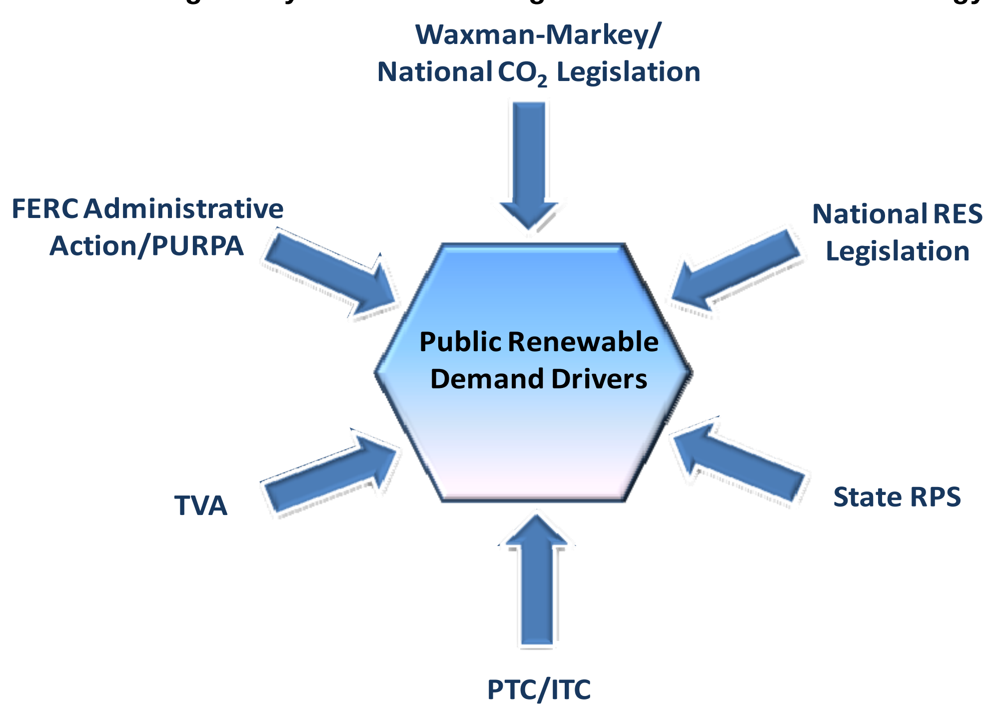
I.2 Benefits of Clean Line Project

There are huge supplies of high quality[1] wind resources in western SPP that cannot be fully utilized within SPP. In contrast, the southeastern U.S. has little or no high quality wind resources but an increasing demand for renewable energy. Clean Line's project will enable consumers in the southeastern U.S. to utilize the abundant high quality wind resources in western SPP. As a result, there will be a variety of benefits. These include:

- **Environmental Benefits** – Increased generation from clean, renewable resources will reduce the reliance on older, more polluting fossil generation units in the southeastern U.S., thereby providing the benefits of reduced air pollutant emissions including NO_x, SO_2, and CO_2. The project will decrease emissions of other pollutants such as mercury. The project will also decrease the use of water.

- **Greater Success in Meeting Renewable Mandates and Goals** – Energy delivered by the Project will allow utilities in the southeastern United States to increase their proportion of energy derived from renewable resources and meet state and potential federal mandates. Numerous policies provide ample evidence that increased access to renewable power is in the public interest (see Exhibit I-2).

Exhibit I-2
Regulatory Policies Creating Demand for Renewable Energy



[1]High quality wind has high power density, and therefore, lower production costs. High power density primarily reflects wind speed.

- **Greater Transmission Capacity and Grid Reliability** – There is a need to expand transmission infrastructure to maintain and enhance grid reliability and to improve overall power system economics. There is also a need for greater inter-regional transmission to support renewable energy development. Evidence of the need for more transmission is found in FERC statements related to FERC Order No. 890. Also, the June 17, 2010 FERC Notice of Proposed Rule making emphasizes the importance of interim regional power lines. Also, recently proposed new environmental regulations on U.S. coal power plant emissions of SO_2, NO_x, CO_2, mercury, the disposal of coal ash and other coal use by-products, and water use could result in the unexpected retirement of some existing coal plant capacity. The Clean Line project supports grid reliability by creating another source of power for the southeastern U.S. The public will benefit from greater transmission capacity, and reliability.

- **Increased Competition for Renewable Supply** – The Project will also increase competition in renewable power supply in the southeastern U.S. Currently, there are approximately 33,000 MW of wind projects in the SPP Interconnection Queue. Average wind speeds at the height of a modern wind turbine (80 m) do not exceed 6.5 meters per second in Arkansas and other southern states such as Louisiana, Tennessee, Kentucky, Mississippi, Alabama, and Georgia. In contrast, average wind speeds in the Texas Panhandle, western Oklahoma, and southwest Kansas regularly exceed 9 meters per second.[2] As a result, wind farms delivering power through the Project will have a higher capacity factor, and therefore lower cost of energy than other renewable projects in the southeastern U.S. Consequently, more affordable renewable power can be made available to utilities serving customers in Arkansas and elsewhere in the region.

- **Job Creation** – The construction and operation of the Clean Line Project will create new jobs for the U.S. economy. Further, the added transmission capacity is needed to allow the construction of new renewable generating facilities in western Oklahoma, southwestern Kansas and the Texas Panhandle. Thus, there will be incremental wind power plant construction and operation jobs. As a result of the Project, businesses, particularly those dedicated to producing blades, towers and turbines, will experience increased demand for their services and hire more workers. Service and hospitality industries will also realize additional revenues as a result of the construction of the Clean Line Project, and be able to hire more employees. These activities will support employment.

- **Other Economic Development** – In addition to direct jobs mentioned above, the economy will benefit from the Clean Line Project because the Project will result in Right-Of-Way ("ROW") payments, tax revenues, enhanced manufacturing potential, indirect economic benefits (i.e., a multiplier effect), and economic development to the U.S. The Project will also result in increased property, sales and income tax revenue for localities, states, and federal government.

- **Lower Wholesale Power Market Prices in Southeastern U.S.** – The Project will increase competition in the wholesale power generation market, reduce the production cost of power, and thus, lower electricity prices to consumers. Put

[2] http://www.windpoweringamerica.gov/wind_maps.asp#us.

another way, the Project will increase the supply of zero variable cost power, and hence, will lower spot wholesale power prices.

- **Improved Access to Stable Priced Power** – The Project will infuse up to 7,000 MW of domestically produced zero fuel cost, zero emission cost electricity into the southeastern U.S. As a result, this supply will have a stable annual price.

I.3 Report Outline

The remainder of the report focuses on the environmental and market benefits of the Project. The study assumes delivery to Tennessee, a potential Southeastern U.S. delivery destination. This is done to illustrate the benefits of supplying SPP wind power to the southeastern U.S. However, as mentioned, the configuration of the line and power sales have not been finalized.

Chapter II provides a brief overview of the Southwest Power Pool (SPP), the source power market. Chapter III provides an overview of the Tennessee Valley Authority (TVA), the example used of a possible destination power market. Chapter IV describes ICF's analytic approach, the scenarios studied and the underlying input assumptions used in the analysis. Chapter V discusses the results of the study. The conclusions are presented in Chapter VI.

Chapter II
Overview of the SPP Market

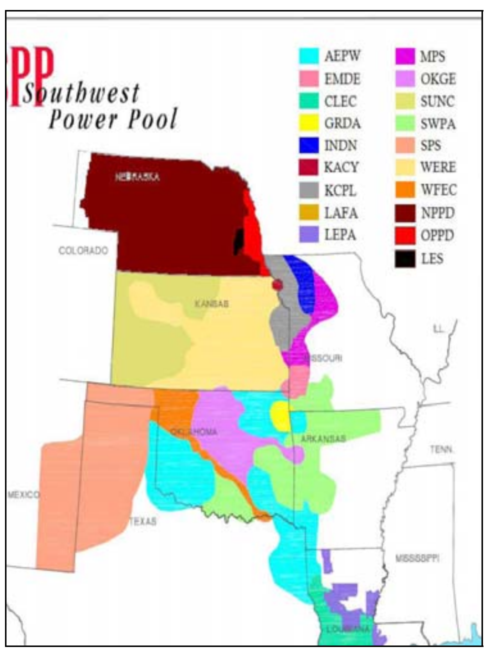
II.1 Summary

SPP has far more high quality wind resources than it can use because SPP's potential wind supply is so much larger than SPP's electricity demand. An attractive market for this resource surplus is the southeastern U.S. which has far less high quality wind resources than it can use. SPP transmission capability to the southeastern U.S., however, is very limited. SPP is upgrading its transmission, but is focusing on delivery within SPP rather than inter-regional export over long distances. The Clean Line project provides an alternative to the resource imbalances that exists in SPP and the southeastern U.S. by creating transfer capability that otherwise would not exist.

II.2 SPP Introduction

SPP is a Regional Transmission Organization (RTO) that manages transmission in eight states: Arkansas, Kansas, Louisiana, Missouri, Nebraska, New Mexico, Oklahoma, and Texas (see Exhibit II-1 and II-2). In April 2009, three Nebraska utilities, Nebraska Public power District (NPPD), Omaha Public Power District (OPPD) and Lincoln Electric System (LES), joined SPP as full members of the SPP RTO.

Exhibit II-1: Map of SPP Balancing Authorities



Source: SPP 2009 State of the Market

As an RTO, SPP is mandated by FERC to ensure reliable supplies of power, adequate transmission infrastructure, and competitive wholesale prices of electricity. SPP is also a North American Electric Reliability Corporation (NERC) Regional Entity.

Relative to other RTO markets, SPP is a small to medium regional market, with annual peak demand of approximately 47,000 MW. In comparison, annual peak demands in the PJM and Midwestern Independent System Operator (MISO) are above 100,000 MW. The peak annual demand of the Southeastern Electric Reliability Council (SERC) is above 200,000 MW.

The relatively small size of SPP's demand is an important issue for SPP planners who recognize that SPP has more wind resource potential than it can use. This imbalance is discussed later in this report.

Exhibit II-2: SPP Overview

Metric	Parameter
Territory	370,000 square miles covering 9 states. Control center in a suburb of Little Rock, AR.
Market Participants	54 including 11 cooperatives, 9 municipals, 12 investor-owned entities, 10 marketers, 5 IPPs and 4 state agencies
Generation Capacity	66,175 MW
Non-coincidental Peak Load	47,365 MW (set in June 23rd, 2009))
Transmission	47,000 miles including 500kV, 345kV, 230kV, 161kV, 138kV, 115kV, 69kV
Market Operations	Uses security-constrained unit commitment and economic dispatch of generation. Operates bilateral market for Day-Ahead, Energy Imbalance market in the real-time
Balancing Authorities	19 Balancing Authorities including the Southwestern Power Administration (SWPA) , NPPD, OPPD and LES

Source: SPP

II.3 SPP Wind Potential

II.3.1 Existing SPP Wind Capacity

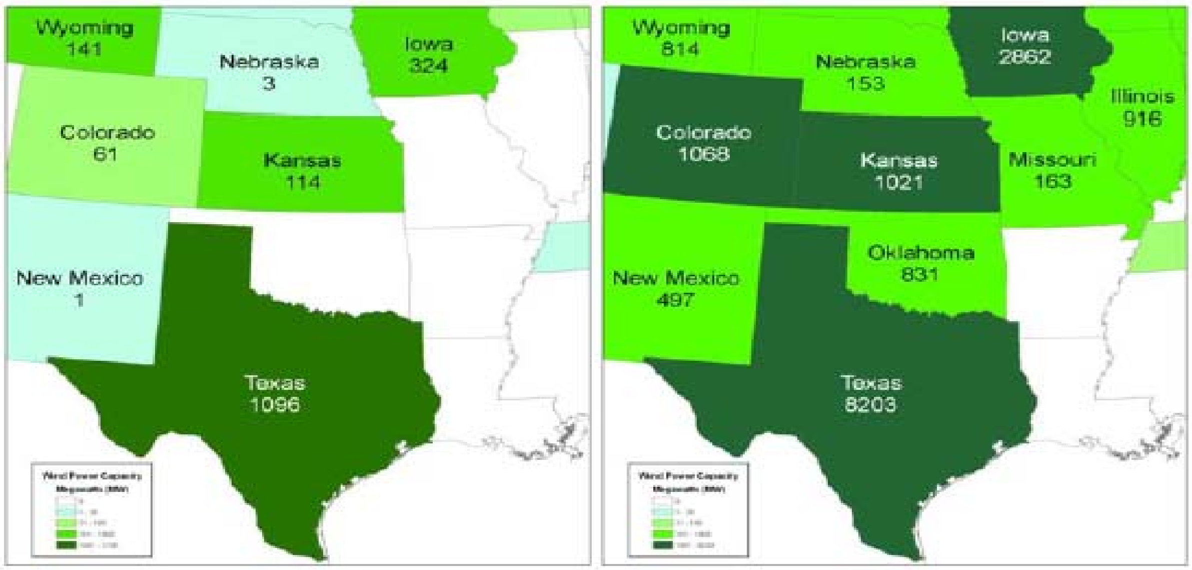
The Project has the potential to provide significant benefits by allowing southeastern U.S. markets to access the large supply of wind in western SPP. Thus, it is necessary to demonstrate the existence of a large wind resource potential in SPP. As of early 2010, SPP had approximately 3,200 MW of existing wind capacity. This is approximately 4% of the existing capacity resources.[3]

However, there has been a rapid increase in SPP wind capacity additions in recent years which is one indication of the huge wind resource potential in SPP. Exhibit II-3 compares the total generation capacity in service in selected states in 2001 to the capacity in 2009. In 2001, SPP

[3] SPP had 3,165 MW of wind capacity in operation based on the SPP Interconnection Queue as of March 12, 2010. Note, this does not include distributed or community wind farms being installed on distribution systems or behind the meter.

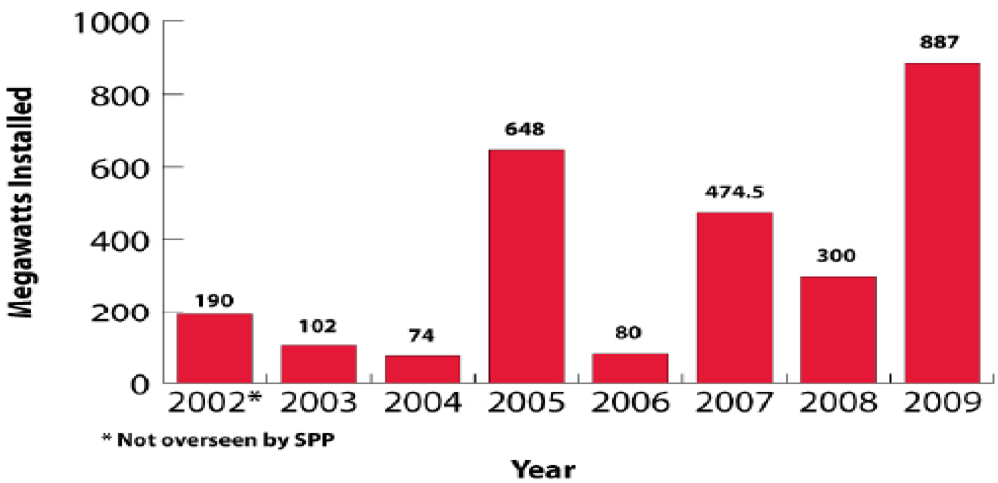
had less than 200 MW of wind generation capacity in service. Therefore almost all of the approximately 3,200 MW of capacity currently in service came on-line after 2001. This is also evident in Exhibit II-4, which shows the annual capacity of wind generation installed in SPP since 2002. More than half of the existing capacity was installed between 2007 and 2009. This large and rapid increase is however small compared to huge increase in the proposed wind projects discussed below.

Exhibit II-3
SPP Wind Capacity in Service: 2001 versus 2009 (MW)



Source: NREL

Exhibit II-4
SPP Wind Installed by Year (2002 – 2009)



Source: SPP

II.3.2 SPP Interconnection Queue and Proposed SPP Wind Projects

The SPP Interconnection Queue is a list used in the process to obtain an interconnection agreement to place new generation on the SPP electric transmission system. The SPP Interconnection Queue includes both planned generation facilities that have submitted requests for interconnection and facilities that have already obtained interconnection agreements and are operational. It therefore provides a measure of the potential for future generation capacity additions.

The total generation capacity in the SPP Interconnection Queue as of March 12, 2010 was 41,586 MW. Approximately 80% of this capacity, or 33,228 MW, is wind generation. Thus, the SPP Interconnection Queue contains approximately ten times the amount of existing wind. As shown in Exhibit II-5, this includes 3,165 MW of on-line[4] wind generation, and 30,063 MW of proposed wind generation.

Exhibit II-5
Wind Generation Capacity in the SPP Interconnection Queue

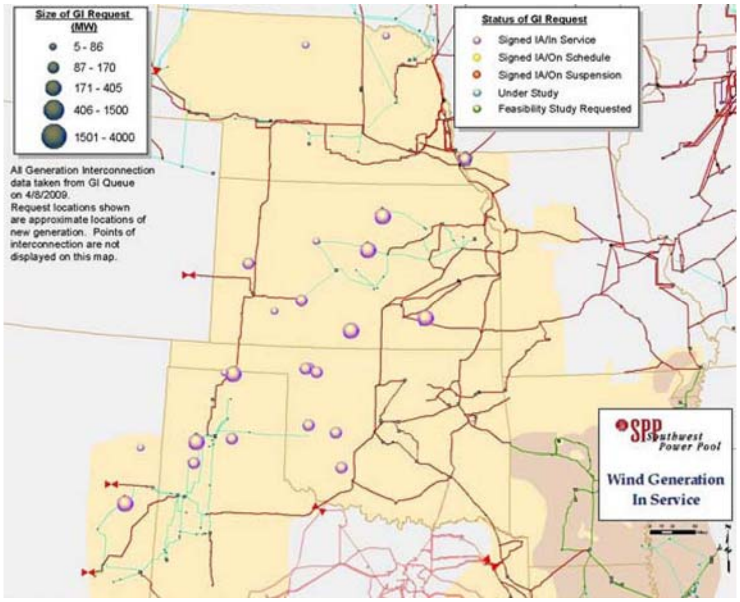
Study Stage	Status	Deposit Required	Capacity (MW)
Feasibility Study Stage	Feasibility Study Requested	~$10,000	2,633
	Feasibility Study Stage		952
Impact Study Stage	PISIS[1]	Depends on size of the unit - $40,000 to $60,000	10,138
	DISIS[2]	Depends on size of the unit - $75,000 to $150,000	812
	Impact Study Completed	N/A	200
Facility Study Stage	Facility Study in Progress	Interconnection customer pays either $100,000 or the interconnection customer's portion of the estimated monthly cost of conducting the interconnection facilities study, whichever is greater.	205
	Facility Study Stage		8,386
N/A	IA Pending[3]	$250,000 that will count IA towards network upgrades	942
	IA Fully Executed/On Suspension[3]		3,433
	IA Fully Executed On Schedule		2,362
	IA Fully Executed/ Commercial Operation	N/A	3,165
	Total		**33,228**

Source: SPP Interconnection Queue as of March 12, 2010.
[1] Preliminary Interconnection System Impact Study ("PISIS"). PISIS queue positions have priority over Feasibility Study queue positions.
[2] Definitive Interconnection System Impact Study ("DISIS"). DISIS queue positions have queue priority over PISIS queue positions.
[3] Interconnection Customer (IC) has the ability to suspend the construction of network upgrades and interconnection facilities limited to those facilities for which the IC has sole cost responsibility. An IC cannot suspend construction of a project for which it shares costs.

[4] These are projects designated as "IA Fully Executed/ Commercial Operation".

In terms of wind speed and geographical location, some of the most attractive locations to site wind in SPP are in the Oklahoma and Texas panhandle, and central and western Kansas. Exhibit II-6 shows the distribution of wind that is currently in the SPP system. The wind facilities in the SPP Interconnection Queue, including the proposed projects, are concentrated in western SPP (see Exhibit II-7). As noted, the Project is expected to have its source interconnection node in western Oklahoma, providing access to the major wind sites in SPP.

Exhibit II-6: Distribution of Wind Capacity in SPP



Source: Intro to SPP Presentation, October 9, 2009

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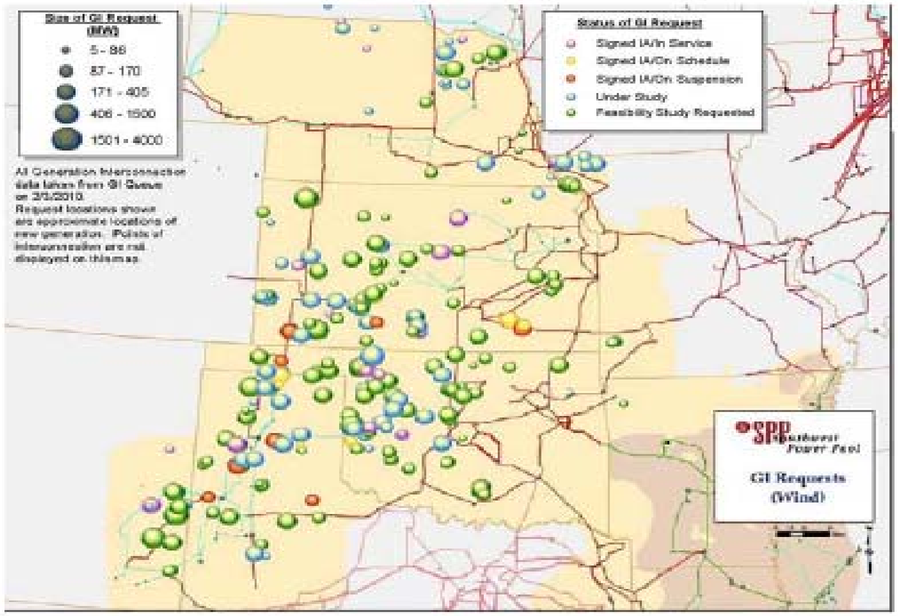
Exhibit II-7
Distribution of Wind Capacity in SPP Interconnection Queue

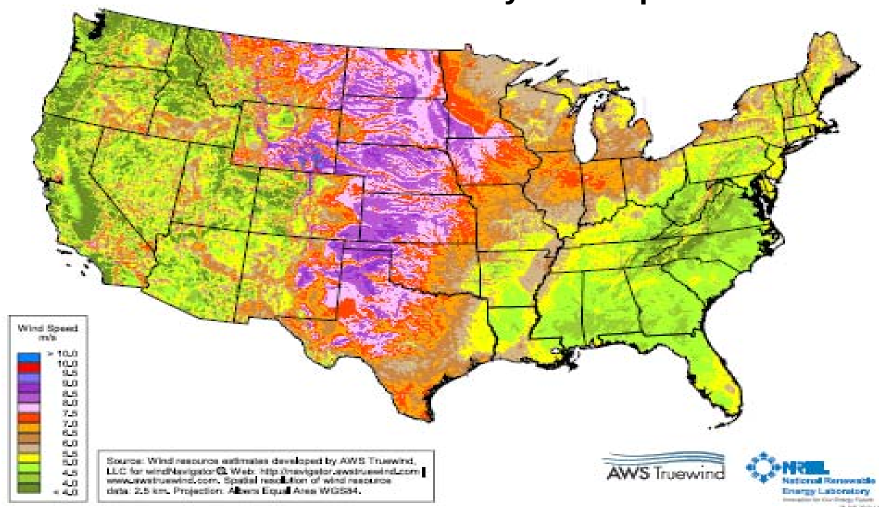


Source: SPP

II.3.3 SPP Wind Quality Compared to Southeastern U.S. Wind Quality

As shown in Exhibits II-8 and II-9, SPP has all of the high quality wind resources closest to the Southeastern U.S. Also, the Southeastern states to the east of SPP do not have high quality wind resources compared to Oklahoma, Texas, and other states in the center of the country. For example, TVA's service territory lacks high quality wind resources. This imbalance in wind resource endowment creates large export potential from western SPP to the southeastern U.S.

Exhibit II-8
US Wind Resources by Wind Speed



The southeastern U.S. has lower quality wind resources than Oklahoma and other parts of western SPP.

Exhibit II-9
Annual Average 80m Wind Speed

II.3.4 Other SPP Wind Resource Estimates

Estimates from other sources indicate that the potential SPP wind capacity may be even larger than the current wind capacity in the SPP Interconnection Queue.

There are several estimates of potential SPP wind capacity including (see Exhibit II-10):

- **NREL** – The National Renewable Energy Laboratory ("NREL") estimates that SPP has 275 MW of Class 6 wind generation, 1,402 MW of Class 5, 583,977 MW of Class 4, and 1,120,721 MW of Class 3.[5] *The quantity of Class 4-6 wind generation potential in SPP is approximately 18 times the total amount of wind capacity in the SPP Interconnection Queue.* The quantity of Class 3 wind generation alone is approximately 34 times the amount in the SPP Interconnection Queue. The class of wind refers to the wind power density. For example, Class 6 wind is defined as wind that represents a power density range of 400 to 800 watts per meter squared. Class 6 is the highest class, and Class 1 the lowest. Class 6 is rare in the U.S., especially in terrain that is readily accessible.

- **EWITS** – The recent DOE Eastern Wind Integration Transmission Study ("EWITS") examined scenarios in which up to 95,000 MW of wind was operational in SPP by 2024.

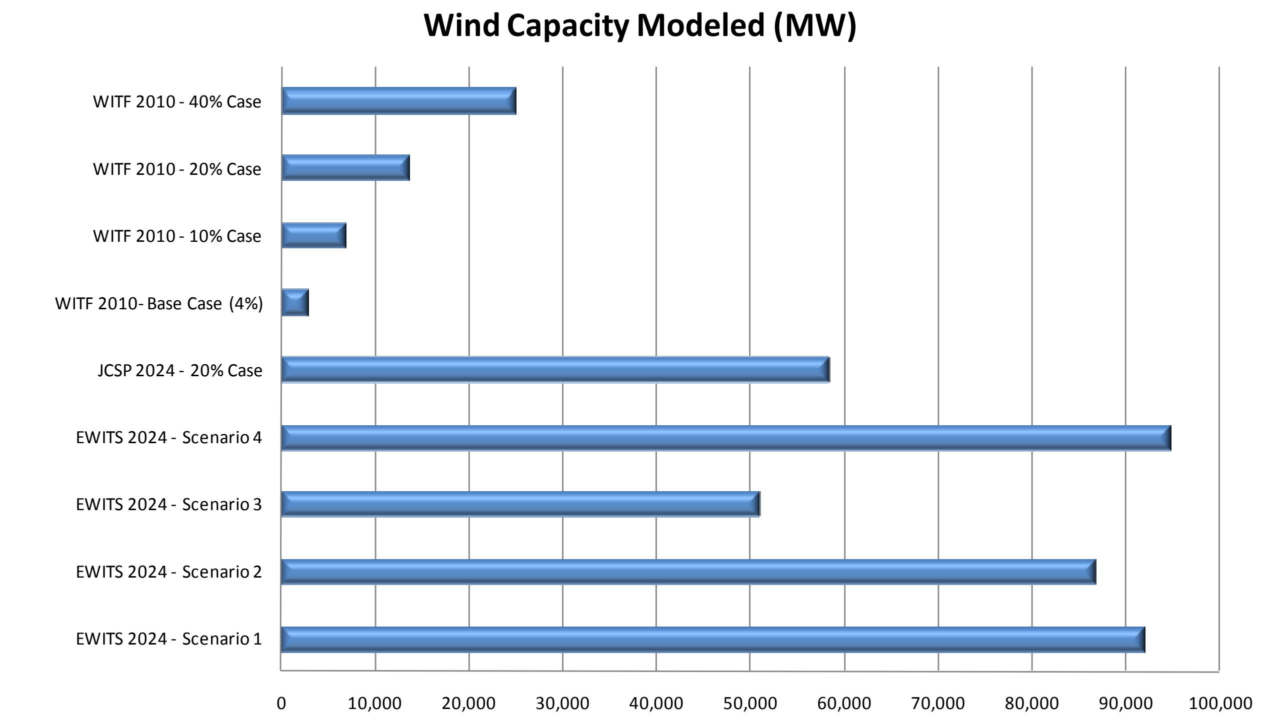
- **JCSP** – The Joint Coordinated System Plan ("JCSP"), a study conducted by SPP, MISO, TVA, and the PJM Interconnection ("PJM") also included a 20% wind penetration scenario in which more than 58,000 MW of wind generation was operational in SPP by 2024.

- **WITF** – In addition, SPP's Wind Integration Task Force ("WITF") recently concluded a study in which it determined the operational and reliability impacts of wind integration into the SPP transmission system and energy markets.[6] The analysis included up to nearly 25,000 MW of wind in SPP. A summary of some of the scenarios examined in recent studies is shown in Exhibit IV-9.

[5] *2006 Documentation of WinDS Base Case Data* (http://www.nrel.gov/analysis/winds/pdfs/winds_data.pdf), National Renewable Energy Laboratory. Table A1, "Wind Resource by WinDS Region" provides capacity data by WinDS region and wind class. ICF mapped these regions to counties and then aggregated to ICF model regions.

[6] The study determined that SPP could reliably integrate approximately 14,000 MW (20% penetration) of wind. The study recommended major transmission reinforcement (especially west to east) at 6,800 MW (or 10% penetration) of wind.

Exhibit II-10
Various SPP Wind Scenarios – WITF, EWITS and JCSP



	EWITS 2024 - Scenario 1	EWITS 2024 - Scenario 2	EWITS 2024 - Scenario 3	EWITS 2024 - Scenario 4	JCSP 2024 - 20% Case	WITF 2010- Base Case (4%)	WITF 2010 - 10% Case	WITF 2010 - 20% Case	WITF 2010 - 40% Case
Wind Capacity Modeled (MW)	91,843	86,666	50,958	94,576	58,333	2,877	6,840	13,674	25,003

Source: ICF

II.3.5 SPP Wind Capacity Cannot be Fully Utilized Without Exports

The wind capacity of 30,063 MW in the SPP Interconnection Queue is an extremely large amount, especially given the size of SPP's load. It is more than nine times the current existing wind capacity in SPP. This amount is also approximately equal to 75% of total U.S. on-line wind capacity. While prospects for individual projects are uncertain, and many may ultimately not be built, the large amount of capacity in the Interconnection Queue creates the possibility that a very large amount of wind generation can be developed in western SPP.

SPP has acknowledged that the wind resource potential in its territory is very large. On April 24, 2009, SPP responded to the Arkansas Public Service Commission in Docket No. 08-144-U, In the Matter of a Notice of Inquiry Regarding the Expanded Development of Sustainable Energy Resources in Arkansas.[7] SPP stated that "the potential for development of significant renewable resources in terms of wind and solar resources within SPP is almost unlimited and

[7] Response of Southwest Power Pool, Inc. to Order No. 8 Estimate of the Impact of Proposals to Adopt Federal, Renewable Portfolio Standards, Renewable Electricity Standards, and Energy Efficiency Resource Standards, see pages 2-3.

can be more fully realized only if SPP and its neighbors work together to coordinate bulk power planning and operations to effectively integrate and deliver renewable resources within the SPP footprint and to markets throughout the United States." (underline added) In addition, in a publicly-available report, SPP estimated the wind potential at 60,000 MW – 95,000 MW based on the EWITS. In that report, SPP also refers to its western region as the wind "Saudi Arabia."[8] (underline added).

The amount of wind generation in the SPP Interconnection Queue is large relative to the demand in SPP (see Exhibit II-11). In 2009, the peak demand in SPP was approximately 47,365 MW.[9] ICF estimates that the average demand in 2009 was approximately 26,000 MW.[10] The deep off-peak demand was roughly 16,000[11] MW. Thus, the wind capacity in the SPP Interconnection Queue equals nearly 63% of peak demand, approximately 115% of average demand, and 208 percent of deep off-peak, *i.e., supply is more than two times demand in that hour even if all other power plants are shut down entirely*. SPP cannot accommodate this amount of wind capacity locally, so it will need to consider exporting some of the capacity to regions such as the southeastern U.S. that do not have high quality wind resources.

Exhibit II-11
SPP Wind Cannot Be Fully Used by SPP

Demand Measure	Demand Level (MW)	Wind in SPP Interconnection Queue	Wind as Percentage of Demand (%)
Annual peak	47,365	33,228	63
Average	26,000	33,228	115
Deep Off-Peak	16,000	33,228	208

II.4 II.4.1 Summary

SPP has significant and recurring internal transmission congestion that limits the flow of power among its sub-regions. One of the key congestion points is between the sub-region areas with high quality wind resources and the rest of SPP. Once a large amount of wind is added to western SPP, it will stress the system even as flows change. The ability to export from SPP to the southeastern U.S. is even more limited by additional transmission constraints between SPP and other regions

SPP has numerous transmission investment programs including the recently adopted Priority Projects Phase II program to enhance the ability to move power, especially wind power from western SPP. However, these projects are designed to resolve internal SPP congestion and do not significantly increase the export capability to the southeastern U.S. or any other region outside SPP. Thus, Clean Line is needed to permit inter-regional exports from SPP to the southeastern U.S. and is the only project proposed along this critical route.

II.4.2 Current Transmission Congestion

The major congested SPP transmission interfaces are shown in Exhibit II-12.

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[8] http://www.spp.org/publications/Intro_to_SPP_Presentation.pdf, page 55; accessed on May 13,2010.
[9] http://www.spp.org/publications/SPP_Fast_Facts.pdf.
[10] Assumes a 55% load factor. Average load is thus approximately 26,000 MW.
[11] Calculated as 1/3rd of the system peak demand.

Exhibit II-12
Major Congested facilities in the EIS Market (2009)

Location	Flowgate Name	Voltage (kV)	Balancing Authority	% of Total Intervals Congested	Average Hourly Shadow Price ($/MWh)	Aggregate Shadow Price $/MW
Randall County to Palo Duro	RANPALAMASWI	115	SPS	20.4%	(29.79)	(260,925)
Osage Switch to Canyon East	TEMP01_15940	115	SPS	13.2%	(18.40)	(161,218)
Lake Road to Alabama	LAKALAIATSTR	161	MPS	2.6%	(14.27)	(124,981)
Neosho to Columbus	TEMP06_16094	161	AEPW	1.7%	(9.15)	(80,152)
Hugo Power Plant to Valliant	HPPVALPITVAL	138	WFEC-AEPW	5.5%	(7.60)	(66,576)
Longwood to Noram	TEMP05_15882	138	AEPW	0.7%	(7.37)	(64,537)
Gentleman to Red Willow	GENTLMREDWIL	345	NPPD	4.2%	(6.00)	(52,574)
Kress to Hale Co.	TEMP07_15765	115	SPS	5.1%	(5.74)	(50,247)
Okmulgee to Henryetta	OKMHENOKMKEL	138	AEPW	1.7%	(4.70)	(41,211)
Longwood Transformer	TEMP02_15679	345/138	AEPW	0.5%	(4.43)	(38,777)

Source: SPP 2009 State of the Market

Evidence of the existence of transmission limitations within SPP is found in the SPP's 2008 and 2009 State of the Market reports (SOM). Following are the highlights from the two reports:

- According to the 2008 SOM, 75% of the congestion occurred on just 10 flowgates (out of a total of over 200 flowgates).
- According to the 2009 SOM, the percentage of time where at least one flowgate was congested increased from 56% in 2008 to 71% in 2009. The report suggests that number of congestion intervals has increased in the market footprint due to the following reasons
    - Five new market participants were added in 2009 adding many new flowgates.
    - Temporary flowgates were used to improve congestion management in the Panhandle of Texas (the wind rich region of SPP).
    - Transmission upgrades in several specific areas required the use of more than expected temporary flowgates for longer than expected.

The Exhibit II-13 displays the geographic location of the top ten flowgates from 2008 and 2009. In this figure, notable cities are denoted with large green circles while the flowgates are depicted by lines with bullet points at the ends. The flowgates with clear (or transparent) bullets are flowgates that were in 2008's top ten but are not in the 2009 top ten list. Conversely, the flowgates with blue bullets are flowgates that were in the top ten for 2009 but not in 2008. Finally, the flowgates with red bullets represent those flowgates that were in top ten in both 2008 and 2009. Note, there is a concentration of congested facilities in the Amarillo area which is a key wind rich area.

Exhibit II-13
Map of the Major Congested facilities in the EIS Market (2009)

Source: SPP 2009 State of the Market

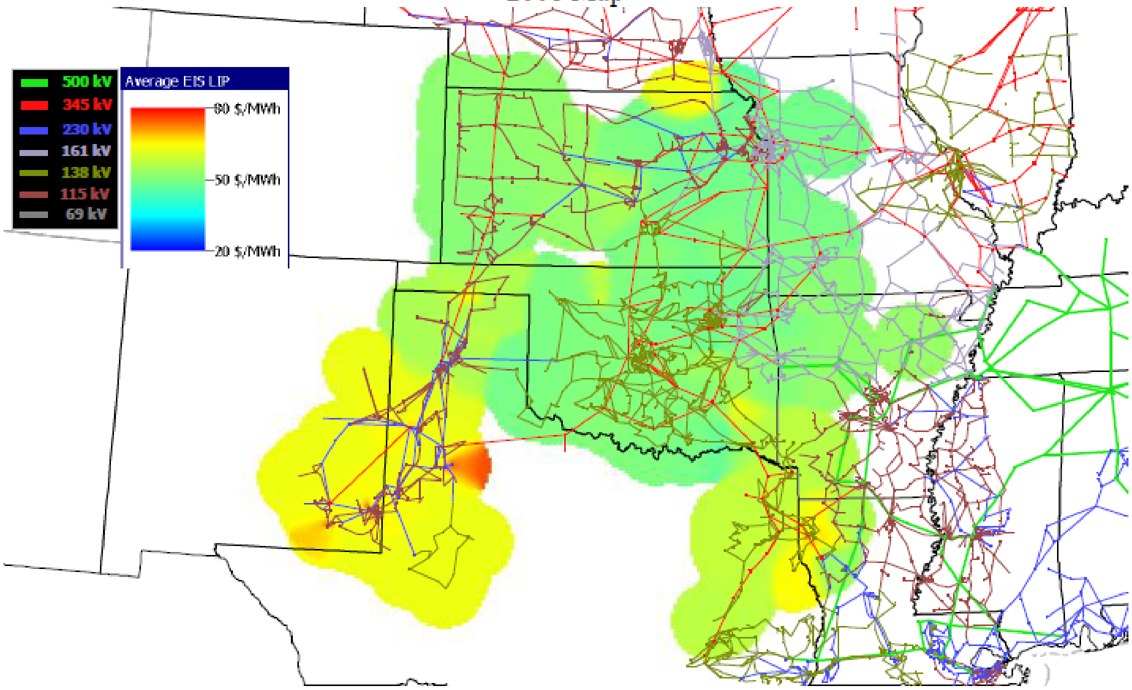
From the figure, the SPP staff concluded the following:

- First, the flows have changed somewhat in 2009 compared to 2008.
- Second, three of the top ten flowgates from 2008 were on the 2009 list also. The SOM suggests that SPP's 2009 expansion plan will at least partially mitigate these constraints.
- Third, there appears to be continued congestion in the Texas panhandle and Northwest Louisiana. The flowgates in the Texas panhandle were congested due to high north to south flows.

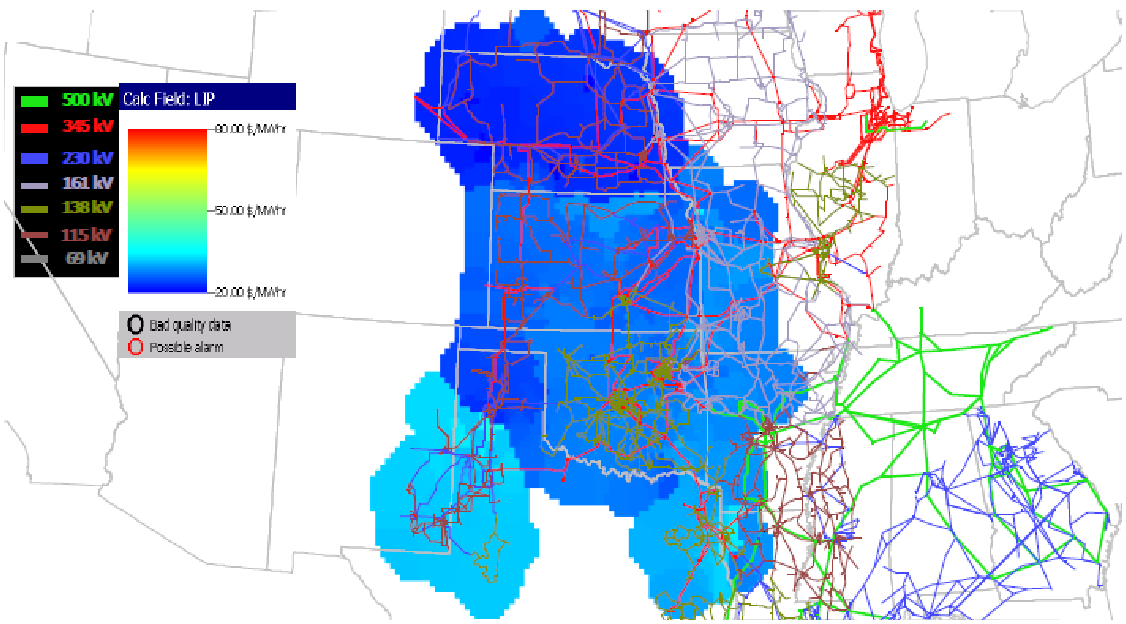
In 2008 and 2009 prices were the highest in the wind rich southwestern part of SPP, in Southwestern Public Service (SPS) territory and the southeastern part of SPP, in the northwest Louisiana (See Exhibit II-14). The higher costs in these parts of SPP result from congestion in these areas as described above. Congestion across these regions may limit transmission access for potential wind projects unless steps are taken to remedy the congestion.

Exhibit II-14
SPS Has the Highest Prices in SPP, Especially Southern SPS

2008 Map



2009 Map



Source: SPP 2009 State of the Market

As noted, power typically flows from east to west within SPP. Power flows into the SPS load zone, especially southern SPS are constrained. As more wind is being integrated especially in western SPP, this phenomenon is reversing. In fact, SPS is already experiencing negative prices especially during the deep off-peak hours. The nodal prices in the SPS load zone of

SPP's Energy Imbalance Service ("EIS") market are lower than in other sub-regions and have become negative in a few hours (i.e., the supplier must pay SPP to operate). Also, curtailment of wind output is occurring. In 2009, there were 1,726 hours, nearly 20% of the year, in which SPS power prices were lower than $20/MWh. SPS experienced negative prices for 26 hours in 2009 (see Exhibit II-15). We expect that in the absence of major upgrades, wind contribution in western SPP will shift the flow pattern and create large west to east transmission constraints.

Exhibit II-15
SPS Price – 2009

Price Level ($/MWh)	Hours
< 0	26
0 – 10	51
10 – 20	1,649
Total	1,726

Source: SPP EIS Balancing Market

There is also numerous evidence of existing transmission bottlenecks within the Entergy transmission system. Evidence of issues on the transmission grid is the frequency of transmission loading relief (TLR)[12] calls on the Entergy system. According to ICT's[13] quarterly performance report, SPP initiated forty-nine TLR Level 3, 4, and 5 events with a total curtailment of 64,674 MWh from December 1, 2009 to February 28, 2010. This included approximately 3,600 MWh of firm service curtailment. The curtailments were significantly higher during the summer period. For example, 286,776 MWh were curtailed from June 1, 2009 to August 31, 2009. 18% of the transactions that were curtailed during that period has firm transmission reservation. During this period, ICT initiated 128 TLR calls. The report states that the TLR events during the summer period were caused by high load requirements and unplanned outages.

The problem is especially severe in the Acadiana load pocket (ALP) in the Entergy system where a voluntary procedure is implemented to reduce the severity of the TLR call. According to this procedure, "Cleco Power LLC (CLEC) and the Lafayette Utilities System (LAFA) voluntarily increased the energy output of certain specific generating units on their respective

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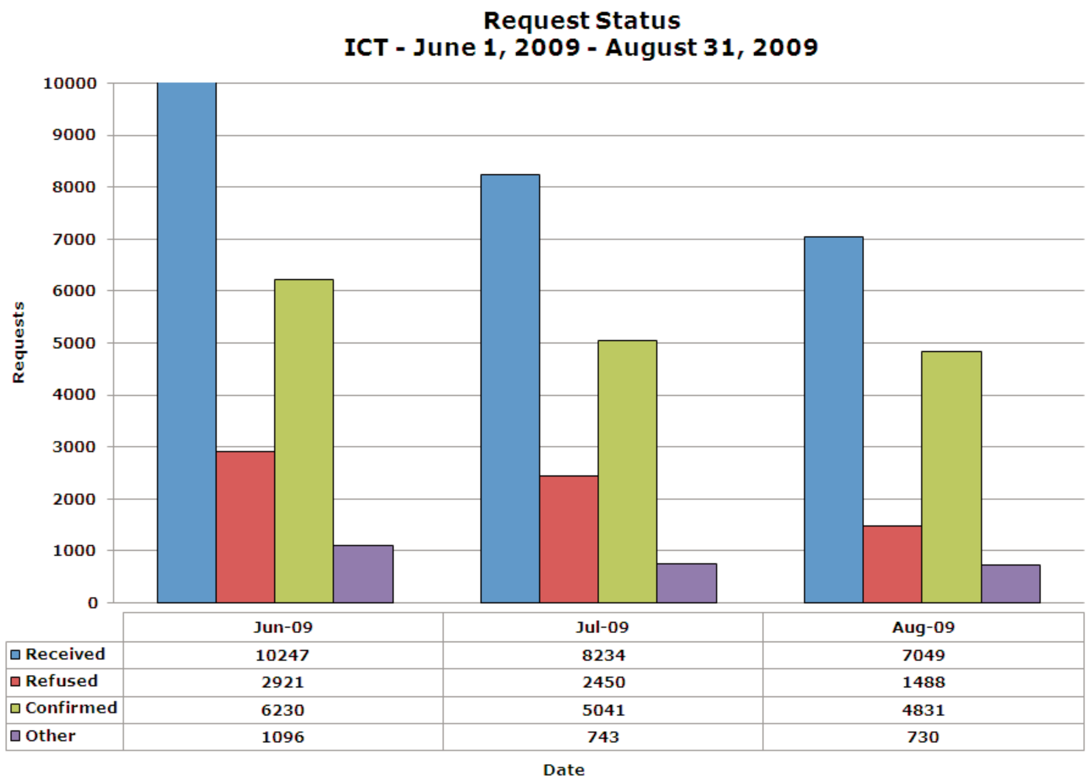
[12] Transmission Loading Relief- TLRs are used to curtail transmission service and help prevent instability, uncontrolled separation, or cascading outages. NERC prescribes eight levels of TLRs. The higher the TLR level, the more critical the potential problem is on the transmission system. Actions taken by SPP on TLR levels one through four include curtailment or holding of Non-Firm transmission service. Reallocation, curtailment, or holding of Firm transmission service occurs when TLRs reach levels five or above

[13] Independent Coordinator of Transmission- On May 27, 2005, Entergy submitted to the Federal Energy Regulatory Commission on behalf of the Entergy Operating Companies, a proposed revision of its Open Access Transmission Tariff (OATT or Tariff) reflecting its proposal to establish an ICT for its energy system and a Weekly Procurement Process (WPP). In its filing, Entergy identified Southwest Power Pool, Inc. (SPP) as the candidate it had chosen to perform the function of the ICT. On April 24, 2006, in Docket No. ER05-1065-000 (hereinafter, ICT Approval Order), the Commission found that SPP, operating as a Regional Transmission Organization (RTO), satisfied the independence requirement of operating in the capacity of the ICT for Entergy and conditionally approved the tariff changes filed by Entergy. The ICT initiated its duties laid out in Attachment A of the ICT Agreement and further defined in Attachment S of Entergy's OATT on November 17, 2006, with select reliability functions starting on November 1, 2006.

systems that have positive Generation Shift Factors on ICTE Flowgate 1902[14], which is located on the Entergy transmission system. But for the implementation of this voluntary ALP Local Area Procedure, the ICT-RC[15] would have found it necessary to declare a Level 5a or Level 5b TLR event for the ICTE Flowgate 1902. The voluntary ALP Local Area Procedure results in additional system energy costs for CLEC and LAFA but provides operating and service reliability benefits for CLEC, LAFA, and Entergy. Accordingly, the operation of the ALP Agreement reduced the severity of TLR events on Entergy's system during this reporting period by eliminating the need for the ICT Reliability Coordinator to declare a Level 5a or 5b TLR event for the ALP area".

Another evidence of transmission bottlenecks is the high refusal rate of transmission service requests. Transmission service is evaluated through the Available Flowgate Capacity system, which determines what capacity is available on a select list of flowgates. There are a number of these flowgates which are more limiting to service than others. During the period June 1, 2009 to August 31, 2009, 26% (of a total of 25,530 requests) transmission requests were denied.



	Jun-09	Jul-09	Aug-09
Received	10247	8234	7049
Refused	2921	2450	1488
Confirmed	6230	5041	4831
Other	1096	743	730

Source: FERC ICT Quarterly Performance Report: June - August 2009

In summary, a number of interfaces can limit transmission access for potential wind projects especially in western SPP unless steps are taken to remedy the congestion. Furthermore, there are additional limits outside SPP and between SPP and the southeastern U.S. that limit exports. It is highly likely that wind development could significantly outpace the transmission development. The Project has its origin in the wind rich western SPP and therefore provides

[14] Monitor 138 kV line fom Scott to Bonin for the loss of 230 kV line from Renaud to Bonin

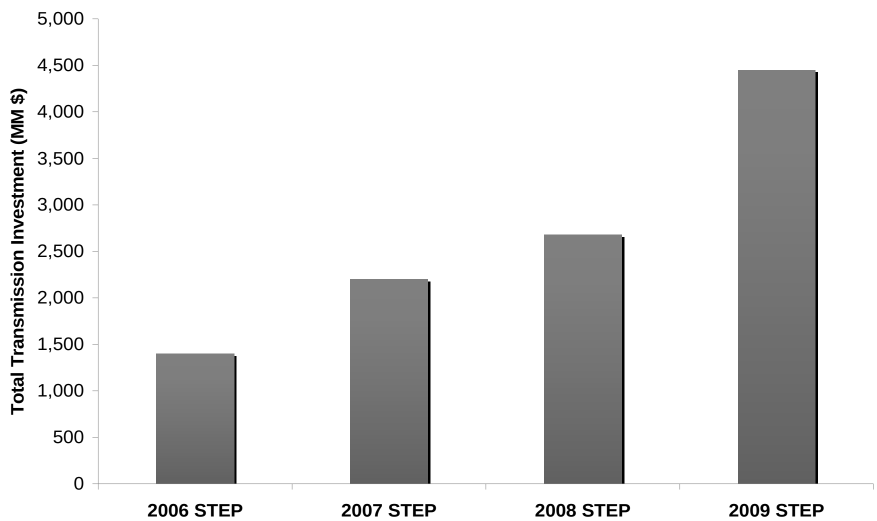
[15] Independent Coordinator of Transmission-Reliability Coordinator

benefits by improving transfer capability from a very constrained area and also increasing the inter-regional transfer capability.

II.4.3 SPP Planned Transmission Upgrades

The level of SPP transmission investment has increased between 2006 and 2009, approximately, by a factor of three (see Exhibit II-16). This shows that SPP is increasingly addressing the need for internal intra-regional transmission upgrades.

Exhibit II-16
SPP Transmission Investment – 2006 - 2009



Source: SPP

At its inception in April 2009, the Synergistic Planning Project Team (SPPT)[16] recommended that SPP should evaluate and recommend to the Regional State Committee (RSC) within six months a list of priority projects for approval. In February 2010, the SPP staff released a study based on which the staff recommended the approval of "Group 2" Priority projects. A revised report was released in April 2010.[17] The Group 2 projects include a set of six transmission lines with estimated engineering and construction cost of $1.1 billion. SPP approved the projects in late June 2010. The analysis assumes 11,300 MW of new wind over time.

The Exhibit II-17 below shows the current export capability out of Southwestern Public Service (SPS) load zone and compares it to the installed wind capacity. The SPS zone is the location of

[16] The SPPT consists of a cross section of SPP stakeholders including representatives from Arkansas Electric Cooperative Corp., the Arkansas Public Service Commission, Dogwood Energy, the Public Utility Commission of Texas, Prudential Capital Group, Westar Energy, and SPP staff.
[17] *SPP Priority Projects Phase II Report Revision 1,* Southwest Power Pool, April 2, 2010. http://www.spp.org/publications/Priority%20Projects%20Phase%20II%20Rev%201%20Report%20-%204-2-10_final%20with%20Attachments.pdf.

valuable wind resources. It also shows the projected increase in transfer capability assuming all the transmission projects that have been approved by the SPP Board of Directors are constructed and the projected wind capacity based on SPP latest generation interconnection queue. As will be noted, the increase in transmission capacity is less than the amount of wind expected by 2016 in the SPS area. Therefore, additional transmission capability from SPS is needed. The Clean Line project directly addresses this particular issue.

Exhibit II-17
Wind Versus Export Capability - SPS

Year	Installed Wind Capacity in SPS (MW) (A)	Export Capability (MW) (B)	Estimated Transmission Gap Assuming Nameplate Capacity (MW) (A-B)	Estimated Transmission Gap Assuming 70% Contribution from Wind(MW) (70%*A-B)
Existing as of 2009	980[1]	529[2]	451	157
All Wind in the Queue by 2016	9,819[3]	3,090[4]	6,729	3,783

[1] Source: SPP Queue, Units with "IA FULLY EXECUTED/COMMERCIAL OPERATION" status
[2] Transfer limit based on NERC Flowgate 5248 - SPSSPPTIES
[3] All units in the SPP Queue
[4] Source: SPP WITF Wind Integration Task Force assumes 3,090 MW transfer limit in their 20% wind scenario

In sum, proposed upgrades are intra-regional and provide for decreased SPP congestion. They do not increase capacity to the southeastern U.S.

Chapter III
Overview of TVA

III.1 Summary

TVA is a possible purchaser of capacity on the Clean Line Project and delivery to TVA provides an example of the potential benefits from the project. TVA is also similar to the rest of the southeastern U.S. in that it lacks high quality wind resources and has a large potential demand for renewable supply. Currently, TVA has a program to increase renewable power use and TVA has begun implementing this plan. However, existing transmission does not allow significant SPP exports to TVA and the ability of TVA to import even already contracted wind output from other regions such as MISO is questionable without major transmission upgrades. Hence, Clean Line is an alternative for addressing TVA's renewable needs.

III.2 Introduction to TVA

TVA operates the nation's largest public power system and supplies power in most of Tennessee, northern Alabama, northeastern Mississippi, and southwestern Kentucky and in portions of northern Georgia, western North Carolina, and southwestern Virginia to a population of nearly nine million people. In 2009, the revenues generated from TVA's electricity sales were $11.1 billion and accounted for virtually all of TVA's revenues. TVA is also the leading public power consumer of coal.

III.3 TVA Demand for Wind

Like many other regions, TVA is also actively pursuing renewable and other clean generation supply. In 2008 approximately 37% of energy produced by TVA was from low- or zero-carbon sources such as hydro and nuclear generation. TVA, however, has an even more aggressive goal – to serve at least 50% of its energy demand from low- or zero-carbon sources by 2020. As it moves towards this goal, TVA is seeking to supplement its portfolio of low-carbon assets with wind generation. However, TVA has little attractive wind resources.

In December 2008, TVA issued a request for proposal for the purchase of up to 2,000 MW of wind energy. Currently, TVA has contracted for approximately 1,380 MW of wind power from suppliers in North Dakota, South Dakota, Kansas, Iowa and Illinois. The facilities are located far from TVA, and in different power markets, and the power from these facilities will be delivered to TVA through one or more balancing authorities. To guarantee that the power will be available for use in TVA, suppliers are required to deliver the power into TVA using "pseudo ties" or dynamic scheduling, in addition to demonstrating deliverability into the TVA system. Several of these facilities are in areas with limited transmission capacity, and power exports from these facilities would require the use of transmission facilities and interfaces that are constrained in some hours. The wind projects could therefore face transmission congestion risk that, in the extreme, could affect the deliverability of power into TVA, but at least could affect the cost of power to TVA.

Clean Line's Project would go a long way to help TVA achieve its clean energy goals. Since the Project will use HVDC technology, power will be delivered directly into TVA with little transmission congestion or curtailment risk.

To summarize, there are large supplies of high quality wind resources in western SPP that cannot be fully utilized within SPP. In contrast, the southeastern U.S. has fewer wind resources but an increasing demand for renewable energy. Clean Line's project will enable consumers in the southeastern U.S. to utilize the abundant wind resources in western SPP. TVA is a useful example of a beneficiary of this project.

Chapter IV
Modeling Approach and Scenarios Studied

IV.1 Introduction

ICF performed a simulation of the dispatch of generation to meet demand in the Eastern Interconnect[18], with specific focus on SPP and the southeastern U.S. power markets. This simulation was carried out for 2016, the expected on-line year of the Project. We assume that the Project would be accompanied by 7,000 MW of incremental wind capacity that otherwise would not be built but for the Project.

IV.2 Modeling Approach – MAPS

ICF used GE Energy's MAPS™ (MAPS) model for this analysis. MAPS is a widely recognized and highly detailed model that chronologically calculates hour-by-hour production costs while recognizing the constraints on the dispatch of generation imposed by the transmission system. MAPS uses a detailed electrical model of the entire transmission network, along with generation shift factors from a solved power flow case to determine how power from generating plants will flow over the alternating current (AC) transmission network.[19] This feature enables MAPS to capture the economic penalties of re-dispatching generation to satisfy transmission facility limits and security constraints. Using MAPS ICF performed a security constrained unit commitment and economic dispatch of generating resources to meet load and reserve requirements. The outputs of the modeling exercise include power plant dispatch, fuel use, emissions, and power flows on monitored transmission lines and transmission interfaces. The model also produces wholesale power prices by using the assumption that prices equal marginal costs.

Although ICF modeled the entire Eastern Interconnect, commitment hurdles were used in the model to decentralize the operation of the entire system and recognize market boundaries. Without the use of commitment hurdle rates, most production cost models would assume a single region-wide market where all units are equally eligible to commit to serve the region-wide load based on economics. For example a unit in PJM (outside of the TVA market) could be committed to serve load in TVA and vice versa, to the extent it is economic to do so. The use of commitment hurdles provides the MAPS model with the sophistication to recognize market and operational boundaries such as those between PJM and the Tennessee Valley Authority. During the commitment process, these hurdles ensure that only installed capacity resources within a balancing authority are committed to meet the balancing authority load first before becoming available to meet the needs of adjacent balancing authorities which have resource deficiencies and cannot meet their own load.

IV.3 Study Scope

This study assessed the benefits to consumers in TVA and the rest of the Eastern Interconnect from the construction of the Project. Note, ICF expects all, or nearly all of the U.S. benefits to be in the Eastern Interconnect, and hence, the study is effectively national in scope.

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[18] Eastern Interconnect includes all of the contiguous U.S. exclusive of the WECC and ERCOT.
™ GE-MAPS is a trademark of General Electric Company.
[19] MAPS uses a linearized Direct Current (DC) network approximation.

IV.4 Study Scenarios

To carry out the assessment, ICF examined two scenarios, a reference case that reflected expected conditions in 2016, but without the Project, and a change case that was similar to the reference case but included the Project and, therefore, an incremental 7,000 MW of wind generation in western SPP. More specifically:

- **Reference Case** – This scenario is reflective of expected 2016 conditions without the Project and includes all transmission additions and future planned generation builds (all projects with executed Interconnection Agreements and/or under construction) as included in SPP's Priority Projects Phase II Report Revision 1 analysis. The reference case included a total of 11,300 MW of wind generation in SPP, similar to SPP's Priority Projects Phase II Report Revision 1 analysis. This analysis assumes that the 7,000 MW of wind associated with the project do not come on-line. This analysis assumes a national regulatory program for CO_2 that results in a CO_2 price of $20/ton in real 2009 dollars. Thus, the analysis may be conservative and estimate less benefits than if no CO_2 program was in place. This is because the CO_2 levels are already decreased in the Reference Scenario before the Project comes on-line.

- **Change Case** – This scenario was similar to the Reference Scenario, with two main changes.

  – First, it included the Project, modeled as two 500 kV, 3,500 MW HVDC lines. Both HVDC lines originated at the Hitchland substation in western Oklahoma, but the first terminated at the 500 kV Shelby substation near Memphis, Tennessee, while the second terminated at the 500 kV Maury substation, also in Tennessee.

  – Second, the Change Case included an incremental 7,000 MW of wind generation capacity in western SPP. When added to the 11,300 MW of wind generation in the Reference Case, this resulted in a total of 18,300 MW of wind generation in SPP. ICF used SPP's Interconnection Queue as the guide to site the incremental 7,000 MW of wind capacity.

IV.5 Summary of Key Assumptions

ICF developed assumptions for the expected operation of the SPP market. The key assumptions include:

- **Demand** – The demand forecast for SPP was based on SPP's EIA 411 Form. The TVA demand forecast was based on NERC ES&D 2009.

- **Fuel** – The ICF fuel price forecasts were used, including natural gas, oil and coal prices.

- **Environmental Regulatory Assumptions** – The environmental regulatory assumptions including a future federal CO_2 emission control program on the national level starting in 2015, and tightened regulations on existing coal plants related to SO_2, NO_x, mercury and other pollutants.

- **Allowance Forecasts** – The study used emission allowance price forecasts including ICF CO_2 emission allowance prices for the post-2014 period .

- **New Plant Builds** – Future planned generation builds (all projects with executed IA and/or under construction) as included in SPP's Priority Projects Phase II Report Revision 1 analysis. It included a total of 11,300 MW of wind generation in SPP, similar to SPP's Priority Projects Phase II Report Revision 1 analysis.

Some key modeling assumptions are shown in Exhibit IV-1. Appendix A gives more details on ICF's firm capacity assumptions.

Exhibit IV-1
Illustrative Modeling Inputs

Parameter	Treatment	Source
Market Structure	Perfect Competition	N/A
2010 SPP Net Internal Demand (MW)	45,113	SPP's EIA 411 (2009) report
2010 SPP Weather-Normalized Net Energy for Load (GWh)	211,343	SPP's EIA 411 (2009) report
SPP Annual Load Growth 2009-2016 (%)	1.2 (1.45 energy)	SPP's EIA 411 (2009) report
2010 TVA Net Internal Demand (MW)	42,902	NERC ES&D
2010 TVA Weather-Normalized Net Energy for Load (GWh)	233,465	NERC ES&D
TVA Annual Load Growth 2009-2016 (%)	2 (1 energy)	NERC ES&D
2016 Henry Hub Gas Price Forecast (Nominal $/MMBtu)	7.14	ICF Fundamentals
2016 Residual Oil Price Forecast (Nominal $/Bbl) (1% Resid)	11.3	ICF Fundamentals
Expected 2016 National Air Emissions Control NO_x Allowance Prices for Zone 1[1] (Nominal $/ton)	713	March 2010 ICF Multi-Client Report
Expected 2016 National Air Emissions Control NO_x Allowance Prices for Zone 2 [1] (Nominal $/ton)	2,867	March 2010 ICF Multi-Client Report
Expected 2016 National Air Emissions Control SO_2 Allowance Prices (Nominal $/ton)	1,095	March 2010 ICF Multi-Client Report
Expected 2016 National Air Emissions Control CO_2 Allowance Prices (Nominal $/ton)	24	March 2010 ICF Multi-Client Report

Note:

[1] Zone 1 states are the district of Columbia, Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia, and Wisconsin. Zone 2 states are all other states in the lower-48

ICF's representation of the SPP transmission topology in the Reference Case was based on SPP's 2009 MDWG power flow case for 2014. It includes all major transmission projects that were approved as a part of SPP's STEP 2009. These projects (shown in Appendix) include both projects identified as reliability transmission upgrades and approved Balanced Portfolio and Priority projects. Appendix A gives more details on ICF's firm transmission build assumptions.

Chapter V
Key Findings

V.1 Introduction

ICF compared the dispatch of generation in the Change Case to that in the Reference Case and determined the reduction in emission of pollutants in the Change Case relative to the Base Case for all generation resources in the Eastern Interconnect in general and TVA specifically. The reduction in emissions is due to the Project and the availability of the incremental 7,000 MW[20] of wind generation for exports to TVA and other southeastern U.S. markets. ICF also compared water usage and power prices.

V.2 Air Pollutant Emissions

Exhibit V-1 shows a summary of the TVA emissions results for 2016. The injection of wind power into TVA results in an annual region-wide reduction in NO_x emissions of 12,000 tons, and SO_2 emissions of 47,000 tons. The Project also results in CO_2 reduction of approximately 21 million tons in TVA.

Exhibit V-1
Summary of Reduction in Emission by Pollutants in TVA- 2016

Pollutant	Reference Case (A)	Change Case Including Plains and Eastern Clean Line and 7,000 MW wind injection in SPP (B)	Net Decrease in Emission (C)= (B)-(A)
Nitrogen Oxides (NOx) (Tons)	52,397	39,986	-12,411
Sulfur Dioxide (SO2) (Tons)	208,727	161,450	-47,277
Carbon Dioxide (CO2) (Tons)	99,697,984	78,191,637	-21,506,346
Mercury (Hg) (Pounds)	564	469	-95

Exhibit V-1 is a summary of the reduction in air emissions in TVA and Exhibit V-2 shows the reduction in the Eastern Interconnect. As noted, Exhibit V-2 is equivalent to a U.S. summary. Emission decreases in the Eastern Interconnect as a whole are less than in the TVA only assessment due to some increase in SPP.

[20] Nameplate capacity.

The Eastern Interconnect CO_2 reduction of 14,261,363 is equivalent to eliminating 2 million cars on an annual basis.[21]

Exhibit V-2
Summary of Reduction in Emission by Pollutants in Eastern Interconnect – 2016[1]

Pollutant	Reference Case (A)	Change Case Including Plains and Eastern Clean Line and 7,000 MW wind injection in SPP (B)	Net Decrease in Emission (C)= (B)-(A)
Nitrogen Oxides (NOx) (Tons)	1,584,326	1,575,783	-8,543
Sulfur Dioxide (SO2) (Tons)	4,133,550	4,095,909	-37,641
Carbon Dioxide (CO2) (Tons)	1,982,236,231	1,967,974,868	-14,261,363
Mercury (Hg) (Pounds)	24,251	24,161	-90
[1] Equivalent to U.S. totals			

V.3 Generation Impacts

Exhibit V-3 shows the dispatch by type and emissions by type for the Reference Case and Change Case for TVA. Our analysis showed a 54% reduction in the dispatch of gas fired combined cycle and cogeneration facilities and a 17% reduction in the dispatch of base load coal plants. There is nearly a one for one reduction in fossil-fuel generation for the increase in generation.

[21] 15,000 miles per year x 1 gallon/20 miles x 125,000 btu/gallon x 160 pounds CO2/mmBtu x ton/2000 lb = 7.5 tons per car per year. 14,261,363 tons divided by 7.5 tons/car is equal to 2 million cars

Exhibit V-3
Dispatch by Type in TVA- 2016

Unit Type	Reference Case (GWh) (A)	Change Case Including Plains and Eastern Clean Line and 7,000 MW wind injection in SPP (GWh) (B)	Change in Dispatch (GWh) (C)=(B)-(A)
Coal	85,481	71,072	-14,410
Combined Cycle	19,597	9,141	-10,456
Cogeneration	9,140	4,371	-4,769
Combustion Turbine	651	333	-318
Oil/Gas	1	0	-1
Hydro	17,218	17,218	0
Wind	6	6	0
Nuclear	62,278	62,278	0
Total	**194,372**	**164,419**	**-29,953**

The results nationwide (i.e., Eastern Interconnect) confirm lower fossil generation, but the decrease in fossil generation is not as large as for TVA alone (see Exhibit V-4). There are some increases in SPP fossil generation.

Exhibit V-4
Dispatch by Type in Eastern Interconnect- 2016

Unit Type	Reference Case (GWh) (A)	Change Case Including Plains and Eastern Clean Line and 7,000 MW wind injection in SPP (GWh) (B)	Change in Dispatch (GWh) (C)=(B)-(A)
Coal	1,606,003	1,600,072	-5,931
Combined Cycle	627,085	616,078	-11,007
Cogeneration	112,053	107,255	-4,798
Combustion Turbine	34,565	32,092	-2,473
Oil/Gas	48,217	48,651	434
Hydro	91,283	91,283	0
Wind	129,900	153,645	23,745
Nuclear	710,767	710,792	26
Other including Solar	3,402	3,402	0
Total	**3,363,273**	**3,363,269**	**-3**

V.4 TVA Wholesale Power Prices

Wholesale power market spot prices drop in the TVA zone due to the 7,000 MW[22] of incremental wind capacity delivered into western TVA. On average, wholesale power market prices decrease from approximately $75/MWh in the Reference Case to $71/MWh in the

[22] Nameplate capacity

Change Case (see Exhibit V-5). This is due to the increased supply of wind power. The decline is larger in TVA than other southeastern power markets such as Entergy as power is delivered directly to TVA.

Exhibit V-5
Wholesale Power Prices – 2016 ($/MWh)

Scenario	Period[1]	TVA	Entergy-Arkansas
Reference Case	Off-Peak	57.9	59.4
	Peak	83.0	86.3
	All Hours	74.7	77.3
Change Case – Includes Clean Line Project and 7,000 MW Wind Injection in SPP	Off-Peak	54.9	59.4
	Peak	78.4	84.6
	All Hours	70.5	76.2

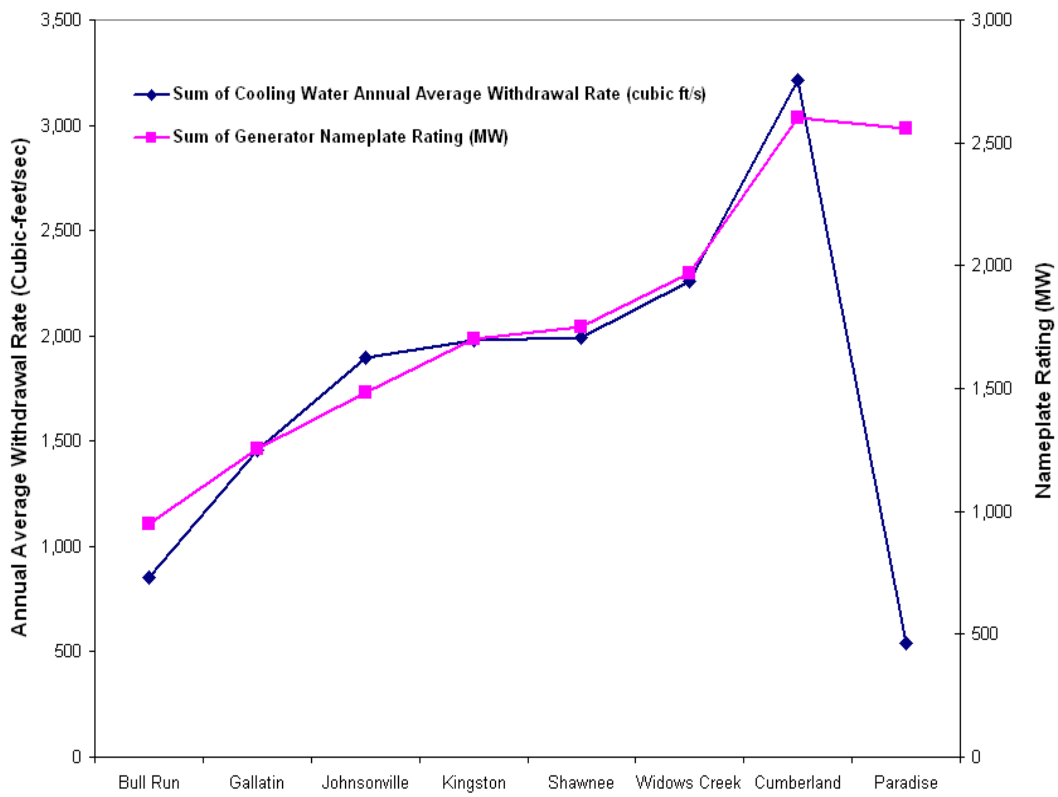
[1]On-peak is defined as 7 x 16

V.5 Water Usage Impacts

Nearly all TVA coal power plants use a “once through fresh water” cooling system. According to EIA estimates, water withdrawal rate of a 1,500 MW coal power plant with fresh water cooling technology is approximately 1,900 cubic-feet per sec. Thermal power plants can use large amounts of water, whereas wind power plants do not. Increased reliance on fresh water cooling could lead to load curtailment during drought conditions. According to a 2008 press release[23], drought conditions in southeastern US affected power plant operations. According to the press release, Tennessee Valley Authority said that higher inlet water temperatures caused by lower water levels had forced load curtailments or plant shutdowns at its Browns Ferry, Gallatin, and Cumberland plants. The 7,000 MW of incremental wind decreases thermal generation and lowers water use.

The Exhibit V-7 shows withdrawal rate for selected power plants in TVA. It is noted that the withdrawal rate is linearly proportional to the size and the dispatch of the power plant. Paradise coal power plant is the only power plant with “recirculating with natural draft cooling tower(s)” cooling technology and hence a lower withdrawal rate.

Exhibit V-7
Withdrawal rate of Select Reduction in Water Consumption due to Clean Line – 2016



Source: EIA 2005

[23] http://www.powermag.com/coal/New-coal-plant-technologies-will-demand-more-water_61.html

Our results show that coal dispatch decreases by approximately 14,000 GWh. Using the EIA 2005 water discharge rates, corresponding reduction in water withdrawal would be 1,273,700 acre-feet/year in 2016 (see Exhibit V-7). Please note the estimated reduction in water withdrawal (shown in Exhibit V-7) is due to coal power plants only. Effect of reduced combined cycle power plant dispatch has not been included in the analysis and hence, the reduction in water is larger than estimated.

Exhibit V-7
Reduction in Water Consumption due to drop in Coal Dispatch – 2016

Drop in Coal Dispatch in TVA (GWh)	14,410
Convert the drop in dispatch into average megawatts assuming 73%[1] capacity factor (MW)	2,247
Amount of water consumed by a coal plant[2] corresponding to the above nameplate capacity (cubic-feet per sec)[3]	1,759
Amount of water consumed by a coal plant corresponding to the above nameplate capacity (US Gallons per Sec)	13,159
Amount of water consumed by a coal plant corresponding to the above nameplate capacity (Acre-feet per year)	1,273,700

Note:

[1] Model Forecast- 2016 Reference Case

[2]Coal plant is assumed to utilize fresh water cooling system cooling technology.
[3]One cubic-feet per second is equal to 7.48051945 US gallons per second and 723 acre-feet per year

Chapter VI
Conclusions

The Clean Line Project provides significant benefits. These include:

- **Lower Air Pollutant Emissions** – The Clean Line Project is forecast to decrease 2016 U.S. emissions of 8,543 tons of NO_x, 37,641 tons of SO_2, 14,261,363 tons of CO_2, and 90 pounds of mercury, The CO_2 reduction is equal to eliminating approximately 2 million cars[24]. The reduction may be conservative since the reference case assumes national CO_2 controls are in place in the Reference Case. There are no national CO_2 emission regulations in place for power generation at this time and prospects for such regulations are uncertain.

- **Creates Renewable Competition** – The Project increases competition in renewable supply in the Southeastern U.S. and will lower costs to consumers of using renewable power.

- **Greater Transmission Reliability** – The Project increases transmission capacity and grid reliability. This is especially important in light of potential for coal power plant retirements and the lack of inter-regional transmission projects.

- **Lower Water Consumption** – The Project lowers use of thermal power plants, and hence, TVA coal power plant water use by 1,273,700 acre-feet per year in 2016.

- **Lower Spot Wholesale Market Power Prices** – TVA wholesale power prices decrease $4/MWh in 2016. This is due to the 7,000 MW of zero variable cost power injection.

- **Increased Jobs** – The Project results in new jobs for construction and operation of the wind power plants and transmission lines.

- **Other Economic Benefits** – The Project also provides indirect economic benefit (i.e., multiplier effects), tax revenues, royalties, manufacturing development, and other economic development opportunities.

- **Meeting Including Domestic Production and Stable Annual Power Prices** – The Project provides greater ability to meet renewable standards which results in domestic production of electricity with a stable annual price, i.e., no annual fuel price uncertainty.

[24] 14,261,363 tons divided by 7.5 tons/car is equal to 2 million cars

Appendix A
Detailed Study Assumptions

Reference Case- Firm Wind Capacity Assumptions

Gen Interconnection Number	State	CA	Capacity in Queue (MW)	Prorated Capacity[1] (MW)		Gen Interconnection Number	State	CA	Capacity in Queue (MW)	Prorated Capacity (MW)
GEN-2001-014	OK	WFEC	96	96		GEN-2006-049	KS	SWPS	400	400
GEN-2003-004	OK	WFEC	100	100		GEN-2007-013	KS	SUNC	99	99
GEN-2004-023	OK	WFEC	20.6	20.6		GEN-2007-015	KS	WERE	135	135
GEN-2005-003	OK	WFEC	30.6	30.6		GEN-2007-017	MO	MIPU	100.5	100.5
GEN-2001-026	OK	WFEC	74	74		GEN-2006-044N	NE	NPPD	40.5	23.895
GEN-2003-022	OK	AEPW	120	120		GEN-2007-005	TX	SWPS	200	118
GEN-2004-020	OK	AEPW	27	27		GEN-2007-008	TX	SWPS	300	177
GEN-2006-043	OK	AEPW	99	99		GEN-2007-011N06	NE	NPPD	75	44.25
GEN-2001-033	NM	SWPS	180	180		GEN-2007-021	OK	OKGE	201	118.59
GEN-2001-036	NM	SWPS	80	80		GEN-2007-025	KS	WERE	300	177
GEN-2001-037	OK	OKGE	100	100		GEN-2007-032	OK	WFEC	150	88.5
GEN-2001-039M	KS	SUNC	100	100		GEN-2007-034	TX	SWPS	150	88.5
GEN-2002-004	KS	WERE	200	200		GEN-2007-038	KS	SUNC	200	118
GEN-2002-005	OK	WFEC	120	120		GEN-2007-040	KS	SUNC	200.1	118.059
GEN-2002-008	TX	SWPS	240	240		GEN-2007-043	OK	AEPW	300	177
GEN-2002-009	TX	SWPS	80	80		GEN-2007-044	OK	OKGE	300	177
GEN-2002-022	TX	SWPS	240	240		GEN-2007-045	TX	SWPS	171	100.89
GEN-2002-025A	KS	WPEK	150	150		GEN-2007-046	OK	SWPS	199.5	117.705
GEN-2003-005	OK	WFEC	100	100		GEN-2007-048	TX	SWPS	400	236
GEN-2003-019	KS	MIDW	250	250		GEN-2007-050	OK	OKGE	171	100.89
GEN-2003-020	TX	SWPS	160	160		GEN-2007-053	MO	MIPU	110	64.9
GEN-2003-021N	NE	NPPD	75	75		GEN-2007-057	TX	SWPS	34.5	20.355
GEN-2005-008	OK	OKGE	120	120		GEN-2007-062	OK	OKGE	765	451.35
GEN-2006-021	KS	WPEK	101	101		GEN-2008-003	OK	OKGE	101	59.59
GEN-2006-024S	OK	WFEC	19.8	19.8		GEN-2008-008	TX	SWPS	60	35.4
GEN-2007-011N08	NE	NPPD	81	81		GEN-2008-009	NM	SWPS	60	35.4
GEN-2003-013	KS	SWPS	198	198		GEN-2008-013	OK	OKGE	300	177
GEN-2006-020N	NE	NPPD	42	42		GEN-2008-014	TX	SWPS	150	88.5
GEN-2006-032	KS	MIDW	200	200		GEN-2008-016	TX	SWPS	248	146.32
GEN-2006-035	OK	AEPW	225	225		GEN-2008-017	KS	SUNC	300	177
GEN-2006-040	KS	SUNC	108	108		GEN-2008-018	KS	SWPS	405	238.95
GEN-2006-046	OK	OKGE	131	131		GEN-2008-019	OK	OKGE	300	177
GEN-2007-011	KS	SUNC	135	135		GEN-2008-023	OK	AEPW	150	88.5
GEN-2002-006	OK	SWPS	150	150		GEN-2008-025	KS	SUNC	101.2	59.708
GEN-2004-014	KS	MIDW	154.5	154.5		GEN-2008-029	OK	OKGE	250.5	147.795
GEN-2005-012	KS	WPEK	250	250		GEN-2008-038	OK	AEPW	144	84.96
GEN-2006-020S	TX	SWPS	18.9	18.9		GEN-2008-051	TX	SWPS	322	189.98
GEN-2005-016	KS	WERE	150	150		GEN-2008-079	KS	MKEC	100.5	59.295
GEN-2006-014	MO	MIPU	300	300		GEN-2008-092	KS	MIDW	201	118.59
GEN-2006-047	TX	SWPS	240	240		GEN-2008-124	KS	MKEC	200.1	118.059
GEN-2008-119O	NE	OPPD	60	60		GEN-2008-127	KS	WERE	200.1	118.059
GEN-2005-005	OK	OKGE	18	18		GEN-2009-011	KS	MKEC	50	29.5
GEN-2006-038N005	NE	NPPD	80	80		GEN-2009-016	KS	MKEC	140	82.6
GEN-2006-038N019	NE	NPPD	80	80		GEN-2009-025	OK	OKGE	60	35.4

[1]In our Base Case we have used SPP's interconnection queue to site the incremental wind capacity. We first include all projects with fully executed and pending interconnection agreements (IA). The combined capacity of such wind plants (i.e., existing plants and plants with approved or pending IAs) is 6.2 GW. We then pro-rate the total capacity of all wind resources in the "facility study" stage (a total of approximately 8.1 GW) to site the remaining 4.7 GW. Source: SPP Interconnection Queue as of March 12, 2010.

Major 345 kV Projects included in the 2009 STEP

345 kV transmission line from to Northwest Texarkana in northeast Texas
345 kV transmission line from Flint Creek to Shipe Road in northwest Arkansas
345 kV transmission line from Shipe Road to Osage
345 kV transmission line from Blackberry in southwestern Missouri to Sportsman to GRDA 1
345 kV transmission line from Hugo Power Station to Valliant in southeastern Oklahoma
345 kV transmission line from Iatan to Nashua in northwest Missouri
345 kV transmission line from Shell Creek to Columbus East to NW 68 and Holdrege
345 kV transmission line from Northwest to Woodward District EHV in western Oklahoma
345 kV transmission line from Rose Hill in central Kansas to Sooner in central Oklahoma
345 kV transmission line from Sooner to Cleveland in central Oklahoma
345 kV transmission line from Hugo to Sunnyside in southern Oklahoma
345 kV transmission line from Seminole to Muskogee in central Oklahoma
345 kV transmission line from Woodward District EHV in western Oklahoma to Tuco
345 kV transmission line from Reno County to Summit in central Kansas
345 kV transmission line from Spearville to Wolf (Knoll) in western Kansas
345 kV transmission line from Wolf in western Kansas to Axtell in southern Nebraska
Convert from 230 kV to 345 kV transmission line from Hobbs Interchange to Midland
345 kV transmission line from Potter County Interchange to Frio-Draw in western Texas
345 kV transmission line from Oklahoma/Texas Stateline to Gracemont in western Oklahoma
345 kV transmission line from Potter County Interchange to Oklahoma/Texas
345 kV transmission line from Tuco to Jones in western Texas

SPP Load and Energy Forecast for 2016

Control Area	Peak (MW)	Energy (GWh)
AECC	1,203	5,289
CELE	2,206	10,706
AEPW	9,425	45,675
EMDE	1,336	6,440
GRRD	1,079	5,273
INDN	349	1,344
KACY	531	2,712
KACP	3,609	17,757
LAFA	513	2,302
LEPA	230	1,005
MIDW	374	1,820
MIPU	2,084	9,548
OKGE	6,714	29,050
OMPA	1,167	4,768
SPRM	898	3,884
SUNC	1,159	6,516
SWPA	1,118	4,523
SWPS	6,624	34,509
WEFA	1,606	8,233
WERE	6,055	28,075
Total	48,280	229,429

Source: SPP EIA-411 Report for 2009 posted on 2009/08/25

Gas Price Forecast (2009 $/MMbtu)

Year	Henry Hub	Delivered to SPS	Delivered to SPP West
2016	6.01	5.77	5.85
2021	6.71	6.46	6.55

Source: ICF Fundamentals

Allowance Price Forecast (2009 $/Ton)

Year	SO_X	NO_X Zone 1[1]	NO_X Zone 2[1]	CO_2
2016	922	600	2,412	20.4

[1] Zone 1 states are the district of Columbia, Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia, and Wisconsin.

Source: March 2010 ICF Multi-Client Report