Contract No:

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Disclaimer:

Research Performance Progress Report – DOE Solar Program, Soft Costs, National Lab Projects

Project Title:	Promotion of PV Soft Cost Reductions in the Southeastern US
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Recipient:	Savannah River National Laboratory
Address:	#1 Road 1, Aiken, SC 29809
Awarding Agency:	DOE EERE SETO PV Soft Costs
Working Partners:	Duke Energy South Carolina Electric & Gas SC Energy Office Central Electric Power Cooperative SC Coastal Conservation League SC Solar Council Solar Business Alliance
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Executive Summary:

Beginning in 2014, the installed solar capacity in South Carolina (SC) grew from less than 20 megawatts to more than 300 megawatts today. Concurrently, the number of customer-sited, load-centered solar generation is expected to grow from less than 500 statewide to as many as 10,000 by 2021. This growth is the direct result of a landmark state policy initiative, Act 236, passed by the South Carolina General Assembly and signed into law by the Governor in June of 2014. Today, local policy makers in South Carolina are ill-equipped to handle the onslaught of solar permitting and zoning requests expected to come with such quick growth of an emerging market. Similarly, the state's building inspectors, first responders, and tax assessors know little about photovoltaic (PV) technology and best practices. Finally, South Carolina's workforce and workforce trainers continue to be underprepared to benefit from the tremendous opportunity created by the passage of Act 236. Each of these deficits in knowledge of and preparedness for solar PV translates into higher "soft costs" of installed solar PV in South Carolina.

The Savannah River National Laboratory (SRNL), together with almost a dozen electricity stakeholders in the southeast, worked to create a replicable model for solar PV soft cost reduction in South Carolina through human capacity-building at the local level and direct efforts to harmonize policy at the inter-county or regional level. The primary goal of this effort was to close the gap between South Carolina installed costs of residential rooftop solar and national averages. The secondary goal is to develop a portable and replicable model that can be applied to other jurisdictions in the future. A diverse team consisting of SRNL, Duke Energy, Central Electric Cooperative (Central), Santee Cooper, The South Carolina Energy Office (SCEO), The South Carolina Solar Council (SCSC), The South Carolina Solar Business Alliance (SBA), and the Coastal Conservation League (CCL), worked to address the knowledge gap of the impacts of this ground-breaking legislation and address training shortages of the SC solar market preparing to emerge from its infancy. This study offers a unique perspective and understanding of the actual impact of the rapid integration of solar energy starting at a penetration of 0.1% and increasing to over 2%, while expanding access, developing regional specific training and educational materials, and developing datasets to support expanding solar markets. Through targeted tracking and analysis, we developed a baseline of the current market, identified the major obstacles in soft cost reduction, and cooperatively developed stakeholder centric strategies.

Background:

South Carolina and the southeastern U.S. is predicted to have soft costs that are at least 25% higher than those in other regions of the country. A steep reduction in these costs is needed, not only to meet nationwide parity, but also grid parity. In order for Act 236 to successfully reach its goals of 1% utility scale and 1% distributed scale solar power by 2021, without rate basing solar incentives, steep cost reductions must be realized. High solar soft costs combined with the low electricity rates and low average income level of consumers, make the target distributed levels harder to achieve than similar penetrations in other states. This project aimed to not only reduce the costs associated with solar, but also decrease the time and educational barriers associated with doing so. This study offered a unique perspective on and understanding of the real impact of the rapid integration of solar energy starting at a penetration of 0.1% and increasing to over 2%, while expanding access, developing regional specific training and educational materials, and developing datasets to support expanding solar markets. This work encompassed a comprehensive solution to make solar deployment faster, cheaper, and significantly easier in the region.

The overreaching goal of this effort was to close the gap between South Carolina and other southeastern states installed costs of residential rooftop solar and national averages, while developing a portable and replicable model that can be applied to similar jurisdictions in the future. Through careful tracking and data analysis, we developed a baseline of the current market, identified the largest issues in soft cost reduction, and cooperatively developed strategies to tackle them in a manner that works for all parties involved. This project provided a financial analysis and model of PV soft costs that not only provided a detailed assessment of the costs, but also portable, replicable models for workforce development, cost reduction, and policy development that may be used not only in the southeast, but in other regions of the country with immature solar markets.

Introduction:

Our team is comprised of stakeholders from all areas: utilities, power generators, small and large businesses, non-profits, and environmental groups, many of which helped craft Act 236. Their working knowledge, expertise, and access to information were vital to ensure that this project reached its full potential. It was also important for a project of this magnitude and complexity to be led by an independent research organization, and there is no other organization in South Carolina with the needed credibility and expertise. SRNL was able to provide a fully dedicated staff of scientists and engineers to track, push forward, and analyze the data on a scale and complexity that would not be possible otherwise. The scope of this project was larger than can reasonably be accomplished by one entity alone. Utilities and businesses have a larger focus on day

to day operations and cannot dedicate the required time and funding needed to accomplish such a study. In addition, the seasoned relationships between all involved parties helped ensure full cooperation and usefulness of the end products.

Energy metrics (Q1FY16- Q4FY18)

A complete picture of the current status of solar installations, including costing, number of installations, and distribution across the state was not well defined. In order to understand economic growth and the potential for solar cost reduction, we first determined the current state of practice. After the baseline was established, quarterly reporting based on data collected through surveys and roundtables determined current solar costs and process times, while also tracking market growth and identifying emerging issues. Progress was carefully tracked in order to better determine and project work force needs, economic impact of the DER, impact of cost reduction efforts of this proposed effort, and emerging issues.

Soft cost reductions (Q1FY16- Q4FY18)

The state's IOU's, power generators, and rural electric cooperatives worked with project partners, as well as installers and local governments, to identify problems they can help address such as taxation and permitting, indirect corporate costs, installation costs, and customer acquisition costs. We evaluated the effectiveness of existing incentives, while also examining current disincentives, such as home owner association and architectural review board solar prohibitions. In the short term, recommendations and guides were put in place to help individual users identify the correct permitting process in their area. Recommendations were crafted from the Solar ABCS Expedited Permit process for installers, counties, and municipalities and opportunities to unify local permitting were proposed. Recommendations were also put forth by non-profits on any legislative action that may have been needed to facilitate the process to address longer-term issues, such as tax abatement and incentives, and to unify the permitting process. This was completed through the development of the SC Energy Plan, multi-group meetings to discuss the next generation of state legislation, Quarterly reporting and round tables identified additional needs and challenges to address, particularly consumer protection, as well as to track progress on permitting streamlining. These soft cost reduction strategies were communicated with the local governments through both the SCEO and the Municipal Association through multiple in person meetings. They continue to be communicated at twice yearly meetings of the South Carolina Solar Council, which typically has over 100 stakeholders from around the state in attendance.

Public Education (Q1FY16- Q4FY18)

A one-stop-shop for the region was established to help increase and speed up customer access to installation information (www.solar.SC.gov). Ready access to this sort of trusted quality information has the potential to take much of the educational

burden off the installer and thus reduce their customer acquisition cost. This site expanded upon and included already existing informational packets developed by the SCEO, utilities, and others which include a Solar 101 guide and homeowners' guidelines. This website includes informational bulletins on the following areas:

1) how to identify a legitimate quote and installer and evaluate the value of the system
2) understanding solar electricity and the related rules and regulations
3) what reporting needs to be completed to the power company and how to do it
4) how the DER program individually impacts them, including how to participate
5) a public database of licensed solar installers and installation companies in the state by county
6) tracking of utility scale and distributed scale installations and
7) financially focused homeowner solar guides.

Workforce training (Q1FY16-Q4FY18)

A vital component to help meet quality standards and cost reduction goals was the training of licensed and qualified installers. We anticipated training a minimum of three to six trainers and 30 installers by the end of FY18. Due to discussion with small business owners, installers, and the state's apprenticeship program, it was determined that the most efficient and useful route to increasing installers would be to develop an apprentice training program. This program was initiated with a Charleston, SC based installation company, Alder Energy, who continues to hire installers under the guidelines developed through he program. Another important and often overlooked component we wanted to highlight was training first responders. This expanded upon an already existing State Fire Marshall program and it was also offered to the state electric cooperatives, IOU's, and power providers. We trained an additional 200 first responders by the end FY18.

Project Results and Discussion:

The cost of residential installations remained an impediment to access to solar energy, particularly in poor and rural communities. However, simply the action of signing Act 236 had a direct, immediate impact on the cost of solar energy in SC in the residential, commercial, and utility sectors. In 2014, residential systems installed for an average of $4.40/W-DC, see Figure 1. This immediately dropped by $0.87/W-DC to $3.53 in 2015 before Act 236 was fully implemented. In 2016, when third party leasing became available, the average cost decreased another $0.19/W-DC, and the estimated cost from the 2017 survey was $3.38/W-DC. Overall, total cost dropped 23% in the three-year period. The cost of residential and utility scale installations dropped $0.48/W-DC for commercial installations and $0.65/W-DC for utility-scale installations between 2014 and 2015, see Figures 2 and 3, respectively. Overall, the cost of commercial

installations dropped by 39% over the three-year period, while the cost of utility-scale installations dropped by 43%. This large drop in price has allowed several power purchase agreements (PPAs) to be signed with the utilities for below avoided cost.

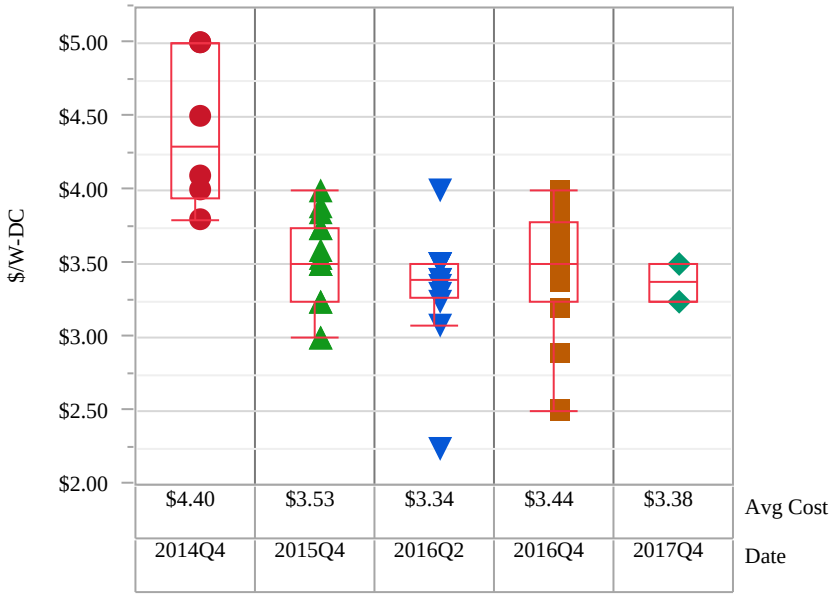

Figure 1. Total Cost of Residential PV Installations in $/W-DC from 2014 through 2017.

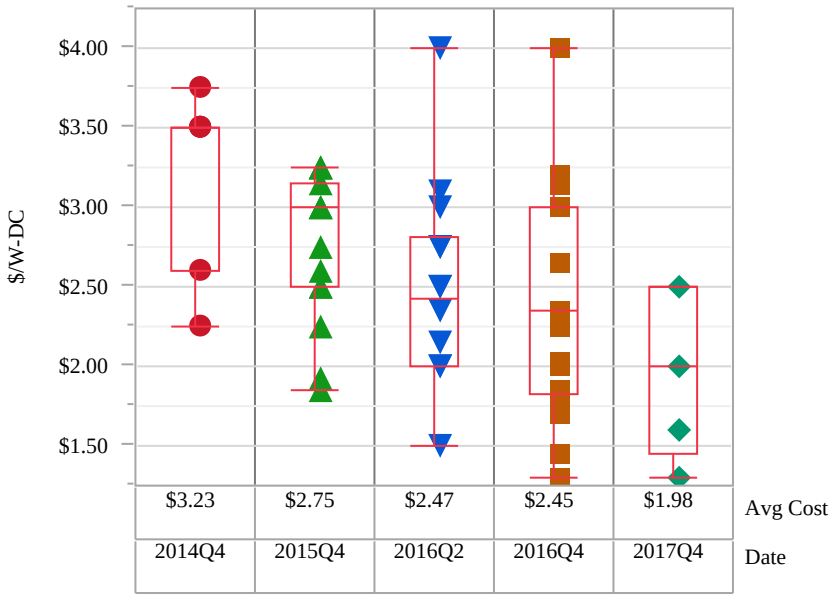

Figure 2. Total Cost of Commercial PV Installations in $/W-DC from 2014 through 2017.

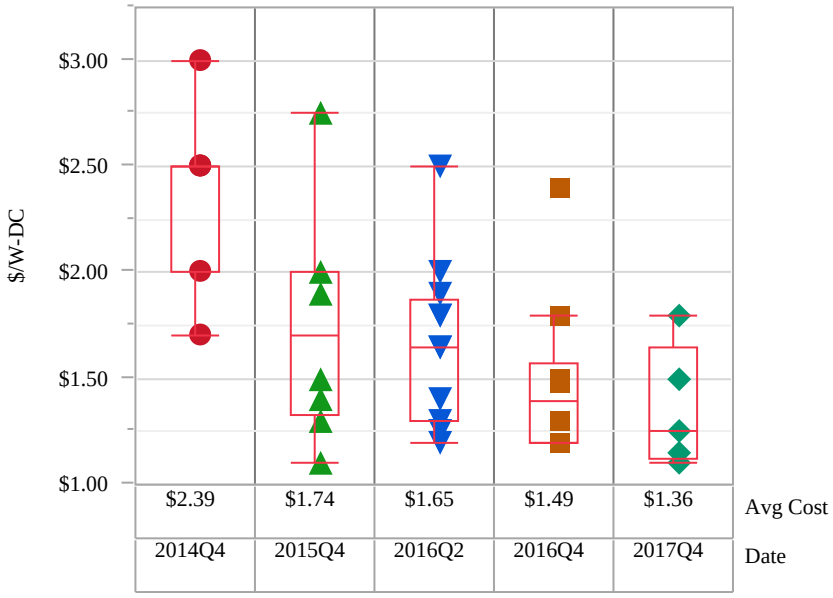

Figure 3. Total Cost of Utility PV Installations in $/W-DC from 2014 through 2017. Average Hardware Cost ($/W-DC) by Type of Installation

To better understand changing costs, the percentage of the cost of installation in each sector has been tracked over the three-year period. In each sector, the total percentage of cost attributed to hardware has essentially remained flat since 2014, see Figures 4-6, for residential, commercial, and utility sectors, respectively. Hardware remains 60% for residential systems, 59% for commercial systems, and 65% for utility-scale systems.

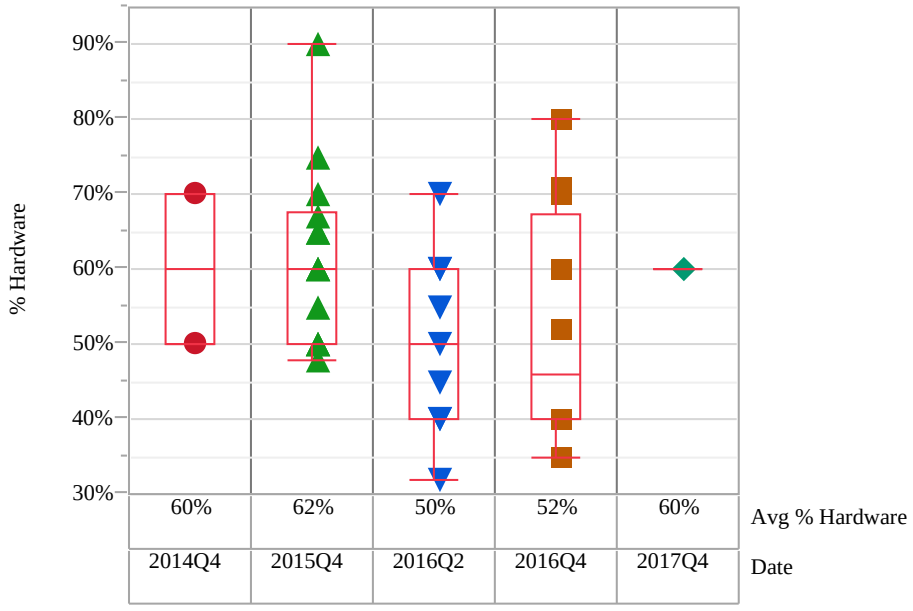

Figure 4. Percent hardware cost for residential solar by date.

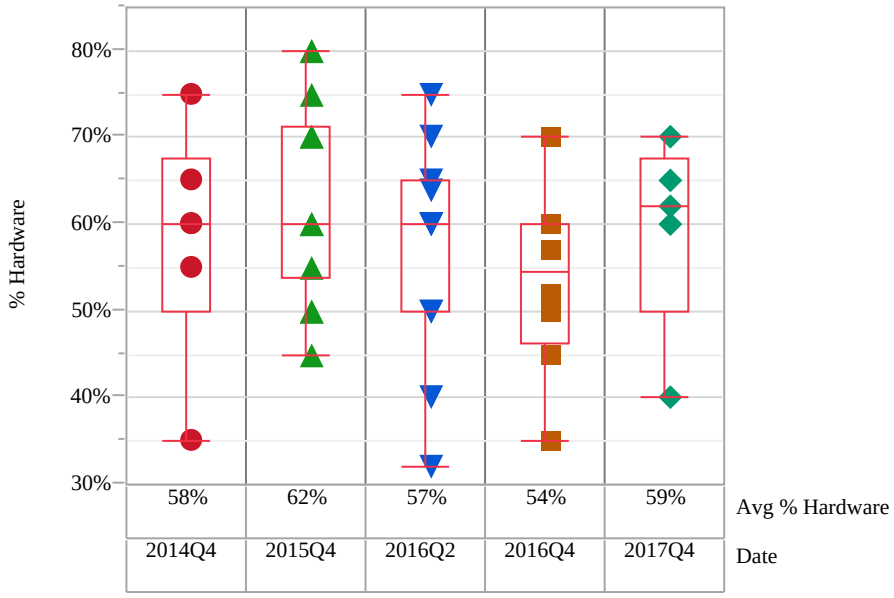

Figure 5. Percent hardware cost for commercial solar by date.

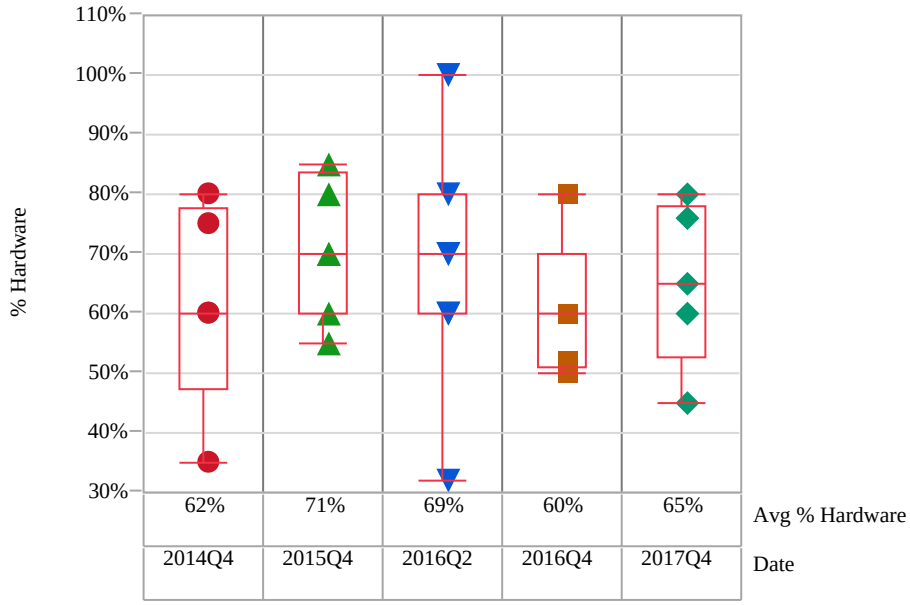

Figure 6. Percent hardware cost for utility-scale solar by date.

When calculated on a $/W-DC basis (see Table 2), the hardware costs for residential systems have dropped $0.50/W-DC in three years. Commercial systems hardware dropped by $0.71/W-DC in the same period, while utility-scale systems hardware dropped by $0.55/W-DC. Impacts of recently imposed solar tariffs, which began in early 2018, are expected to lead to increases in the cost of about $0.10/W-DC in 2018 but only about $0.04/W-DC in 2022. [1] This 2018 increase would represent a 5% increase in hardware costs for residential systems, a 9% increase for commercial systems, and a 12% increase in hardware for utility scale systems.

Table 1. Average cost for hardware in $/W by sector at the end of each calendar year 2014-2017.

Segment Served	2014	2015	2016	2017
Residential	$2.53	$2.17	$1.76	$2.03
Commercial	$1.85	$1.69	$1.35	$1.14
Utility	$1.41	$1.18	$0.86	$0.86

Total soft costs for each sector were calculated from the reported total cost and hardware costs and tabulated in Table 1. In addition to tracking percentage of hardware and soft costs for the three different solar sectors, soft costs were further broken down into four categories: 1) marketing, sales, and lead generation, 2) permitting, interconnection, and associated labor costs with those efforts, 3) installation, and 4) profit, overhead, and taxes. The variability plot for these costs in 2017 can be found in Figure 7.

Table 2. Average total soft cost in $/W for each sector at year end 2014-2017.

Segment Served	2014	2015	2016	2017
Residential	$1.63	$1.38	$1.68	$1.35
Commercial	$1.33	$1.02	$1.16	$0.84
Utility	$0.93	$0.56	$0.56	$0.50

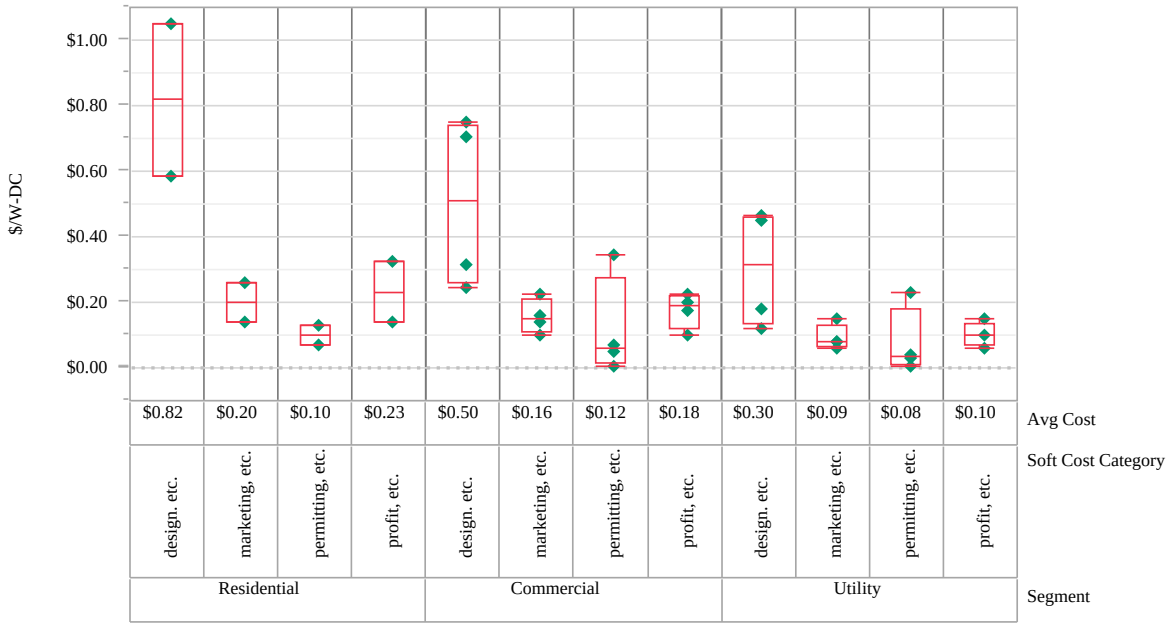

Figure 7. Variability chart for soft cost by sector in $/W-DC in 2017.

A comparison of changes in each category for all three sectors can be found in Figures 8-11 below. In all three sectors, costs for installation and design have tended to

increase since 2014 — though most dramatically for the residential sector. It is not clear why installation costs almost doubled for the residential sector between 2014 and 2015, though it may be due to wage incentives to promote a rapid increase in hiring. The price increase for installation was more moderate for commercial and utility scale systems at close to $0.10/W-DC for each sector.

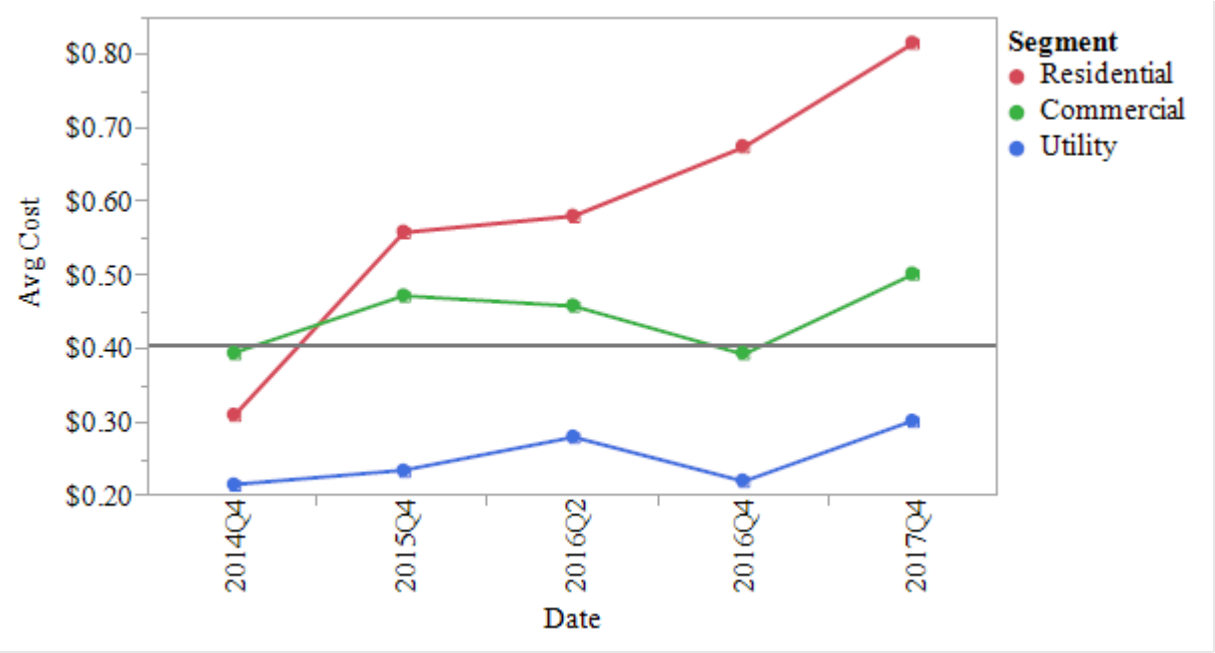

Figure 8. Installation, Design, Engineering, and Construction Labor Soft Cost In $/W-DC.

One very clear, immediate effect of signing Act 236 was the decrease in costs associated with marketing and sales between 2014 and 2015, see Figure 9. These costs remained low and were cut in half merely by signing the legislation. This would be due to increased customer awareness and education levels. The programs developed by the IOUs educated their customers on the benefits of solar, and the positive press that was generated by the enabling legislation added to awareness. Marketing and sales costs remained from 60-75% lower in 2017 from associated costs in 2014. This soft cost category has had the largest contribution to decreasing the overall system cost for all three sectors.

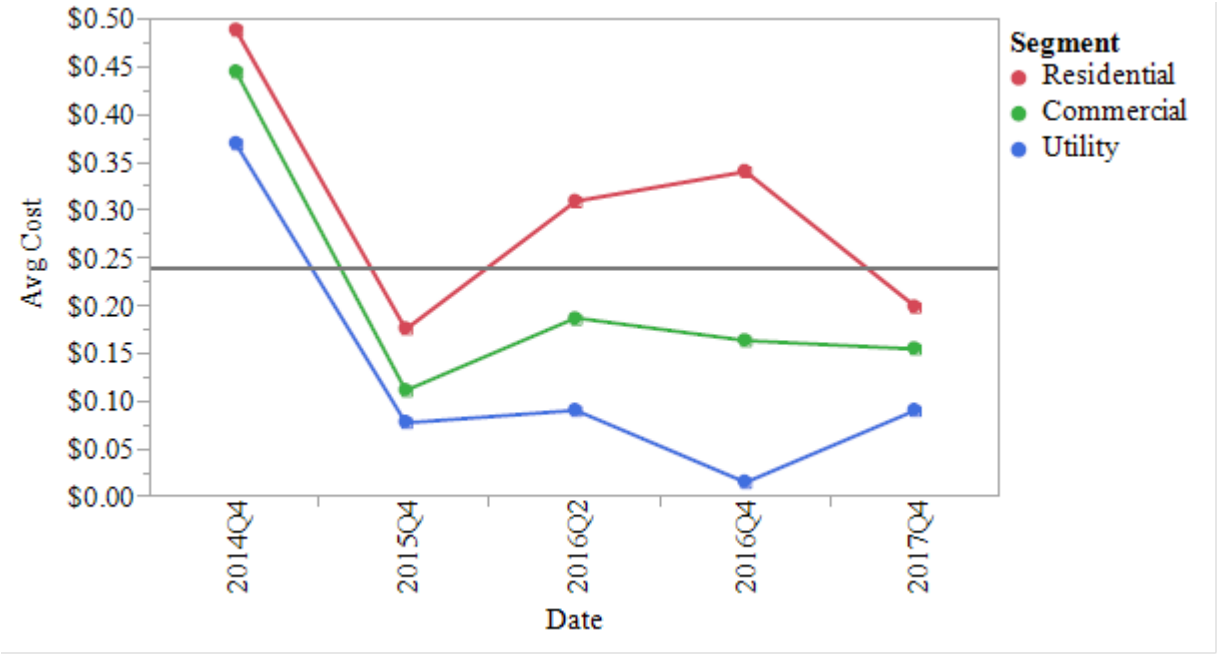

Figure 9. Marketing, Lead Generation, and Sales Soft Cost in $/W-DC.

Costs associated with permitting and interconnection caused the greatest headache for installers, yet remain the lowest overall cost category, see Figure 10. These costs have remained the same for utility-scale installations but increased by $0.02/W-DC for commercial systems, while dropping by $0.08/W-DC for residential systems since 2014. The fees associated with each type of installation have remained unchanged since 2014, so all changes in cost would be due to labor contributions for the permitting and interconnection process.

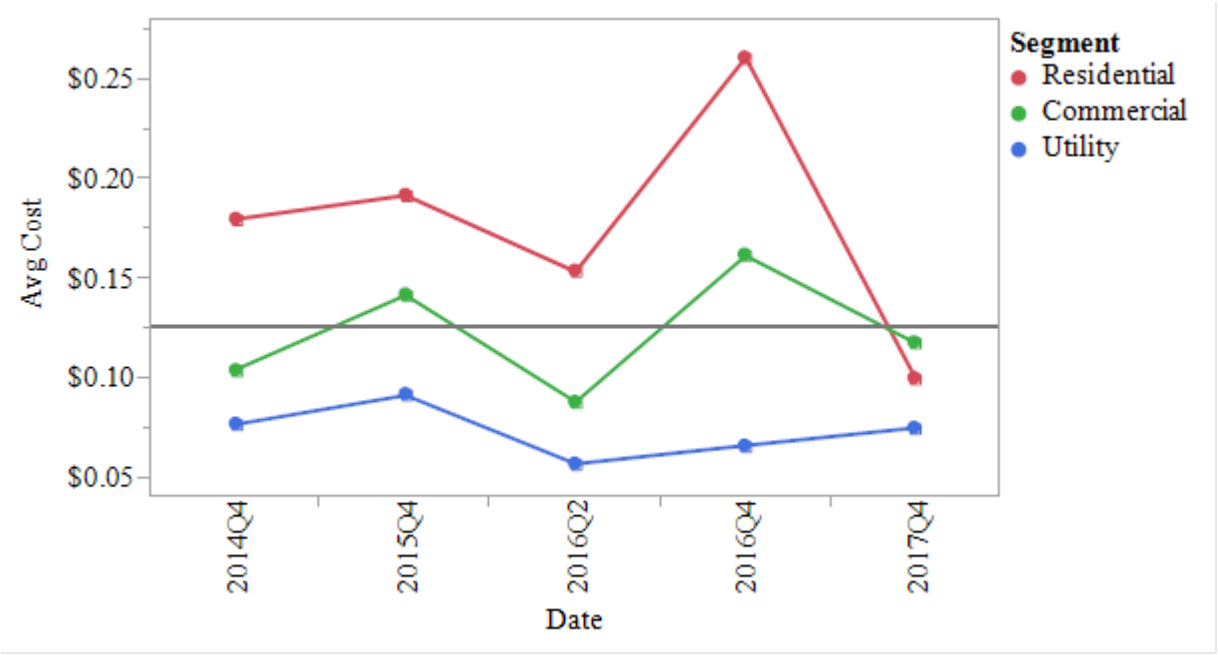

Figure 10. Permitting, Interconnect Fees, and Administrative Labor Soft Costs in $/W-DC.

Profit, overhead, and taxes also decreased on a $/W-DC basis for all three sectors since 2014, see Figure 11. In 2015, the costs associated with this category took a dramatic drop before increasing again in 2016. Based on discussions with installers, this was due to dramatic cuts in profit the installers put in place to help drive a market share and business growth, in many cases with installers installing below cost. These cuts were unsustainable and resulted in increases to at or above 2014 costs in 2016. Since then, these costs have continued to decline by 65% for the residential sector, 54% for the commercial sector, and 62% for the utility sector. As taxation rates have remained unchanged in that time frame, the cost decreases are associated with trimming overhead costs and profits.

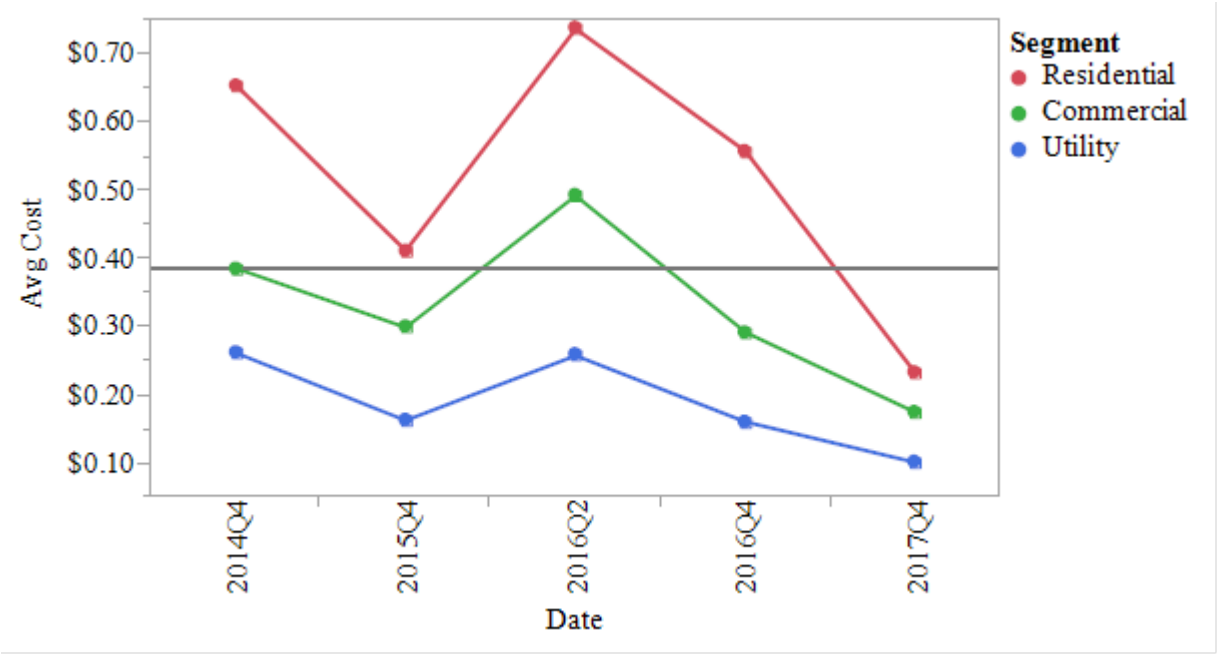

Figure 11. Profit, Overhead, and Taxes Soft Cost in $/W-DC.

In 2014, there were less than 3MW total solar energy in SC. By 2015, there were over 5MW of distributed energy systems alone. That number ballooned to over 25 MW of distributed systems in 2016. There were over 83 MW of distributed systems sized 20 kW or less in SC by the middle of 2017[1]. The installation data was further broken down by region in SC. A comparison for each region based on population, income, and capacity is found in Table 5. To provide additional comparison, the installed watts per person in each region was also calculated.

Table 3. Demographics of Each Region in SC as Compared to Installed Capacity.

	# of Counties	[1]Population	Median Income	Percent living in poverty	[2]Percent capacity customer owned installations	[2]Total capacity/kW-AC	W per person
Piedmont	13	1,516,456	$45,485	14.6	56%	28,592	18.9
Midlands	17	1,692,996	$48,335	15.9	54%	28,414	16.8
Coastal	7	1,048,346	$54,194	13.4	65.3%	23,487	22.4
PeeDee	9	766,571	$40,758	18.4	100%	3,380	4.4
State Total	46	5,024,369	$47,541	15.3	59.5%	83,873	16.7

Calculated from U.S Census Bureau Data, 2017; median income and % in poverty were determined using a weighted (by population) average

Calculated from S.C. Energy Office Data, August 2017 for installations under 20 kW in size. In the PeeDee Region there are two large commercial systems over 200kW that are leased. These were incorrectly captured in [2] as small-scale systems.

[1] During the same period, commercial and industrial installations rose from 0.79MW in 2014 to 39.3 MW in 2017, while utility scale installations rose from 2.5MW in 2014 to 233.6MW in 2017.

For additional comparison, the number of installations in a county was plotted against the percentage of that county living in poverty based on US Census Bureau data. There is a clear cut off for the number of installations in a county when the poverty level is above 17%. Only six of SC's forty-six counties have poverty rates lower than the national average of 12.7%, which is an important factor when considering accessibility to solar and financing options.

Leasing had a clear and immediate effect on residential installations, as indicated by the large jump in installations in 2016, when third party leasing became available to homeowners and businesses in the state. Since data on leased installation were available beginning in 2016, we monitored trends on purchasing and leasing behavior. There is a clear correlation between the number of systems in a given county and the percentage of those systems that are leased. There is a strong correlation between the number of installations and poverty level, and correlation with median income. There is a slight correlation between median income and the number of systems leased, which suggests that rural areas with lower populations could benefit from access to leased installations.

In 2016, the majority of installations in the Midlands region, which includes the middle band of the state from the North Carolina to the Georgia boarders, were leased. The Midlands region also had the highest installed capacity in the state. In 2017, the percentage of leased systems dropped slightly, but the total installed capacity in the region increased by 278%. The Midlands also have fallen behind the Piedmont region, which is in bordered in the Northwest corner of the state between Georgia and North Carolina, on total installed capacity. The PeeDee region, the poorest and most rural region along the border with North Carolina that stretches to the coast, continues to struggle to install capacity, likely affected by the lack of leased systems in the community. There are currently no residential leased systems in the PeeDee region, though there are a few cases of commercial systems installed under a lease. Theoretically, leasing can increase access to communities that cannot qualify for the large loans needed to purchase a PV system or do not have the upfront capital for down payments on a system. Leasing companies are also reluctant to install in cooperative territories, which show decreased installation rates in their more rural areas over the IOU territories, which tend to be more urban.

The ability to continue to track the costs at the end of each year until 2021, the deadline for Act 236 implementation, could provide additional insight into the effects of the imposed solar tariffs, the effect of reaching the initial net metering cap of 2% on the state's solar industry, and the effect of the phase-out of the federal investment tax credit for residential installations. This would help better develop guidelines and recommendations on how a sustainable solar economy can be developed. Many states have had well known transition issues (e.g. New Mexico, Arizona) as the incentives

wind down and utilities are expected to develop policies to bluster the installation of distributed systems as their percentage of total power production occurs. This is a gap in understanding policy in developing (but not emerging) solar economies. It is also important to understand how this effects factors such as long term cost and needed job skills.

Conclusions:

Even though it did not fully go into effect until early 2016, SC's Act 236 had a clear and immediate effect on the business climate for solar installers during the summer of 2014 when it was signed into law. In the first year, residential solar costs dropped by $0.87/W-DC and have continued to slowly decline by $1.02/W since 2014. Similarly, commercial and industrial prices have fallen by $1.25/W-DC to $1.98/W-DC and utility scale installation costs have fallen by $1.03/W-DC to $1.36/W-DC. This decline in cost helped contribute to an additional 85.1 MW of residential solar to the grid since the end of 2014. Commercial and industrial installations have grown 38.5 MW and utility-scale installations have grown 231.1 MW in the three-year period. This explosion of growth has meant that South Carolina would meet the requirements of Act 236 in late 2018, more than three-years earlier than required by law. As Duke Energy Carolinas (DEC) was approaching this cap in late 2018 and an extension to March 15, 2019 was granted by the Public Service Commission (PSC). There is currently pending legislation (2019), which would remove the cap until 2021. This means that as 2021 approaches, there will be contentious debates within the community and legislature on the fate of net metering in SC. This rapid growth has not come without hiccups or delays. Consumer protection continues to be a concern as marketing and sales increase within the state. It also means that the net metering cap will have to be addressed far sooner than expected.

The growth of the residential sector would not have been possible without the targeted segmentation of the agreement. As the state moves beyond Act 236, discussions will need to begin on the value of solar and how net metering will be handled moving forward. Discussions will have to include how low- to moderate-income communities can benefit from solar, whether at the residential scale, through community solar, or through an increase in utility-scale installations. The successful implementation of Act 236 could serve as a model to neighboring states in the Southeast that still have very low solar penetration, including Alabama and Mississippi. Act 236 is also a demonstration of how effective policy can transform and grow a near nonexistent State industry into one that flourishes. Net metering has failed to gain traction in the Alabama legislature, though new utility scale projects have been proposed by Alabama Power.

Budget and Schedule:

Table 1. Project Milestones and Deliverables.

Quarterly and Phase Milestones - Complete					
Budget Period	**Quarter**	**Milestone or Phase ID**	**Milestone**	**Verification Mechanism and/or Deliverable**	**Relevant Task(s) and Subtask(s)**
1	1	Q1.M1	Gather team of stakeholders and determine which soft costs values are currently available, which ones need to be immediately assessed, and which are the highest priorities.	In person meeting participation by at least 50% of proposal partners. Consensus reached among meeting participants on draft of values to be assessed.	Subtask 1.1
1	1	Q1.M1	Initial list of Soft Cost Reduction Strategies compiled through literature review and Interviews, containing at least: a description of the strategy, summary of its use and success, stakeholders required to implement, ease/cost/speed to implement, and potential impact on SC solar market	An organized list of potential Soft Cost Reduction Strategies for Implementation in SC ready for sharing with stakeholders in order to receive their input	Subtask 2.1
1	1	Q1.M1	Help coordinate the creation of a centralized public resource on solar.	Firm commitment from one of the project stakeholders to host the effort. Coordinate with HQ to begin the transfer of DOE templates and applications.	Subtask 3.2
1	1	Q1.M1	Survey questions to assess workforce needs drafted for review	Final workforce assessment survey completed	Subtask 4.1
1	2	Q1.M1	Begin compiling data for current soft cost estimates	Receipt of data from one IOU and one coop. Where possible, break down data based on socio-economic status of the region.	Subtask 1.1
1	2	Q2.M1	Receive feedback from SC stakeholders on potential Soft Cost Reduction Strategies. Provide a recommendation of the top 10 soft cost reduction	Receive feedback in the form of survey response or interview from at least: 3 potential residential solar customers, 3 potential commercial solar	Subtask 2.1

			strategies that will be most effective in the Southeast, based on the results of other DOE funded projects.	customers, 3 solar installers, 8 local government officials, 2 IOU representatives, 2 muni representatives, and 2 EMC representatives At least 8 of the 10 strategies receive strong support from 75% of the project stakeholders. Include strategies specific to low and middle income areas.	
1	2	Q2.M1	Confer with State Fire Marshalls office and code officials to determine any additional needs to support first responder training and PV utilization.	Successful feedback, via teleconference or in person meeting, to identify additional resources if needed.	Subtask 3.1
1	2	Q2.M1	Help coordinate the creation of a centralized public resource on solar.	Obtain URL. Evaluate DOE available resources and outline for South Carolina specific information that is needed.	Subtask 3.2
1	2	Q2.M1	Survey questions for workforce assessment needs are finalized	Survey of workforce assessment needs sent out to identified group of respondents	Subtask 4.1
1	3	Q3.M1	Begin analysis of soft cost data from IOU and cooperative system.	Receive data from at least one IOU and one co-op on soft costs for CY15, broken down by criteria decided on in Q1.	Subtask 1.1
1	3	Q3.M1	Draft report of Recommended Soft Cost Reduction Strategies for South Carolina, including prioritization, impact estimates, cost/difficulty estimates, keys to success, implementation strategies. Determine adequate mechanism for tracking changes in soft costs.	Draft report ready for sharing with stakeholders for feedback. Consensus of 75% of team members on which method is best to track changes and which inputs should be evaluated.	Subtask 2.1
1	3	Q3.M1	Complete interviews with solar installers and SC EMC representatives regarding solar and its soft costs	Summary report of interviews with at least 5 solar installers working in (or interested in working	Subtask 2.2

				in) EMC territories and at least 1 representative from >50% of the EMCs.	
1	3	Q3.M1	Help coordinate the creation of a centralized public resource on solar.	Adopt DOE resources as necessary. Begin developing platform with assembled South Carolina specific data.	Subtask 3.2
1	3	Q3.M1	Survey responses collected. Follow-up with respondents if necessary.	Collection of survey responses from identified respondent group	Subtask 4.1
1	4	Q3.M1	Analyze the gaps in training for the solar industry and where solar markets and training can converge	Report on solar workforce needs for SC. Go/No-Go: Employments needs are met by current training	Subtask 4.1
1	4	Q4.M1	Complete rough analysis of soft costs for CY15	DOE peer-reviewed report on soft costs in CY15 for at least one IOU and the cooperative system. Where possible, break down soft costs by socio-economic conditions.	Subtask 1.1
1	4	Q4.M1	Initiation of semi-annual soft cost analysis	Send out first questionnaire to IOUs, SBA, and cooperatives. Receive appropriate response from a minimum of three entities and complete necessary follow-up by end of Q4. This will cover the first six months of CY16.	Subtask 1.2
1	4	Q4.M1	Issue report on current best practices and how they may be utilized in SC, incorporating available data from Task 1 and stakeholder feedback on draft report.	Published report of Recommended Soft Cost Reduction Strategies for South Carolina, including prioritization, impact estimates, cost/difficulty estimates, keys to success, implementation strategies, and links to best available support materials	Subtask 2.1
1	4	Q4.M1	Draft methodology and metrics for tracking of implementation of soft cost	Summary report of draft methodology and metrics ready for review by DOE	Subtask 2.2

			reduction strategies and their effects	and project partners	
1	4	Q4.M1	Beta test the web site.	Receipt of feedback from all project stakeholders.	Subtask 3.2
1	4	**Phase Milestone Year 1**	Completion of workforce assessment, Baseline cost study completed, action plans established for soft costs and training.	Third party review and or verification of completion.	All
2	5	Q1.M1	Complete soft cost analysis for the first six months of CY 16.	Draft of DOE peer reviewed report out to reviewers comparing changes in soft costs incurred in the first six months of CY16 with the pre-established baseline from CY15.	Subtask 1.2
2	5	Q1.M1	Report on Soft Cost Reduction Strategies for SC sent to SC local governments, solar installers, and other appropriate stakeholders with request for implementation tracking feedback (using developed methodology)	Records of dissemination methods and recipients	Subtask 2.1 & Subtask 2.2
2	5	Q1.M1	Draft report of Recommended Soft Cost Reduction Strategies for South Carolina Electric Membership Cooperative Utilities, including prioritization, impact estimates, cost/difficulty estimates, keys to success, implementation strategies	Draft report ready for sharing with stakeholders for feedback.	Subtask 2.3
2	5	Q1.M1	Support launch of the statewide Solar Resources the web site, with additional external content and coordination of launch dissemination.	Successfully going live with the website.	Subtask 3.2
2	5	Q1.M1	Complete acquisition of standard 40-hour PV installation training curricula(NABCEP ELE PV)	40 hour NABCEP EL PV course materials collected and assembled; partner educational institutions	Subtask 4.2

			from available educational sources; support PV training equipment acquisition for 2-3 South Carolina educational institutions.	promoting PV course offering for the following teaching period	
2	6	Q2.M1	Continuation of semi-annual soft cost analysis	Send out 2nd questionnaire to IOUs, SBA, and cooperatives. Receive appropriate response from a minimum of three entities and complete necessary follow-up by end of Q6. This will cover the second half of CY16.	Subtask 1.2
2	6	Q2.M1	Issue report on Soft Cost Reduction Strategies for South Carolina Electric Membership Cooperative Utilities, incorporating available data from Task 1 and stakeholder feedback on draft report.	Published report of Recommended Soft Cost Reduction Strategies for South Carolina, including prioritization, impact estimates, cost/difficulty estimates, keys to success, implementation strategies, and links to best available support materials	Subtask 2.3
2	6	Q2.M1	Track completion of first responders and code officials on PV safety training.	Successful completion of 80% or higher on training exam, and/or official notice of receipt from compliance officer.	Subtask 3.1
2	6	Q2.M1	Secure delivery of 40 hour NABCEP EL PV course to identified community college instructors	4-6 identified SC community college instructor trainees receive 40 hour NABCEP EL PV training	Subtask 4.2
2	7	Q3.M1	Complete soft cost analysis for the second six months of CY 16.	Draft of DOE peer reviewed report out to reviewers comparing changes in soft costs incurred in the second six months of CY16. Report on changes in cost trends that are seen over CY16.	Subtask 1.2
2	7	Q3.M1	Complete interviews with stakeholders on implementation, lessons	Summary report for DOE and project partners based on interviews of at least 20	Subtask 2.1 & Subtask

			learned, and operational successes and failures	stakeholders	2.2
2	7	Q3.M1	Review needs assessment and update PV safety training needs of first responders and code officials.	Based on results from tracking data, determine if there target locations are needed to increase awareness. Compile list of target areas and contacts. Identify any technical areas which need additional support.	Subtask 3.1
2	7	Q3.M1	Secure/acquire 40 hour NABCEP approved Advanced Design and Installation PV course materials to be offered next quarter	40 hour NABCEP approved Advanced Design and Installation course materials collected and assembled	Subtask 4.2
2	8	Q4.M1	Targeted market segment demonstrates (through survey or measured actions) knowledge of one key topic	One brief on key topic is complete	Subtask 1.1
2	8	Q4.M1	Continuation of semi-annual soft cost analysis	Send out 3nd questionnaire to IOUs, SBA, and cooperatives. Receive appropriate response from a minimum of three entities and complete necessary follow-up by end of Q6. This will cover the first half of CY17.	Subtask 1.2
2	8	Q4.M1	Modify best practices to include lessons learned on operational successes and failures	Publish updated Soft Cost Reduction Strategies report based on input from Task 1, stakeholder interviews, and other stakeholder feedback	Subtask 2.1
2	8	Q4.M1	initial report on Soft Cost Reduction Strategy Implementation and Effects in SC (structure and dissemination method determined by methodology defined in Year 1 and refined with DOE and stakeholder	Published report on Soft Cost Reduction Strategy Implementation and Effects in South Carolina	Subtask 2.2

			feedback)		
2	8	Q4.M1	Deliver technical updates to the Fire Marshall and Code officials for safety training.	Identify existing DOE resources that may be leveraged to update the safety training. Review tracking data to determine increases in successful completion of training. Target 3 major metropolitan areas for successful completion of code official training.	Subtask 3.1
2	8	Q4.M1	Deliver 40 hour Advanced Design and Installation PV course to identified community college instructors Develop "Train the Trainer " curriculum for a 40 hour NABCEP EL PV course with slide notes- to be used by community college instructors at their respective institutions Develop "Train the Trainer " curriculum for 40 hour Advanced PV course with slide notes- to be used by community college instructors at their respective institutions	4-6 identified SC community college instructor receive 40 hour NABCEP approved Advanced PV Design and Installation training "Train the Trainer" 40 hour NABCEP EL curriculum "Train the Trainer" 40 hour NABCEP approved Advanced Design and Installation curriculum	Subtask 4.2
2	8	**Phase Milestone Year 2**	Train the trainer program initiated, CY16 soft cost analysis, implementation of recommended soft cost strategies for middle-low income areas	Number of new qualified trainers, third party review and/or verification of reports,	**All**
3	9	Q1.M1	Complete soft cost analysis for the first six months of CY 17.	Draft of DOE peer reviewed report out to reviewers comparing changes in soft costs incurred in the first six months of CY17.	Subtask 1.2

3	9	Q1.M1	Updated soft cost reduction literature review and interviews and potential for implementation in SC.	Summary report for DOE and project partners on national trends and emerging best practices related to solar soft cost reduction and potential for implementation in SC	Subtask 2.1
3	9	Q1.M1	Updated soft cost reduction literature review and interviews and potential for implementation in SC for EMCs.	Summary report for DOE and project partners on national trends and emerging best practices related to solar soft cost reduction and potential for implementation in SC for EMCs.	Subtask 2.3
3	9	Q1.M1	Update website by contributing most recently available data and documents.	Assemble and update data on the website. Based on visitor feedback, strengthen areas needing additional resources.	Subtask 3.2
3	9	Q1.M1	Disseminate “Train the Trainer “ entry level NABCEP PV course curriculum to the SC community college instructor trainees that received instruction in Year 2 and that will receive instruction in Year 3 Disseminate “Train the Trainer “ Advanced Design and Installation course curriculum to the SC community college instructor trainees that received instruction in Year 2 and that will receive instruction in Year 3	7-12 Identified SC community college programs receive a “Train the Trainer” 40 hour NABCEP EL course curriculum 7-12 Identified SC community college programs receive a “Train the Trainer” 40 hour NABCEP approved Advanced Design and Installation course curriculum	Subtask 4.2
3	10	Q2.M1	Education and training for C-suite decision makers is occurring; organizations who can cross-promote materials and/or webinars are identified. continuation of semi-annual soft cost analysis	Two fact sheets, two slide decks, and two webinars. Send out 4th questionnaire to IOUs, SBA, and cooperatives. Receive appropriate response from a minimum of three entities and complete necessary follow-up by end of Q6. This will cover the	Subtask 1.2

				second half of CY17.	
3	10	Q2.M1	Completion of 50% of stakeholder interviews planned for Year 3	Summary report of implementation levels, locations, lessons learned, successes, and failures. Include list of planned interviews and completed interviews.	Subtasks 2.1, 2.2, and 2.3
3	10	Q2.M1	Identify resources and develop guidelines for Architectural Review Boards on PV use.	Identify areas where Architectural Review Boards are resistant to PV. Help develop resources that can be utilized to alleviate concerns from ARBs. Help develop home owner resources on their rights for PV installations.	Subtask 3.1
3	10	Q2.M1	Deliver 40 hour NABCEP EL Course to additional identified SC community college instructor trainees	Additional 3-5 identified SC community college instructor trainees receive 40 hour NABCEP EL training	Subtask 4.2
3	11	Q3.M1	Complete soft cost analysis for the second six months of CY 17.	Draft of DOE peer reviewed report out to reviewers comparing changes in soft costs incurred in the second six months of CY17. Report on changes in cost trends that are seen over CY17.	Subtask 1.2
3	11	Q3.M1	Completion of 90% of stakeholder interviews planned for Year 3	Summary report of implementation levels, locations, lessons learned, successes, and failures. Include list of planned interviews and completed interviews.	Subtasks 2.1, 2.2, and 2.3
3	11	Q3.M1	Update website by contributing the most recently available data and documents.	Assemble and update data on the website. Based on visitor feedback, strengthen areas needing additional resources.	Subtask 3.2
3	11	Q3.M1	Deliver 40 hour NABCEP EL Course to identified SC installers	Up to 30 identified SC installers receive 40 hours of NABCEP EL PV training	Subtask 4.2

3	12	Q4.M1	Continuation of semi-annual soft cost analysis	Send out 5th questionnaire to IOUs, SBA, and cooperatives. Receive appropriate response from a minimum of three entities and complete necessary follow-up by end of Q6. This will cover the second half of CY17.	Subtask 1.2
3	12	Q4.M1	Further refine best practices to include lessons learned on operational successes and failures	Publish updated Soft Cost Reduction Strategies report based on input from Task 1, stakeholder interviews, and other stakeholder feedback	Subtask 2.1
3	12	Q4.M1	Report on Soft Cost Reduction Strategy Implementation and Effects in SC (structure and dissemination method determined by methodology defined in Year 1 and refined with DOE and stakeholder feedback)	Publish updated report on Soft Cost Reduction Strategy Implementation and Effects in South Carolina	Subtask 2.2
3	12	Q4.M1	Further refine best practices for cooperatives to include lessons learned on operational successes and failures	Publish updated Soft Cost Reduction Strategies for EMCs report based on input from Task 1, stakeholder interviews, and other stakeholder feedback	Subtask 2.3
3	12	Q4.M1	Complete tracking on first responder and code official training.	Successful completion of training for code officials in 3 major metropolitan areas and 5 rural jurisdictions. Successful completion of first responder training in the same identified areas.	Subtask 3.1
3	12	Q4.M1	Deliver 40 hour Advanced Design and Installation PV Course to SC instructor trainees and identified SC installers	Up to 30 identified SC installers and 3-5 instructor trainees receive 40 hours of NABCEP approved Advanced Design and Installation training	Subtask 4.2

3	12	**Phase Milestone Year 3**	**Reduction in soft costs and increased participation in low-middle income areas**	**25% reduction in soft costs and a 25% increase in participation in rural, low-middle income areas.**	**Subtasks**

Table 2. Project Budget

	Expenditures (SF-424A)		
Budget Categories per SF-424A	**BP 1**	**BP 2**	**BP 3**
a. Personnel	$48,967.70	$114,546.70	$131,519.17
b. Fringe Benefits	$22,961.00	$54,225.78	$67,616.02
c. Travel	$5,505.00	$5,652.86	$3,948.03
d. Equipment	$0.00	$0.00	$0.00
e. Supplies	$2,446.73	$330.00	$575.49
f. Contractual	$166,608.00	$35,901.72	$31,214.28
g. Construction	$0.00	$0.00	$0.00
h. Other	$0.00	$0.00	$0.00
i. Total Direct Charges (4)	**$246,488.43**	**$210,657.06**	**$234,872.99**
j. Indirect Charges	$123,001.28	$315,021.15	$349,959.09
k. Total Charges (5)	**$369,489.71**	**$525,678.21**	**$584,832.08**
DOE Share	$369,489.71	$525,678.21	$584,832.08
Cost Share	$24,000.00	$6,000.00	$0.00
Cost Share Percentage (6)	6.5%	1.1%	0.0%

Path Forward:

This work was a demonstration on the importance of developing and building a regional and local understanding of renewable energy deployment, policy, and workforce. It is recommended that SETO continue to support regional expertise in these matters. Renewable policy is not a one size fits all approach and meaningful progress needs boots on the ground to help push policy forward.

Publications Resulting from This Work:

1. Fox, E.B., M. Drory, and T.B. Edwards, Fox, E.B., M. Drory, and T.B. Edwards, “Impact of State Policy on Photovoltaic Adoption Rates in the Southeastern US”, *Energy Policy*, **submitted and in review**.

2. Fox, E.B., M. Drory, and T.B. Edwards, “A Tale of Two States: The Power of a Consensus based Approach”, Conference Proceedings of the American Solar Energy Society Solar 2017, p49-55. **http://proceedings.ises.org/paper/solar2017/solar2017-0006-Fox.pdf**

3. E. B. Fox, “ A Step-by-Step Guide for South Carolina Residential Solar Customers”, SRNL-STI-2016-00168 rev 2, Jan 2017. https://www.osti.gov/scitech/biblio/1245740-step-step-guide-south-carolina-residential-solar-customers

4. E.B. Fox and T.B. Edwards, “2015 South Carolina PV Soft Cost and Workforce Development, Part 1: Initial Survey Results”, SRNL-STI-2016-00177, May 2016. https://www.osti.gov/scitech/biblio/1252420-south-carolina-pv-soft-cost-workforce-development-part-initial-survey-results

5. E.B. Fox and T.B. Edwards, “2016 Alabama PV Soft Cost and Workforce Development”, SRNL-STI-2016-00717, Dec 2016. https://www.osti.gov/scitech/biblio/1335827-alabama-pv-soft-cost-workforce-development

6. E.B. Fox and T.B. Edwards, “2015 South Carolina PV Soft Cost and Workforce Development, Part 2: Six month confirmation of anticipated job growth”, SRNL-STI-2017-00039, Jan 2017. https://www.osti.gov/scitech/biblio/1342716-south-carolina-pv-soft-cost-workforce-development-part-six-month-confirmation-anticipated-job-growth

7. E.B. Fox M.D. Drory, and T.B. Edwards, “2016 End of Year South Carolina PV Soft Cost and Workforce Development, SRNL-STI-2017-00474. https://sti.srs.gov/fulltext/SRNL-STI-2017-00474.pdf

8. E.B Fox, T.B. Edwards, and M.D. Drory, “2017 Alabama PV Soft Cost and Workforce Development”, SRNL-STI-2018-00152, https://sti.srs.gov/fulltext/SRNL-STI-2018-00152.pdf

9. E.B. Fox, T.B. Edwards, and M.D. Drory, “South Carolina Solar Development – Tracking the Effects of Act 236”, SRNL-STI-2018-00239, https://sti.srs.gov/fulltext/SRNL-STI-2018-00239.pdf

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References:

1. *New Tariffs to Curb US SOlar Installations by 11% Through 2022*. Greentech Media, 2018. **https://www.greentechmedia.com/articles/read/tariffs-to-curb-solar-installations-by-11-through-2022#gs.yeKStAI**.
2. Fox Elise, B., T.B. Edwards, and M.D. Drory, *2016 End of Year South Carolina PV Soft Cost and Workforce Development.* DOE Technical Report, 2017. **SRNL-STI-2017-00474**: p. https://www.osti.gov/scitech/biblio/1377028-end-year-south-carolina-pv-soft-cost-workforce-development.