BEFORE THE NORTH CAROLINA UTILITIES COMMISSION
DOCKET NO. E-100, SUB 83[1]

FILED
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Clerk's Office
N.C. Utilities Commission

In the Matter of: **Investigation of Net Metering**	))))	**MOTION FOR DISCLOSURE AND EQUITABLE RELIEF**

NCSEA'S MOTION FOR DISCLOSURE AND EQUITABLE RELIEF

NOW COMES the North Carolina Sustainable Energy Association ("NCSEA") and respectfully moves the North Carolina Utilities Commission ("Commission"), pursuant to Commission Rule R1-7, to direct Duke Energy Corporation, through its two North Carolina operating companies, to (1) guarantee, at a minimum, the continued availability of the current net metering terms and conditions for a period of 10 years from the customer's install date to each residential or commercial customer who installs a net metered rooftop solar system prior to issuance of a final order in any net metering proceeding initiated in the coming year; and (2) disclose, within a reasonable period, to NCSEA and other intervenors the analysis upon which Duke Energy Corporation is basing its messaging that net metering in North Carolina is unfair.

In support of the motion, NCSEA respectfully shows the following:

1. The North Carolina Public Staff stated almost 20 years ago that "[o]n a retail level, the only competitive threat [to a public electric utility] in North Carolina . . . is customer-owned generation." *Petition of the Public Staff for the Initiation of a Generic Proceeding and Consideration of Proposed Interim Guidelines*, p. 3, Commission Docket

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[1] NCSEA is filing this motion in Commission Docket No. E-100, Sub 83 because this is the docket in which the Commission created Rider NM and it appears, based on recent testimony, that Duke Energy Corporation believes any change to Rider NM must be made in this docket. *See Rebuttal Testimony of Michael T. O'Sheasy*, pp. 35-36, Commission Docket No. E-2, Sub 1023 (14 March 2013).

No. E-100, Sub 73 (22 April 1994). It remains true that the only competitive retail threat is customer-owned generation.

2. It is perhaps solely the existence of this competitive threat that prevents Duke Energy Corporation's two North Carolina operating companies from rising to the level of monopolies that violate the State's Constitution. N.C. Const. art. I, § 34 (2013) ("Perpetuities and *monopolies are contrary to the genius of a free state and shall not be allowed.*") (emphasis added).

3. Duke Energy Corporation is currently messaging that it will seek to alter one of the fundamental policies that makes customer-generation a viable option for residential and commercial customers.

4. Duke Energy Corporation has, for example, indicated its intent to alter the State's net metering rules in a 7 January 2014 presentation to a legislative study committee. During the 7 January 2014 study committee meeting, the President of Duke Energy Corporation's North Carolina operating companies made the following statement:

> [The] net metering customer is expecting to use the grid when they need it but the credited rate they pay does not fully cover their cost for the share for maintaining that infrastructure. The result is a shifting of cost from those who want solar panels to those who do not. In fact, unless we fix the rules, fixed income and low income customers, those who can least afford it, actually help pay for the solar panels of those who can afford to install them. . . . The cost burden for net metering shifts to households with fewer resources to spare and this has to change. . . . *We plan to ask the Utilities Commission to take a look at the rules around that metering in the state and to ensure those rules are fair to all our customers.*

(Emphasis added). Similarly, a 22 January 2014 Duke Energy Corporation meeting with the *News & Observer* editorial board prompted a published newspaper article that included the following statement: "[E]xecutives with the Charlotte power company say they will push for one change: reducing how much North Carolina households are paid for generating electricity from solar panels."[2]

5. Duke Energy Corporation's messaging indicates that it will seek to change the current net metering rules because the rules are unfair, but the North Carolina Crossborder Energy study, attached hereto as **Exhibit A**,[3] shows that net metering is not unfair to ratepayers. The Crossborder Energy study indicates that when the costs and benefits are taken into account, "the costs of net metered solar DG for non-participating customers are at the low end of the range of benefits . . . indicat[ing] that North Carolina ratepayers generally would benefit from the continued availability of net metering." The Crossborder Energy study also concludes that "[b]ased on the midpoints of the ranges of costs and benefits . . . the benefits of solar DG are 30% greater [than the costs.]"[4]

6. While the Crossborder Energy study has been made available for public review, Duke Energy Corporation has not made available for review the underlying analysis upon which its disputed messaging is based.

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[2] *Duke Energy to seek reduction in payments to NC homes with solar panels*, Murawski, J. Charlotte Observer (22 January 2014) (accessed on 1 February 2014 at http://www.charlotteobserver.com/2014/01/22/4632104/duke-energy-to-seek-reduction.html#.Uu0QwYyYZYc).

[3] The Crossborder Energy study attachment includes the resume of the principal author, Tom Beach, as well as a representative list of Crossborder Energy's clients.

[4] It is worth noting that even if the Commission were to ignore the Crossborder Energy study, Duke Energy Corporation itself has conceded that net metering is not currently a "huge issue" nor is it likely to become a "huge issue" during the pendency of any Commission proceeding. In January 2014, the President of Duke Energy Corporation's North Carolina operating companies stated, "I think it's time to take a look at it before it becomes a huge issue in North Carolina." *Duke Energy to seek reduction in payments to NC homes with solar panels*, Murawski, J. Charlotte Observer (22 January 2014) (accessed on 1 February 2014 at http://www.charlotteobserver.com/2014/01/22/4632104/duke-energy-to-seek-reduction.html#.Uu0QwYyYZYc).

7. The Public Utilities Act provides that it is the policy of the State to "provide just and reasonable rates and charges for public utility services *without . . . unfair or destructive competitive practices*[.]" N.C. Gen. Stat. § 62-2(a)(4) (emphasis added).

8. Duke Energy Corporation's unsupported messaging has created significant market uncertainty. The uncertainty is having a destructive "chilling" impact on the rooftop solar market in North Carolina and is (a) unfairly interfering with the ability of rooftop solar installers in the State to do business and (b) unfairly constraining the ability of the utility's residential and commercial customers to avail themselves of the only retail alternative to Duke Energy Corporation: self-generation. *See* affidavits of Jason A. Epstein (Baker Renewables), David B. Hollister (Sundance Power Systems), Robert S. Kingery (Southern Energy Management), and Stewart A. Miller (Yes! Solar Solutions) attached hereto as **Exhibit B**. The "chilling" effect of Duke Energy Corporation's messaging is particularly pernicious because it comes as the window of opportunity to make use of the state tax credit is quickly closing. Given Duke Energy Corporation's market dominance, its messaging – timed as it is and in the absence of a filing at the Commission – constitutes a destructive competitive practice that runs counter to State policy and should be redressed.

9. The destructive impact of Duke Energy Corporation's messaging cannot be fully mitigated until (a) the premise, upon which the messaging is based, is disproved in a Commission proceeding and (b) net metering tariffs, terms and conditions as they currently exist (or even in a form more favorable to net metering customers[5]) are upheld

[5] Given the Crossborder Energy study's conclusion that "[b]ased on the midpoints of the ranges of costs and benefits . . . the benefits of solar DG are 30% greater [than the costs,]" the net metering tariffs, terms and conditions may need to be modified to better

as fair. However, the Commission is in a position to offer interim equitable relief that will mitigate the effects of Duke Energy Corporation's destructive competitive practice.

10. Specifically, the Commission can issue an order

- directing Duke Energy Corporation to guarantee, at a minimum,[6] the continued availability of the current net metering terms and conditions for a period of 10 years[7] from the customer's install date to each residential or commercial customer who installs a net metered rooftop solar system prior to issuance of a final order in any net metering proceeding initiated in the coming year. Such a directive will restore sufficient certainty to the market prior to and during the pendency of any Commission proceeding to (a) maintain the continued viability of rooftop solar as a retail option and (b) contribute to ensuring that self-generation, at a minimum, continues to serve as a check on the monopolistic tendencies of our electric service providers; and
- directing Duke Energy Corporation to make available any underlying analysis upon which the disputed messaging is based, such that the analysis can be subjected to scrutiny without further delay. To the extent the analysis is alleged to contain trade secrets, Duke Energy Corporation should be directed to make the

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recognize the net benefits rooftop solar conveys. This motion simply seeks to remediate the destructive competitive practice; the relief asked for herein should not be viewed as a concession by NCSEA or its members that the current net metering tariffs, terms and conditions adequately recognize the net benefits rooftop solar conveys.

[6] NCSEA has inserted the term "at a minimum" to capture the following concept: If a Commission final order expands the net metering tariffs, terms and conditions in recognition of the net benefits rooftop solar conveys, the customer-beneficiaries of any guarantee ordered herein should be eligible for the expanded tariffs, terms and conditions.

[7] At present, ten years is a fair payback period in North Carolina based on, among other things, current system prices, current net metering rules, and an assumption that residential and commercial rates will continue to rise.

analysis available to parties to this docket and any expert consultants upon execution of a non-disclosure agreement. Permitting intervenors to begin their scrutiny of any Duke Energy Corporation analysis at the earliest possible date will help expedite any eventual proceeding initiated by Duke Energy Corporation.

WHEREFORE, NCSEA prays the Commission direct Duke Energy Corporation, through its two North Carolina operating companies, to (1) guarantee, at a minimum , the continued availability of the current net metering terms and conditions for a period of 10 years from the customer's install date to each residential or commercial customer who installs a net metered rooftop solar system prior to issuance of a final order in any net metering proceeding initiated in the coming year; and (2) disclose, within a reasonable period, to NCSEA and other intervenors the analysis upon which Duke Energy Corporation is basing its messaging that net metering in North Carolina is unfair. NCSEA also prays the Commission grant any other equitable relief the Commission deems appropriate.

Respectfully submitted, this the 24 day of February, 2014.

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CERTIFICATE OF SERVICE

I hereby certify that all persons on the docket service list have been served true and accurate copies of the foregoing motion, together with any attachments, by hand delivery, first class mail deposited in the U.S. mail, postage pre-paid, or by email transmission with the party's consent.

This the 24 day of February, 2014.

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EXHIBIT A

The Benefits and Costs of Solar Generation for Electric Ratepayers in North Carolina

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October 18, 2013

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The Benefits and Costs of Solar Generation for Electric Ratepayers in North Carolina

This report provides an independent analysis of the benefits and costs of solar photovoltaic (PV) generation for electric ratepayers in the service territories of the major electric utilities in North Carolina – Duke Energy Carolinas (DEC), Duke Energy Progress (DEP), and Dominion North Carolina Power (DNCP). North Carolina Sustainable Energy Association asked Crossborder Energy to apply to the three North Carolina utilities the same approach to analyzing the benefits and costs of solar generation which we have used in similar studies in other states.[1]

This report identifies the benefits and costs of solar for both (1) wholesale utility-scale solar projects whose output is sold to the utilities and (2) solar distributed generation (solar DG or demand-side solar) installed on a customer's premises behind the customer's utility meter. This study explains which of the benefits of solar generation apply to both wholesale and demand-side solar, and which are limited to one of these different types of solar resources. On the cost side, it is important to recognize that wholesale solar and solar DG result in different types of costs for utility ratepayers. The ratepayer costs of wholesale solar are principally the capital and O&M costs of utility-scale solar generation, which the utility will pay directly through a power purchase contract with the solar project. In contrast, the customer who installs solar DG bears the capital and operating costs of the solar resource. With solar DG, the costs to other, non-participating ratepayers are principally the revenues which the utility loses as a result of the output of solar DG serving the customer's on-site load, plus the energy credits which the utility provides, through net energy metering, when the solar customer exports power to the grid. These exports serve the loads of nearby retail customers. The utility may also provide incentive payments to solar DG customers. Finally, both wholesale and demand-side solar may cause the utility to incur new costs to integrate intermittent solar generation into the grid. **Table 1** summarizes the principal costs and benefits of both wholesale solar and solar DG.

Table 1: *Benefits and Costs of Solar Generation for North Carolina Ratepayers*

Benefits	Wholesale Solar	Solar DG
Energy	✔	✔
Generation capacity	✔	✔
Transmission	✔ (≤ 5 MW)	✔
Distribution		✔
Avoided Emissions	✔	✔
Avoided Renewables	✔	✔
Costs		
Capital and operating costs	✔	
Lost retail rate revenues		✔
DG incentives		✔
Integration costs	✔	✔

[1] See "The Benefits and Costs of Solar Distributed Generation for Arizona Public Service" (May 2013), available at http://www.seia.org/research-resources/benefits-costs-solar-distributed-generation-arizona-public-service. Also, "Evaluating the Benefits and Costs of Net Energy Metering in California" (January 2013), available at http://votesolar.org/wp-content/uploads/2013/01/Crossborder-Energy-CA-Net-Metering-Cost-Benefit-Jan-2013-final.pdf .

In assessing the benefits and costs of solar generation from a utility ratepayer perspective, it is important to use a long-term time frame which recognizes that solar PV systems have useful lives of 20 to 30 years. A long-term perspective is also necessary to treat demand-side solar on the same basis as other supply- or demand-side resources. When a utility assesses the merits of adding a new power plant, or a new energy efficiency program, the company will look at the costs to build and operate the plant or the program over their useful lives, compared to the costs avoided by not operating or building other resource options. Solar DG should be evaluated over the same long-term time frame.

Solar generation can be installed at a wide range of scales, from a system serving a single home to utility-scale plants. Solar is feasible in a greater diversity of locations than other renewable technologies such as wind and hydro. Solar also can be installed with shorter lead times and on a wider variety of sites than conventional, large-scale fossil generation resources. Solar can combine with other small-scale, short-lead-time, demand-side resources, such as energy efficiency (EE) and demand response (DR) programs, to reduce a utility's need for supply-side generation, both in the near- and long-terms. An analysis of the benefits of solar should recognize its scalability and short lead times, by acknowledging that solar and demand-side programs combine to continuously avoid the need for supply-side resources, without the "lumpiness" associated with a conventional utility-scale power plant. Accordingly, we evaluate the benefits of solar based on the change in a utility's costs per unit of solar installed, without requiring solar to be installed in the same large increments as conventional fossil or nuclear generation.

This report relies on data from the North Carolina utilities' latest integrated resource plans (IRPs), supplemented with data from recent avoided cost proceedings and general rate cases. We also have used a limited amount of current data from the regional gas and electric markets in which the North Carolina utilities operate. This work relies to the greatest extent possible on public data and on transparent calculations of the benefits and costs. Our intent in using public data and transparent methodologies is to minimize debates over the input assumptions and to reduce reliance on opaque models. We agree with the Rocky Mountain Institute's recent meta-analysis of solar DG cost / benefit studies, which concluded that "in any benefit/cost study, it is critical to be transparent about assumptions, perspectives, sources and methodologies so that studies can be more readily compared, best practices developed, and drivers of results understood."[2] Where there is debate over certain benefits or costs of solar, we have provided ranges that we believe span the likely range of benefits or costs.

Our work concludes that the benefits of solar generation in North Carolina equal or exceed the ratepayer costs of solar resources, such that new solar resources will provide economic benefits for electric ratepayers in the state. The following **Tables 2 and 3** summarize our results, for wholesale solar and solar DG, respectively. The benefits of wholesale solar typically exceed the costs, even if one does not include the environmental benefits of mitigating carbon emissions. The costs of net metered solar DG for non-participating residential customers are at the low end of the range of benefits, while the benefits of solar DG exceed the costs in the commercial market, where marginal retail rates are lower. These results indicate that North Carolina ratepayers generally would benefit from the continued availability of net metering.

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[2] Rocky Mountain Institute. "A Review of Solar PV Benefit and Cost Studies" July 2013, at page 5. http://www.rmi.org/Knowledge-Center/Library/2013-13_eLabDERCostValue.

Based on the midpoints of the ranges of costs and benefits shown in Tables 2 and 3, the benefits of wholesale solar are 40% larger than the costs, and the benefits of solar DG are 30% greater. Were the North Carolina utilities to add 400 MW of wholesale solar and 100 MW of solar DG resources, the net benefits for ratepayers would be $26 million per year.

Table 2: *Benefits and Costs of Wholesale Solar (15-year levelized cents/kWh - 2013 $)*

Benefits	**DEC**	**DEP**	**DNCP**
Energy (includes line losses)	5.7 – 6.5	5.5 – 6.3	5.8 – 6.6
Generation capacity	1.9 – 3.2	2.1 – 3.2	2.6 – 3.6
Transmission capacity (< 5 MW)	0 – 1.0	0 – 0.7	0 – 0.9
Avoided Emissions	0.4 – 2.2	0.4 – 2.2	0.4 – 2.2
Avoided Renewables	1.0 – 2.0	1.0 – 2.0	1.0 – 2.0
Total Benefits	**9.0 – 14.9**	**9.0 – 14.4**	**9.8 – 15.3**
Costs			
Capital and O&M (All-in PPA)	7.0 – 9.0	7.0 – 9.0	7.0 – 9.0
Integration	0.3	0.3	0.3
Total Costs	**7.3 – 9.3**	**7.3 – 9.3**	**7.3 – 9.3**

Table 3: *Benefits and Costs of Solar DG (15-year levelized cents/kWh - 2013 $)*

Benefits	**DEC**	**DEP**	**DNCP**
Energy (includes line losses)	5.7 – 6.5	5.5 – 6.3	5.8 – 6.6
Generation capacity	2.2 – 3.7	2.4 – 3.7	3.0 – 4.1
Transmission capacity	1.0	0.7	0.9
Distribution capacity	0.2 – 0.5	0.2 – 0.5	0.2 – 0.5
Environmental	0.4 – 2.2	0.4 – 2.2	0.4 – 2.2
Avoided Renewables	0.1 – 2.2	0.1 – 2.2	0.1 – 2.2
Total Benefits	**9.6 – 16.1**	**9.3 – 15.6**	**10.4 – 16.5**
Costs			
Lost Revenues			
Residential	9.8 – 10.7	10.5 – 11.5	10.1 – 11.0
Commercial	7.7 – 8.4	9.7 – 10.6	8.7 – 9.4
Integration	0.3	0.3	0.3
Total Costs			
Residential	**10.1 – 11.0**	**10.8 – 11.8**	**10.4 – 11.3**
Commercial	**8.0 – 8.7**	**10.0 – 10.9**	**9.0 – 9.7**

1. Methodology

Solar DG is a long-term source of electric generation that uses a renewable resource. New solar systems will provide benefits for North Carolina ratepayers for the next 20 to 30 years. Data to perform a long-term (15-year) assessment of these benefits is available from utility avoided cost filings, from recent IRPs and general rate cases, and from market data. The core of this study is the calculation of 15-year levelized benefits and costs for solar resources on the DEC, DEP, and DNCP systems.

1.1 Benefits.

We briefly describe our approach to calculating each of the benefits of solar generation in North Carolina.

- **Energy.** DEC, DEP, and DNCP have currently-effective 15-year avoided energy prices in the range of 4.5 – 5.0 c/kWh for a base load profile, based on production cost modeling of their incremental energy costs over the next 15 years. These avoided energy rates are currently under review in North Carolina Utilities Commission (NCUC) Docket No. E-100, Sub 136. As these production cost models are confidential, we have separately projected 15-year avoided energy costs using a more transparent approach, based on natural gas forward market data, combined with the heat rates, variable O&M costs, and other operating parameters of the long-term fossil resources that solar generation will avoid. Other similar studies have taken a comparable approach to calculating long-term avoided energy costs.[3] We also have considered whether avoided energy costs should be adjusted to reflect the costs which some utilities have incurred to hedge the volatility in their natural gas costs. Finally, avoided energy costs should consider the daily profile of solar generation, which peaks during the early afternoon, making it a more valuable resource than a constant, "flat" profile in all daylight hours.

- **Generating Capacity.** The North Carolina utilities calculate 15-year avoided capacity prices under the assumption that a new combustion turbine (CT) is the least-cost source of new generating capacity. This is commonly called the "peaker" method. Although the details of these calculations are confidential, there is public data on CT costs in nearby markets which can be used to review filed capacity prices. The capacity value of solar, per unit of output, also must consider both the peaking profile of solar generation as well as its variability. Utilities and control area operators in the U.S. have developed well-accepted methods to value the contribution of solar PV resources to capacity resources. In North Carolina, the utilities appear to value solar's capacity at 40% to 50% of its nameplate capacity, comparable to the valuation adopted by the nearby PJM system.

- **Transmission Capacity.** The output of solar DG primarily serves on-site loads and never touches the grid, thus clearly reducing loads on the transmission grid. Given the penetration levels of solar DG on the system today, the power exported from solar DG

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[3] This is generally the approach taken in the avoided cost calculator that California Public Utilities Commission (CPUC) has approved for cost-effectiveness analyses of demand-side programs in California, including solar DG. See, generally, CPUC Decision 09-08-026. Energy and Environmental Economics (E3) has developed the avoided cost calculator under contract to the CPUC. See http://www.ethree.com/public_projects/cpuc5.php. The DG version of the model is titled "DERAvoidedCostModel_v3.9_2011 v4d.xlsm."

units is entirely consumed on the distribution system by the solar customer's neighbors, again unloading transmission capacity. Thus, much like energy-efficiency and demand response resources, solar DG can avoid transmission capacity costs, but only to the extent that solar is producing during the peak demand periods that drive load-related transmission investments. As DEC itself notes in describing its utility-owned solar DG program: "Power is produced at the site, reducing the need for extensive transmission lines or a complex infrastructure."[4] Wholesale solar facilities interconnected at the distribution level – typically, projects at or below 5 MW in size – also can avoid transmission capacity costs to the extent that their output is consumed on the distribution system and produces minimal impacts on the upstream transmission grid.

We understand that there has been debate in North Carolina over the magnitude of the avoided T&D benefits attributable to EE and DR programs, with the debate centering on the extent to which T&D costs are load-related. We calculate long-term marginal transmission costs for DEC and DEP using an approach that considers only load-related transmission. Our method uses a regression of each utility's historical and forecasted transmission investments as a function of load growth, to determine the change in these costs as a function of increases in peak demand. This is a longstanding methodology used by many utilities to determine marginal, load-related transmission costs.

- **Distribution Capacity.** Whether solar generation avoids distribution capacity is a more complex question than transmission capacity, for several reasons. First, distribution substations and circuits can peak at different times than the system as a whole, complicating the calculation of whether solar can reduce distribution system peaks. Second, the timing of load-related distribution expansions is location-specific, and many utilities do not know where or when solar DG will be developed. Third, the time frames for utility distribution plans often is only 3-5 years into the future, providing only limited insight into the impact of distributed solar resources with 20-year lives. Finally, larger solar facilities may require distribution upgrades to accept their output, although the costs of such upgrades usually are the responsibility of the solar project. Nonetheless, studies using a variety of techniques have identified at least a modest amount of avoided capacity-related distribution costs resulting from the installation of solar DG.

- **Line Losses.** New solar generation reduces losses on the margin, and marginal line losses are significantly higher than average losses. The North Carolina utilities state that they use marginal transmission loss factors in their avoided energy costs. However, solar facilities produce power during daylight hours over which system loads, and system losses, are above-average. In addition, solar DG can avoid distribution losses. Thus, the current loss factors in avoided cost prices are likely to understate the line loss benefits of solar generation.

- **Avoided Emissions.** The North Carolina utilities' avoided cost calculations appear to include the costs of emission allowances associated with criteria pollutants, but not of carbon dioxide (CO_2). However, the IRPs of the Duke utilities recognize the potential long-term need to reduce CO_2 emissions – for example, by maintaining an option to add

[4] See "What are some advantages of solar energy?" http://www.duke-energy.com/north-carolina/renewable-energy/nc-solar-distributed-generation-program-FAQs.asp

nuclear generation – and include a base case CO_2 emission cost of $17 per ton in 2020, escalating to $44 per ton in 2032.[5] Accordingly, a long-term projection of the benefits of solar generation should recognize the value of these resources in mitigating carbon pollution. Given the uncertainty in the timing and magnitude of these costs, we have calculated a range of benefits from avoided CO_2 emissions.

- **Avoided Renewables Costs.** Bundled wholesale solar sold to the North Carolina utilities contributes to their compliance with state's Renewable Energy and Energy Efficiency Portfolio Standard (REPS) requirements, both today and in future years when those requirements will increase. The measure of the value of this compliance is the cost for an unbundled renewable energy certificate (REC) in North Carolina. If developers did not invest in wholesale solar systems and then sell the resulting RECs to the utility, of if solar DG customers did not invest in on-site solar and then sell or transfer their RECs, the utilities would have to make their own investments in renewable generation, presumably at a higher cost than the RECs available from developers and solar DG customers.

  Public data is not widely available in North Carolina on the cost of unbundled RECs today. We have estimated such costs based on a range of data, including (1) recent reports on a solar REC purchase by a municipal utility, (2) the utilities' reported 2012-2014 incremental costs associated with their compliance with the REPS requirement, and (3) cost premiums for green pricing programs in North Carolina.

  We assume that this category of avoided costs encompasses a number of the difficult-to-quantify benefits of renewable generation that are embodied in the attributes of a REC, including:

  - **Fuel Diversity.** Renewables generally have zero fuel costs (with the possible exception of some types of biomass), and present a different set of operating risks (lower capacity factors and intermittency) than conventional fossil resources. As a result, an increasing penetration of renewables will diversify a utility's fuel sources and resource mix, and reduce the risks of reliance on a small set of generation technologies.
  - **Price mitigation benefits.** Solar DG reduces the demand for electricity (and for the gas used to produce the marginal kWh of power). These reductions have the broad benefit of lowering prices across the gas and electric markets in North Carolina, to the benefit of all ratepayers. This benefit is also known as the "demand reduction induced price effect" (DRIPE), and has been quantified in several regions of the U.S.
  - **Grid security.** Renewable DG resources are installed as many small, distributed systems and thus are highly unlikely to fail at the same time. They are also located at the point of end use, and thus reduce the risk of outages due to transmission or distribution system failures. This reduces the economic impacts of power outages.
  - **Economic development.** Renewable DG results in more local job creation than fossil generation, enhancing tax revenues.

5 DEC 2012 IRP, at Appendix A, p. 106.

1.2 Costs

The ratepayer costs for wholesale solar are the payments that the utilities will make to purchase solar generation under long-term power purchase agreements (PPAs). We estimate these costs using available data on the recent trends in the prices in PPAs for utility-scale solar projects. For solar DG, the principal costs are the revenues which the North Carolina utilities will lose from customers serving their own load with on-site solar, including the credits provided under net metering when solar generation is exported to the grid. We estimate the lost revenues for the rate schedules on which many solar customers take service. Finally, we include an estimate of the costs of additional operating reserves needed to integrate intermittent solar generation into the grid. We are not aware that any of the North Carolina utilities have performed and publicly-disclosed a solar integration study specific to their systems, so we use a typical value from utility-sponsored integration studies in other states.

The following sections discuss in more detail each of the benefits and costs of solar DG on the DEC, DEP, and DNCP systems. As noted above, solar is a long-term resource with an expected useful life of at least 20 years. Accordingly, when we calculate the benefits and costs of DG over a 15-year period, the result is a conservative estimate of the value of these long-term resources. We express our results as 15-year levelized costs using a discount rate of 7.7%.[6]

2. Benefits of Solar DG

2.1 Energy

The North Carolina utilities' 2012 resource plans make clear that, to meet near- and intermediate-term growth, the utilities will rely on energy efficiency and demand-side resources, renewable purchases to meet North Carolina's REPS standard, and new efficient natural gas-fired generation, with the possibility of adding new nuclear generation in the post-2020 time frame. In these plans, gas-fired generation is the predominant marginal resource, so if North Carolina utilities were to increase their procurement of wholesale or distributed solar resources, the resources likely to be displaced would be new gas-fired generation.

Accordingly, we would expect the utilities' long-term, 15-year avoided cost energy prices to reflect the energy costs of relatively efficient gas-fired generation resources. DEC's, DEP's and DNCP's current 15-year levelized avoided energy prices are in the range of 4.5 to 5.0 c/kWh. As a check on these values, we first developed a 15-year natural gas cost forecast for gas-fired generation in North Carolina. This forecast uses recent forward gas price data from the NYMEX Henry Hub market plus a market differential from the Henry Hub to Zone 5 on the Transco pipeline. Based on this gas cost forecast, we estimated the marginal heat rates over the next 15 years that would produce the utilities' current 15-year avoided energy costs. These marginal heat rates are about 9,000 Btu per kWh today, declining to about 7,500 Btu/kWh in 2027. These heat rates are reasonably representative of the efficient combined-cycle and gas turbine units that the North Carolina utilities expect to add over this period.

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6 This is average of DEC's and DEP's currently-authorized weighted average costs of capital, from these utilities' most recent general rate case decisions. See the May 30, 2013 NCUC order in Docket No. E-2, Sub 1023, at 11 (for DEP) and the September 24, 2013 NCUC order in Docket No. E-7, Sub 1026 at 10 (for DEC). For DNCP, we use the same 8.5% discount rate which the utility used in its most recent public avoided cost filing.

Renewable generation has no fuel costs and thus avoids the volatility associated with generation sources whose cost depends principally on fossil fuel prices. Our gas cost forecast is based on forward market natural gas prices; thus, it represents a cost of gas that the North Carolina utilities theoretically could fix for the next 15 years, thus in principle capturing the fuel price hedging benefit of renewable generation. However, such a hedging strategy may not be cost-less; for example, in 2011-2012 DEP incurred $121 million in above-market costs to hedge one-half of its 163 Bcf of gas purchases, a cost premium of $0.74 per MMBtu when spread over the utility's full portfolio of gas purchases. From the customer's perspective, DEP's financial hedges effectively increased the price of each MMBtu consumed by $0.74. These hedging costs are not included in current avoided cost prices. We include such costs to develop the high end of our range of avoided energy benefits; the low end of our range is the utilities' filed 15-year avoided energy costs, adjusted as described below to reflect the hourly profile of solar output.

North Carolina avoided cost prices are differentiated into on- and off-peak prices, and also can vary seasonally by peak vs. off-peak months. This differentiation captures some, but not all of the hourly variation in the energy benefits of solar. What is missing is the likelihood that the diurnal profile of solar output will have a higher value than a flat block of on-peak power, because solar output peaks in the early afternoon hours and produces significant power in the mid-afternoon hours of peak demand. We are able to assess the hourly value of solar directly for DCNP, because it operates in the PJM market with visible hourly locational marginal prices (LMPs). DNCP's solar-weighted avoided cost energy price is 14% higher than the annual average avoided cost energy price for a baseload profile.[7] We have applied the same premium to the average, base load avoided cost energy prices for DEC and DEP, as a reasonable estimate of the time-varying energy value of solar in North Carolina. **Table 4** summarizes the avoided energy value of solar generation for the three utilities.

Table 4: *Avoided Energy Value of Solar (15-year levelized, $ per kWh, 2013$)*

Component	DEC	DEP	DNCP
Avoided Energy Costs	5.7	5.5	5.8
Hedging Costs	0.8	0.8	0.8

2.2 Generation Capacity

The North Carolina utilities use the annualized fixed costs of a new combustion turbine as the measure of avoided capacity costs – the standard "peaker" method. **Table 5** shows the annualized CT capacity costs now embedded in the utilities' current 15-year avoided capacity prices, assuming that a resource operates at an 83% capacity factor.[8] The detailed CT capital cost and financing data used to set these current avoided cost prices are confidential, so we "back into" the CT fixed capacity costs in Table 5 for the three utilities by multiplying (1) the currently-effective avoided capacity credit times (2) the number of hours per year in the time period in which the capacity credit is paid, times (3) the 83% capacity factor. The table also shows other relevant, public sources of data on CT fixed costs.

[7] In comparison, DEC's Option A avoided cost prices for an average solar profile in Charlotte are 4% higher than the annual average price for a base load profile.

[8] Based on the 1.2 "performance adjustment factor" used to calculate these prices.

Table 5: *Annualized CT Fixed Capacity Costs (Distribution Voltage)*

Source	**CT Fixed Capacity Cost** *($/kW-year)*	**Range** *($/kW-year)*
DEC	$57	$57 - $104
DEP	$65	$65 - $104
DNCP	$75	$75 - $108
PJM Net CONE, Area 5	$108	
EIA, *AEO13*, Advanced CTs[9]	$100	

There is ongoing litigation in North Carolina concerning QF capacity prices, with parties challenging the utilities' filed and currently-effective capacity credits. Accordingly, we use a range for the value of avoided generating capacity, as shown in the third column of Table 5. At the low end of the range for DEC and DEP, we use the currently-filed utility values; at the high end, we average the public, transparent PJM and EIA data. For DNCP, as it is on the PJM system, we use the utility's filed cost as the low end, and the PJM values as the high end.[10]

We make three adjustments to these CT-based capacity values. First, we add the fixed reservation charges for firm transmission on the Transco interstate pipeline to provide the new gas-fired capacity with a firm gas supply, to the extent that these reservation charges exceed a typical market-based "basis" differential in natural gas prices between the U.S. Gulf Coast and North Carolina. In the long-run, natural gas pipelines need to be able to recover their full cost of service. Second, we assume that behind-the-meter solar DG will be reflected in utility planning as a reduction in peak demand. Accordingly, solar DG also will reduce each utility's capacity need by an additional amount equal to the required reserve margin (15%) times the effective solar capacity.

Third, a calculation of the capacity value of solar resources must recognize that solar is a resource whose availability depends on weather and the time of the day. Although peak solar output typically occurs in the early afternoon when demand is relatively high, the peak output does not correlate perfectly with the utility's peak demand, which tends to occur later in the afternoon. As a result, solar does not provide 100% of its nameplate capacity to the grid as reliable generating capacity.

Utilities and control area operators in the U.S. generally use one of two approaches to determine the effective capacity provided by a solar resource. The most complex, and often considered to be the most rigorous, approach is the Effective Load Carrying Capacity (ELCC) method. This approach uses a production simulation model of the electric system in question to determine how much load a kW of solar capacity can "carry" without a diminution in reliability. Thus, if 100 MW of solar generation provides the same level of reliability when it replaces 50 MW of a reference resource (such as a CT), the ELCC of the solar resource is 50 MW / 100 MW = 50%. ELCC analyses require computer models which are complex and expensive to license and run, and which are not transparent except to the analysts who run them. They also require hourly data on

[9] EIA data on CT costs is from http://www.instituteforenergyresearch.org/wp-content/uploads/2009/05/2.15.13-IER-Web-LevelizedCost-MKM.pdf at page 3. Includes levelized fixed costs, fixed O&M, and associated transmission investments. 2011 $ are escalated to 2013 $ at 2.5% per year.

[10] For the high case, we use PJM RPM clearing prices for capacity through 2016, and its Net Cost of New Entry (CONE) thereafter.

loads and solar output which are correlated in time. As a result of the limitations and complexities of ELCC analyses, most control area operators in the U.S. use the simpler and more transparent "capacity factor" approach to setting the capacity value of intermittent renewable resources. This method sets the capacity value of the renewable resource based on its demonstrated capacity factor during certain critical hours of peak demand. For example, Appendix B of PJM's Manual 21 specifies that the capacity value of a solar resource should be calculated based on its summer (June-August) capacity factor during the hours ending 3-6 p.m.[11] For a solar profile for Norfolk, Virginia, the PJM Manual 21 method yields capacity values of 46% of nameplate for a fixed array and 58% of nameplate for a single-axis tracking system.

In their IRPs, the North Carolina utilities appear to assume that a solar resource's capacity value is 40% to 50% of its nameplate, consistent with the PJM capacity factor valuation for fixed arrays. DEC and DEP have confirmed in non-confidential data responses in the NCUC avoided cost docket that their 2013 IRPs value solar at 42% of nameplate. They also assume that solar operates at a 17.4% capacity factor.[12]

Table 6 shows our final calculation of the range of benefits that solar provides from avoiding the need for generation capacity, over a 15-year period. We add the CT fixed costs and pipeline reservation costs, multiply the total by the 42% contribution of solar to reducing peak demand, then divide by the typical output of a solar resource in North Carolina (1,524 kWh per kW per year based on the 17.4% capacity factor). The resulting avoided generation capacity costs, in dollars per MWh, are shown in the table below, for the range of CT fixed costs in Table 5. Finally, we observe that behind-the-meter solar DG, unlike wholesale solar, reduces the utility's peak demand. As a result, solar DG also reduces the utility's capacity requirements to meet its reserve margin, which is about 15% for the North Carolina utilities. Thus, for solar DG we increase the avoided generation capacity value by 15% above the numbers shown in Table 6.

Table 6: *Avoided Generation Capacity Value ($ per kW-yr in 2013$)*

Component	**DEC**		**DEP**		**DNCP**	
	Low	**High**	**Low**	**High**	**Low**	**High**
CT Fixed Costs	57	104	65	104	75	108
Pipeline Reservation	12	12	12	12	12	12
Total	69	116	77	116	87	120
Solar Capacity as % of Nameplate	42%	42%	42%	42%	46%	46%
Solar Capacity Value *($ per kW-yr)*	29	49	32	49	40	55
Annual Output *(kWh / kW)*	1,524	1,524	1,524	1,524	1,524	1,524
Solar Capacity Value *(cents per kWh)*	1.9	3.2	2.1	3.2	2.6	3.6

11 *See* http://www.pjm.com/documents/manuals.aspx .

12 DEC and DEP response to NCSEA Data Request No. 4, Item 4-15 in Docket No. E-100, Sub 136.

2.3 Transmission Capacity

Most, if not all, solar DG output is either consumed behind the meter or on the distribution system by the neighbors of the DG system, and never touches the transmission system. Solar DG thus reduces the use of the transmission system, and will reduce peak demands on the transmission system even if solar output and peak demand are not perfectly correlated. This benefit is similar to the benefit of other demand-side programs in avoiding transmission and distribution (T&D) capacity-related costs.

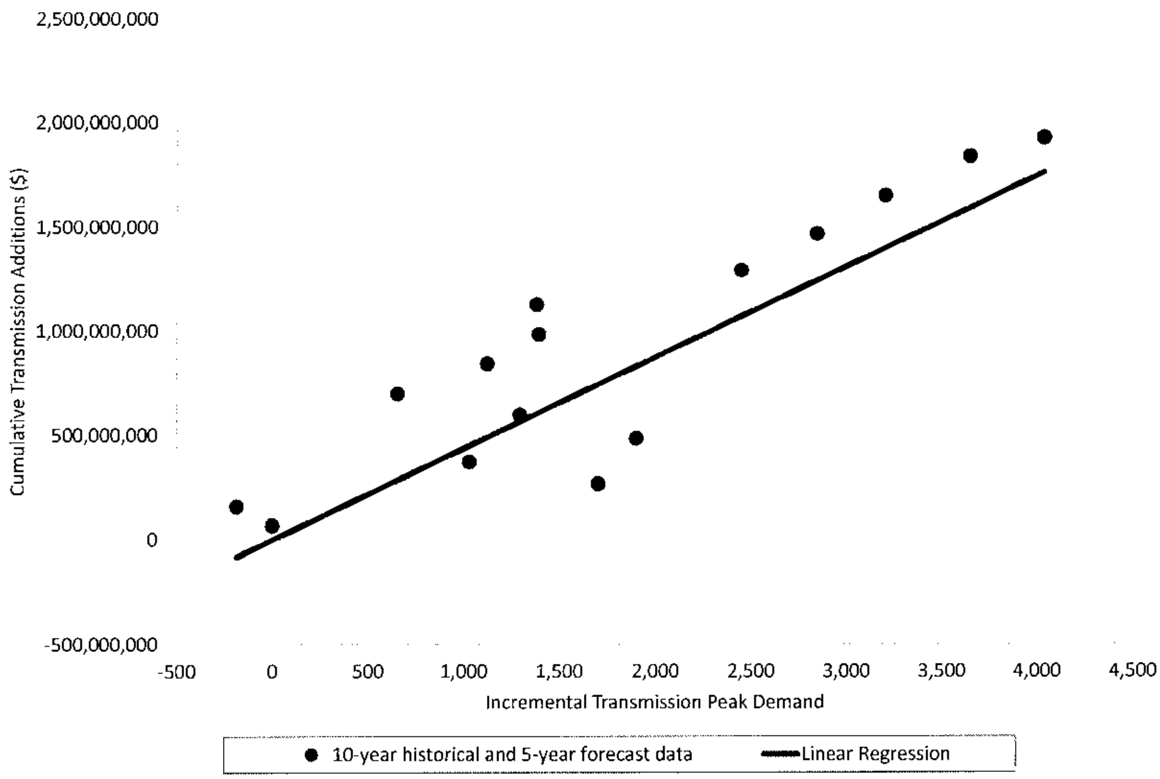
North Carolina utilities include avoided capacity-related T&D costs in assessing the costs and benefits of EE and DR programs. However, the methodology used to calculate these avoided costs is not public and we are aware that there is debate over the magnitude of these avoided costs. In particular, the NC Public Staff have questioned whether DEC's assumed avoided T&D costs are too high because they include transmission costs that are reliability-related, and thus not driven by load increases.[13]

There is a well-accepted way to address this debate. We have calculated DEC's and DEP's long-term marginal transmission capacity costs using the industry-standard NERA regression method used by many utilities to determine their marginal T&D capacity costs which are load-related.[14] **Figure 1** shows, for DEC, the regression fit of cumulative transmission capital additions as a function of incremental demand growth. We convert the regression slope of $438 per kW using a real economic carrying charge of 7.41%, and add loaders for general plant and transmission O&M costs based on FERC Form 1 data. Our estimate of annualized marginal transmission costs for DEC is $37.45 per kW-year.

[13] See NC Public Staff witness Robert Hinton testimony in Docket E-7, Sub 1032 pre-filed on August 7, 2013. http://ncuc.commerce.state.nc.us/cgi-bin/webview/senddoc.pgm?dispfmt=&itype=Q&authorization=&parm2=TBAAAA02231B&parm3=000141791 .

[14] The NERA regression model fits incremental transmission costs to demand growth. The slope of the resulting regression line provides an estimate of the marginal cost of transmission associated with a change in load. The NERA methodology typically uses 10-15 years of historical expenditures on transmission and peak transmission system load, as reported in FERC Form 1, and a five-year forecast of future expenditures and load growth. Crossborder's analysis used DEC's FERC Form 1 data for the most recent 10 years (2003-2012), and a forecast of T&D project costs over the five future years (2013-2017) based on data from DEC's most recent general rate case (Docket E-7 Sub 1026, E-1 Data Item 23b). Future T&D project costs are allocated between transmission and distribution based on the historical division between these categories. Peak demand data is from Docket E-7, Sub 1026, E-1 Data Item 43a.

Figure 1:
Linear Regression for DEC Transmission Costs



Transmission system peaks tend to coincide with system demand peaks, and thus we assume that solar's contribution to reducing transmission system peaks is the same as its contribution to avoided demand for generating capacity. Thus, we assume that each kW of solar DG capacity reduces DEC's peak transmission demand by 0.42 kW, and we convert avoided transmission capacity costs to dollars per MWh of solar DG output assuming an average annual output of 1,524 kWh per kW-AC. **Table 7** shows this calculation. The result for DEC is $10 per MWh (1.0 cents per kWh) for the transmission capacity costs avoided by solar DG; a parallel calculation for DEP yields avoided transmission capacity costs of 0.7 cents per kWh.

Table 7: *Calculation of Transmission Capacity Costs Avoided by Solar DG*

Component	**DEC**	**DEP**	***Units***
Marginal Transmission Capacity Cost (2014 $)	37	27	*per kW-year*
Solar Capacity as % of Nameplate	42%	42%	
Transmission Capacity Costs Avoided	16	11	*per kW-year*
Annual PV Output per kW-DC	1,524	1,524	*kWh per year*
Generation Capacity Cost Avoided by DSG	1.0	0.7	*cents / kWh*

As a check on this calculation, we have looked at DEC's filed avoided T&D benefits for several of its DR programs. These programs principally provide capacity benefits, and the avoided T&D portion of the benefits average about 40% of the generating capacity benefits. We understand that DEC and North Carolina Public Staff recently stipulated to the use of these T&D

benefits.[15] This level of T&D benefits is broadly consistent with our avoided transmission capacity costs in Table 7 compared to the avoided generation capacity benefits that we determined in Table 6.

Our approach for DNCP is different, given that DNCP is on the PJM system. For DNCP, we use the PJM rate for network integrated transmission service (the NITS rate), as a more direct measure of the costs which Dominion can avoid if solar reduces DNCP's peak demand on the PJM grid. As with avoided generation capacity costs, we apply the PJM solar capacity value percentage (46% of nameplate) to the avoided transmission costs, in recognition that peak solar output does not necessarily coincide with system peak demands. The resulting avoided transmission cost for DNCP is 0.9 cents per kWh.

2.4 Distribution

Solar DG also can reduce peak loads on distribution circuits, and thus avoid or delay the need to upgrade or re-configure the circuit if it is approaching capacity. However, circuits and substations on the distribution system can peak at different times than the system as a whole, which complicates the assessment of the extent to which solar DG can avoid or defer distribution capacity upgrades. As DG penetration grows, and a deeper understanding is gained of the impacts of DG on distribution circuit loadings, we anticipate that utility distribution planners will integrate existing and expected DG capacity into their planning, enabling DG to avoid or defer distribution capacity costs.[16] A comparable evolution has occurred over the last several decades, as the long-term impacts of EE and DR programs are now incorporated into utilities' capacity expansion plans for generation, transmission, and distribution, and it is generally recognized that these demand-side programs can help to manage demand growth even though the specific locations where these resources will be installed are difficult to predict.

The available studies which quantify the distribution capacity costs avoided by solar generation generally have calculated relatively modest values. **Table 8** below lists some of the studies which have calculated avoided distribution capacity costs. The most recent study, performed for the California Public Utilities Commission by the E3 consulting firm, based its calculations on marginal distribution costs in California and the correlation between solar output and distribution substation peaks. This study used data on distribution substation loads that is not typically available. Based on these studies, a reasonable range for avoided distribution capacity costs is 0.2 to 0.5 cents per kWh.

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[15] See the settlement filed August 19, 2013 in NCUC Docket E-7, Sub 1032, at page 6.

[16] A public summary of a confidential report on solar's modeled impacts on the DEC distribution system indicates that solar DG can also provide benefits such as voltage support and reduced line losses on feeder circuits, and that the value of solar along a circuit varies with proximity to the substation, load centers and other factors. See DEC witness Jonathan Byrd testimony in Docket E-7, Sub 1034, in the September 17, 2013 hearing transcript at p. 77-80 at http://ncuc.commerce.state.nc.us/cgi-bin/webview/senddoc.pgm?dispfmt=&itype=Q&authorization=&parm2=PAAAAA36131B&parm3=000141801. See the report summary filed as exhibit 4 to DEC witness Jonathan Byrd's testimony pre-filed on March 13, 2013 at http://ncuc.commerce.state.nc.us/cgi-bin/webview/senddoc.pgm?dispfmt=&itype=Q&authorization=&parm2=KAAAAA47031B&parm3=000141801 (beginning at pdf page 44).

Table 8: *Studies of Avoided Distribution Capacity Costs*[17]

State / Study / Date	Avoided Distribution Capacity Costs *(c/kWh)*	*Source*
AZ / R.W. Beck / 2009	0 to 0.31	*Fig. 6-2 at 6-14.*
PA-NJ / Clean Power / 2012	0.1 to 0.8	*Table 4*
AZ / Crossborder / 2013	0.2	*Table 1, at 2.*
AZ / SAIC / 2013	0	*pp. 2-10 to 2-12. No savings unless solar is targeted to circuits that are close to capacity.*
CA / CPUC-E3 / 2013 *(draft released 9/26/2013)*	0.6	*Includes sub-transmission and distribution costs. Based on correlation of distribution substation peaks to solar peaks.*
CO / Xcel Energy / 2013	0.05	*Table 1, at v and 27-36.*

2.5 Line Losses

The currently effective avoided energy prices for the North Carolina utilities include line loss adjustments in the range of 2% to 3%. The utilities state that these represent their marginal transmission line losses avoided by QF generation. There are several reasons why these loss adjustments are likely to be too low. First, solar projects generate during daylight hours over which system loads, and system losses, are above-average, while the QF loss factors may reflect a baseload output profile. Second, solar DG also avoids marginal distribution losses, which can be in the 5% to 8% range. Other studies have used combined marginal T&D loss factors in the 8% to 12% range.[18] In Virginia, Dominion appears to use at least an 8% distribution loss adjustment in settlements with competitive energy suppliers.[19] We have not included an additional line loss adjustment above the loss factor included in QF prices, but further data on distribution loss adjustments in North Carolina could justify additional benefits in this category of costs.

2.6 Avoided Emissions

Solar generation avoids emissions of both greenhouse gases and criteria air pollutants (SO_2, NO_x, and PM 10). It is our understanding that compliance costs for criteria pollutants are included in the production cost models used to determining avoided energy costs, but that future costs to mitigate greenhouse gas (GHG) emissions are not considered. We note that the North Carolina utilities do include future carbon emission costs in their IRPs. For example, DEC's 2012 IRP assumes a Base Case CO_2 emission cost of $17 per ton in 2020, escalating to $44 per ton in 2032.[20] The DEC IRP also includes a High Case for CO_2 emission costs of $31 per ton in 2020, escalating to $80 per ton in 2032.

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[17] All of these studies except the newly-released draft CPUC-E3 study are referenced and discussed in the RMI meta-analysis cited in Footnote 2 above. The new CPUC-E3 draft net metering cost-benefit study is available at http://www.cpuc.ca.gov/PUC/energy/Solar/nem_cost_effectiveness_evaluation.htm .

[18] The CPUC-E3 2013 study referenced in Table 7, at Table 5 in Appendix C, shows loss factors ranging from 5.7% to 10.9%. The R.W. Beck Study in Arizona, at Table 4-3, shows T&D loss reductions of 11.2% to 12.2%. of solar output.

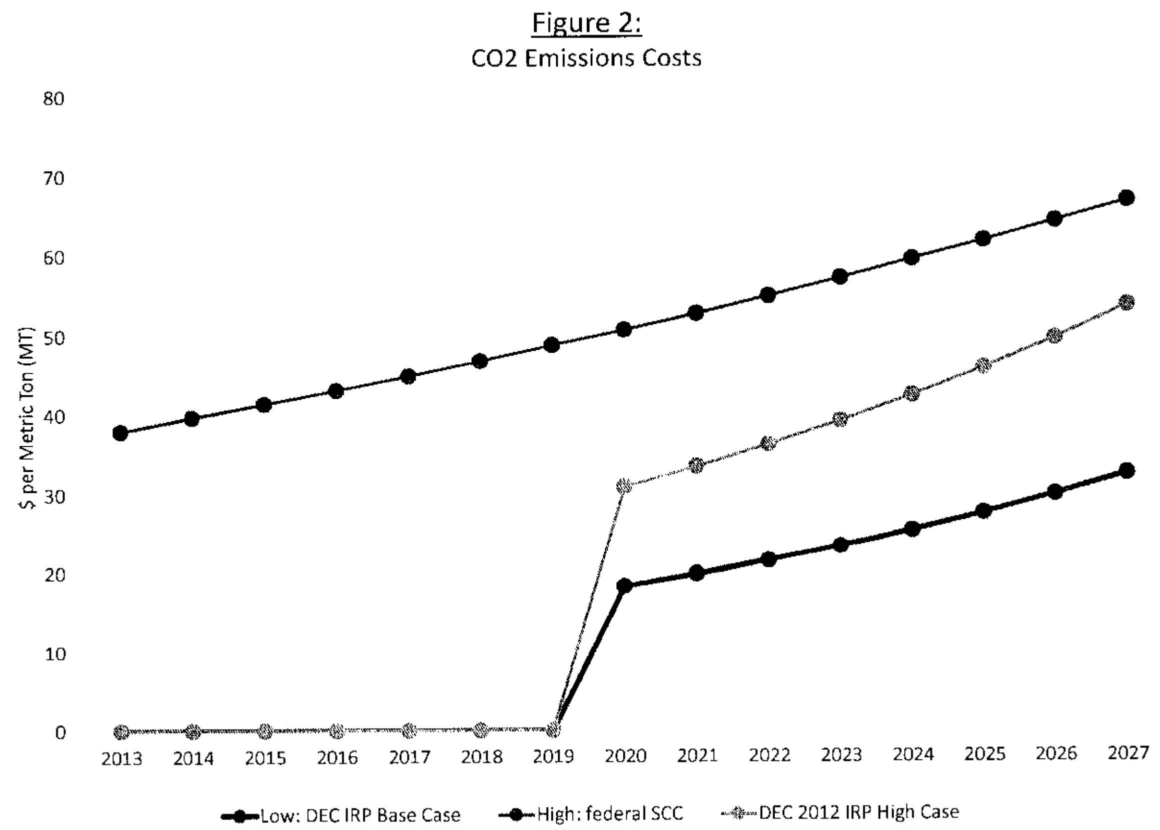
[19] See the loss expansion factors in http://www.dom.com/business/electric-suppliers/index.jsp .

[20] DEC 2012 IRP, at 106.

As another metric for the costs of mitigating CO_2 emissions, the federal government has announced that it will prioritize reductions of greenhouse gas (GHG) emissions by focusing on reducing pollution from electric power generation. This effort will employ a Social Cost of Carbon (SCC), with a base scenario of a carbon cost of $35 per metric ton CO_2 in 2012 (in 2007 $), growing at 2.1% per year plus inflation through 2050.[21] This is equivalent to a $34 per ton in 2013, rising to $46 per ton in 2020, and $61 per ton in 2027.

Given these developments, we believe that a reasonable range for the value of avoided GHG emissions uses DEC's IRP Base Case values as the low scenario, and the federal SCC as the high scenario. The SCC values in the high case also assume that CO_2 emission costs have an impact immediately, not just in 2020. Although it is clear that the U.S. (except for California and the Northeast) will not have a GHG allowance trading scheme in place for the power sector in the near future, it is more likely that there will be further regulatory actions from the Environmental Protection Agency to regulate carbon emissions from power plants. The SCC emission values can be considered a proxy for such regulatory actions.

Figure 2 shows these two projections of the costs of CO_2 emissions. We also indicate the DEC high CO_2 case from its 2012 IRP.



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21 See http://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf at page 18.

We convert these costs of mitigating carbon emissions from dollars per ton to $/MMBtu with a natural gas emission factor, and then to an energy price (in $/MWh) using the natural gas-based marginal heat rates assumed in our avoided energy cost forecast. **Table 9** shows these results. This calculation assumes, conservatively, that the North Carolina utilities' marginal generation, and marginal emissions, are entirely from natural gas. The utilities' avoided cost filings show that, today, their marginal emissions are from a combination of natural gas, coal, and purchased power, with coal constituting 20% to 30% of the mix. This suggests that our assumption that 100% of marginal emissions are from natural gas understates the utilities' actual marginal emissions, and thus underestimates the emission savings from new renewable generation.

Table 9: *Avoided Emissions Costs*

Case	**CO2 Mitigation Costs** *($ per ton)*			**Avoided GHG Costs** *(15-year levelized cents / kWh)*
	2013	**2020**	**2034**	
Base	0	17	30	0.4
High	34	46	61	2.2

2.7 Avoided Renewables Costs

The North Carolina REPS requires utilities to serve at least 12.5% of their customers' electricity needs through new renewable energy sources or energy efficiency measures by 2021. The current REPS requirement is 3%; it increases to 6% in 2015 and 10% in 2018.

Wholesale Solar. We assume that the cost of wholesale solar purchased by the utilities will include the transfer of the associated REPS REC, such that wholesale solar will count directly toward meeting the REPS requirements. Thus, the cost of a REC represents the value of wholesale solar in meeting the utilities' REPS needs. We discuss below the available data on the cost of an unbundled REC in North Carolina.

Solar DG. Distributed solar does not necessarily count toward the REPS, if the customer who installs solar DG retains the RECs associated with their production. However, solar DG output reduces the utility's sales, and thus lowers its future REPS obligations by the solar output times the applicable REPS percentage (i.e. by 3% today, by 6% in 2015-2017, by 10% in 2018-2019, and by 12.5% in 2020). Over the 15-year period from 2013 – 2027, the average REPS obligation is 9.6%. Thus, solar DG provides at least this modest benefit in reducing future REPS obligations. In addition, we also understand that, although solar DG customers may net meter under any available rate schedule, customers can retain their RECs only if they take service under a time-of-use (TOU) tariff with demand charges; otherwise, they must surrender all RECs to the utility, without compensation.[22] Our review of the utilities' tariffs indicates that most residential and small commercial solar DG customers are likely to be better off net metering under an all-volumetric tariff, and conveying their RECs to the utility for free. We also understand that, even if a solar DG customer retains his RECs, the customer often does not or is not able to monetize them, in which case the value of the REC accrues to the general body of ratepayers in

[22] See http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NC05R&re=0&ee=0 . Also, NCUC order dated March 31, 2009 in Docket E-100, Sub 83.

North Carolina at no cost to them even though such a REC is not be counted for REPS compliance. In this last case, in effect, free RECs are donated to the system and North Carolina achieves a higher renewables penetration than required by the REPS program. Thus, the maximum benefit that solar DG provides to ratepayers is about 110% of the value of a REC – i.e. 100% from the REC conveyed to the utility for free, plus the extra 9.6% from the reduction in the utility's sales.

Cost of RECs. There is only limited public data on the cost of unbundled RECs in North Carolina today. We have estimated this cost based on a range of data, including the following:

- A recent filing by the Town of Fountain municipal utility publicly reporting a purchase of 2011-vintage solar RECs for $15 per MWh (1.5 cents per kWh).[23]

- The utilities' 2012-2014 incremental costs associated with their compliance with the 3% REPS requirement for these years, as reported in their 2013 REPS compliance filings. These incremental REPS costs for DEC and DEP are summarized in **Table 10** below. DNCP does not have a commission-approved REPS Rider to recover incremental REPS costs, although they have filed for one. North Carolina's REPS statute generally defines "incremental" REPS costs as the costs to procure renewable generation that exceed the utility's avoided costs.[24]

Table 10: *2012-2014 Incremental REPS Costs*

Component	DEC	DEP
Incremental REPS Costs *($ millions)*	$52.3	$63.3
REPS Requirement *(millions of kWh)*	5.29	3.36
Incremental REPS Costs *(cents / kWh)*	1.0	1.9

- Cost premiums for North Carolina's "green pricing" program. All of the North Carolina utilities have tariffs which offer customers the ability to purchase blocks of renewable power for a set premium. This "green pricing" program is administered by an independent non-profit, NC GreenPower. The premium for residential customers is 4 cents per kWh; commercial customers pay an additional 2.5 cents per kWh.[25] NC GreenPower states that 75% of its revenues are used to purchase RECs, and contributions appear to be deductible from federal income taxes as a charitable contribution.[26] The non-profit offers to purchase RECs from small renewable generators for 6 cents per kWh over 5 years (equivalent to a 15-year levelized price of 2.8 cents per kWh).[27] The NC GreenPower price represents a price premium that ratepayers are willing to pay to increase the percentage of renewable power they use to above the REPS requirement for grid power. Customers install solar DG for the same purpose. The NC GreenPower premiums are high compared to the other REC metrics, although the effective price is lower if the

[23] See http://ncuc.commerce.state.nc.us/cgi-bin/webview/senddoc.pgm?dispfmt=&itype=Q&authorization=&parm2=WAAAAA23231B&parm3=000143195.

[24] North Carolina statutes § 62-133.8(h)(1).

[25] See the utilities' NC GreenPower tariffs.

26 See https://www.ncgreenpower.org/faq/ .

[27] See https://www.ncgreenpower.org/ncgp-announces-a-change-in-premium-payment-for-new-small-solar-pv-agreements-effective-june-3-2013/ .

payments are tax-deductible, and one would presume that the utilities would not offer this program as a tariffed service if NC GreenPower were overcharging consumers for the incremental cost of renewable generation, or if the utilities themselves could or were willing to meet the demand for the service at a lower cost.

Considering all of the above metrics, a reasonable range for the cost of a REC in North Carolina is 1.0 to 2.0 cents per kWh, with the lower end based on DEC's incremental REPS costs and the high end reflecting DEP's incremental REPS costs and the cost of RECs through NC GreenPower.

It is fair to ask what is included in the value of a REC, particularly if mitigating carbon pollution is accounted for separately.[28] We have discussed above a number of the difficult-to-quantify benefits of renewable generation that are encompassed in the value of a REC, including:

- Fuel Diversity
- Price mitigation benefits[29]
- Grid security[30]
- Economic development[31]

We assume that the cost of a REC provides a proxy for these benefits. When calculated separately and then summed, these benefits typically far exceed the cost of a REC. A number of studies have quantified one of more of these benefits, as referenced in the footnotes to the above list. For example, the Clean Power Research study of the value of solar DG in Pennsylvania and New Jersey estimated the price mitigation, grid security, and economic development benefits of solar PV in those states, and found those benefits together to range from $102 to $137 per MWh, in 20-year levelized dollars.[32]

Conclusion. The avoided renewables benefit of wholesale solar is the full cost of the RECs that we assume the utility acquires when it purchases solar generation under a wholesale PPA. This cost is 1 to 2 cents per kWh. For solar DG, the avoided renewables costs over the 2013-2027 period is, at a minimum, 9.6% of the cost of a REC, based on the reduced REPS costs when solar DG reduces utility sales. If solar DG customers convey their RECs to the utility, or cannot monetize their RECs, the attributes of these RECs will accrue to the general body of ratepayers in North Carolina. Thus, at the high end, the value of solar DG to North Carolina ratepayers is the 110% of the full cost of a REC.

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[28] North Carolina statute § 62-133.8(a)(6) defines a REC to not include the value of reducing CO_2 emissions.

[29] For example, a Lawrence Berkeley National Lab study has estimated that the consumer gas bill savings associated with increased amounts of renewable energy and energy efficiency, expressed in terms of $ per MWh of renewable energy, range from $7.50 to $20 per MWh. Wiser, Ryan; Bolinger, Mark; and St. Clair, Matt, "Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency" (January 2005), at ix, http://eetd.lbl.gov/EA/EMP .

[30] Hoff, Norris and Perez, *The Value of Distributed Solar Electric Generation to New Jersey and Pennsylvania* (November 2012), at Table ES-2.

[31] *Ibid.* Also, a 2013 study by RTI International and La Capra Associates found that north Carolina's clean energy and energy efficiency programs contributed $1.7 billion to the state's economy from 2007-2012, created or retained 21,163 job-years over this period, and will provide long-term ratepayer benefits for the state. The study can be found at http://energync.org/assets/files/RTI%20Study%202013.pdf .

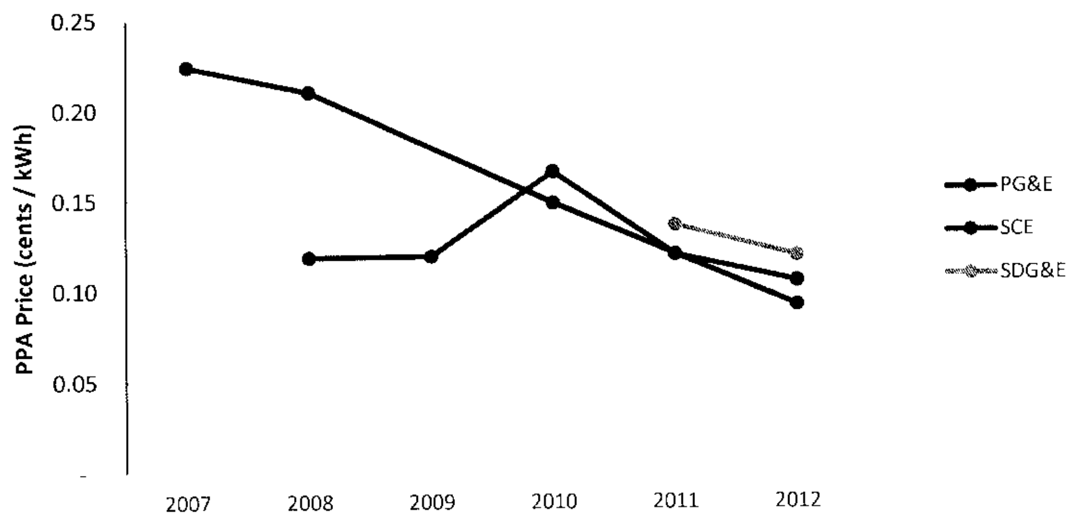
[32] *Ibid.*

3. Costs of Solar Generation

3.1 Wholesale Solar PPA Prices

Wholesale solar PPA prices provide perhaps the most dramatic evidence of the continued decline in solar PV costs. Solar PPA prices have fallen dramatically over the past several years, to the point that, in some regions of the U.S., solar is now competitive with other generation resources, including wind and natural gas. Xcel Energy in Colorado recently announced that it is proposing to add 170 MW of utility-scale solar to its system, with its CEO stating "[f]or the first time ever, we are adding cost competitive utility scale solar to the system."[33] The California electric utilities make public each year the average PPA prices for renewable contracts approved by the CPUC in the prior year. **Figure 3** shows the trend in the prices for their solar PV PPAs; CPUC contract approval can occur up to a year or more after bids are received, so the figure is indicative of prices through roughly 2011.[34] 2012 solicitations for solar PPAs in California in the 3 MW to 20 MW size range through the Renewable Auction Mechanism (RAM) have yielded market-clearing prices in the 8 to 9 cents per kWh range.[35]

Figure 3: California Solar PV PPA Prices



[33] See http://www.xcelenergy.com/About_Us/Energy_News/News_Releases/Xcel_Energy_proposes_adding_economic_solar,_wind_to_meet_future_customer_energy_demands .

[34] See http://www.cpuc.ca.gov/NR/rdonlyres/F0F6E15A-6A04-41C3-ACBA-8C13726FB5CB/0/PadillaReport2012Final.pdf .

[35] See http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/Renewable+Auction+Mechanism.htm for details on the RAM program and the RAM auction results in MW. See http://votesolar.org/2012/03/30/ram-results-11-projects-130-mw-total-most-solar-all-under-8-9-centskwh/ for RAM prices from 2012.

The Lawrence Berkeley National Lab (LBNL) conducts and publishes regular national surveys of the installed costs of solar PV; these surveys include PPA prices for utility-scale solar projects. LBNL recently released its most recent survey of wholesale, utility-scale solar PPA prices, including data to September 2013.[36] LBNL samples the prices only for utility-scale solar PV projects that sell both electricity and RECs in the wholesale power market through a long-term PPA that includes the "bundled" sale of both power and RECs.[37] **Figure 4** illustrates the trend in utility-scale, wholesale solar PPA prices.[38] Based on the 2012-2013 data, utility-scale solar PPAs now appear to be in the range of $55 to $75 per MWh. The data for PPAs from 2012 and 2013 are for projects that are not yet on-line, and thus remain subject to some uncertainty over contract performance. However, LBNL's PPA data from earlier years is based on projects which in general are now on-line, which substantiates the trend of rapidly dropping PPA prices and provides confidence that most of the reported 2012-2013 PPA prices will result in successful projects.

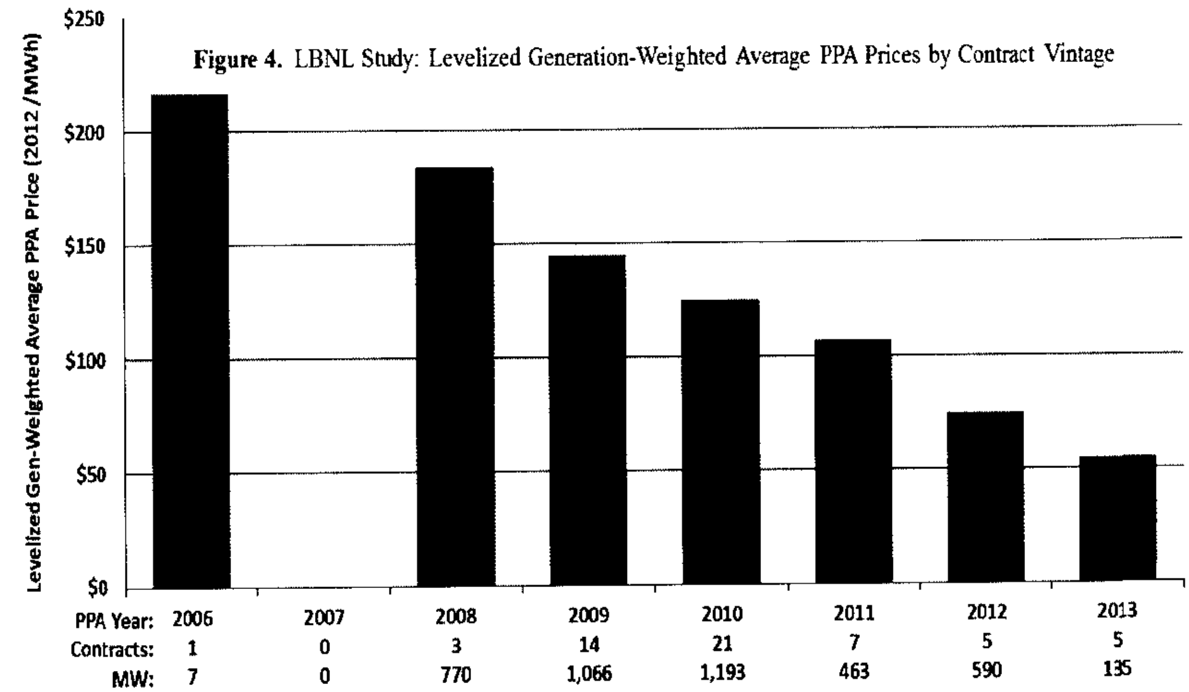


Figure 4. LBNL Study: Levelized Generation-Weighted Average PPA Prices by Contract Vintage

LBNL also reports on the installed costs of utility-scale solar projects, by region. The most recent data indicates that costs in the southeastern U.S. (data from North Carolina and Florida) have dropped almost to par with costs in the western U.S. where the bulk of utility-scale solar projects are located.[39]

An important caveat to the LBNL data is that most of the PPAs sampled are in the western

[36] See "Utility-scale Solar: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States" (September 2013, LBNL Publication 6408-E), hereafter "LBNL Study." Available at http://emp.lbl.gov/reports/re .

[37] *Ibid.*, at 19.

[38] *Ibid.*, Figure 16.

[39] *Ibid.*, at Figure 4.

U.S., which has higher solar insolation levels than the eastern U.S.[40] Using the NREL PVWATTS calculator, the expected annual output (in kWh per kW) of a fixed array in Charlotte is 11% lower than the average annual output of PV systems in Sacramento, Los Angeles, Phoenix, and Boulder. LBNL reports capacity factors for utility-scale solar projects in the U.S. Southeast that are about 20% lower than in the western U.S.[41] As a result, the LBNL data needs to be adjusted upwards to estimate potential wholesale solar PPA prices in North Carolina. Adjusting the LBNL 2012 - 2013 range of solar PPA prices ($55 to $75 per MWh) upward by 25% to reflect the North Carolina capacity factors are 20% lower than in the western U.S., and placing somewhat greater emphasis on the most recent 2013 data, yields a range of $70 to $90 per MWh (7 to 9 cents per kWh), which we believe to be a reasonable, current range for the cost of wholesale solar PPAs in North Carolina.[42]

3.2 Solar DG Costs – Lost Revenues

The primary costs of solar DG are the retail rate credits provided to solar customers through net metering, i.e. the revenues that the utility loses as a result of DG customers serving their own load and exporting power to the grid when the solar output exceeds the on-site load. The lost revenues are dependent on the utility's retail rate design, and can vary considerably based on the rate structure. Solar DG customers are primarily able to avoid volumetric, per kWh rates. They are much less able to avoid demand charges, and of course cannot avoid fixed monthly charges that do not depend on usage.

North Carolina utilities have a variety of retail rate structures. Residential rates consist largely of a single volumetric rate, with some seasonal (summer / winter) differentiation, plus a significant fixed monthly charge. DEP's residential solar customers must use a time-of-use rate with a demand charge (R-TOUD) in order to qualify for an incentive under DEP's SunSense program. Small commercial rates feature a declining block structure, such that the average rate decreases as usage goes up. Large industrial customers pay significant demand charges and time-of-use energy rates.

We have assumed that the lost revenues from residential solar DG are based on the customer's volumetric rate for the marginal usage served by the solar unit, and assume that the solar DG customer takes service under the rate schedule with the highest volumetric rates in order to maximize bill savings under net metering. The lost revenues from a small commercial solar customer under a declining block rate will depend on the size of the solar system relative to the customer's usage; we have generally assumed that the rates for usage above the first tier represent the marginal lost revenues.

Lost revenues on a 15-year levelized basis also depend on the assumed future escalation in future rates. A recent rate case settlement approved for DEC included a near-term, three-year rate increase averaging 1.7% per year.[43] EIA data shows that electric rates in North Carolina over the 20 year period from 1992 - 2011 increased at 1.4% per year. We have calculated a range of lost revenues based on future rate escalations from 1.0% to 2.5% per year. These results are shown in **Table 11**.

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[40] *Ibid.*, at 22.
[41] *Ibid.*, at Figure 11.
[42] Of course, this range of PPA prices all assume the availability of federal and state tax credits at 2013 levels.
[43] See http://www.duke-energy.com/north-carolina/nc-rate-case.asp.

3.3 Integration Costs

Finally, several utilities have completed studies on solar integration costs. A recent study which Arizona Public Service commissioned estimated integration costs of $2 per MWh in 2020 and $3 per MWh in 2030.[44] Xcel Energy in Colorado has calculated solar integration costs as $1.80 per MWh on a 20-year levelized basis.[45] Based on the high end of the range in these studies, we have added an assumed solar integration cost of $3 per MWh (0.3 cents per kWh).

Table 11 summarizes all of these costs of solar DG for North Carolina ratepayers.

Table 11: *Costs of Residential and Commercial Solar DG (15-year levelized cents / kWh)*

Class	**DEC**	**DEP**	**DNCP**
Lost Revenues			
Residential	9.8 – 10.7	10.5 – 11.5	10.1 – 11.0
Commercial	7.7 – 8.4	9.7 – 10.6	8.7 – 9.4
Integration	0.3	0.3	0.3
Total Costs			
Residential	**10.1 – 11.0**	**10.8 – 11.8**	**10.4 – 11.3**
Commercial	**8.0 – 8.7**	**10.0 – 10.9**	**9.0 – 9.7**

4. Conclusion

The benefits of solar generation in North Carolina equal or exceed the costs of this source of renewable generation. This conclusion is valid regardless of whether solar is developed as wholesale generation with the entire output sold to the utilities or as demand-side distributed generation under net metering. The quantitative results of our work are summarized in Tables 2 and 3. If one uses the midpoints of the ranges of costs and benefits shown in these tables, the benefits of wholesale solar exceed the costs by about 40% (a benefit / cost ratio of 1.43), and the benefits of solar DG are almost 30% larger than the costs (a benefit / cost ratio of 1.27). Over the next several years, if North Carolina utilities were to add 400 MW of wholesale solar and 100 MW of solar DG resources, the net benefits for ratepayers would be $26 million per year.

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44 Black & Veatch, "Solar Photovoltaic (PV) Integration Cost Study" (B&V Project No. 174880, November 2012).

45 Xcel Energy Services for Public Service Company of Colorado, "Cost and Benefit Study of Distributed Solar Generation on the Public Service Company of Colorado System" (May 23, 2013), at Table 1, pages v and 41-42.

Mr. Beach is principal consultant with the consulting firm Crossborder Energy. Crossborder Energy provides economic consulting services and strategic advice on market and regulatory issues concerning the natural gas and electric industries. The firm is based in Berkeley, California, and its practice focuses on the energy markets in California, the western U.S., Canada, and Mexico.

Since 1989, Mr. Beach has participated actively in most of the major energy policy debates in California, including renewable energy development, the restructuring of the state's gas and electric industries, the addition of new natural gas pipeline and storage capacity, and a wide range of issues concerning California's large independent power community. From 1981 through 1989 he served at the California Public Utilities Commission, including five years as an advisor to three CPUC commissioners. While at the CPUC, he was a key advisor on the CPUC's restructuring of the natural gas industry in California, and worked extensively on the state's implementation of PURPA.

AREAS OF EXPERTISE

- *Renewable Energy Issues:* extensive experience assisting clients with issues concerning California's Renewable Portfolio Standard program, including the calculation of the state's Market Price Referent for new renewable generation. He has also worked for the solar industry on the creation of the California Solar Initiative (the Million Solar Roofs), as well as on a wide range of solar issues in other states.

- *Restructuring the Natural Gas and Electric Industries:* consulting and expert testimony on numerous issues involving the restructuring of the electric industry, including the 2000 - 2001 Western energy crisis.

- *Energy Markets:* studies and consultation on the dynamics of natural gas and electric markets, including the impacts of new pipeline capacity on natural gas prices and of electric restructuring on wholesale electric prices.

- *Qualifying Facility Issues:* consulting with QF clients on a broad range of issues involving independent power facilities in the Western U.S. He is one of the leading experts in California on the calculation of avoided cost prices. Other QF issues on which he has worked include complex QF contract restructurings, electric transmission and interconnection issues, property tax matters, standby rates, QF efficiency standards, and natural gas rates for cogenerators. Crossborder Energy's QF clients include the full range of QF technologies, both fossil-fueled and renewable.

- *Pricing Policy in Regulated Industries:* consulting and expert testimony on natural gas pipeline rates and on marginal cost-based rates for natural gas and electric utilities.

EDUCATION

Mr. Beach holds a B.A. in English and physics from Dartmouth College, and an M.E. in mechanical engineering from the University of California at Berkeley.

ACADEMIC HONORS

Graduated from Dartmouth with high honors in physics and honors in English.
Chevron Fellowship, U.C. Berkeley, 1978-79

PROFESSIONAL ACCREDITATION

Registered professional engineer in the state of California.

EXPERT WITNESS TESTIMONY BEFORE THE CPUC

1. Prepared Direct Testimony on Behalf of **Pacific Gas & Electric Company/Pacific Gas Transmission** (I. 88-12-027 — July 15, 1989)

   - *Competitive and environmental benefits of new natural gas pipeline capacity to California.*

2. a. Prepared Direct Testimony on Behalf of the **Canadian Producer Group** (A. 89-08-024 — November 10, 1989)
   b. Prepared Rebuttal Testimony on Behalf of the **Canadian Producer Group** (A. 89-08-024 — November 30, 1989)

   - *Natural gas procurement policy; gas cost forecasting.*

3. Prepared Direct Testimony on Behalf of the **Canadian Producer Group** (R. 88-08-018 — December 7, 1989)

   - *Brokering of interstate pipeline capacity.*

4. Prepared Direct Testimony on Behalf of the **Canadian Producer Group** (A. 90-08-029 — November 1, 1990)

   - *Natural gas procurement policy; gas cost forecasting; brokerage fees.*

5. Prepared Direct Testimony on Behalf of the **Alberta Petroleum Marketing Commission and the Canadian Producer Group** (I. 86-06-005 — December 21, 1990)

   - *Firm and interruptible rates for noncore natural gas users*

6. a. Prepared Direct Testimony on Behalf of the **Alberta Petroleum Marketing Commission** (R. 88-08-018 — January 25, 1991)
   b. Prepared Responsive Testimony on Behalf of the **Alberta Petroleum Marketing Commission** (R. 88-08-018 — March 29, 1991)

   - *Brokering of interstate pipeline capacity; intrastate transportation policies.*

7. Prepared Direct Testimony on Behalf of the **Canadian Producer Group** (A. 90-08-029/Phase II — April 17, 1991)

   - *Natural gas brokerage and transport fees.*

8. Prepared Direct Testimony on Behalf of **LUZ Partnership Management** (A. 91-01-027 — July 15, 1991)

   - *Natural gas parity rates for cogenerators and solar power plants.*

9. Prepared Joint Testimony of R. Thomas Beach and Dr. Robert B. Weisenmiller on Behalf of the **California Cogeneration Council** (I. 89-07-004 — July 15, 1991)

   - *Avoided cost pricing; use of published natural gas price indices to set avoided cost prices for qualifying facilities.*

10. a. Prepared Direct Testimony on Behalf of the **Indicated Expansion Shippers** (A. 89-04-033 — October 28, 1991)
    b. Prepared Rebuttal Testimony on Behalf of the **Indicated Expansion Shippers** (A. 89-04-0033 — November 26,1991)

    - *Natural gas pipeline rate design; cost/benefit analysis of rolled-in rates.*

11. Prepared Direct Testimony on Behalf of the **Independent Petroleum Association of Canada** (A. 91-04-003 — January 17, 1992)

    - *Natural gas procurement policy; prudence of past gas purchases.*

12. a. Prepared Direct Testimony on Behalf of the **California Cogeneration Council** (I.86-06-005/Phase II — June 18, 1992)
    b. Prepared Rebuttal Testimony on Behalf of the **California Cogeneration Council** (I. 86-06-005/Phase II — July 2, 1992)

    - *Long-Run Marginal Cost (LRMC) rate design for natural gas utilities.*

13. Prepared Direct Testimony on Behalf of the **California Cogeneration Council** (A. 92-10-017 — February 19, 1993)

    - *Performance-based ratemaking for electric utilities.*

14. Prepared Direct Testimony on Behalf of the **SEGS Projects** (C. 93-02-014/A. 93-03-053 — May 21, 1993)

    - *Natural gas transportation service for wholesale customers.*

15 a. Prepared Direct Testimony on Behalf of the **Canadian Association of Petroleum Producers** (A. 92-12-043/A. 93-03-038 — June 28, 1993)
   b. Prepared Rebuttal Testimony of Behalf of the **Canadian Association of Petroleum Producers** (A. 92-12-043/A. 93-03-038 — July 8, 1993)

    - *Natural gas pipeline rate design issues.*

16. a. Prepared Direct Testimony on Behalf of the **SEGS Projects** (C. 93-05-023 — November 10, 1993)
    b. Prepared Rebuttal Testimony on Behalf of the **SEGS Projects** (C. 93-05-023 — January 10, 1994)

    - *Utility overcharges for natural gas service; cogeneration parity issues.*

17. Prepared Direct Testimony on Behalf of the **City of Vernon** (A. 93-09-006/A. 93-08-022/A. 93-09-048 — June 17, 1994)

    - *Natural gas rate design for wholesale customers; retail competition issues.*

18. Prepared Direct Testimony of R. Thomas Beach on Behalf of the **SEGS Projects** (A. 94-01-021 — August 5, 1994)

    - *Natural gas rate design issues; rate parity for solar power plants.*

19. Prepared Direct Testimony on Transition Cost Issues on Behalf of **Watson Cogeneration Company** (R. 94-04-031/I. 94-04-032 — December 5, 1994)

    - *Policy issues concerning the calculation, allocation, and recovery of transition costs associated with electric industry restructuring.*

20. Prepared Direct Testimony on Nuclear Cost Recovery Issues on Behalf of the **California Cogeneration Council** (A. 93-12-025/I. 94-02-002 — February 14, 1995)

    - *Recovery of above-market nuclear plant costs under electric restructuring.*

21. Prepared Direct Testimony on Behalf of the **Sacramento Municipal Utility District** (A. 94-11-015 — June 16, 1995)

    - *Natural gas rate design; unbundled mainline transportation rates.*

22. Prepared Direct Testimony on Behalf of **Watson Cogeneration Company** (A. 95-05-049 — September 11, 1995)

    - *Incremental Energy Rates; air quality compliance costs.*

23. a. Prepared Direct Testimony on Behalf of the **Canadian Association of Petroleum Producers** (A. 92-12-043/A. 93-03-038/A. 94-05-035/A. 94-06-034/A. 94-09-056/A. 94-06-044 — January 30, 1996)
    b. Prepared Rebuttal Testimony on Behalf of the **Canadian Association of Petroleum Producers** (A. 92-12-043/A. 93-03-038/A. 94-05-035/A. 94-06-034/A. 94-09-056/A. 94-06-044 — February 28, 1996)

    - *Natural gas market dynamics; gas pipeline rate design.*

24. Prepared Direct Testimony on Behalf of the **California Cogeneration Council and Watson Cogeneration Company** (A. 96-03-031 — July 12, 1996)

    - *Natural gas rate design: parity rates for cogenerators.*

25. Prepared Direct Testimony on Behalf of the **City of Vernon** (A. 96-10-038 — August 6, 1997)

    - *Impacts of a major utility merger on competition in natural gas and electric markets.*

26. a. Prepared Direct Testimony on Behalf of the **Electricity Generation Coalition** (A. 97-03-002 — December 18, 1997)
    b. Prepared Rebuttal Testimony on Behalf of the **Electricity Generation Coalition** (A. 97-03-002 — January 9, 1998)

    - *Natural gas rate design for gas-fired electric generators.*

27. Prepared Direct Testimony on Behalf of the **City of Vernon** (A. 97-03-015 — January 16, 1998)

    - *Natural gas service to Baja, California, Mexico.*

28. a. Prepared Direct Testimony on Behalf of the **California Cogeneration Council and Watson Cogeneration Company** (A. 98-10-012/A. 98-10-031/A. 98-07-005 — March 4, 1999).
    b. Prepared Direct Testimony on Behalf of the **California Cogeneration Council** (A. 98-10-012/A. 98-01-031/A. 98-07-005 — March 15, 1999).
    c. Prepared Direct Testimony on Behalf of the **California Cogeneration Council** (A. 98-10-012/A. 98-01-031/A. 98-07-005 — June 25, 1999).

    - *Natural gas cost allocation and rate design for gas-fired electric generators.*

29. a. Prepared Direct Testimony on Behalf of the **California Cogeneration Council and Watson Cogeneration Company** (R. 99-11-022 — February 11, 2000).
    b. Prepared Rebuttal Testimony on Behalf of the **California Cogeneration Council and Watson Cogeneration Company** (R. 99-11-022 — March 6, 2000).
    c. Prepared Direct Testimony on Line Loss Issues of behalf of the **California Cogeneration Council** (R. 99-11-022 — April 28, 2000).
    d. Supplemental Direct Testimony in Response to ALJ Cooke's Request on behalf of the **California Cogeneration Council and Watson Cogeneration Company** (R. 99-11-022 — April 28, 2000).
    e. Prepared Rebuttal Testimony on Line Loss Issues on behalf of the **California Cogeneration Council** (R. 99-11-022 — May 8, 2000).

    - *Market-based, avoided cost pricing for the electric output of gas-fired cogeneration facilities in the California market; electric line losses.*

30. a. Direct Testimony on behalf of the **Indicated Electric Generators** in Support of the Comprehensive Gas OII Settlement Agreement for Southern California Gas Company and San Diego Gas & Electric Company (I. 99-07-003 — May 5, 2000).
    b. Rebuttal Testimony in Support of the Comprehensive Settlement Agreement on behalf of the **Indicated Electric Generators** (I. 99-07-003 — May 19, 2000).

    - *Testimony in support of a comprehensive restructuring of natural gas rates and services on the Southern California Gas Company system. Natural gas cost allocation and rate design for gas-fired electric generators.*

31. a. Prepared Direct Testimony on the Cogeneration Gas Allowance on behalf of the **California Cogeneration Council** (A. 00-04-002 — September 1, 2000).
    b. Prepared Direct Testimony on behalf of **Southern Energy California** (A. 00-04-002 — September 1, 2000).

    - *Natural gas cost allocation and rate design for gas-fired electric generators.*

32. a. Prepared Direct Testimony on behalf of **Watson Cogeneration Company** (A. 00-06-032 — September 18, 2000).
    b. Prepared Rebuttal Testimony on behalf of **Watson Cogeneration Company** (A. 00-06-032 — October 6, 2000).

    - *Rate design for a natural gas "peaking service."*

33. a. Prepared Direct Testimony on behalf of **PG&E National Energy Group & Calpine Corporation** (I. 00-11-002—April 25, 2001).
    b. Prepared Rebuttal Testimony on behalf of **PG&E National Energy Group & Calpine Corporation** (I. 00-11-002—May 15, 2001).

    - *Terms and conditions of natural gas service to electric generators; gas curtailment policies.*

34. a. Prepared Direct Testimony on behalf of the **California Cogeneration Council** (R. 99-11-022—May 7, 2001).
    b. Prepared Rebuttal Testimony on behalf of the **California Cogeneration Council** (R. 99-11-022—May 30, 2001).

    - *Avoided cost pricing for alternative energy producers in California.*

35. a. Prepared Direct Testimony of R. Thomas Beach in Support of the Application of **Wild Goose Storage Inc.** (A. 01-06-029—June 18, 2001).
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Wild Goose Storage** (A. 01-06-029—November 2, 2001)

    - *Consumer benefits from expanded natural gas storage capacity in California.*

36. Prepared Direct Testimony of R. Thomas Beach on behalf of the **County of San Bernardino** (I. 01-06-047—December 14, 2001)

    - *Reasonableness review of a natural gas utility's procurement practices and storage operations.*

37. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 01-10-024—May 31, 2002)
    b. Prepared Supplemental Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 01-10-024—May 31, 2002)

    - *Electric procurement policies for California's electric utilities in the aftermath of the California energy crisis.*

38. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers & Technology Association** (R. 02-01-011—June 6, 2002)

- *"Exit fees" for direct access customers in California.*

39. Prepared Direct Testimony of R. Thomas Beach on behalf of the **County of San Bernardino** (A. 02-02-012 — August 5, 2002)

- *General rate case issues for a natural gas utility; reasonableness review of a natural gas utility's procurement practices.*

40. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association** (A. 98-07-003 — February 7, 2003)

- *Recovery of past utility procurement costs from direct access customers.*

41. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council, the California Manufacturers & Technology Association, Calpine Corporation, and Mirant Americas, Inc.** (A 01-10-011 — February 28, 2003)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council, the California Manufacturers & Technology Association, Calpine Corporation, and Mirant Americas, Inc.** (A 01-10-011 — March 24, 2003)

- *Rate design issues for Pacific Gas & Electric's gas transmission system (Gas Accord II).*

42. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers & Technology Association; Calpine Corporation; Duke Energy North America; Mirant Americas, Inc.; Watson Cogeneration Company; and West Coast Power, Inc.** (R. 02-06-041 — March 21, 2003)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Manufacturers & Technology Association; Calpine Corporation; Duke Energy North America; Mirant Americas, Inc.; Watson Cogeneration Company; and West Coast Power, Inc.** (R. 02-06-041 — April 4, 2003)

- *Cost allocation of above-market interstate pipeline costs for the California natural gas utilities.*

43. Prepared Direct Testimony of R. Thomas Beach and Nancy Rader on behalf of the **California Wind Energy Association** (R. 01-10-024 — April 1, 2003)

- *Design and implementation of a Renewable Portfolio Standard in California.*

44. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 01-10-024 — June 23, 2003)
    b. Prepared Supplemental Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 01-10-024 — June 29, 2003)

    - *Power procurement policies for electric utilities in California.*

45. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Indicated Commercial Parties** (02-05-004 — August 29, 2003)

    - *Electric revenue allocation and rate design for commercial customers in southern California.*

46. a. Prepared Direct Testimony of R. Thomas Beach on behalf of **Calpine Corporation and the California Cogeneration Council** (A. 04-03-021 — July 16, 2004)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Calpine Corporation and the California Cogeneration Council** (A. 04-03-021 — July 26, 2004)

    - *Policy and rate design issues for Pacific Gas & Electric's gas transmission system (Gas Accord III).*

47. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (A. 04-04-003 — August 6, 2004)

    - *Policy and contract issues concerning cogeneration QFs in California.*

48. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council and the California Manufacturers and Technology Association** (A. 04-07-044 — January 11, 2005)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council and the California Manufacturers and Technology Association** (A. 04-07-044 — January 28, 2005)

    - *Natural gas cost allocation and rate design for large transportation customers in northern California.*

49. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association and the Indicated Commercial Parties** (A. 04-06-024 — March 7, 2005)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association and the Indicated Commercial Parties** (A. 04-06-024 — April 26, 2005)

    - *Electric marginal costs, revenue allocation, and rate design for commercial and industrial electric customers in northern California.*

50. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Solar Energy Industries Association** (R. 04-03-017 — April 28, 2005)

- *Cost-effectiveness of the Million Solar Roofs Program.*

51. Prepared Direct Testimony of R. Thomas Beach on behalf of **Watson Cogeneration Company, the Indicated Producers, and the California Manufacturing and Technology Association** (A. 04-12-004 — July 29, 2005)

- *Natural gas rate design policy; integration of gas utility systems.*

52. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 04-04-003/R. 04-04-025 — August 31, 2005)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 04-04-003/R. 04-04-025 — October 28, 2005)

- *Avoided cost rates and contracting policies for QFs in California*

53. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association and the Indicated Commercial Parties** (A. 05-05-023 — January 20, 2006)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association and the Indicated Commercial Parties** (A. 05-05-023 — February 24, 2006)

- *Electric marginal costs, revenue allocation, and rate design for commercial and industrial electric customers in southern California.*

54. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Producers** (R. 04-08-018 – January 30, 2006)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Producers** (R. 04-08-018 – February 21, 2006)

- *Transportation and balancing issues concerning California gas production.*

55. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association and the Indicated Commercial Parties** (A. 06-03-005 — October 27, 2006)

- *Electric marginal costs, revenue allocation, and rate design for commercial and industrial electric customers in northern California.*

56. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (A. 05-12-030 — March 29, 2006)

- *Review and approval of a new contract with a gas-fired cogeneration project.*

57. a. Prepared Direct Testimony of R. Thomas Beach on behalf of **Watson Cogeneration, Indicated Producers, the California Cogeneration Council, and the California Manufacturers and Technology Association** (A. 04-12-004 — July 14, 2006)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Watson Cogeneration, Indicated Producers, the California Cogeneration Council, and the California Manufacturers and Technology Association** (A. 04-12-004 — July 31, 2006)

    - *Restructuring of the natural gas system in southern California to include firm capacity rights; unbundling of natural gas services; risk/reward issues for natural gas utilities.*

58. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 06-02-013 — March 2, 2007)

    - *Utility procurement policies concerning gas-fired cogeneration facilities.*

59. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 07-01-047 — August 10, 2007)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 07-01-047 — September 24, 2007)

    - *Electric rate design issues that impact customers installing solar photovoltaic systems.*

60. a. Prepared Direct Testimony of R,. Thomas Beach on Behalf of **Gas Transmission Northwest Corporation** (A. 07-12-021 — May 15, 2008)
    b. Prepared Rebuttal Testimony of R,. Thomas Beach on Behalf of **Gas Transmission Northwest Corporation** (A. 07-12-021 — June 13, 2008)

    - *Utility subscription to new natural gas pipeline capacity serving California.*

61. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 08-03-015 — September 12, 2008)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 08-03-015 — October 3, 2008)

    - *Issues concerning the design of a utility-sponsored program to install 500 MW of utility- and independently-owned solar photovoltaic systems.*

62. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 08-03-002 — October 31, 2008)

   - *Electric rate design issues that impact customers installing solar photovoltaic systems.*

63. a. Phase II Direct Testimony of R. Thomas Beach on behalf of **Indicated Producers, the California Cogeneration Council, California Manufacturers and Technology Association, and Watson Cogeneration Company** (A. 08-02-001 — December 23, 2008)
   b. Phase II Rebuttal Testimony of R. Thomas Beach on behalf of **Indicated Producers, the California Cogeneration Council, California Manufacturers and Technology Association, and Watson Cogeneration Company** (A. 08-02-001 — January 27, 2009)

   - *Natural gas cost allocation and rate design issues for large customers.*

64. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (A. 09-05-026 — November 4, 2009)

   - *Natural gas cost allocation and rate design issues for large customers.*

65. a. Prepared Direct Testimony of R. Thomas Beach on behalf of **Indicated Producers and Watson Cogeneration Company** (A. 10-03-028 — October 5, 2010)
   b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Indicated Producers and Watson Cogeneration Company** (A. 10-03-028 — October 26, 2010)

   - *Revisions to a program of firm backbone capacity rights on natural gas pipelines.*

66. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 10-03-014 — October 6, 2010)

   - *Electric rate design issues that impact customers installing solar photovoltaic systems.*

67. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Indicated Settling Parties** (A. 09-09-013 — October 11, 2010)

   - *Testimony on proposed modifications to a broad-based settlement of rate-related issues on the Pacific Gas & Electric natural gas pipeline system.*

68. a. Supplemental Prepared Direct Testimony of R. Thomas Beach on behalf of **Sacramento Natural Gas Storage, LLC** (A. 07-04-013 — December 6, 2010)
    b. Supplemental Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Sacramento Natural Gas Storage, LLC** (A. 07-04-013 — December 13, 2010)
    c. Supplemental Prepared Reply Testimony of R. Thomas Beach on behalf of **Sacramento Natural Gas Storage, LLC** (A. 07-04-013 — December 20, 2010)

    - *Local reliability benefits of a new natural gas storage facility.*

69. Prepared Direct Testimony of R. Thomas Beach on behalf of **The Vote Solar Initiative** (A. 10-11-015—June 1, 2011)

    - *Distributed generation policies; utility distribution planning.*

70. Prepared Reply Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 10-03-014—August 5, 2011)

    - *Electric rate design for commercial & industrial solar customers.*

71. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A. 11-06-007—February 6, 2012)

    - *Electric rate design for solar customers; marginal costs.*

72. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Northern California Indicated Producers** (R.11-02-019—January 31, 2012)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Northern California Indicated Producers** (R. 11-02-019—February 28, 2012)

    - *Natural gas pipeline safety policies and costs*

73. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A. 11-10-002—June 12, 2012)

    - *Electric rate design for solar customers; marginal costs.*

74. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Southern California Indicated Producers** and **Watson Cogeneration Company** (A. 11-11-002—June 19, 2012)

    - *Natural gas pipeline safety policies and costs*

75. a. Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 12-03-014—June 25, 2012)
    b. Reply Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 12-03-014—July 23, 2012)

    - *Ability of combined heat and power resources to serve local reliability needs in southern California.*

76. a. Prepared Testimony of R. Thomas Beach on behalf of the **Southern California Indicated Producers** and **Watson Cogeneration Company** (A. 11-11-002, Phase 2—November 16, 2012)
    b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Southern California Indicated Producers** and **Watson Cogeneration Company** (A. 11-11-002, Phase 2—December 14, 2012)

    - *Allocation and recovery of natural gas pipeline safety costs.*

77. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A. 12-12-002—May 10, 2013)

    - *Electric rate design for commercial & industrial solar customers.*

EXPERT WITNESS TESTIMONY BEFORE THE COLORADO PUBLIC UTILITIES COMMISSION

1. Direct Testimony and Exhibits of R. Thomas Beach on behalf of the Colorado Solar Energy Industries Association and the Solar Alliance, (Docket No. 09AL-299E – October 2, 2009).

    - *Electric rate design policies to encourage the use of distributed solar generation.*

2. Direct Testimony and Exhibits of R. Thomas Beach on behalf of the Vote Solar Initiative and the Interstate Renewable Energy Council, (Docket No. 11A-418E – September 21, 2011).

    - *Development of a community solar program for Xcel Energy.*

EXPERT WITNESS TESTIMONY BEFORE THE IDAHO PUBLIC UTILITIES COMMISSION

1. Direct Testimony of R. Thomas Beach on behalf of the **Idaho Conservation League** (Case No. IPC-E-12-27—May 10, 2013)

    - *Costs and benefits of net energy metering in Idaho.*

EXPERT WITNESS TESTIMONY BEFORE THE PUBLIC SERVICE COMMISSION OF NEVADA

1. Pre-filed Direct Testimony on Behalf of the **Nevada Geothermal Industry Council** (Docket No. 97-2001—May 28, 1997)

    - *Avoided cost pricing for the electric output of geothermal generation facilities in Nevada.*

2. Pre-filed Direct Testimony on Behalf of **Nevada Sun-Peak Limited Partnership** (Docket No. 97-6008—September 5, 1997)

3. Pre-filed Direct Testimony on Behalf of the **Nevada Geothermal Industry Council** (Docket No. 98-2002 — June 18, 1998)

    - *Market-based, avoided cost pricing for the electric output of geothermal generation facilities in Nevada.*

EXPERT WITNESS TESTIMONY BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

1. Direct Testimony of R. Thomas Beach on Behalf of the **Interstate Renewable Energy Council** (Case No. 10-00086-UT—February 28, 2011)

    - *Testimony on proposed standby rates for new distributed generation projects; cost-effectiveness of DG in New Mexico.*

2. Direct Testimony and Exhibits of R. Thomas Beach on behalf of the **New Mexico Independent Power Producers** (Case No. 11-00265-UT, October 3, 2011)

    - *Cost cap for the Renewable Portfolio Standard program in New Mexico*

EXPERT WITNESS TESTIMONY BEFORE THE PUBLIC UTILITIES COMMISSION OF OREGON

1. a. Direct Testimony of Behalf of **Weyerhaeuser Company** (UM 1129 — August 3, 2004)
   b. Surrebuttal Testimony of Behalf of **Weyerhaeuser Company** (UM 1129 — October 14, 2004)

2. a. Direct Testimony of Behalf of **Weyerhaeuser Company and the Industrial Customers of Northwest Utilities** (UM 1129 / Phase II — February 27, 2006)
   b. Rebuttal Testimony of Behalf of **Weyerhaeuser Company and the Industrial Customers of Northwest Utilities** (UM 1129 / Phase II — April 7, 2006)

   - *Policies to promote the development of cogeneration and other qualifying facilities in Oregon.*

EXPERT WITNESS TESTIMONY BEFORE THE VIRGINIA CORPORATION COMMISSION

1. Direct Testimony and Exhibits of R. Thomas Beach on Behalf of the Maryland – District of Columbia – Virginia Solar Energy Industries Association, (Case No. PUE-2011-00088, October 11, 2011)

   - *Standby rates for net-metered solar customers, and the cost-effectiveness of net energy metering.*

LITIGATION EXPERIENCE

Mr. Beach has been retained as an expert in a variety of civil litigation matters. His work has included the preparation of reports on the following topics:

- The calculation of damages in disputes over the pricing terms of natural gas sales contracts (2 separate cases).
- The valuation of a contract for the purchase of power produced from wind generators.
- The compliance of cogeneration facilities with the policies and regulations applicable to Qualifying Facilities (QFs) under PURPA in California.
- Audit reports on the obligations of buyers and sellers under direct access electric contracts in the California market (2 separate cases).
- The valuation of interstate pipeline capacity contracts (3 separate cases).

In several of these matters, Mr. Beach was deposed by opposing counsel. Mr. Beach has also testified at trial in the bankruptcy of a major U.S. energy company, and has been retained as a consultant in anti-trust litigation concerning the California natural gas market in the period prior to and during the 2000-2001 California energy crisis.

Crossborder Energy

Client List: 2005 - 2012

1. End-Use Customers

California Manufacturers and Technology Association
Catholic Healthcare West, now Dignity Health
County of Los Angeles
Del Taco
Industrial Customers of Northwest Utilities
Los Angeles Unified School District
Lowe's Home Improvement Warehouses
Matheson-TriGas
Proterra
San Joaquin Refining
Sony Pictures Entertainment

2. Independent Power Producers

Abengoa Solar
BP Carson Hydrogen Project
California Coalition for Clean Distributed Generation

California Cogeneration Council, including
- Berry Petroleum
- CP Kelco
- Delta Power
- Foster Wheeler
- Graphics Packaging
- Juniper Generation
- Primary Energy
- Proctor & Gamble
- Purenergy
- Searles Valley Minerals (IMC Chemicals)
- Smurfit - Stone Container
- Temple - Inland
- United Airlines
- U.S. Borax
- Weyerhaeuser
- Willamette Industries

Calpine Corporation
Countryside U.S. Power
GE Energy
GWF Power Systems
TransCanada
Veresen
Watson Cogeneration Company (now owned by Tesoro)

3. Renewable Power Producers / Advocates

Akeena Solar
Babcock & Brown
California Solar Energy Industries Association

California Wind Energy Association, including

- Acciona Energy North America
- AES
- AltaGas
- Ameron International
- CalWind Resources
- Cannon Power Group
- Clipper Windpower
- Coram Energy
- CPV Renewable Energy Company
- enXco Development Corp
- Eurus Energy
- First Wind
- Invenergy, LLC
- KEMCO
- Milbank, Tweed, Hadley & McCloy
- Oak Creek Energy Systems
- Padoma Wind Power, LLC
- Pattern Energy Group LP
- Renewable Energy Systems Americas Inc.
- San Gorgonio Farms
- Sapphos Environmental, Inc.
- Stoel Rives, LLP
- Terra-Gen Power
- Wind Stream Properties, LLC

Colorado Solar Energy Industries Association
GreenVolts
Interstate Renewable Energy Council
Maryland – DC – Virginia Solar Energy Industries Association
New Mexico Independent Energy Producers
NextEra (Solar Electric Generation Station Units III - IX)
NGP Power
Ormat

Crossborder Energy

Client List: 2005 - 2012

Solar Energy Industries Association, including

- Applied Materials
- Borrego Solar Systems
- BP Solar
- Community Energy
- EnXco
- First Solar
- Kyocera Solar
- Mainstream Energy Corporation
- Mitsubishi Electric
- Oerlikon Solar
- Petra
- QCells
- Sanyo Energy Corporation
- Schott Solar
- Sharp Solar
- SolarCity
- Solaria
- Solar Power Partners
- SolarWorld
- Solyndra, Inc.
- SPG Solar
- SunEdison
- SunPower
- SunRun
- Suntech America
- Tioga Energy
- Trinity Solar
- Uni-Rac
- UniSolar
- Yingli Solar

Southern Alliance for Clean Energy
Vote Solar Initiative

4. Natural Gas Pipelines / Storage Providers

Kern River Gas Transmission
Sacramento Natural Gas Storage
TransCanada's Gas Transmission Northwest and North Baja Systems

5. Natural Gas Producers / Marketers

Aera Energy
Chevron U.S.A.
Core Transport Agent Consortium
Occidental Petroleum
Northern California Indicated Producers, including
- ConocoPhillips Company
- Chevron U.S.A. Inc.
- Aera Energy LLC Inc.
- Equilon Enterprises, LLC dba Shell Oil Products U.S.

Southern California Indicated Producers, including
- ConocoPhillips Company
- Chevron U.S.A. Inc.
- Exxon Mobil Gas Corporation

6. Utilities

City of Vernon
Sacramento Municipal Utility District

EXHIBIT B

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION
DOCKET NO. E-100, SUB 83

In the Matter of:	)	**AFFIDAVIT IN SUPPORT OF**
Investigation of Net Metering	)	**MOTION FOR DISCLOSURE**
	)	**AND EQUITABLE RELIEF**

AFFIDAVIT OF ROBERT S. KINGERY

STATE OF NORTH CAROLINA

WAKE COUNTY

I, Robert ("Bob") S. Kingery, being first duly sworn, do depose and say:

1. I currently serve as President of Southern Energy Management, Inc. ("SEM"), a North Carolina S-Corporation. SEM provides solar and energy efficiency services to residential and commercial clients. To date, SEM is responsible for the development of more than 15 MWs of currently interconnected rooftop solar energy systems in North Carolina. In my current position, I oversee all business functions. I have held my current position for 13 years.

2. I have attached my resume as Appendix A. My resume provides a summary of my education and additional experience.

3. The current net metering messaging by Duke Energy Corporation is negatively impacting SEM's business in two ways: First, the messaging is creating significant uncertainty for our *current* customers who are already net metering; these customers, in turn, are asking us how their net metering is unfair and how their bills might change as a result of any changes to the net metering tariff. Because of how Duke Energy Corporation is messaging without having filed anything definitive at the Utilities Commission, we are not in a position to be as responsive as we would like or to provide

the customer service we would like. This is bad for business. Second, and perhaps more destructive to our relatively small, locally-operated business, Duke Energy Corporation's messaging is creating uncertainty among *prospective, potential* customers and is having a "chilling" effect on the market. Duke Energy Corporation's mere messaging is effectively causing potential customers to sit on the sidelines until there is more certainty. For example, our sales team has reported that multiple clients are "in a holding pattern," having expressed uncertainty and a desire to "wait until the dust settles" on net metering before making a solar investment. Duke Energy Corporation's use of its market dominance to unfairly "chill" the limited market available to Duke's competitors is clearly bad for Duke's competitors' businesses, including our business.

4. This completes my affidavit.

Robert S. Kingery

SWORN TO AND SUBSCRIBED BEFORE ME
ON THIS THE 18th DAY OF FEBRUARY, 2014.

Erica H. Boisvert
Notary Public

My Commission Expires: 3-19-18

ERICA H BOISVERT
Notary Public
Wake County
NORTH CAROLINA

Robert S. Kingery

101 Kitty Hawk Drive • Morrisville, NC 27560 • (919) 836-0330
• bkingery@southern-energy.com

President / Co-owner

Over 25 years in business and operations with experience in manufacturing, design, consultation and planning.

Employment History

SOUTHERN ENERGY MANAGEMENT (Morrisville, NC) — **Co-Owner,** 2001 to Present

Co-owner and operations manager with company focusing on energy efficiency, green building and solar solutions for residential, commercial and industrial clients.

- SEM received Energy Star partner of the year nationally 2007-2013
- Certified Energy Star home rater
- HERS provider
- NABCEP Certified solar installer
- Sunpower Premier dealer

BURT'S BEES, INC. (Durham, NC) — **Director of Manufacturing,** 1998 to 2001

- Manage all aspects of purchasing, distribution, and materials management for a multi million-dollar personal care manufacturer and distributor.
- Capital Expenditure and facility planning, budgeting and implementation, including custom specifications and designs.
- Serve as operations tie to research and development and marketing departments.

BURT'S BEES, INC. (Durham, NC) — **Plant Engineer,** 1994 to 1998

- Developed an SOP (standard operating procedure) system to bring manufacturing into FDA compliance and facilitate the training of new employees.

- Developed a plant layout and executed a plant move with no lost shipping days and no customer impact.
- Developed and implemented processes and product specifications required for new product launches.

ASTRON TECHNOLOGIES. (Durham, NC) — **Solar Engineer,** 1993 to 1994

- Designed solar equipment, heat exchangers and solar storage tanks.
- Manufactured active solar hot water systems.

SOLAR CONSULTANTS. (Durham, NC) — **Solar Technician,** 1992 to 1993

- Designed and installed active solar hot water and space heating systems in residential and commercial applications.
- Designed photovoltaic systems. Maintained active solar systems.

Education & Certifications

North Carolina State University, Raleigh, NC Bachelor of Science Mechanical Engineering, 1991

♦ Co-designed and manufactured award winning grass processor for group project course

North American Board of Certified Energy Practitioners

Certified Solar Thermal Installer, 2010 to 2013

Offices Held

Treasurer, North Carolina Sustainable Energy Association; Board of Directors, North Carolina Sustainable Energy Association; Board of Directors, Sustainable North Carolina; President, NC/VA Macola User Group

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION
DOCKET NO. E-100, SUB 83

In the Matter of:	)	**AFFIDAVIT IN SUPPORT OF**
Investigation of Net Metering	)	**MOTION FOR DISCLOSURE**
	)	

AFFIDAVIT OF Jason A Epstein

STATE OF NORTH CAROLINA

Wake COUNTY

I, Jason A Epstein, being first duly sworn, do depose and say:

1. I currently serve as Executive Vice President and General Manager at Baker Renewable Energy, a North Carolina S Corporation. Baker Renewable Energy provides complete solar energy systems and installations for commercial and residential purposes. To date, Baker Renewable Energy is responsible for the installation of 5 MWs of currently interconnected rooftop solar energy systems in North Carolina. In my current position, I am responsible for overseeing Operations, Standards, Safety, and Business Development. I have held my current position for 5 years.

2. The current messaging by Duke Energy Corporation is negatively impacting Baker Renewable Energy's business in two ways: First, the messaging is creating significant uncertainty for our *current* customers who are already net metering; these customers, in turn, are asking us how their net metering is unfair and how their bills might change as a result of any changes to the net metering tariff. Because of how Duke Energy Corporation is messaging without having filed anything definitive at the Utilities Commission, we are not in a position to be as responsive as we would like or to provide the customer service we would like. This is bad for business. Second, and perhaps more

destructive to our relatively small, locally-operated business, Duke Energy Corporation's messaging is creating uncertainty among *prospective, potential* customers and is having a "chilling" effect on the market. Duke Energy Corporation's mere messaging is effectively causing potential customers to sit on the sidelines until there is more certainty. For example, since the article has come out we have had a number of potential clients hold off on making purchases until this is resolved. Duke Energy Corporation's use of its market dominance to unfairly "chill" the limited market available to Duke's competitors is clearly bad for Duke's competitors' businesses, including our business.

3. This completes my affidavit.

Jason A Epstein
Executive Vice President and GM
Baker Renewable Energy

SWORN TO AND SUBSCRIBED BEFORE ME
ON THIS THE 11th DAY OF FEBRUARY, 2014.

Notary Public

My Commission Expires: 10/30/17

CAITLIN BLAIR DARNER
NOTARY PUBLIC
WAKE COUNTY, NC
MY COMMISSION EXPIRES 10/30/17

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION
DOCKET NO. E-100, SUB 83

In the Matter of:	)	**AFFIDAVIT IN SUPPORT OF**
Investigation of Net Metering	)	**MOTION FOR DISCLOSURE**
	)	

AFFIDAVIT OF David B. Hollister

STATE OF NORTH CAROLINA

____Buncombe____ COUNTY

I, ___Dave B. Hollister____, being first duly sworn, do depose and say:

1. I currently serve as President/CEO of Sundance Power Systems, Inc., a North Carolina Corporation. Sundance Power Systems, Inc. provides complete solar energy systems and installations for commercial, institutional and residential purposes. To date, Sundance Power Systems is responsible for the development of 3 MWs of currently interconnected rooftop solar energy systems in North Carolina. In my current position, I am responsible for managing the day to day operations of the company, managing the financial health of the company and guide the future long term directive of the company. I have held my current position for 19 years and 7 months.

2. The current actions and messaging by Duke Energy Corporation is negatively impacting Sundance Power Systems, Inc.'s business in three ways: First, the messaging is creating significant uncertainty for our *current* customers who are already net metering; these customers, in turn, are asking us how their net metering is unfair and how their bills might change as a result of any changes to the net metering tariff. Because of how Duke Energy Corporation is messaging without having filed anything definitive at the Utilities Commission, we are not in a position to be as responsive as we would like or

to provide the customer service we would like. This is bad for business. Second, and perhaps more destructive to our relatively small, locally-operated business, Duke Energy Corporation's messaging is creating uncertainty among *prospective, potential* customers and is having a "chilling" effect on the market. Duke Energy Corporation's mere messaging is effectively causing potential customers to sit on the sidelines until there is more certainty. And third, Duke Energy Corporations slow process and response to requests for interconnection and cutting nearly two months off of the end of the year for interconnecting systems dramatically inhibits the number of systems that can be effectively sold and completed throughout any given year. Our customers have experienced these issues regularly and often comment on how this feels like they do not support their efforts to install solar energy. Duke Energy Corporation's use of its market dominance to unfairly "chill" the limited market available to Duke's competitors is clearly bad for Duke's competitors' businesses, including our business.

3. This completes my affidavit.

David B. Hollister

SWORN TO AND SUBSCRIBED BEFORE ME
ON THIS THE 19th DAY OF FEBRUARY, 2014.

Melissa A. Mace
Notary Public

My Commission Expires: 6-2-16

MELISSA A MACE
NOTARY PUBLIC
MADISON COUNTY, NORTH CAROLINA

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION
DOCKET NO. E-100, SUB 83

In the Matter of:	)	**AFFIDAVIT IN SUPPORT OF**
Investigation of Net Metering	)	**MOTION FOR DISCLOSURE**
	)	

AFFIDAVIT OF ____________________

STATE OF NORTH CAROLINA

WAKE COUNTY

I, Stewart A. Miller, being first duly sworn, do depose and say:

1. I currently serve as Co-Owner and President of Cate Associates, Inc., DBA Yes! Solar Solutions of the Triangle, a North Carolina S Corporation that provides complete solar energy system design and installation services for commercial and residential clients throughout North Carolina. To date, Yes! Solar Solutions has been responsible for the installation of approximately 1.1MWs of currently interconnected rooftop and ground mounted solar energy systems in North Carolina. In my current position, I am responsible for overseeing all facets of our company and for calling on commercial clients interested in reducing electricity costs through net metering solar production on building rooftops. I have held my current position for 4 years and 10 months.

2. I have attached my resume as Appendix A. My resume provides a summary of my education and additional experience.

3. In my opinion as a business proprietor, Duke Energy Corporation's messaging about net metering changes in North Carolina is contributing to significant uncertainty among *prospective, potential* customers. I believe Duke Energy Corporation's mere messaging is contributing to potential rooftop solar customers sitting on the sidelines

until there is more certainty about the future of net metering. Uncertain customers yield business uncertainty. When potential rooftop solar customers sit on the sidelines, it is bad for Duke's competitors' businesses, including our business.

4. This completes my affidavit.

Stewart A. Miller

SWORN TO AND SUBSCRIBED BEFORE ME
ON THIS THE 17th DAY OF FEBRUARY, 2014.

Kathleen Miller
Notary Public

My Commission Expires: January 16, 2017

KATHLEEN MILLER
NOTARY PUBLIC
WAKE COUNTY, NC

Yes!

solar solutions

the power of independence

Stew Miller, Bio

Stew Miller is co-Owner and President of Yes! Solar Solutions, with responsibility for sales, financials and most operations. Stew is also a licensed NC General Contractor, 67356 and has renovated several historical buildings in Cary and the surrounding areas.

Prior to starting Yes! Solar Solutions, Stew and his wife Kathy, created a multi-million dollar private education company called Primrose Schools of Cary, employing over 80 employees and graduating thousands of children in the Triangle area. The Millers sold the schools in 2004.

Prior to opening the Primrose School franchise, Stew Miller worked for NCR Corporation for 21 years primarily in sales and product management. He rose from salesperson to District Sales Manager, to Director of Product Management at the Atlanta-based, Engineering & Manufacturing facility.

Stew has a degree in Economics and Business Administration from Albion College in Albion, Michigan.

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