BEFORE THE GEORGIA PUBLIC SERVICE COMMISSION

STATE OF GEORGIA

In Re: Georgia Power Company's 2016 Integrated Resource Plan and Application for Decertification of Plant Mitchell Units 3, 4A and 4B, Plant Kraft Unit 1 CT, and Intercession City CT.	)	**Docket No. 40161 and 40162**
In Re: Georgia Power Company's Application for the Certification, Decertification and Amended Demand Side Management Plan	)	

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DIRECT TESTIMONY OF

DAVID BERRY

ON BEHALF OF

CLEAN LINE ENERGY PARTNERS LLC

May 3, 2016

TABLE OF CONTENTS

I. Witness Introduction and Purpose of Testimony

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

A. My name is David Berry. I am Chief Financial Officer and Executive Vice President-Strategy and Finance for Clean Line Energy Partners LLC ("Clean Line"). Clean Line is developing five merchant transmission lines, including the Plains & Eastern Clean Line ("Plains & Eastern"), a high voltage direct current transmission ("HVDC") line that will enable the delivery of 4,000 megawatts ("MW") of low cost wind power to the Southeast. My business address is 1001 McKinney Street, Suite 700, Houston, Texas 77002.

Q. Please describe your education and professional background.

A. I received a Bachelor of Arts degree from Rice University with a major in economics and a second major in history. Prior to joining Clean Line, I was employed by Horizon Wind Energy as Finance Director. At Horizon Wind Energy, I was responsible for financing transactions, investment analysis, power purchase agreement pricing and acquisitions. I worked on and led over $2 billion of project finance transactions, including a non-recourse debt financing that was named North American Renewables Deal of the Year by *Project Finance*, and several equity transactions for wind generation projects in development, construction, and operations. I joined Clean Line as one of its first employees in late 2009.

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

A. I am responsible for developing the transmission capacity products offered to Plains & Eastern's transmission customer. I lead a team responsible for ensuring that the transmission service offered by Clean Line results in a compelling value proposition for utilities and their end-use customers. I oversee and am responsible for the financing

activities, accounting, transaction structuring, and market analysis for Clean Line and its subsidiaries. I regularly provide testimony in regulatory proceedings on behalf of Clean Line and its subsidiaries, including Plains & Eastern. I have testified in support of Plains & Eastern's application for certificate to construct its proposed transmission project before the Tennessee Regulatory Authority and the Oklahoma Corporation Commission. I have testified before the Illinois Commerce Commission, the Indiana Utility Regulatory Commission, the Kansas Corporation Commission, and the Missouri Public Service Commission on behalf of other Clean Line subsidiaries.

Q. What is the purpose of your direct testimony?

A. I am testifying on behalf of Clean Line in connection with its intervention in dockets 40161 and 40162 regarding Georgia Power Company's 2016 Integrated Resource Plan and Application for Decertification of Plant Mitchell Units 3, 4A and 4B, Plant Kraft Unit 1 CT, and Intercession City CT and Georgia Power Company's Application for the Certification, Decertification and Amended Demand Side Management Plan.

Q. Please summarize your testimony.

A. Clean Line Energy Partners is developing the Plains & Eastern Clean Line, an approximately 700-mile HVDC transmission line to be located in Oklahoma, Arkansas and Tennessee. This project will deliver 4,000 MW of low cost, high capacity factor wind generation located in the Oklahoma Panhandle region to the Southeastern United States via a 500 MW converter station located near Entergy's Arkansas Nuclear One facility and a 3,500 MW converter station located near TVA's Shelby Substation. Using TVA point-to-point transmission service, wind energy transmitted on Plains & Eastern can be delivered to Georgia Power.

Clean Line has reviewed the Integrated Resource Plan ("IRP") filed with the Georgia Public Service Commission (the "Commission") on January 29, 2016, and commends Georgia Power on its efforts to provide Georgia ratepayers with reliable, low cost electric service. Clean Line proposes several measures in furtherance of this mission, and to ensure Georgia ratepayers realize the maximum benefits available from the procurement of renewable energy resources. Specifically, Clean Line submits the following recommendations to the Commission.

- *Authorize and direct the procurement of additional renewables beyond the 525 MW currently identified in the IRP so long as the resources are below Georgia Power's avoided cost.* Georgia Power currently proposes initiating a Renewable Energy Development Initiative ("REDI"), which includes plans to procure an additional 525 MW of renewable capacity through a REDI Request for Proposal ("RFP"). As identified in the IRP on page 10-104, Table 2: Components by Resource Type-Wind & Biomass, integrating wind resources results in significant benefits due to avoided fuel and purchased power costs, avoided operations and maintenance costs, avoided environmental compliance costs, and avoided capacity costs. The Commission should authorize and direct Georgia Power to procure more than 525 MW of renewables if additional proposals are received that have a higher benefit to Georgia Power ratepayers than cost, which will result in downward pressure in rates.
- *Maintain the RFP's flexibility across technologies.* Renewable energy technologies, particularly wind and solar, are complementary resources. Wind energy is typically the lowest cost resource, produces more energy per megawatt ("MW") installed, contributes substantially to meeting winter peak demand and provides for economic development opportunities in the supply chain. Solar energy contributes substantially to meeting summer peak demand and provides for local construction job opportunities. The two resources also complement one another on a time of day basis, and a portfolio of both wind and solar produces less system

variability. By increasing the size of the RFP, there will be substantial opportunities to include both cost-effective wind and solar generation into Georgia Power's supply portfolio.

- *Accelerate the timing of the RFP to align with the wind Production Tax Credit phase out, resulting in lower costs of wind generation.* The REDI RFP should begin as soon as possible to ensure that the wind proposals received capture the full value of the Production Tax Credit ("PTC"). 2016 will be the last year that new wind project construction will be eligible for the full value of the PTC. Wind generators can preserve this value by incurring 5% of the total cost, or starting construction, of the facility during 2016. However, without firm commercial commitments from Georgia Power, wind generation companies are unlikely to invest the significant capital needed to qualify wind farms for the full PTC value in order to supply the lowest cost wind power. Delaying the start of the RFP until late this year, or until 2017, will result in wind generation proposals that are more expensive due to a lower PTC value.
- *Allow proposals commencing operations as late as 2021 if they offer higher net benefits to customers.* The current construct of the RFP proposes procuring 210 MW of utility scale renewable projects that can attain commercial operation in 2018 and 215 MW of utility scale renewable projects that can attain commercial operation in 2019. This does not provide sufficient time for wind generators using Plains & Eastern or other new transmission lines to come online. Clean Line believes that the lowest-cost renewable resource available to Georgia Power is Oklahoma Panhandle wind power delivered via Plains & Eastern, which will begin delivering energy to the Southeast in 2020. Closing the RFP to such a resource would likely increase costs for Georgia Power customers.
- *Encourage Georgia Power to evaluate ownership of wind assets.* Finally, the RFP should consider the additional benefits to ratepayers if Georgia Power were to own the wind facilities. Clean Line supports the following statement from pg. 10-106 of the IRP: "third-party proposals that allow for Georgia Power ownership will be considered." Investments in wind will likely result in a lower delivered cost of

energy than the same resource procured via a power purchase agreement, due to Georgia Power's low cost of capital and efficient use of tax credits.

Ultimately, the purpose of the REDI RFP is to identify the best options for securing reliable, low-cost energy for Georgia ratepayers. Clean Line's analysis suggests that there is good reason to believe Oklahoma Panhandle wind can be among the most cost-effective resources, and our recommendations are meant to ensure all available options are fully considered. These recommendations will be discussed in more detail in the remaining sections of my testimony.

II. Plains & Eastern is in an advanced stage of development and will begin delivering low cost, high capacity factor wind energy to the Southeast in 2020

Q. What is the purpose of the Plains & Eastern?

A. The Plains & Eastern Clean Line is an approximately 700-mile, +/-600 kilovolt ("kV") HVDC transmission line and associated facilities that will connect abundant wind resources in the Oklahoma Panhandle region to load centers in Tennessee, the Mid-South and the Southeast with a demand for low-cost, clean energy. The Plains & Eastern Project will deliver up to 3,500 MW of low-cost wind power from Oklahoma to the TVA system at the Shelby Substation, where it will be available for purchase by Georgia Power. In addition, Plains and Eastern will deliver up to 500 MW of power to the Entergy 500 kV transmission system at an intermediate delivery point in Arkansas. Wind power sourced from the Oklahoma Panhandle is some of the cheapest renewable energy in the country and is a valuable option as Georgia Power builds a diverse and affordable portfolio of electric generation.

Q. Why has Plains & Eastern decided to utilize HVDC technology for the Project?

A. HVDC is a more efficient technology for long-haul transmission of large amounts of electric power because substantially more energy can be transmitted with lower losses, narrower rights-of-way, and fewer conductors than with an equivalent high voltage AC system. At distances beyond about 300 miles, HVDC is generally the most cost efficient means to move large quantities of power.

The use of HVDC technology is a particularly appropriate solution for the Plains & Eastern's goal of moving large amounts of wind generation over long distances. In this application, HVDC lines result in a lower cost of transmission than AC lines.

Q. Why is moving wind power through a dedicated HVDC line preferable to using the existing alternating current ("AC") transmission system?

A. The existing AC system was not designed to move wind power and is reaching its full capacity. To use the existing grid to reach the Southeast, generators in the Southwest Power Pool ("SPP") must obtain multiple transmission service requests through multiple utilities' service territories, typically through SPP and the Midcontinent Independent System Operator ("MISO"). Not only is this a more complex arrangement than the direct delivery to TVA provided by Plains & Eastern, the arrangement creates three major risks for the generator or purchasing utility.

First, each segment of service (or "wheel") is subject to rate increases over time and cannot be purchased at a long-term, fixed rate. Second, transmission through an AC system is at risk of congestion, meaning too much generation tries to use too little transmission. Congestion increases the cost of moving power through the AC system. Third, generators may also be subject to curtailment, meaning they cannot actually operate reliably due to constraints on the AC system. All of these factors increase the cost of wind

procurement. Further, they limit the ability to rely on the existing AC system to meet the need for transmission capacity to deliver new sources of renewable energy to the Mid-South and Southeast.

A dedicated HVDC line like the Project does not carry the same risk of cost increases over time, congestion or curtailment. As a dedicated HVDC line, the Plains & Eastern Project can provide a single, fixed cost transmission service to reach the TVA system. Not only is HVDC the right technical solution, it creates direct access for utilities in the South without managing multiple, complex transmission service requests through other utilities' territories.

Q. How would power be moved from the Plains & Eastern converter station to a TVA-Southern interface, and does this create a risk of future cost increases?

A. From the Plains & Eastern converter station in TVA, the owner of the wind generation can procure firm point-to-point transmission service across TVA's service territory that will guarantee delivery to the TVA-Southern interface. This firm service eliminates the curtailment and congestion risk that increases the cost of wheeling through a regional transmission organization ("RTO"). The cost of firm transmission service through TVA is subject to rate changes over time, however these costs have been far less volatile than service through MISO or SPP. Figure 1, below, outlines the changes in transmission service over the last several years in TVA, MISO, and SPP.

	SPP	MISO	TVA
2013	25,712	41,082	26,412
2014	32,332	40,150	27,492
2015	35,646	42,670	28,008
2016	38,740	45,108	26,460

Figure 1. Total cost of transmission service, $/MW-year[1]

Q. Have any studies shown that transmission across TVA is available and that transmission service requests will not trigger significant upgrades?

A. Yes. Southeastern Regional Transmission Planning ("SERTP") studies have shown that significant energy transfers can be accommodated across TVA's transmission system at reasonable cost.

SERTP's 2015 Economic Planning Study Report assessed the upgrades necessary to accommodate 1,200 MW of transfers from TVA to Southern Company.[2] This study identified ten upgrades within the Southern system totaling $147.3 million that would be needed to accommodate the transfer of 1,200 MW to the Southern system.[3] This

[1] SPP transmission service includes schedule 1, 2, 7, 11, and administrative charges, years 2013-2015 are an average of winter and summer charges. Summer 2016 charges have not yet been released. MISO transmission service includes schedule 1, 2, 7, 26, 33, and 45 charges. TVA transmission service includes schedule 1, 2 and 7 charges.

[2] The 2015 Economic Planning Study Assumptions assume the following share of Plains & Eastern delivered energy: SOCO- 1,200 MW, TVA- 1,639 MW, Duke Energy- 661 MW.

[3] Of these ten upgrades, three have previously been identified in Southern Company's transmission planning process. The cost of accelerating these previously identified upgrades is $9.8 million, this cost is included in the $147.3 million upgrade cost. This figure does not include the upgrades that are already required for Plains & Eastern's interconnection to the TVA system

investment in Southern's transmission system is approximately 6% of the pro-rata capital required to build 1200 MW of Plains & Eastern and the connected wind resource.

Q. Has the project obtained all necessary regulatory approvals needed to site and construct the transmission line?

A. Yes. On March 25, 2016, the U.S. Department of Energy ("DOE") issued a Record of Decision ("ROD") approving the Plains & Eastern Clean Line transmission project, noting DOE's decision to participate in the project and designating a preferred route for the transmission line in Oklahoma and Arkansas. The ROD outlined the roles of Clean Line and DOE in the project, identified a route for the interstate direct current transmission line, and confirmed the beginning point of the project in Oklahoma and a converter station in Arkansas that will deliver 500 MW of wind power.

Additionally, on October 28, 2011, the Oklahoma Corporation Commission ("OCC") approved Plains and Eastern Clean Line Oklahoma LLC's request to conduct business as a public utility in Oklahoma. As an Oklahoma public utility, Plains and Eastern Oklahoma can construct, own, and operate electric transmission lines within the state. On January 12, 2015, the Tennessee Regulatory Authority ("TRA") unanimously voted to approve the application of Plains and Eastern for a Certificate of Public Convenience and Necessity and to grant Plains and Eastern the authority to operate as a wholesale transmission-only public utility in Tennessee.

Q. Has Clean Line quantified the available supply of Oklahoma Panhandle wind generation available for supplying Georgia Power?

A. Yes. From May 22 to July 25, 2014, Clean Line conducted an open solicitation pursuant to its FERC negotiated rate authority and is now in the process of allocating capacity on the

line. Clean Line received requests from fifteen different potential transmission customers for 17,000 MW of transmission service, or nearly four times the Project's total transfer capacity. Of these 17,000 MW of requests, 15,000 MW were for service from Oklahoma to the TVA converter station. The remainder of the requests were for service from Oklahoma to the Arkansas converter station.

Since the close of the initial open solicitation window, several respondents have increased the size of their capacity requests. To date, Clean Line has received requests for a total of 22,000 MW of transmission service, 19,500 MW of which are for service to Tennessee.

Q. Has Clean Line demonstrated the quality of the Oklahoma wind resource?

A. Yes. In June 2013, Clean Line issued a Request for Information ("RFI") to gather information about wind projects that are currently under development in the Oklahoma Panhandle region. RFI respondents confirmed the very high quality wind resources in the Oklahoma Panhandle region, which supports attractive pricing for wind energy. The RFI respondents reported an average capacity factor of 51%, while the average capacity factor of the lowest priced 4,000 MW of submissions was 53%. A capacity factor is the ratio of actual generation to the total possible generation assuming ideal wind speeds. Capacity factors in excess of 50% are a result of improving turbine technology and the abundance of high wind speed sites in the Oklahoma Panhandle region.

The average 80-meter (80 meters is a typical hub height of modern wind turbines) wind speed of the projects submitted in the RFI was 8.8 meters per second ("m/s"). States in the Southeast, such as Georgia, do not typically have average wind speeds above 7.0 m/s, and only very few sites in the Southeast have average wind speeds that are above 6.5

m/s. The kinetic power potential of wind varies with the cube of the wind velocity. In other words, the power potential varies proportionally to the wind velocity raised to the third power. Consequently, an 8.5 m/s average wind speed site will have, other things being equal, 1.79 times the power potential of a 7 m/s site. This is a key factor in the low cost of Oklahoma wind power.

III. The Commission should authorize and direct the procurement of more than 525 MW of renewables *so long as the resources are below Georgia Power's avoided cost*

Q. Should Georgia Power procure more than 525 MW during the upcoming renewable RFP?

A. Yes. The document TS Wind Analysis included by Georgia Power in the 2016 IRP filing shows significant net benefits for thousands of megawatts of renewable power. Plains & Eastern can provide thousands of megawatts of high capacity factor wind from the Oklahoma Panhandle at a price below avoided cost. The Commission should encourage Georgia Power to expand the scope of the REDI RFP to fully capture the value available to Georgia ratepayers through additional renewable procurements.

Q. Is the Plains & Eastern wind resource below Georgia Power Company's avoided cost?

A. Yes. Wind prices across the country have continued to fall, with the lowest prices being seen in the central United States, where Plains & Eastern will interconnect. Each year the Department of Energy publishes a report of wind industry statistics, including observed PPA prices. The report published in 2015 documented average wind PPA prices of

\$22.4/MWh in the central United States.[4] One specific example is Southwestern Public Service Company's ("SPS") recent power purchase agreement with the Palo Duro wind farm located in the Texas Panhandle, adjacent to the Plains & Eastern converter station. The PPA price for SPS's contract is \$23.35/MWh for 20 years.[5]

The other major component of the delivered cost of wind to Georgia is the cost of transmission. Transmission from Oklahoma to the TVA system in Memphis across Plains & Eastern will cost approximately \$20-25/MWh, including losses. Plains & Eastern offers firm transmission service from Oklahoma to TVA at a fixed-price with no congestion risk. This service can be used in conjunction with TVA point-to-point transmission service to deliver directly to Georgia Power, which is estimated to cost approximately \$8/MWh, including losses.

The TS-Wind Analysis appendix included in the IRP filing calculated the net avoided cost on the Georgia Power system of two 1,000 MW tranches of wind procurement. The anticipated delivered cost of energy of a wind purchase over Plains & Eastern, inclusive of the Plains & Eastern transmission tariff, point-to-point transmission service across the TVA system, and electrical losses is well below the net avoided cost identified for the full 2,000 MW studied in the TS Wind Analysis.

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[4] U.S. Department of Energy, *2014 Wind Technologies Market Report*, page 57.

[5] Direct Testimony of Jessica Collins, Docket No: 13-00233-UT, *In the matter of Southwestern Public Service Company's Application for Approval and Authority to: (1) Enter into separate power purchases agreements with NextEra Energy Resources' Mammoth Plains and Palo Duro Wind Energy Centers and Infinity Wind Power's Roosevelt Wind Ranch for wind energy; and (2) recover the associated energy costs through its fuel and purchased power cost adjustment clause.*

Q. Are there any additional value components associated with Oklahoma wind that should be evaluated during the renewable RFP process?

A. Yes. Though the Clean Power Plan has been stayed, it is reasonable and prudent to plan for future carbon constraints, whether they are implemented via the Clean Power Plan, another regulatory vehicle, or a price on carbon. Georgia Power has recognized in its IRP and in its public testimony the need to ensure that the Company is well positioned to respond to any future carbon regulations. Delivered wind power from Plains & Eastern can reduce carbon emissions and provide an insurance policy against future environmental regulations.

Q. Are there any additional value components associated with transmission service across Plains & Eastern that should be evaluated during the renewable RFP process?

A. Yes. In addition to transferring low cost wind, transmission capacity on Plains & Eastern can be used to deliver bulk power from the SPP system during the hours when wind generation is not using the entire capacity of Plains & Eastern. Clean Line has estimated that the ability to deliver SPP market power could save Georgia ratepayers approximately $9 million dollars a year.[6] This calculation assumes that Georgia Power or a wind generator has obtained enough transmission service across Plains & Eastern to deliver 1000 MW to the Southern system.

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[6] This analysis identified hours during years 2006 through 2012 when Southern Company's marginal costs of energy were higher than SPP's marginal cost, and then multiplied the difference in price of Southern's marginal costs and SPP market power by the energy delivery available on Plains & Eastern at that time.

In addition to the benefits outlined above, and in the TS Wind Analysis appendix, Georgia Power and the Commission should consider the long-term nature of the transmission infrastructure provided by Plains & Eastern. Most of the HVDC transmission lines in the United States were built more than thirty years ago and all continue to operate and provide value to the transmission system today. Unlike resources that are delivered via the existing AC system, the renewable energy delivered on Plains & Eastern is coupled with a new physical asset that will provide resources and optionality to Georgia Power for decades.

Q. Can Georgia Power successfully manage renewable penetration beyond the 525 MW that the REDI currently calls for?

A. Yes, I believe they can. The main challenge in integrating renewable energy is the variability of the resources. However, power systems are already in place to manage generation and this normally occurring load variability on the grid. Renewables are simply an addition to this existing variability that grid operators manage every day. Wind forecasting has become highly sophisticated, allowing operators to plan for the availability of other resources efficiently, while most natural gas plants can be online in less than 30 minutes- giving grid operators flexibility to respond to changes in net load rapidly.

Clean Line's analysis has shown that adding substantially more renewable power than the 525 MW that is currently called for in the IRP does not significantly affect the total variability on the Georgia Power system. More information on this analysis can be found in lines 348-397 of this testimony.

Q, Are there any examples of other systems that have integrated significant amounts of renewable energy?

A. Utilities today reliably integrate wind at high penetration levels at a low cost to consumers. A 2013 review of the actual cost to integrate 10,000 MW of wind into ERCOT's system over one year found that the total cost of integration was only $0.50/MWh.[7] Xcel Energy Colorado meets 20% of its load on average with wind generation, and at times can meet up to 50% of instantaneous demand with wind.[8] Xcel worked with the National Center for Atmospheric Research to develop an advanced wind forecasting system using inputs from satellites, planes, radars, weather stations, and turbine sensors. The system produces a new, highly accurate forecast every 15 minutes.[9]

IV. The Commission should maintain the RFP's flexibility across technologies.

Q. Should the RFP include carve outs for specific generation types?

A. The primary focus of any energy or capacity procurement process should be to obtain the resource, or portfolio of resources, that reliably serves load in the most cost effective manner, rather than carve outs for specific resources. Georgia Power and the Commission have shown a commitment to reliably serving load in the most cost effective manner possible, and should continue this tradition in the upcoming RFP. If any carve outs are created, Clean Line recommends that they be small compared to the overall RFP. By increasing the size of the RFP, the Commission can allow all technologies to be part of the

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[7] Presentation by Mark Ahlstrom, A Market Perspective on Forecast Value. UVIG Workshop on Forecasting Applications, Feb 26, 2013.Accessed at: http://www.uwig.org/slcforework/Ahlstrom-Session1.pdf

[8] Weiss, J; Tsuchida, B. "Integrating Renewable Energy into the Electricity Grid", June 2015.

[9] *Ibid.*

solution, and can maximize benefits to the state. As described in this section, Georgia Power ratepayers will realize benefits from a diverse portfolio of renewable energy, including Oklahoma Panhandle wind and Georgia solar resources.

Q. Please describe the advantages that a portfolio of energy resources will bring to Georgia ratepayers.

A. As identified in the IRP, Georgia Power has a wide range of renewable resources available that can contribute to a cost-effective renewable portfolio. Two of these resources are in-state solar generation, and Oklahoma Panhandle wind generation delivered via Plains & Eastern.

Georgia solar and Oklahoma Panhandle wind bring a range of economic development benefits to Georgia ratepayers. The development of Georgia solar resources supports Georgia jobs related to the installation of solar panels, and contributes to local tax bases. Procuring Oklahoma Panhandle wind creates manufacturing opportunities in the wind and transmission supply chain. Moreover, procuring wind generation at below Georgia Power's avoided cost should have a downward effect on electricity rates, which will attract and maintain commercial and industrial interest in the state of Georgia and provide more disposable income to all Georgia Power customers.

In addition, Georgia solar and Oklahoma Panhandle wind have complementary production profiles- their peak output typically occurs at different times of the day and in different seasons of the year. As a result, a renewable portfolio that consists of a mix of wind and solar will result in less overall variability on the system and lower integration costs than a portfolio of only Georgia solar.

Q. Can you provide a concrete example of how a combination of wind power and solar power provide benefits to Georgia Power?

A. Yes. Clean Line performed an analysis to show that a combination of Oklahoma wind generation and Georgia solar results in a substantially lower amount of hourly variability than a portfolio of only in-state solar generation. Lower variability means that Georgia Power can integrate more variable renewable energy onto its system at a lower cost.

Q. How did you measure variability in your analysis?

A. We used an industry-standard measure of the variability introduced by renewable resources. This measure is called the three-sigma net load variability.

Net load means Georgia Power load minus variable renewable energy generation. Georgia Power must use its dispatchable fleet of resource to balance both load and variable renewable energy. A variable renewable resource is therefore treated as a negative load. If renewable output ramps up as the overall system load ramps up, then net load variability will be less than it would be if the renewables were not on the system. If renewable output ramps down as load ramps up, net load variability increases.

Three times the standard deviation, or three sigma, represents the maximum amount of hourly change in load present 99.7% of the time. The idea is that the power system must be planned and run for "tail events" that are uncommon but require an adequate response. Combining the concept of "net load" and "three sigma," three-sigma net load variability means the amount of hourly variability from the combination of load changes and changes in renewable energy output that occurs in only 0.3% of hours.

Q. What portfolios of renewable generation did you compare in your analysis?

A. For illustrative purposes, we set the size of the renewable portfolio at 1,500 MW. We then compared a portfolio of 100% solar versus a portfolio of approximately 70% Oklahoma Panhandle wind and 30% in-state solar.

Q. What were the results of your analysis?

A. We found that the solar-only portfolio increased hourly variability (i.e., three-sigma net load variability) by 2.4 times the amount of the increase by the combined wind and solar portfolio—this even though the combined wind and solar portfolio delivered almost twice as much renewable energy to the Georgia Power system because of the higher capacity factor of the wind generation.

Q. Please provide some additional results of your variability analysis.

A. First, we established the baseline level of hourly variability in the Georgia Power system. Prior to the integration of this new 1,500 MW renewable portfolio, three-sigma, net load variability was calculated to be 1,293 MW in magnitude.[10]

Second, we assessed the incremental net load variability from adding 1,500 MW of new solar generation. This analysis found that three-sigma net load variability increased from 1,293 MW to 1,546 MW- an increase of 253 MW.

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[10] Georgia Power load data obtained from FERC Form 714. Georgia Power's baseline load was calculated as the historical FERC Form 714 data less the output from the renewable generation already procured by Georgia Power. 250 MW of Oklahoma wind was modeled using EWITS site number 00014. 1,000 MW of existing Georgia solar generation was modeled using solar production profiles for Marietta, Athens, Albany, Savannah, Augusta, Brunswick, and Columbus, Georgia, from NREL's System Advisor Model.

Finally, we assessed the incremental net load variability from adding a portfolio of 1,040 MW of Oklahoma Panhandle wind and 460 MW of Georgia solar. [11] Three-sigma net load variability increased to 1,397 MW, or 104 MW above the baseline level.

The increased net load variability from the 1,500 MW combined portfolio of wind and solar represents an increase of only eight percent over Georgia Power's existing net load variability. This result suggests such a level of renewable penetration would be feasible. Georgia Power's abundance of capacity resources, as shown by the lack of capacity need until 2024, indicates that this additional variability could likely be handled by the existing Georgia Power generation fleet and would not require additional investment in capacity resources. While Clean Line acknowledges that Georgia Power will always perform detailed technical studies around specific proposals, our analysis suggests that a large portfolio of both wind and solar generation is both technically feasible and desirable.

V. The REDI RFP should begin as soon as possible, and should allow proposals for delivery later than 2018.

Q. How will the timing of the REDI RFP affect the wind prices that are received?

A. The timing of the RFP will have a large effect on the wind proposals received, as the Production Tax Credit will begin a multi-year phase out in 2017. The Consolidated Appropriations Act of 2015 extended the Section 45 PTC for electricity produced from wind generation retroactively to January 1, 2015, and prospectively through the end of

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[11] The Oklahoma wind profile was created with 3Tier modeled data of an Oklahoma wind farm with a 55% capacity factor site using a GE 1.7-100 power curve. The Georgia solar production profile is a blend of simulated solar production profiles from Savannah and Columbus, GA, via NREL's System Advisor Model.

2019. After 2016, the credit will be reduced by 20% for projects that begin construction in 2017, by 40% for projects that begin construction in 2018, and by 60% for projects that begin in 2019. The wind PTC would expire for projects that begin construction on or after January 1, 2020.

Under guidance previously issued by the IRS interpreting the "beginning of construction" rule for qualified renewable power facilities there are two methods that a taxpayer may use to establish that construction of a qualified facility has begun:

1. A taxpayer may establish the beginning of construction by: (a) starting physical work of a significant nature (Physical Work Test) and (b) thereafter maintaining a continuous program of construction.
2. Under the second method, a taxpayer may establish the beginning of construction by meeting the so-called "5% safe harbor," which provides that construction of a facility will be considered as having begun if (1) a taxpayer pays or incurs five percent or more of the total cost of the facility before the applicable expiration date, and (2) thereafter, the taxpayer makes continuous efforts to advance towards completion of the facility.

Wind generators need certainty of offtake arrangements prior to incurring five percent of the total cost of the facility or commencing construction. Georgia Power currently plans to file a detailed RFP schedule with the Commission in September 2016, which would lead to the issuance of the RFP likely in early 2017.[12] This timing would eliminate the potential

[12] Transcript of Public Hearing regarding Georgia Power Company's 2016 Integrated Resource Plan and Application for Decertification of Plant Mitchell Units 3, 4A and 4B, Plant Kraft Unit 1 CT, and Intercession City CT, Docket 40161, Tuesday, April 19, 2016. Page 571, line 12.

425 for wind proposals that include the full value of the PTC. Georgia Power should release
426 the RFP as soon as possible.
427 This declining PTC value means that the lowest cost wind will be procured in 2016,
428 and the cost of wind energy will rise between 2016 and 2020 as the tax credit is phased
429 out. Improvements in wind turbine technology have significantly increased the capacity
430 factor of wind, thereby lowering the delivered cost of energy, but near-term improvements
431 in turbine technology will not be sufficient to compensate for this lost PTC value.
432 A Lawrence Berkeley National Laboratory analysis on capturing the value of
433 renewable energy tax credits estimated an increase in the levelized PPA price of a wind
434 contract of between $3.8 and $6.6/MWh as the PTC dropped from 100% to 80% of its
435 value.[13]

436 **Q. Have other load serving entities acted quickly to take advantage of this opportunity?**
437 Yes. As one example, on April 14, 2016, MidAmerican Energy announced a plan to invest
438 another $3.6 billion in wind generation in Iowa. MidAmerican plans to request approval
439 from the Iowa Utilities Board over the next few months. According to the press release
440 available on the MidAmerican website: "We have asked the Iowa Utilities Board to
441 approve our request by September 2016, which will allow us to take full advantage of the
442 federal production tax credits available for construction of new wind projects."

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[13] Bolinger, M, Lawrence Berkeley National Laboratory. "An Analysis of the Costs, Benefits, and Implications of Difference Approaches to Capturing the Value of Renewable Energy Tax Incentives", May 2014.

Q. Please explain how specifying required online dates may limit the responses received in the REDI RFP

A. The current construct of the RFP proposes procuring 210 MW of utility scale renewable projects that can attain commercial operation in 2018 and 215 MW of utility scale renewable projects that can attain commercial operation in 2019. The lowest cost wind resource available to Georgia Power is likely to be Oklahoma Panhandle wind delivered via Plains & Eastern, which will begin delivering energy to the Southeast in 2020. Clean Line plans to allocate a majority of the 4,000 MW of transmission capacity to the Southeast to generator-shippers in 2016 and early 2017. This finite resource will not be available if Georgia Power waits until the next IRP cycle in 2019 to evaluate delivered Plains & Eastern wind, and maintaining a 2018 or 2019 required online date may preclude these resources from competing in the proposed REDI RFP.

VI. The Commission should encourage Georgia Power to evaluate ownership of wind assets.

Q. Please explain how the delivered cost of wind energy would be affected if Georgia Power owned the wind assets.

A. Clean Line supports Georgia Power for its willingness to consider asset ownership in the upcoming REDI RFP.[14] Due to Georgia Power's low cost of capital and its ability to apply all tax credits generated in a year against other taxable income, Georgia Power's ownership

[14] Georgia Power Company's 2016 Integrated Resource Plan and Application for Decertification of Plant Mitchell Units 3, 4A and 4B, Plant Kraft Unit 1 CT, and Intercession City CT, pg. 10-106.

of wind will provide more value to Georgia Power ratepayers than the purchase of wind under a PPA.[15] Clean Line's analysis indicates that a Georgia Power investment in wind will be approximately $12/MWh cheaper than the same wind procured via a power purchase agreement, which translates to savings of hundreds of millions of dollars over the life of the asset.

Plains & Eastern will tap some of the most competitively priced wind generation that would otherwise be stranded due to lack of transmission. Wind farm development and construction in the Oklahoma Panhandle region is low risk due to favorable permitting rules, low population density, good soil conditions, and local community support. The Request for Information and Open Solicitation processes have shown that thousands of megawatts of wind are under development in the Plains & Eastern resource area. Georgia Power could partner with one of these wind developers, and could ultimately take control of the wind development upon commercial operation, after the development and construction risk has been eliminated.

Q. In the past, Georgia Power has found that power purchase agreements have been more economic than utility ownership of solar plants. Would the same be true for wind farms?

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[15] Georgia Power's recent issuance of $325 million of Green Bonds is one evidence of Georgia Power's ability to utilize lower costs of capital compared to typical project financed deals. Typical project finance issuances are priced at approximately 200-250 basis points above U.S. Treasury yields. With a coupon rate of 3.25% issued on March 2nd, Georgia Power's Green Bond is 145 basis points above the 10-year U.S. Treasury yield of approximately 1.8% at the time.

A. Likely not. Due to restrictions in the tax code on the solar Investment Tax Credit ("ITC"), third-party generators have an inherent advantage over cost-of-service utilities like Georgia Power. The Internal Revenue Service requires that cost-of-service utilities incorporate the solar investment tax credit ("ITC") into their ratebase pro rata over the useful life of the facility. This is commonly known as "normalization." For example, if a solar plant has a useful life of 25 years, a utility could reduce its ratebase in the plant by only 4% of the ITC value per year. In contrast, a third-party generator can recognize the full value of the ITC as soon as the solar plant is placed in service. The present value of the ITC to end-use customers is therefore approximately twice as high for a third-party PPA than for utility ownership, assuming a 7% discount rate.

There is no normalization requirement for the wind PTC. In fact, due to their lower cost of capital and tax base, many utilities have found that ownership of wind farms is cheaper for customers than a third-party power purchase agreement.

Q. Have affiliates of Georgia Power owned wind assets?

A. Yes. Georgia Power's independent power producer affiliate, Southern Power, owns 344 MW of wind farms in the United States. While Southern Power is legally separated from Georgia Power, its investment in wind assets is evidence that a low cost of capital and tax capacity allow companies with the Southern Company group to be efficient owners of wind farms.

Q. Please provide examples of other utilities that have benefited from ownership of wind assets.

A. According to the American Wind Energy Association, at least 15% of all wind energy generated since 2009 was generated from wind projects owned by utilities. Berkshire

Hathaway entities MidAmerican and PacifiCorp own 3,343 MW and 1,031 MW of wind generation respectively. As discussed above, MidAmerican recently announced plan to install another 3,600 MW of wind generation to take advantage of the current PTC extensions. Puget Sound Energy, Portland General Electric, Xcel Energy, Alliant Energy and Minnesota Power all own over 500 MW of wind generation.[16]

VII. Conclusion

Q. Please provide a summary of Clean Line's recommendations to the Commission and Georgia Power Company.

A. Clean Line makes the following recommendations on the planned REDI RFP to ensure that the maximum value is realized for Georgia ratepayers.

- Authorize and direct the procurement of additional renewables beyond the 525 MW currently identified in the IRP so long as the resources are below Georgia Power's avoided cost.
- Maintain the RFP's flexibility across technologies
- Accelerate the timing of the RFP to align with the wind Production Tax Credit phase out, resulting in lower costs of wind generation.
- Allow proposals commencing operations as late as 2021 if they offer higher net benefits to customers.
- Encourage Georgia Power to evaluate ownership of wind assets.

Clean Line commends Georgia Power and the Georgia Public Service Commission for its demonstrated commitment to providing affordable, reliable energy to the residents of the

[16] AWEA, *US Wind Industry Annual Market Report, Year Ending 2015*, pg. 46-47.

State of Georgia. The recommendations above will ensure ratepayers have access to the cheapest portfolio of resources for years to come.

Q. Does this conclude your prepared direct testimony?

A. Yes, it does.