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December 21, 2012

VIA ELECTRONIC FILING

Mr. Joel H. Peck, Clerk
c/o Document Control Center
State Corporation Commission
Tyler Building – First Floor
1300 East Main Street
Richmond, Virginia 23219

RE: Petition of Virginia Electric and Power Company for approval of a special tariff to facilitate customer-owned distributed solar generation pursuant to Chapter 771 of the 2011 Virginia Acts of Assembly

Case No. PUE-2012-00064

Dear Mr. Peck:

Enclosed for filing in the above-captioned matter is the direct testimony, with exhibits, of Karl R. Rábago on behalf of Appalachian Voices, the Chesapeake Climate Action Network, and the Virginia Chapter of the Sierra Club (collectively, "Environmental Respondents").

Should you have any questions regarding this filing, please contact me at (434) 977-4090. Thank you for your assistance.

Regards,

Cale Jaffe

cc: Parties on Service List
Commission Staff

DIRECT TESTIMONY
OF
KARL R. RÁBAGO, RÁBAGO ENERGY LLC
ON BEHALF OF
ENVIRONMENTAL RESPONDENTS
BEFORE THE
STATE CORPORATION COMMISSION OF VIRGINIA
CASE NO. PUE-2012-00064

Introduction

Q. Please state your name, business name and address, and role with the Environmental Respondents.

A. My name is Karl R. Rábago. I am the principal of Rábago Energy LLC, a Texas limited liability corporation, located at 9512 Vera Cruz, Austin, Texas. I appear here in my capacity as an expert witness on behalf of Environmental Respondents, having been retained by the Southern Environmental Law Center ("SELC").

Q. Please summarize your experience and expertise in the field of electric utility regulation and the renewable energy field.

A. I have worked for more than 20 years in the electricity industry and related fields. Of note, my previous employment experience includes Commissioner with the Public Utility Commission of Texas, Deputy Assistant Secretary with the U.S. Department of Energy, Vice President with Austin Energy, and Director with AES Corporation, among others. A detailed resume is attached as Exhibit KRR-1.

Q. Do you have any business relationships with the Virginia Electric and Power Company ("Dominion Virginia Power" or the "Company")?

A. I do not have any direct business relationships with the Company, its parent

company, or any affiliates. I sit as Chair of the Board of Directors for the Center for Resource Solutions ("CRS"). CRS is a not-for-profit California corporation that offers certification services to green pricing and green power products throughout the U.S., under the certification mark called the "Green-e." The Company's Green Power Program is certified under the Green-e Energy program, and pays a fee to the Center for Resource Solutions for use of the certification mark. I have no direct involvement with the certification of programs under the Green-e Energy program and I will have no involvement with matters directly relating to the Company's certification. Consistent with the conflict of interest policy adopted by the CRS Board, I have notified my fellow board members of my participation in this proceeding as an expert witness.

Q. What is the purpose of your testimony?

A. I was retained by SELC to offer testimony that would facilitate and support full and fair evaluation of the Company's Solar Purchase Program ("SP Program") proposal in this proceeding. To that end, my testimony will identify positive and negative aspects of the SP Program proposal, and I will offer alternative approaches and modifications to the proposal that could better serve the statutory and regulatory goals for solar energy in Virginia.

Summary of Findings and Recommendations

Q. Please summarize your findings.

A. As set forth below, my key findings are:

1. The Company's SP Program proposal cannot be evaluated as reasonable given the lack of demonstrated analysis underpinning the proposal.

2. The Company's SP Program proposal fails to demonstrate that it will promote solar energy development as required by Chapter 771 of the 2011 Virginia Acts of Assembly ("Chapter 771").

3. The Company's SP Program proposal would have benefitted from an effort to reflect sound design principles for an effective distributed solar program.

4. The Company's SP Program proposal would have benefitted from more rigorous and data-based analysis in support of the program design. Such analysis would likely result in an efficient allocation of Green Power Program funds and a reasonable compensation rate for customer-owned distributed solar generation.

Q. Given those findings, please summarize your recommendations regarding the Company's SP Program proposal.

A. As set forth below, my key recommendations are:

1. The Company should undertake a more comprehensive analysis of the value of distributed solar generation in order to set a base value for a revised model that fairly credits solar generators.

2. The Company should fully document its cost and market data and assumptions in establishing any pilot program.

3. The Company should use this pilot program as a method for promoting new solar installations in its distribution grid, not merely converting existing net metered customers into SP Program customers.

Q. What materials did you review in preparing this testimony?

A. I reviewed all the official filings in this proceeding, as well as laws, rules and

other materials referenced in those documents. I also consulted a wide range of studies, reports, and articles. These materials are listed on Exhibit KRR-2.

Dominion Virginia Power's Solar Purchase Program

Q. What is your understanding of the authority for the Company's proposal?

A. The Company submitted the SP Program proposal under authority of Chapter 771 of the 2011 Virginia Acts of Assembly. The Act provides:

> *That in order to promote solar energy through distributed generation, the State Corporation Commission shall exercise its existing authority to consider for approval, after notice to all affected parties and opportunity for hearing, petitions filed by a utility to construct and operate distributed solar generation facilities and to offer special tariffs to facilitate customer-owned distributed solar generation as alternatives to net energy metering, with an aggregate amount of rated generating capacity of up to 0.20 percent of each electric utility's adjusted Virginia peak load for the calendar year 2010. Such petitions may be made during the period of July 1, 2011, through July 1, 2015, and the Commission, on its own motion, may extend this period an additional year for good cause. Each distributed solar generation installation approved pursuant to this section shall be considered to be part of a demonstration program to assess benefits to the utility's distribution system, including constrained or high load growth circuits, for a period of five years from the date each installation becomes operational. Thereafter each installation shall cease to be part of a demonstration program and, in the case of a utility-owned installation, shall continue to operate as a utility-owned generating facility, and in the case of a customer-owned installation, shall continue to provide power to the utility pursuant to the terms of the agreed upon tariff arrangement. Subject to review by the Commission, such utility-owned distributed solar generation facilities and tariffs for power generated from customer-owned distributed solar installations shall be prioritized in areas identified by the utility as areas where localized solar generation would provide benefits to the utility's distribution system, including constrained or high-growth areas. The Commission shall approve such programs or distributed generation facilities if it determines that the programs or facilities, including those targeting constrained or high load growth areas, are reasonably designed to be in furtherance of the public interest.* [Emphasis added]

Chapter 771 directs the State Corporation Commission to consider for approval utility petitions to offer special tariffs for distributed solar generation. The special tariff must meet the stated criteria of Chapter 771, including, most

notably, that the special tariff should:

- Promote solar energy;
- Facilitate customer-owned distributed solar generation;
- Prioritize distributed solar generation that provides distribution system benefits to address high-growth or constrained portions of the system;
- Be reasonably designed to be in furtherance of the public interest.

In addition, consistent with Chapter 771, programs may continue after the completion of the demonstration period.

Q. Does the Company offer other policy or statutory justification for its proposal?

A. Yes. The Company also cites the Commonwealth Energy Policy as set forth in Va. Code §§ 67-101 and 67-102. The Company's petition states that the SP Program will meet the objective of § 67-101 to increase Virginia's reliance on less polluting energy sources. In addition, the Company asserts that its proposal serves the stated goal under § 67-102 to "[p]romote the generation of electricity through technologies that do not contribute to greenhouse gases and global warming."

Q. What is the relevance of this authority and justification?

A. Through Chapter 771, the Virginia General Assembly created a special opportunity for innovation in promoting solar energy, especially where this kind of generation offers benefits to the utility's distribution system. In my opinion, it is incumbent on the Company to design a distributed solar demonstration tariff and program to target these benefits. That, in turn, requires that the Company take steps to understand the value of distributed solar as a part of designing its solar

demonstration program.

Q. What design principles do you recommend that the Company should have considered in developing the distributed solar tariff?

A. First, and foremost, a distributed solar tariff should be fair to the utility and to ratepayers not enrolled in the SP Program. The tariff should ensure that the utility has the opportunity to collect its cost of service to the solar customer, including a reasonable opportunity to earn a return. The tariff should also ensure that non-participating ratepayers are not unfairly paying costs created by customers enrolled in the SP Program and that those ratepayers are not receiving benefits from SP Program participants that are unfairly subsidized by the Green Power Program.

Second, the ideal solar tariff should fairly compensate the solar customer, through a credit, for the value that their solar generation brings to the utility system. Value-based analysis should be used to reveal the benefits that distributed solar generation brings to the utility system.

Third, the tariff should recover costs and give compensation credit for value independent of an incentive designed to overcome market failures. Incentives are a legitimate public policy tool, widely used in the electricity and other industries, to encourage certain kinds of market behavior. One justification for solar incentives is that they help overcome certain market failures such as lack of information and practical experience with the technology among homeowners, lenders, and others. Ideally, these incentives will be less necessary as the residential solar market matures. But incentive levels are not necessarily

connected to the value and costs of solar, and should be subject to independent, policy-based adjustments separate from value and cost recovery calculations.

Fourth, an ideal distributed solar tariff would operate as a complement to other electricity policy goals and objectives, including the goal of more efficient use of energy. Other goals that a solar tariff should complement include credit for performance, rather than just investment; encouragement of long-term performance of solar systems; reduction of long-term risks or generational cost shifting; and strong alignment with market signals.

Finally, an ideal solar tariff should be intuitively sound and administratively simple to implement and manage. Analytical inputs should be rationally related to the character of solar systems and the quantity and character of energy output associated with the technology. Inputs should also be simply calculated from information the utility already routinely produces.

Q. Please summarize your understanding of the Company's SP Program proposal.

A. The Company proposes to offer customers an alternative to the traditional net metering regime currently in place. The SP Program is essentially a 5-year behind-the-meter feed-in-tariff that pays customers for all solar generation as if they were operating a commercial business generation facility on their premises. The Company will charge customers for on-site usage at the applicable service rate and pay the customer $0.15 for each kWh of production from their solar systems. Customers are required to transfer all renewable energy credits ("RECs") to the Company as a condition of the tariff. The SCC Staff refers to the overall proposal as a "buy all/sell all" arrangement.

Q. Please summarize your understanding of the Company's net metering program.

A. The structure of the net metering approach is simple—customers are allowed to "net" their production of solar energy against their household energy consumption. This has often been described as "spinning the meter backwards"—a nod to the phenomena that local generation can actually cause mechanical meters to spin backwards when generation exceeds consumption. In the event that the customer produces excess energy during the netting period, the Company's approach, like several other net metering schemes in the United States, allows for a payment related to the utility's avoided cost, or Locational Marginal Price ("LMP"). This calculation of avoided costs is based on the idea that the utility is buying the excess generation at wholesale as is done with large Qualifying Facilities under the Federal Public Utility Regulatory Policy Act of 1978 ("PURPA").

If customers exercised a one-time-only option, they may also sell RECs at the Rate G, CR component value of $0.65/kWh. Customers who choose not to sell their RECs may keep them, or sell them where they can.

Q. Does net metering, or net energy metering, offer an ideal solar tariff formulation?

A. No, it does not. While net metering is a significant improvement over a utility doing nothing to enable or support distributed solar energy, it has several problems that should be considered and addressed in designing a demonstration tariff or program.

For example, traditional net metering assigns a retail value to local solar energy (at least up to the point of consumption during the netting period) that is

not necessarily representative of the true value of solar. In addition, there does not appear to be a cost-based reason to assign a different value to energy offset by consumption and energy that is excess to consumption during the netting period. I will discuss these issues in greater detail later in my testimony when I explain how Austin Energy developed its Value of Solar calculation.

Q. What are the significant differences between the Company's SP Program proposal and the Company's net metering program?

A. There are several key differences, including:

- The SP Program is proposed for a fixed term of five years, after which it may be extended. The net metering rate is not currently time limited.
- The SP Program proposal is limited to 3 MW, or about 0.018% of the Company's 2010 adjusted peak load. Net metering is limited to 1% of adjusted peak load, or about 165 MW.
- The SP Program proposal draws on the Green Power Program revenues for most of the funding for the proposed rate. The energy payment portion, or about $0.04 of the total $0.15/kWh payment rate for the SP Program, will be recovered through the fuel adjustment clause. Costs to the Company for net metering may be recovered through the RPS charge or the fuel adjustment charge.
- The net metering customer always receives credit up to the standard applicable retail rate, regardless of how that rate changes, up to the point of overall consumption during the netting period. That is, the value of solar under net metering is effectively deemed to be the value of regular retail

service, at least up to the point of consumption. Under the SP Program proposal, the total compensation rate is fixed for at least the five years of the demonstration program as a combination of payment and incentive, and for those five years, is set at $0.15/kWh. The SP Program proposal eliminates the "rate increase insurance" aspect of net metering—under net metering, the value of solar rises as rates rise.

- The customer who participates in the proposed SP Program must convey all RECs to the Company. Estimates of the value of these RECs are provided by the Hampton Roads Solar Group in comments filed Sept. 14, 2012, but not by the Company. Based on the comments of Hampton Roads Solar, the proposed $0.15/kWh rate appears to be about the same or less than the total value a customer would receive today under net metering if they sold their RECs on the market, or about $0.04 higher than the retail rate credit they would receive under net metering. Net metering customers may also sell their RECs to the Company, but this is not required.
- Under net metering, the LMP-derived payment rate is applied only to excess generation during the netting period. Under the Company SP Program proposal, the LMP-derived value is applied to all energy generated by the solar facility, though the Company's proposal suggested an adjustment for line losses that is not discussed in the net metering tariff.

Q. What do you think are the most positive aspects of the Company's proposal?

A. The Company's SP Program proposal does include several positive features that could improve the climate and opportunity for distributed solar development in

the Company's service territory. While these attributes bear mentioning, the proposed SP Program design is not the only or, in my opinion, best structure for accomplishing these results. The key positive attributes that I identified are:

- Value. The SP Program proposal correctly benchmarks a value for solar generation that is higher than both the LMP-derived value and the retail rate for regular electric service. However, the Company improperly assumes that most of this value, which accrues to all ratepayers, must be made up from non-ratepayer-funded incentives (i.e., Green Power Program funds).
- Administrative simplicity. The SP Program's structure is simple and should be easy to administer. Customers can understand the energy purchase price for the first five years easily.
- Efficiency price signal. The SP Program proposal is consistent with other efforts (e.g., inclining block or tiered rates) that could send an energy efficiency price signal to customers. Under the proposed structure, customers can maximize benefits by reducing consumption during periods of solar generation—the SP Program proposal decouples consumption from solar compensation.
- Time of use benefits. The SP Program proposal could create an added benefit for customers under certain time-of-use rate options. That is, to the extent that the rate encourages customers to increase net benefits by reducing consumption when the solar installation is generating electricity, the Company can strengthen the benefit by reducing consumption during peak pricing periods. Of course, the Company's SP Program proposal does not

share with customers the benefit of injecting energy into the grid at times of peak pricing, something that could be accomplished with a detailed valuation analysis.

Q. What do you think are the most negative aspects of the Company's proposal?

A. The Company's SP Program proposal contains a number of design flaws. Due to a lack of substantiation and analysis, it is unclear whether the Company addressed them in the preparation of the application. Based on the Company's filing, apparent problems include:

- Basis for valuation unclear. The most significant problem with the SP Program proposal is that it appears to be nearly devoid of any evidence of a relationship between the proposed payment and the actual value of solar energy generated by a customer at or near the point of use. This lack of disciplined evaluation almost certainly undervalues solar energy generation, dampens potential customer participation, and may give rise to a web of cross-subsidies including a subsidy from SP Program customers to the Company, from Green Power Program customers to SP Program customers, from Green Power Program customers to the Company and customers not participating in the Green Power Program, and from SP Program customers to non-SP Program customers.
- Investment uncertainty. The SP Program proposal makes it difficult for customers to evaluate the value and payback periods associated with investment in a solar system. This uncertainty stems primarily from the lack of a clear analytical framework for calculating the total compensation level for

solar generation. In addition, it is unknowable at this time whether the SP Program rate will be continued beyond the initial five-year term. The uncertainty significantly diminishes the extent to which customer participation in the SP Program truly indicates a customer perception of value. Finally, at its core, the SP Program essentially fixes the value of payment for RECs and any additional incentive. The marginal solar customer considering participation in the proposed SP Program is deciding whether to take the net metering rate and sell their RECs in the market, or take the SP Program rate and sell their RECs and energy to the Company for $0.15/kWh. So the critical evaluation that such a customer must make is whether the Company is offering a better price for RECs than would be available in the marketplace. Since the SP Program proposal locks in the net incentive, including REC value, at the difference between the retail rate and this $0.15 price, the customer faces an opportunity cost and investment uncertainty regarding potential increases in REC market value.

- Taxes. While I am not a tax expert and I am not offering a professional tax opinion, I am concerned that there could be adverse tax consequences for customers participating in the proposed SP Program. The Company does not address potential tax issues in the petition. Issues that merit more careful review and study regarding taxes include whether the solar customer is assuming a new role as an independent generation facility—in effect going "into business" as a solar generator. Other issues include whether the proposed approach impacts federal tax status and liability, whether the shift

from a net metering credit to a power purchase payment changes tax and accounting treatment of the flow of funds for the customer and the Company, and whether federal tax credit eligibility would be impacted through participation in the SP Program.

There are also questions regarding the impact, if any, of participation in the SP Program on local property tax benefits. Under Va. Code § 58.1-3661, certain solar investments are eligible for county, city or town property tax exemptions, at the discretion of the taxing body, as "[c]ertified solar energy equipment, facilities or devices." The statutory definition includes "any property, including real or personal property, equipment, facilities, or devices, certified by the local certifying authority to be designed and used primarily for the purpose of providing for the collection and use of incident solar energy for water heating, space heating or cooling or other application which would otherwise require a conventional source of energy such as petroleum products, natural gas, or electricity." (Emphasis added) This raises the question whether solar energy equipment, facilities or devices used to generate power sales to the Company qualify as "designed and used primarily to displace conventional energy," since the SP Program customer would still purchase all of their energy from the Company under the "buy all/sell all" structure. The Virginia Administrative Code, 13 VAC § 5-200-50, contains similar language and raises similar questions.

- Eroding benefits. The SP Program initially provides the benefit of a payment rate that is greater than the regular retail rate for electric service and an

implied value for RECs that is within the range of estimates for REC prices. However, because the proposed SP Program does not include an adjustment mechanism for increased rates or REC value, participating customers could see erosion in their value proposition over the life of the pilot. This potential erosion of value adds to the uncertainty for new solar investors, and might even lead to a higher premium than would be necessary with adjustment mechanisms. In fact, if rates and REC values declined during the pilot period, the Company could face a need to more heavily tax the Green Power Program to maintain the $0.15/kWh rate.

- Free ridership. The SP Program proposal appears to encourage free ridership from current net metering customers by allowing them to opt into the rate. For each customer that switches from net metering to the SP Program, the marginal demonstration value of the program decreases, and, more importantly, so does the net benefit in terms of additional solar investment in the service territory. As discussed above, for existing net metered customers, the SP Program proposal is a test of short-term value, not a demonstration of a mechanism for promoting solar investment.
- System design uncertainty. The uncertainty associated with what rate will apply when the SP Program proposal expires adds a level of complication to the burden that a solar installer faces in designing and estimating a system for a new solar customer. While a certain measure of uncertainty is always inherent in predicting prices and paybacks for energy-related investments, it is important to note that the proposal adds a requirement for contingent

valuation estimates likely to overwhelm many customers and add complexity to the solar system sales process.

- Green Power Program funding. Use of Green Power Program funds to pay an incentive may be a win-win solution, but only to the extent that an incentive is required above and beyond a fair compensation rate for the value of the solar energy generated by solar customers. The Company's proposal to pay the difference between the LMP-derived purchase price and the $0.15/kWh power payment rate with Green Power Program funds ignores many benefits that ratepayers would receive from increased distributed solar installations. As a result, Green Power Program participants may be subsidizing a benefit that actually accrues to the ratepayers, and should be paid for by the ratepayers. Unfortunately, the lack of analysis and substantiation in the SP Program proposal makes a precise determination impossible.
- Risk to the customer. In exchange for solar payment certainty during the SP Program demonstration period, the customer assumes two major risks: (1) that the premium over the retail rate is subject to erosion if the retail rate changes during the demonstration period, and (2) that the SP Program customer faces an opportunity cost if REC values increase during that period. The level of financial analysis necessary to fairly and accurately value this risk seems appropriate to a sophisticated, professional generation plant developer, but is likely to prove unacceptably complicated to residential customers without such experience and resources.

Q. In your opinion, is the Company's proposal reasonable?

A. Based on the lack of evidence and substantiation submitted by the Company, I conclude there is insufficient evidence and foundation to find the SP Program proposal reasonable. The Comments of the Hampton Road Solar group suggest that the Company's proposed $0.15/kWh rate may be at the very low end of a reasonable total rate for distributed solar based on market data, but there is no evidence that even this group's market-related anecdotal data accurately reflects the value of distributed solar to the Company and its ratepayers.

Q. In your opinion, does the Company's proposal promote solar energy within the meaning Chapter 771?

A. No. A common Webster's definition of "promote" is to advance. In my opinion, the broader context of Chapter 771 supports adding more non-polluting solar energy to the grid. The absence of any value analysis means that the program may be relying unnecessarily on Green Power Program funds, which would diminish the net additional clean energy impact of the two programs in combination. Moreover, to the extent that the SP Program simply results in existing net-metering customers becoming SP Program participants, then the SP Program is not additive to existing solar resources and there is no net "promotion" of renewable power. The SP Program essentially tests only the proposition of whether solar customers receiving value under net metering will chose to receive essentially the same or less value under the proposed SP Program structure, with unknown tax consequences. New solar customers face the uncertainty of whether the SP Program proposal would continue after the five year demonstration period and the complicating burden of calculating payback under

scenarios where the SP Program structure is in place for five years and then cancelled.

Recommendations for a Solar Purchase Program

Q. What alternatives and modifications do you propose for consideration regarding the Company's proposal?

A. Overall, I recommend that the Company restart its process of substantiating and shaping its SP Program and tariff price.

Q. What are your specific recommendations?

A. My specific recommendations are as follows:

The Company should develop an alternative tariff to traditional net metering that is based on the empirically established value of solar in the distribution grid—a value-based rate. Closing the value gap between the under-compensating LMP level and the true value that distributed solar brings to the grid requires analysis in order to substantiate the ultimate rate credited to customers, to compensate at a level that actually promotes non-polluting, greenhouse gas-reducing distributed solar generation, and to ultimately prioritize the development of distributed solar so as to maximize the benefits that the technology brings to the distribution system.

Second, the Company should work with its own experts and stakeholders to conduct and complete the analysis underpinning its SP Program proposal to evaluate important unanswered questions related to: the tax treatment associated with the SP Program proposal, whether the SP Program approach might be more appropriate for certain subclasses of distribution customers, how

to most efficiently use Green Power Program funds to promote additional solar generation, how to avoid unfair cross-subsidization among ratepayers and programs, how to create a prioritization strategy using benefits analysis for distributed solar deployment, and how to chart a course of research and demonstration to determine the magnitude of non-traditional values such as local economic development, growth in tax base, and others.

Third, in order to promote new solar generation, the Company should limit participation in the SP Program to customers installing new distributed solar energy generation in the service territory. The Company should reserve the decision about whether to make the new SP Program available to existing net metered customers after the initial five-year demonstration period.

Q. Please describe what you mean by a "value-based" rate.

A. A value-based distributed solar rate uses utility-specific data to calculate the value of solar energy to the utility and to its ratepayers. The approach calculates what a kilowatt-hour of solar energy generated at or near the point of consumption would be worth to the utility. It provides a benchmark of the value at which the utility would be economically indifferent to having the customer generate the energy or providing solar or solar-equivalent energy to the customer itself.

Q. What are the value components of a value-based distributed solar rate?

A. Value to the utility and its ratepayers for distributed solar energy accrues from the summation of a number of elements set forth below. This list is drawn extensively from a paper titled "Solar Power Generation in the U.S.: Too Expensive, or a

Bargain?" listed on Exhibit KRR-2 (references from the original omitted):

Transmission (wholesale) energy. Energy generated locally by solar systems is energy that does not need to be purchased on the wholesale markets at the LMP. This is more than the mean LMP because solar electricity naturally coincides with periods of high LMP. The utility should match system prices with solar output values to correctly adjust for the solar energy's value.

Transmission capacity. In essence, the peak load driver, the sun via heat waves and air conditioning demand, is also the fuel powering solar electric technologies. Because of this natural synergy, the solar technologies deliver hard-wired peak shaving capability for the locations/regions with the appropriate demand mix—peak loads driven by commercial/industrial air conditioning. This capability remains significant up to 30% capacity penetration, representing a deployment potential of nearly 375 GW in the U.S. Because of this demand/resource synergy, solar installations can deliver the equivalent of capacity, displacing the need to purchase this capacity elsewhere, *e.g.*, via demand response.

Distribution energy (loss savings). Distributed solar plants can be sited near the load within the distribution system—whether this system is radial or gridded—therefore, they can displace electrical losses incurred when energy transits from power plants to loads on distribution networks (this is in addition to transmission energy losses). This loss savings value is dependent upon the location and size of the solar resource relative to the load, and upon the specific characteristics of the distribution grid carrying power to the customer. The study led by Thomas

Hoff, titled "The Value of Distributed Photovoltaics to Austin Energy and the City of Austin," cited in Exhibit KRR-2, showed that loss savings were worth on average 5% to 10% of energy generation.

Distribution capacity. As with transmission capacity, distributed solar can deliver effective capacity at the feeder level when the feeder load is driven by industrial or commercial air conditioning, hence can reduce the wear and tear of the feeder's equipment (e.g., transformers), as well as defer upgrades, particularly when the concerned distribution system experiences growth. This distribution capacity value is highly dependent upon the feeder and location of the solar resource. Site-specific research shows that this value can vary from no value up to more than 3 cents per generated solar kWh.

Fuel price mitigation. Solar energy production does not depend on commodities (i.e., coal, uranium, natural gas) whose prices fluctuate on short-term scales and may escalate over the long term. Solar energy production represents a very low risk investment that will probably pan out well beyond a standard 30-year business cycle. In the study conducted for Austin Energy, Mr. Hoff quantified the value of solar generation as a hedge against fluctuating natural gas prices. That analysis showed that the hedge value of a low risk generator such as solar can be assessed from two key inputs: (1) the price of the displaced finite energy over the life of the solar system as reflected by futures contracts, and (2) a risk-free discount rate for each year of system operation. Focusing on the short term gas futures market (less than 5 years) of relevance to a utility company such as Austin Energy, and taking a stable outlook on gas

prices beyond this horizon, Hoff quantified the hedged value of solar at roughly 50% of current generation cost, assuming that wholesale energy cost is representative of generation cost.

There are additional benefits that accrue to the ratepayers, shareholders, and society at large from distributed solar generation. These include grid security enhancement, externalized environmental and health costs, other long-term societal values like fuel price hedge benefits in the term beyond typical utility valuation, and economic growth value. While these benefits can be significant, they are also more difficult to quantify. For that reason, I do not recommend their inclusion in a solar valuation study at this time.

Q. You have outlined many of the benefits associated with distributed solar generation. But are there also costs that should be considered?

A. Yes. It is important to recognize that there is also a cost associated with the deployment of solar generation on the power grid, which accrues against the utility and/or its ratepayers. This cost represents the infrastructural and operational expense that will be necessary to manage the flow of intermittent solar energy generation while continuing to reliably meet demand. A recent study showed that in much of the U.S., this cost is negligible at low penetration and remains manageable for a solar capacity penetration of 30%.

Q. Have any studies quantified the value of solar in the Company's service territory?

A. I am not aware of any value of solar studies in Virginia. However, Richard Perez led a team that published a study titled "The Value of Distributed Solar Electric Generation to New Jersey and Pennsylvania" for the Mid-Atlantic and

Pennsylvania Solar Energy Industries Association. That study modeled the value of a 15% peak load penetration of distributed solar electric generation at seven locations in the region. The model addressed the following values:

- Market Price Reduction
- Environmental Value
- Transmission and Distribution Capacity Value
- Fuel Price Hedge Value
- Generation Capacity Value

The study found that the total value of distributed solar ranged from $0.256 to $0.318 per kWh. A citation and link to the complete study is listed on Exhibit KRR-2 and is offered as an indicator of how a comprehensive distributed solar valuation study can and should be conducted.

Q. Can the values you describe be used in constructing a distributed solar rate?

A. Yes. Austin Energy used its value of solar analysis as the basis for a new residential solar rate. The rate was approved by the Austin City Council in June 2012 and went into effect for existing and future residential solar customers in October 2012. I have listed some key documents related to Austin Energy's development of its Value of Solar tariff in Exhibit KRR-2. These include a comprehensive study of benefits conducted in 2006, the description of the rate contained in Austin Energy's recent rate review, the Austin Energy Residential Solar Rate from its rate filing package, and an article that I wrote with others describing the Value of Solar rate and adjustments made to the original valuation to account for ERCOT nodal market prices.

Q. Please describe the Austin Energy "Value of Solar" Tariff.

A. When I served as vice president of Distributed Energy Services at Austin Energy, I took the initiative to fundamentally redesign the way net metering was structured, working with my staff to create a new "Value of Solar" residential solar rate. The tariff design has two basic components. First, the tariff relies on a value of solar calculation that is updated annually and designed to reveal the value to the utility of a unit of generated solar energy. This is essentially the price at which the utility is neutral to the solar energy, and is conservatively calculated. Second, the tariff reconfigures the netting process to ensure that the utility recovers its full cost of serving the solar customer before any credit for solar generation is applied. These two steps result in a residential solar rate that is more fair to the solar customer, the utility, and other utility customers. The Value of Solar rate is administratively simple, aligns with other policy objectives, and decouples solar energy compensation from both consumption and incentives.

Q. Please continue.

A. As used by Austin Energy, the Value of Solar calculation generates a 30-year levelized value of solar in cents per kilowatt/hour, based on five components. These value components are energy, capacity, transmission capacity, transmission and distribution losses, and environmental value. Energy and capacity value are heavily influenced by natural gas prices and make up the bulk of the value. Environmental value is derived from the price premium for Austin Energy's highly successful GreenChoice® renewable energy product offering. Prior to adapting the calculation as a foundation for the residential solar rate,

Austin Energy also added a value derived from nodal market prices, matching 15-minute nodal price data with the average daily output levels of solar energy. In the end, the value of solar today is about three cents higher than the average residential energy rate.

The goal of the calculation process is to estimate the total value of a unit of solar energy generated in the distribution grid, at or very near the point of consumption. Put another way, it is the conservative estimate of the cost that the utility would face in seeking to fill an order for a unit of energy with the same character as that generated from a local solar facility. That is, the utility would have to buy some energy, which would include some capacity value. The energy would have to be transmitted, with losses, over a delivery system, and pay transmission costs and system charges as well. Finally, the energy's environmental impacts would have to be offset or "greened" with some kind of renewable energy credit or certificate.

Q. Why do you say that this value was "conservatively calculated"?

A. The calculation is conservative for several reasons. It does not include so-called externality values related to local economic benefits, local environmental benefits or other valuable attributes of distributed solar. The levelized value is recalculated annually, so as to reflect current utility costs and prevent overpayments when system prices fall.

Q. How was the rate, once calculated, incorporated into a tariff?

A. Once the Austin Energy team decided that the Value of Solar rate was an appropriate foundation for a residential solar rate, the question that remained was

how to incorporate it in a tariff. This was the point at which the "ideal" characteristics for a solar rate came into play. First, it was determined that the value would be recalculated and reset in conjunction with the annual fuel adjustment charge calculation. The update calculation performed for the first iteration of the rate was prepared in April 2011 and is referenced at Exhibit KRR-2.

Second, in order to account for utility fixed and variable cost recovery requirements that remain with solar customers, the billing process charges every customer for total energy consumption (whether offset by solar production or not) at their premises using the applicable existing residential service rates. A credit is then applied for units of solar energy produced, at the Value of Solar rate. Excess credit is carried forward each month until the end of the year, when any remaining balance is erased.

Q. What do you see as some of the benefits of Austin Energy's approach?

A. Under the new rate, customers have a strong incentive to use energy efficiently in order to maximize the economic value they receive—making more on-peak energy available to the utility. Because the value is recalculated each year, both the customer and the utility are treated fairly as solar and general system costs change. In the event that the system fails to generate as expected, the netting methodology ensures that the utility always recovers its costs of serving the customer. The calculation and netting approach eliminates the argument that other customers subsidize solar, and the Value of Solar credit ensures that solar customers are not unfairly asked to subsidize the utility.

To the extent that the Value of Solar credit to the customer creates a loss of

revenue to the utility, it would be fair to include that incremental loss in a power system cost recovery factor or fuel adjustment factor, as appropriate.

Q. Why did Austin Energy undertake the development of a new Value of Solar rate?

A. The main reason for developing a Value of Solar rate for a new residential solar was to provide an alternative to net metering that would continue to promote solar energy development while being fair to both participating and non-participating customers as well as protecting the financial concerns of the utility. As Austin Energy reached the point where it had some 1,000 solar installations in its service territory, certain problems with traditional net energy metering began to appear or loom on the near horizon. At the same time, the incentive budgets were increasingly strained by the growth in demand for solar from customers.

Q. Has anyone besides Austin Energy and the Mid-Atlantic and Pennsylvania Solar Energy Industries Association conducted a value of solar analysis?

A. Yes. Based on a review conducted by the Vote Solar Initiative, there have been nine published value of solar studies. The studies share several key features and some differences, set out in the table at Exhibit KRR-3.

Q. Should Dominion Virginia Power develop a value of solar rate?

A. It is my opinion that the Company should develop a value of solar rate as an alternative to its net metering tariff. As already described, the valuation effort serves as an empirically derived value-based framework for a distributed solar tariff.

Q. How should the Company proceed in developing a value of solar calculation tool and rate?

A. In developing a value of solar calculation tool and rate, I recommend that the Company follow an approach similar to what was used at Austin Energy. First, the Company should conduct the actual valuation analysis. Second, the Company should establish a 30-year levelized value of solar as the compensation credit for solar energy generation by a distributed solar customer. Third, the billing and crediting system should be implemented much as the Company has proposed in this proceeding—by charging the customer for total consumption according to the tariff that applies to the customer, and then crediting the same bill at the value of solar rate for each kWh of generation. It is important to note that this approach remains a net metering calculation, and is not a "buy all/sell all" power purchase agreement.

Q. How should the Company adjust the value of solar credit amount?

A. I recommend that the Company refresh and reset its value of solar credit rate each year in conjunction with the routine fuel adjustment factor reconciliation process. The value of solar calculation measures the specific value of solar generation to the Company and uses many similar inputs as the fuel adjustment calculation process. In addition, using the 30-year levelized rate, adjusted annually, the Company can avoid the problem of fixed payment schemes that the rate is either too high or too low due to changes in value fundamentals.

Q. Does this conclude your testimony?

A. Yes.

DIRECT TESTIMONY
OF
KARL R. RÁBAGO, RÁBAGO ENERGY LLC
ON BEHALF OF
ENVIRONMENTAL RESPONDENTS
BEFORE THE
STATE CORPORATION COMMISSION OF VIRGINIA
CASE NO. PUE-2012-00064

Exhibit KRR-1

Resume for Karl R. Rábago

Karl R. Rábago

9512 Vera Cruz Road, Austin, Texas 78737

t: +1.512.968.7543 e: rabago@me.com

Summary

Nationally recognized electricity industry leader. Experienced as a public utility regulatory commissioner, utility executive leader and manager, research and development program manager, educator, business builder, federal executive, corporate sustainability leader, consultant, and advocate. Expert in development of new energy markets in renewables, green power, and tradable credits, and in helping new market entrants shape new products and services. Highly proficient in advising, managing and interacting with government agencies and committees, the media, citizen groups, and business associations. Successful track record of working with US Congress, state legislatures, governors, regulators, city councils, business leaders, researchers, academia, and community groups. National and international contacts through experience with Austin Energy, AES Corporation, US Department of Energy, Texas Public Utility Commission, Jicarilla Apache Tribal Utility Authority, Cargill Dow LLC (now NatureWorks, LLC), Rocky Mountain Institute, CH2M HILL, Houston Advanced Research Center, and Environmental Defense Fund. Environmental law attorney with twenty years experience working with diverse stakeholder communities in guiding electricity policy and regulation, emerging energy markets development, clean energy technology development, electric utility restructuring, smart grid development, and the implementation of sustainability principles. Nationally recognized speaker on energy, environment and sustainable development matters. Directly managed staff as large as 250; responsible for operations of research facilities with staff in excess of 600. Developed and managed budgets in excess of $300 million. Law teaching experience at University of Houston Law Center and U.S. Military Academy. Trial experience as a Judge Advocate. Post doctorate degrees in environmental and military law. Military veteran.

Employment

RÁBAGO ENERGY LLC

Principal: July 2012--Present. Solo consulting practice dedicated to providing strategic advice and support to businesses and organizations in the clean and advanced energy sectors. Services include distributed energy business and product development, energy policy development and advocacy, renewable energy product development and market development, strategic and corporate sustainability planning, and government and regulatory affairs support. Additional activities:

- Chairman of the Board, Center for Resource Solutions (1997-present). CRS is a not-for-profit organization based at the Presidio in California. CRS developed and manages the Green-e Renewable Electricity Brand, a nationally and internationally recognized branding program for green power and green pricing products and programs. Past chair of the Green-e Governance Board (formerly the Green Power Board).

AUSTIN ENERGY – THE CITY OF AUSTIN, TEXAS

Vice President, Distributed Energy Services: April 2009—June 2012. Executive in 8th largest public power electric utility serving more than one million people in the central Texas region. Responsible for management and oversight of energy efficiency and conservation programs, low-income weatherization, distributed solar and other renewable energy technologies, green buildings program, key accounts relationships, electric vehicle infrastructure, and market research and product development. Executive sponsor of Austin Energy's participation in an innovative federally-funded smart grid demonstration project led by the Pecan Street Project, an initiative aimed at developing and implementing a smart grid infrastructure in the City of Austin. Led teams that successfully secured over $39 million in federal stimulus funds for energy efficiency, smart grid, and advanced electric transportation initiatives in just one year. Additional activities included:

- Director, Renewable Energy Markets Association. REMA is a trade association dedicated to maintaining and strengthening renewable energy markets in the United States.

- Membership on Pedernales Electric Cooperative Member Advisory Board. Invited by the Board of Directors to sit on first-ever board to provide formal input and guidance on energy efficiency and renewable energy issues for the nation's largest electric cooperative.

THE AES CORPORATION

Director, Government & Regulatory Affairs: June 2006—December 2008. Government and regulatory affairs manager for AES Wind Generation, one of the largest wind companies in the country. Manage a portfolio of regulatory and legislative initiatives to support wind energy market development in Texas, across the United States, and in many international markets. Active in national policy and the wind industry through work with the American Wind Energy Association as a participant on the organization's leadership council. Also served as Managing Director, Standards and Practices, for Greenhouse Gas Services, LLC, a GE and AES venture committed to generating and marketing greenhouse gas credits to the U.S. voluntary market. Authored and implemented a standard of practice based on ISO 14064 and industry best practices. Commissioned the development of a suite of methodologies and tools for various greenhouse gas credit-producing technologies. Also served as Director, Global Regulatory Affairs, providing regulatory support and group management to AES's international electric utility operations on five continents. Additional activities included:

- Member of the Board and past Chair, Jicarilla Apache Nation Utility Authority (1998 to 2008). Located in New Mexico, the JAUA is an independent utility developing profitable and autonomous utility services that provides natural gas, water utility services, low income housing, and energy planning for the Nation. Authored renewable energy and energy efficiency strategic plan.

HOUSTON ADVANCED RESEARCH CENTER

Group Director, Energy and Buildings Solutions: December 2003—May 2006. Active participant in policy development and regulatory implementation in Texas, the Southwest, and national venues. Responsible for developing, maintaining and expanding upon technology development, application, and commercialization support programmatic activities, including the Center for Fuel Cell Research and Applications, an industry-driven testing and evaluation center for near-commercial fuel cell generators; the Gulf Coast Combined Heat and Power Application Center, a state and federally funded initiative; and the High Performance Green Buildings Practice, a consulting and outreach initiative. Secured funding for major new initiative in carbon nanotechnology applications in the energy sector. Developed and launched new and integrated program activities relating to hydrogen energy technologies, combined heat and power, distributed energy resources, renewable energy, energy efficiency, green buildings, and regional clean energy development. Frequently engaged with policy, regulatory, and market leaders in the region and internationally. The Houston Advanced Research Center (HARC) is a mission-driven not-for-profit contract research organization based in The Woodlands, Texas. Additional activities:

- President, Texas Renewable Energy Industries Association. As elected president of the statewide business association, leader and manager of successful efforts to secure and implement significant expansion of the state's renewable portfolio standard as well as other policy, regulatory, and market development activities.
- Director, Southwest Biofuels Initiative. Established the Initiative acts as an umbrella structure for a number of biofuels related projects, including emissions evaluation for a stationary biodiesel pilot project, feedstock development, and others.
- Member, Committee to Study the Environmental Impacts of Windpower, National Academies of Science National Research Council. The Committee was chartered by Congress and the Council on Environmental Quality to assess the impacts of wind power on the environment.
- Advisory Board Member, Environmental & Energy Law & Policy Journal, University of Houston Law Center.

CARGILL DOW LLC (NOW NATUREWORKS, LLC)

Sustainability Alliances Leader: April 2002—December 2003. Founded in 1997, NatureWorks, LLC is based in Minnetonka, Minnesota. Integrated sustainability principles into all aspects of a ground-breaking biobased polymer manufacturing venture. Responsible for maintaining, enhancing and building relationships with stakeholders in the worldwide sustainability community, as well as managing corporate and external sustainability initiatives. NatureWorks is the first company to offer its customers a family of polymers (polylactide – "PLA") derived entirely from annually renewable resources with the cost and performance necessary to compete with packaging materials and traditional fibers; now marketed under the brand name "Ingeo."

- Successfully completed Minnesota Management Institute at University of Minnesota Carlson School of Management, an alternative to an executive MBA program that surveyed fundamentals and new developments in finance, accounting, operations management, strategic planning, and human resource management.

ROCKY MOUNTAIN INSTITUTE

Managing Director/Principal: October 1999–April 2002. In two years, co-led the team and grew annual revenues from approximately $300,000 to more than $2 million in annual grant and consulting income. Co-authored "Small Is Profitable," a comprehensive analysis of the benefits of distributed energy resources. Worked to increase market opportunities for clean and distributed energy resources through consulting, research, and publication activities. Provided consulting and advisory services to help business and government clients achieve sustainability through application and incorporation of Natural Capitalism principles. Frequent appearance in media at international, national, regional and local levels. RMI is an independent, non-profit research and educational foundation. Joined the organization to develop the Natural Capitalism research and consulting practice at RMI.

- President of the Board, Texas Ratepayers Organization to Save Energy. Texas R.O.S.E. is a non-profit organization advocating low-income consumer issues and energy efficiency programs.
- Co-Founder and Chair of the Advisory Board, Renewable Energy Policy Project-Center for Renewable Energy and Sustainable Technology. REPP-CREST was a national non-profit research and internet services organization.

CH2M HILL

Vice President, Energy, Environment and Systems Group: July 1998–August 1999. Responsible for providing consulting services to a wide range of energy-related businesses and organizations, and for creating new business opportunities in the energy industry for an established engineering and consulting firm. Completed comprehensive electric utility restructuring studies for the states of Colorado and Alaska.

PLANERGY

Vice President, New Energy Markets: January 1998–July 1998. Responsible for developing and managing new business opportunities for the energy services market. Provided consulting and advisory services to utility and energy service companies.

ENVIRONMENTAL DEFENSE FUND

Energy Program Manager: March 1996–January 1998. Managed renewable energy, energy efficiency, and electric utility restructuring programs for a not-for-profit environmental group with a staff of 160 and over 300,000 members. Led regulatory intervention activities in Texas and California. In Texas, played a key role in crafting Deliberative Polling processes, which in turn led to electric utility restructuring legislation and the state's Renewable Portfolio Standard. Initiated and managed nationwide collaborative activities aimed at increasing use of renewable energy and energy efficiency technologies in the electric utility industry, including the Green-e Certification Program, Power Scorecard, and others. Participated in national environmental and energy advocacy networks, including the Energy Advocates Network, the National Wind

Coordinating Committee, the NCSL Advisory Committee on Energy, and the PV-COMPACT Coordinating Council. Frequently appeared before the Texas Legislature, Austin City Council, and regulatory commissions on electric restructuring issues.

UNITED STATES DEPARTMENT OF ENERGY

Deputy Assistant Secretary, Utility Technologies: January 1995–March 1996. Manager of the Department's programs in renewable energy technologies and systems, electric energy systems, energy efficiency, and integrated resource planning. Supervised technology research, development and deployment activities in photovoltaics, wind energy, geothermal energy, solar thermal energy, biomass energy, high-temperature superconductivity, transmission and distribution, hydrogen, and electric and magnetic fields. Developed, coordinated, and advised on legislation, policy, and renewable energy technology development within the Department, among other agencies, and with Congress. Managed, coordinated, and developed international agreements for cooperative activities in renewable energy and utility sector policy, regulation, and market development between the Department and counterpart foreign national entities. Established and enhanced partnerships with stakeholder groups, including technology firms, electric utility companies, state and local governments, and associations. Supervised development and deployment support activities at national laboratories. Developed, advocated and managed a Congressional budget appropriation of approximately $300 million.

STATE OF TEXAS

Commissioner, Public Utility Commission of Texas. May 1992–December 1994. Appointed by Governor Ann W. Richards. Regulated electric and telephone utilities in Texas. Laid the groundwork for legislative and regulatory adoption of integrated resource planning, electric utility restructuring, and significantly increased use of renewable energy and energy efficiency resources. Appointed by Governor Richards to co-chair and organize the Texas Sustainable Energy Development Council, a public/private council that crafted a blueprint for Texas' development of renewable energy, energy efficiency, and other sustainable energy resources. Served as Vice-Chair of the National Association of Regulatory Utility Commissioners (NARUC) Committee on Energy Conservation. Member and co-creator of the Photovoltaic Collaborative Market Project to Accelerate Commercial Technology (PV-COMPACT), a nationwide program to develop domestic markets for photovoltaics. Member, Southern States Energy Board Integrated Resource Planning Task Force. Member of the University of Houston Environmental Institute Board of Advisors.

LAW TEACHING

Associate Professor of Law: University of Houston Law Center, 1990–1992. Full time, tenure track member of faculty. Courses taught: Criminal Law, Environmental Law, Criminal Procedure, Environmental Crimes Seminar, Wildlife Protection Law. Provided *pro bono* legal services in administrative proceedings and filings at the Texas Public Utility Commission. Launched a student clinical effort that reviewed and made recommendations on utility energy efficiency program plans.

Assistant Professor: United States Military Academy, West Point, New York, 1988–1990. Member of the faculty in the Department of Law. Honorably discharged in August 1990, as Major in the Regular Army. Courses taught: Constitutional Law, Military Law, and Environmental Law Seminar. Greatly expanded the environmental law curriculum and laid foundation for the concentration program in law. While carrying a full time teaching load, earned a Master of Laws degree in Environmental Law. Established a program for subsequent environmental law professors to obtain an LL.M. prior to joining the faculty.

LITIGATION

Trial Defense Attorney and Prosecutor, U.S. Army Judge Advocate General's Corps, Fort Polk, Louisiana, January 1985–July 1987. Assigned to Trial Defense Service and Office of the Staff Judge Advocate. Prosecuted and defended over 150 felony courts-martial. As prosecutor, served as legal officer for two brigade-sized units (approximately 5,000 soldiers), advising commanders on appropriate judicial, non-judicial, separation, and other actions. Pioneered use of psychiatric and scientific testimony in administrative and judicial proceedings.

NON-LEGAL MILITARY SERVICE

Armored Cavalry Officer, 2d Squadron 9th Armored Cavalry, Fort Stewart, Georgia, May 1978–August 1981. Served as Logistics Staff Officer (S-4). Managed budget, supplies, fuel, ammunition, and other support for an Armored Cavalry Squadron. Served as Support Platoon Leader for the Squadron (logistical support), and as line Platoon Leader in an Armored Cavalry Troop. Graduate of Airborne and Ranger Schools. Special training in Air Mobilization Planning and Nuclear, Biological and Chemical Warfare.

Formal Education

LL.M., Environmental Law, Pace University School of Law, 1990: Curriculum designed to provide breadth and depth in study of theoretical and practical aspects of environmental law. Courses included: International and Comparative Environmental Law, Conservation Law, Land Use Law, Seminar in Electric Utility Regulation, Scientific and Technical Issues Affecting Environmental Law, Environmental Regulation of Real Estate, Hazardous Wastes Law. Individual research with Hudson Riverkeeper Fund, Garrison, New York.

LL.M., Military Law, U.S. Army Judge Advocate General's School, 1988: Curriculum designed to prepare Judge Advocates for senior level staff service. Courses included: Administrative Law, Defensive Federal Litigation, Government Information Practices, Advanced Federal Litigation, Federal Tort Claims Act Seminar, Legal Writing and Communications, Comparative International Law.

J.D. with Honors, University of Texas School of Law, 1984: Attended law school under the U.S. Army Funded Legal Education Program, a fully funded scholarship awarded to 25 or fewer officers each year. Served as Editor-in-Chief (1983–84); Articles Editor (1982–83); Member (1982) of the Review of Litigation. Moot Court, Mock Trial, Board of Advocates. Summer internship at Staff Judge Advocate's offices. Prosecuted first cases prior to entering law school.

B.B.A., Business Management, Texas A&M University, 1977: ROTC Scholarship (3–yr). Member: Corps of Cadets, Parson's Mounted Cavalry, Wings & Sabers Scholarship Society, Rudder's Rangers, Town Hall Society, Freshman Honor Society, Alpha Phi Omega service fraternity.

Karl R. Rábago

Selected Publications

"A Review of Barriers to Biofuels Market Development in the United States," 2 Environmental & Energy Law & Policy Journal 179 (2008).

"A Strategy for Developing Stationary Biodiesel Generation," Cumberland Law Review, Vol. 36, p.461 (2006).

"Evaluating Fuel Cell Performance through Industry Collaboration," co-author, Fuel Cell Magazine (2005).

"Applications of Life Cycle Assessment to NatureWorks™ Polylactide (PLA) Production," co-author, Polymer Degradation and Stability 80 (2003) 403-419.

"An Energy Resource Investment Strategy for the City of San Francisco: Scenario Analysis of Alternative Electric Resource Options," contributing author, Prepared for the San Francisco Public Utilities Commission, Rocky Mountain Institute (2002).

"Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size," co-author, Rocky Mountain Institute (2002).

"Socio-Economic and Legal Issues Related to an Evaluation of the Regulatory Structure of the Retail Electric Industry in the State of Colorado," with Thomas E. Feiler, Colorado Public Utilities Commission and Colorado Electricity Advisory Panel (April 1, 1999).

"Study of Electric Utility Restructuring in Alaska," with Thomas E. Feiler, Legislative Joint Committee on electric Restructuring and the Alaska Public Utilities Commission (April 1, 1999).

"New Markets and New Opportunities: Competition in the Electric Industry Opens the Way for Renewables and Empowers Customers," EEBA Excellence (Journal of the Energy Efficient Building Association) (Summer 1998).

"Building a Better Future: Why Public Support for Renewable Energy Makes Sense," Spectrum: The Journal of State Government (Spring 1998).

"Preserving the Integrity of Green Markets," Solar Today (May/June 1998).

"The Green-e Program: An Opportunity for Customers," with Ryan Wiser and Jan Hamrin, Electricity Journal, Vol. 11, No. 1 (January/February 1998).

"Being Virtual: Beyond Restructuring and How We Get There," Proceedings of the First Symposium on the Virtual Utility, Klewer Press (1997).

"Information Technology," Public Utilities Fortnightly (March 15, 1996).

"Better Decisions with Better Information: The Promise of GIS," with James P. Spiers, Public Utilities Fortnightly (November 1, 1993).

"The Regulatory Environment for Utility Energy Efficiency Programs," Proceedings of the Meeting on the Efficient Use of Electric Energy, Inter-American Development Bank (May 1993).

"An Alternative Framework for Low-Income Electric Ratepayer Services," with Danielle Jaussaud and Stephen Benenson, Proceedings of the Fourth National Conference on Integrated Resource Planning, National Association of Regulatory Utility Commissioners (September 1992).

"What Comes Out Must Go In: The Federal Non-Regulation of Cooling Water Intakes Under Section 316 of the Clean Water Act," Harvard Environmental Law Review, Vol. 16, p. 429 (1992).

"Least Cost Electricity for Texas," State Bar of Texas Environmental Law Journal, Vol. 22, p. 93 (1992).

"Environmental Costs of Electricity," Pace University School of Law, Contributor–Impingement and Entrainment Impacts, Oceana Publications, Inc. (1990).

DIRECT TESTIMONY
OF
KARL R. RÁBAGO, RÁBAGO ENERGY LLC
ON BEHALF OF
ENVIRONMENTAL RESPONDENTS
BEFORE THE
STATE CORPORATION COMMISSION OF VIRGINIA
CASE NO. PUE-2012-00064

Exhibit KRR-2

List of References Cited and Reviewed

Virginia Statutes, etc.

Code of Virginia § 58.1-3661. Certified solar energy equipment, facilities or devices and certified recycling equipment, facilities or devices.

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Virginia Administrative Code 13 VAC 5-200-50

http://_lis.virginia.gov/cgi-bin/legp604.exe?000+reg+13VAC5-200-50

Dominion Virginia Electric & Power

Dominion Green Power Program

https://www.dom.com/dominion-virginia-power/customer-service/energy-conservation/green-power.jsp

Dominion Virginia Electric & Power Company Rider G – Renewable Energy (Green Power) Program

https://www.dom.com/dominion-virginia-power/customer-service/rates-and-tariffs/pdf/varidg.pdf

Dominion Virginia Electric & Power Company - Terms and Conditions for the Provision of Electric Service – Net Metering (§ XXV)

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http://mseia.net/site/wp-content/uploads/2012/05/Pressreleaseonstudy.Nov2012.pdf

Perez, et al., "Solar Power Generation in the US: Too Expensive, or a Bargain?"

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Austin Energy Solar Valuation Information

Austin Energy, "The Value of Distributed Photovoltaics to Austin Energy and the City of Austin"

http://www.cleanpower.com/wp-content/uploads/034_PV_ValueReportAustinEnergy.pdf

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http://www.austinenergy.com/energy%20efficiency/Programs/Rebates/Solar%20Rebates/proposedValueSolarRate.pdf

Austin Energy, Residential Solar Rate (see Page 4)

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Rábago, et al., "Designing Austin Energy's Solar Tariff Using a Distributed PV Value Calculator"

http://www.cleanpower.com/wp-content/uploads/090_DesigningAustinEnergysSolarTariff.pdf

DIRECT TESTIMONY
OF
KARL R. RÁBAGO, RÁBAGO ENERGY LLC
ON BEHALF OF
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Exhibit KRR-3

Table of Value of Solar Studies

DE Valuation Study (Source: The Vote Solar Initiative, Boulder, CO)

Study	Test perspective	Generation analyzed (gross output or exported energy only)	Costs Analyzed		Benefits Analyzed									Study Result	Source for Study
			Net metering bill credits	Program admin costs	Avoided energy purchases	Avoided capacity purchases	Avoided T&D line losses	Avoided T&D investments / O&M	Environ. benefits	Natural gas price hedge	Avoided RPS purchases	Ancillary services and VAR support	Calculation of net cost to non-participants		
Solar ABCs 2012 (generalized methodology)	Utility/non-participating ratepayers	Exported energy only	X	X	X	X	X	X	X	X	X	X	N/A	N/A	http://www.solarabcs.org/about/publications/reports/value-impact/pdfs/valueimpact_full.pdf
E3 (for CA CPUC, 2010)	Utility/non-participating ratepayers	Exported energy only	X	X	X	X	X	X	X		X	X	Yes	The report estimates that the average net cost of NEM is $0.12 per kilowatt-hour (kWh)-exported. The report estimates that on a lifecycle basis, all PV generation on NEM tariffs (156 megawatts (MW) installed through 2008) will result in a net present value cost to ratepayers of approximately $230 million over the next 20 years, or approximately $20 million per year on an annualized basis. The total net cost of NEM is less than one-tenth of one percent of total utility revenue. NEM as a policy is one small part of the utility's demand side efforts, which overall represent 7 percent of the average residential bill and provide a net savings to ratepayers.	http://www.cpuc.ca.gov/NR/rdonlyres/0F42...E3AD512D8882/0/nem_combined.pdf
Crossborder (update to E3 study, 2012 - residential closer)	Utility/non-participating ratepayers	Exported energy only	X	X	X	X	X	X	X		X	X	Yes	This study focused on updating the results from the CPUC E3 2010 NEM evaluation. The 1st segment of the study focused on residential customer classes. The report found that on average across the three large CA IOUs, NEM does not impose costs, and in fact creates a small net benefit, for non-participating residential ratepayers. Residential NEM customers in PG&E's territory under today's increasing block rates impose a small cost on other ratepayers ($0.007/kWh), as a result of PG&E's relatively higher upper tier rates and lower avoided costs. Due to rate design changes since 2010, in the PG&E residential market these net costs per kWh exported have been reduced to one-seventh the level calculated in the NEM cost/benefit study that the CPUC commissioned in 2009. However, this small cost is offset by the net benefits in the SCE ($0.035/kWh) and SDG&E ($0.035/kWh) residential markets, where upper tier rates are lower and the costs avoided by NEM generation are higher. Overall, assuming no changes in rate design, the net annual benefits of NEM for the non-participating residential customers of the IOUs will be $3 million per year when the current 5% limit on the capacity of NEM systems is reached.	http://votesolar.org/wp-content/uploads/2012/10/Evaluating-the-Benefits-and-Costs-of-Residential-Net-Energy-Metering-in-California-final-with-appendices.pdf
Austin Energy (Clean Power Research, 2006 and updated in 2012)	Utility/non-participating ratepayers	Gross output	N/A	N/A	X	X	X	X	X	X			did not calculate	The 2012 updated study showed that distributed solar energy on a levelized basis represents $0.128/kWh of value to Austin Energy.	http://www.cleanpower.com/wp-content/uploads/ORI_DesigningAustinEnergySolarTariff.pdf
APS (R.W. Beck, 2008)	Utility/non-participating ratepayers	Gross output	N/A	N/A	X	X	X	X				X	did not calculate	The conclusion of the study was that DE deployment produces between $0.79 to $0.141 of value for each kilowatt hour of DE energy added to APS's grid. Much of the potential annual saving from solar DE production resulted from APS avoiding the need to produce that same energy from conventional sources. Other benefits, or value segments studied included the avoided costs associated with fixed operation and maintenance savings, generation savings, and transmission and distribution savings.	http://www.aps.com/_files/solarRenewable/OtherEnOppImpactsStudy.pdf
NV Energy (Navigant Consulting, 2010)	Utility/non-participating ratepayers	economic impact of DG on NV Energy's system and its ratepayers	(the study looked at system protection costs, voltage regulation costs, short circuits upgrades, and net revenue shift from net metering)		attempted to calculate	attempted to calculate	attempted to calculate	did not calculate	attempted to calculate	did not calculate	did not calculate	did not calculate		Navigant's study focused on evaluating the technical and economic impacts of DG on NV Energy's system and its ratepayers. This study does not address the cost, economics or value of DG from the DG owner's perspective. Net Cost to NV Energy Ratepayers was estimated to be $75/MWh in 2011, $121/MWh in 2015, and $141/MWh in 2020.	http://www.leg.state.nv.us/Session/76th2011/Exhibits/Senate/SCL/SCL291F.pdf
Perez (for NYC area, 2011)	Utility/non-participating ratepayers AND state/society	Gross output	N/A	N/A	X	X	X	X	X	X		X	did not calculate	Results for the state of New York suggest that solar electric installations deliver between 15 to 40 cents per kWh to ratepayers and taxpayers.	http://solar.gmu.edu/Research/EnergyPolicy_SolarPowerInstalls_Perez-Zweibel-Hoff.pdf
Perez (for NJ and PA, 2012)	Utility/non-participating ratepayers AND state/society	Gross output	N/A	N/A	X	X	X	X	X			X	calculated additional cost incurred to accept variable solar generation onto the grid	The study found that solar power delivers a total levelized value ranging from $256 to $318 per MWh (25.6 cents to 31.8 cents per kWh). However, this includes a value for Economic Development Value (averaging $44 per MWh).	http://nassis.net/site/wp-content/uploads/2012/09/MSEIA-Final-Benefits-of-Solar-Report-2012-11-01.pdf
NYSERDA/NYDPS (2012)	Utility/non-participating ratepayers	Gross output	N/A	N/A	X	X	X	X	X		X		N/A	The Low Cost scenario had a net benefit while the High Cost scenario had a net cost four times as high as the Base Case. In the Base Case, achieving a 5,000 MW goal would have a ratepayer impact of $3 billion over the study period (2013 – 2045), which would equal on average a 1% impact on ratepayer electric bills. In any given year, this rate impact could be as much as 3%. The ratepayer impact under the Low Cost scenario would be approximately $300 million, whereas the impact under the High Cost scenario would be $9 billion.	http://www.nyserda.ny.gov/Publications/Programs-Planning-Status-and-Evaluation-Reports/Solar-Study.aspx

CERTIFICATE OF SERVICE

I hereby certify that the following have been served with a true and accurate copy of the foregoing by electronic mail and by deposit in the U.S. Mail, first class, postage prepaid:

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