Contract No:

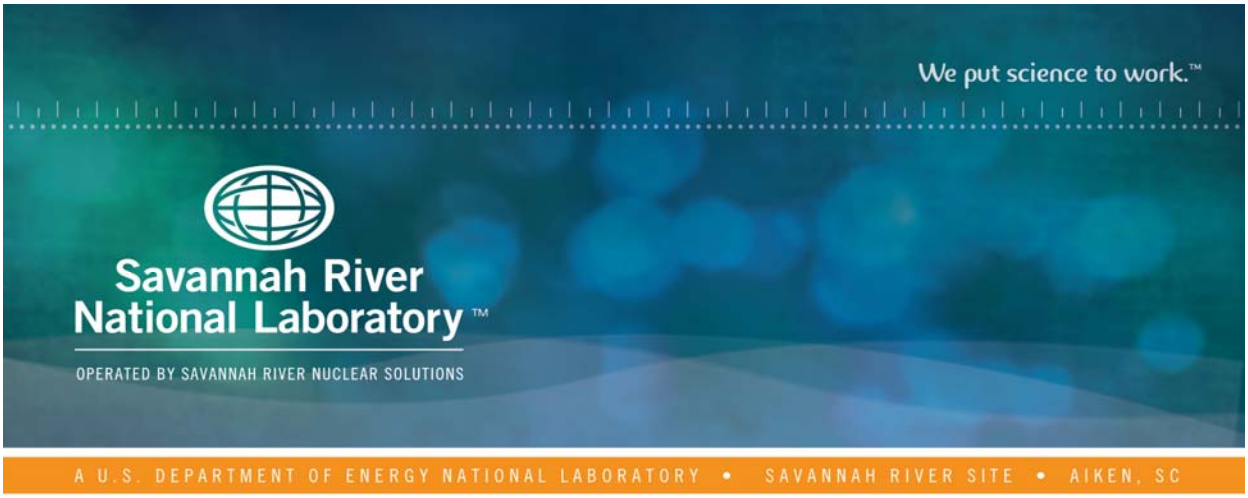
This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-08SR22470 with the U.S. Department of Energy (DOE) Office of Environmental Management (EM).

Disclaimer:

This work was prepared under an agreement with and funded by the U.S. Government. Neither the U. S. Government or its employees, nor any of its contractors, subcontractors or their employees, makes any express or implied:

1) warranty or assumes any legal liability for the accuracy, completeness, or for the use or results of such use of any information, product, or process disclosed; or
2) representation that such use or results of such use would not infringe privately owned rights; or
3) endorsement or recommendation of any specifically identified commercial product, process, or service.

Any views and opinions of authors expressed in this work do not necessarily state or reflect those of the United States Government, or its contractors, or subcontractors.



2015 South Carolina PV Soft Cost and Workforce Development

Part 2: Six Month Confirmation of Anticipated Job Growth

Elise B. Fox

Thomas B. Edwards

January 2017

SRNL-STI-2016-00039, Revision 0

DISCLAIMER

This work was prepared under an agreement with and funded by the U.S. Government. Neither the U.S. Government or its employees, nor any of its contractors, subcontractors or their employees, makes any express or implied:

1. warranty or assumes any legal liability for the accuracy, completeness, or for the use or results of such use of any information, product, or process disclosed; or
2. representation that such use or results of such use would not infringe privately owned rights; or
3. endorsement or recommendation of any specifically identified commercial product, process, or service.

Any views and opinions of authors expressed in this work do not necessarily state or reflect those of the United States Government, or its contractors, or subcontractors.

Printed in the United States of America

Prepared for
U.S. Department of Energy

SRNL-STI-2016-00039
Revision 0

Keywords: *solar, soft cost, residential, commercial, utility, PV*

Retention: *Permanent*

2015 South Carolina PV Soft Cost and Workforce Development

Part 2: Six Month Confirmation of Anticipated Job Growth

Elise B. Fox
Thomas B. Edwards

January 2017

Prepared for the U.S. Department of Energy under contract number DE-AC09-08SR22470.

Savannah River National Laboratory™
OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

REVIEWS AND APPROVALS

AUTHORS:

_____

Elise B. Fox, Energy Materials Date

_____

Thomas B. Edwards, Engineering Process Development Date

TECHNICAL REVIEW:

_____

Holly L. Watson, Analytical Development Date

APPROVAL:

_____

Justin Halverson, Manager Date
Energy Materials

_____

Krissy Zeigler, Manager Date
Materials Science & Technology

ACKNOWLEDGEMENTS

This work would not be possible without the support of our SuNLaMP team. The following individuals (in alphabetical order) are responsible for helping form the survey discussed within, ensuring that it gets in the hands of respondents, reviewing this document, and serving as a continual sounding board throughout the course of this project. Without them, this work would never have come to fruition. We are extremely thankful for their generous, continuous support and advice.

Dale Bradshaw, National Rural Electric Cooperative Association
Tommy Cleveland, North Carolina Clean Energy Technology Center
Andrew Cotter, National Rural Electric Cooperative Association
Ken Sercy, South Carolina Coastal Conservation League
Emily Felt, Duke Energy
Mark Furtick, South Carolina Electric & Gas
Phillip Greenway, SanteeCooper
Scott Hammond, Central Electric Power Cooperative
Trish Jerman, The South Carolina Energy Office at the Office of Regulatory Staff
Elizabeth Kress, SanteeCooper
Jose Merino, Duke Energy
John Raftery, South Carolina Electric & Gas
Lyra Rakusin, North Carolina Clean Energy Technology Center
Mike Smith, Electric Cooperatives of South Carolina (Statewide)
Steve Spivey, SanteeCooper
Don Zimmerman, Alder Energy

This work is funded by the Department of Energy Solar Energy Technology Program's SunShot National Laboratory Multiyear Partnership (SuNLaMP). The authors wish to thank the SunShot Balance of Systems team for their support of this work, in particular, Chris Nichols for project management and review of this document.

The authors also wish to thank Holly Watson, SRNS, for statistical review of the results provided within this document.

EXECUTIVE SUMMARY

In 2015, a program was initiated to carefully track and monitor the growth of the solar industry in SC. Prior to then, little information was available on the costs associated with distributed photovoltaic (PV) installations in the Southeastern US. For this report, data were collected from businesses on the number of hires they had at the end of 2014 and compared with data for 2015 and June 2016. It was found that the percentage of installers within the state who serve the residential sector increased to 82% from 67%. During the same time period, the average size of initiated installations for residential, commercial, and utility scale installations all trended upwards. Where residential installations were typically 5 kW-DC in 2014, they were typically 10 kW-DC by late 2015 and in mid-2016. For commercial installations, the average size grew from 84 kW-DC in 2014 to between 136-236 kW-DC in 2015 and then 188-248 kW-DC in mid-2016. An exception was seen in utility scale installations where a 2.3 MW-DC system was common in 2014, the size grew to be 5-15 MW-DC in late 2015. The average size dropped 3.1-4.4 MW-DC in mid-June 2016, though individual averages up to 20 MW-DC were reported.

Cost continues to be the limiting factor for installations on any scale; however, even within the 18 month period covered by this report, the total cost of residential installations fell from $4.30/W-DC in 2014 to $3.34/W-DC in mid-2016. This represents a 22% decrease in cost or nearly a $1/W-DC. Commercial installations similarly fell by 23% from $3.23/W-DC to $2.28/W-DC over the same time period. Utility scale installation costs dropped even further; they fell by 31%, from $2.29/W-DC to $1.65/W-DC. During that time period the percentage of the total cost attributed to hardware increased between 2014 and 2015 decreased, but rose in mid-June 2016 for all sectors. This may be due to increased competition to cut costs in late 2015 to establish a market share, but those cost cuts may have been found to be unsustainable. Residential systems continue to have the largest percentage of costs attributed to soft costs (47%), while for commercial and utility scale systems soft costs represent 40% of the total cost. In 2014 the largest soft costs for all sectors was marketing and sales. In 2015, this shifted to installation costs, whereas in mid-2016 the highest soft cost was overhead, profit, and taxes. From 2014 to mid-2016 soft costs decreased by 14% for residential installations, 12% for commercial installations, and 23% for utility scale installations.

In October 2015, twenty-seven respondents indicated that between 199-217 new positions would be created over the next six months. The largest needs were for qualified installers and in sales and marketing. Confirmed job growth by eleven employers stated 180-185 new full time equivalent (FTE) positions had been filled. The actual job growth since October 2015 could potentially be as large as 462-473 total positions, with nearly half of the jobs in installation.

As soft costs continue to fall, model permitting and state licensing for PV installers have been identified as pressing needs by installers, building code officials, and municipalities alike. Focusing on licensing adds additional protection for consumers around the state. South Carolina currently has an approval process for PV leasing companies, but not for PV installers marketing directly to homeowners. Focusing on model permitting processes will help prevent returned permitting documentation and likely decrease the time for approvals. This benefits both the municipalities and the installers by streamlining expectations for permit approval.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AC	Alternating current
DC	direct current
FTE	Full Time Equivalent
IOU	Investor Owned Utility
kW	kilowatt
MW	megawatt
PV	photovoltaic
SRNL	Savannah River National Laboratory
SRNS	Savannah River Nuclear Solutions
SC	South Carolina
SuNLaMP	SunShot National Laboratory Multiyear Partnership

1.0 Introduction

In 2015, a program was initiated to carefully track and monitor the growth of the solar industry in SC. Prior to then, there was little data that could be found focusing on the solar industry in the Southeastern US. A majority of reports on the cost and job prospects either did not include data from the SE, or had limited input from the industry in that geographical focus area. The first of a series of surveys was given to the installation professionals in South Carolina in October 2015 in an attempt to better understand and correlate job growth and cost declines to the implementation of Act 236. A follow up survey was given six months later to determine if job projections were realized across the state. A summary analysis of those results is provided within.

2.0 Experimental Procedure

2.1 Data Collection

In May 2016 a survey (see Appendix A) was distributed to members of the South Carolina Solar Council and the Solar Business Alliance. This survey included fifteen questions designed to better understand the solar industry in South Carolina and included questions that were intended to help confirm data obtained in October 2015. Thirty-five responses were received, though some responses were partially complete. The results of this survey are compared to 2015 data, previously reported, within. The analyses presented in this report were conducted using JMP Pro Version 11.2.1 [1].

2.2 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in SRNL Manual E7 2.60. SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2.

3.0 Results and Discussion

The fifteen-question survey was broken down into three parts focusing on: 1) establishing current costs of solar, 2) determining additional workforce needs and suggested training for those positions, and 3) determining the focus and experience of the respondents. Detailed analysis of the survey is presented and discussed below. Where possible, data are broken down by individual sectors: residential, commercial, and utility.

3.1 Solar Sector Served by Respondents

Respondents were asked to indicate which segment of the solar business they serve: residential, commercial, or utility. The results are presented in numerical form in Table 3-1 and in graphical form in Figure 3-1. 82% of the respondents serve the residential sector, but only 26% exclusively serve the residential sector. The residential sector was served by the largest number of respondents, followed by the commercial sector at 63% and the utility sector at 52%. This indicates a growth in service to the residential sector by SC installers from the end of 2015, where 67% of respondents served the residential sector [2].

Table 3-1. Solar PV Segments Served by Respondents.

Segment Served	Number of Respondents	% of Total Responding
Residential	22	82%
Commercial	17	63%
Utility	14	52%
Total Responding	27	100%

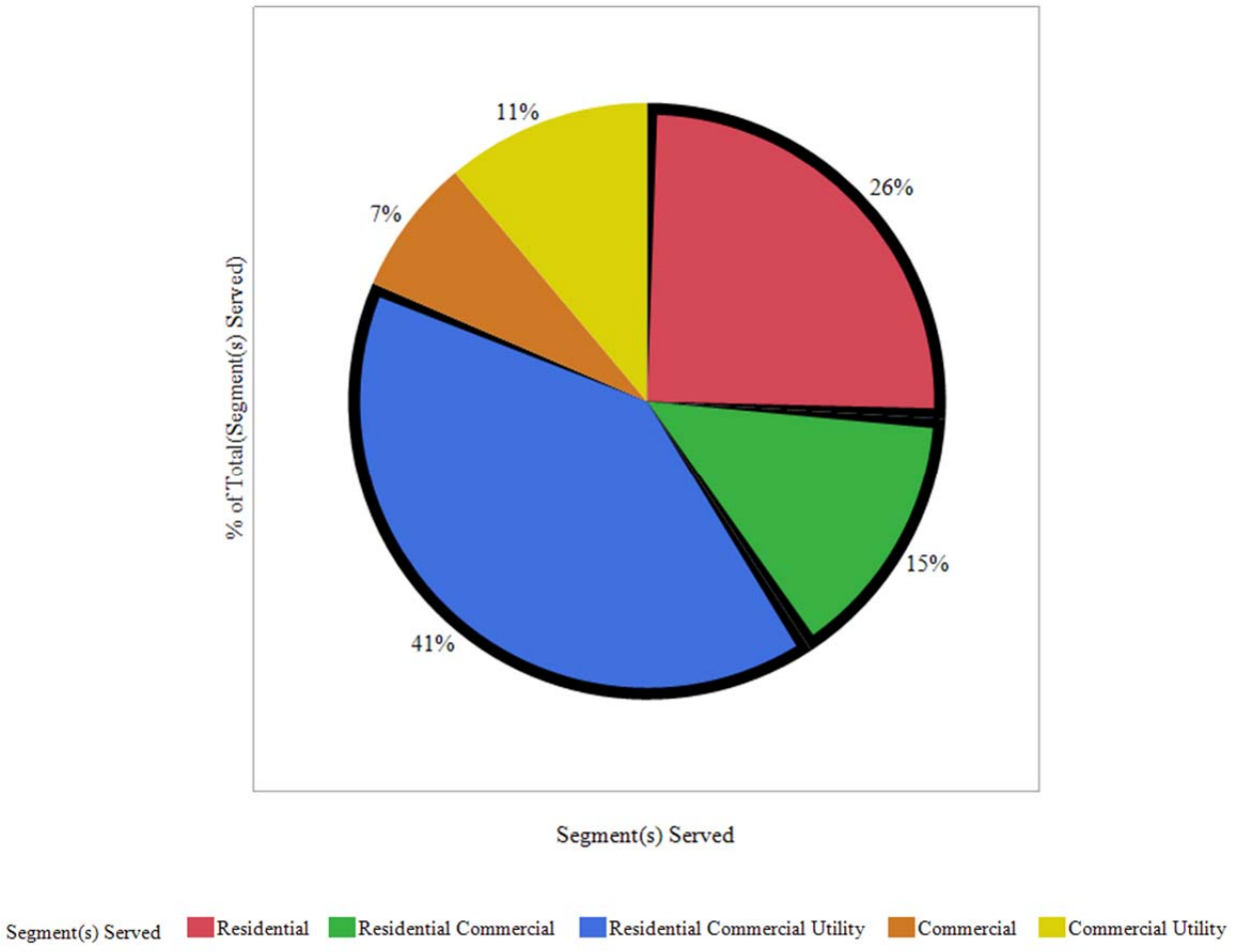


Figure 3-1. Solar PV Segments Served by Respondents.

3.2 Typical Size of Installation by Type

Respondents were asked to provide information on the typical size in kilowatts of direct current (kW-DC) of their installations by type. Some respondents reported their size data as a range, with other respondents providing a single size value for the typical installation. This was also true for other quantitative responses from the survey. In an effort to fully represent the range of values provided in some of the responses, both low-end and high-end size values were established for each respondent. The same value was used for both representations when the respondent provided a single size value. The same convention is followed for the other quantitative responses discussed within.

The values (on a log scale) from the respondents are recorded in Figure 3-2. In 2014, residential installations were typically 5 kW-DC and less than 10 kW-DC. In late 2015, installations were typically 10 kW-DC [2], and this trend held over the following six month period. This suggests that additional utility incentives for residential consumers, which became available in October 2015, enabled consumers to purchase PV systems that would cover a larger portion of their usage. The same trend was found in commercial installations. In 2014, the average commercial system was 84 kW-DC, while in 2015 they typically averaged between 136 – 236 kW-DC. This average grew in the first half of 2016 to 188 – 248 kW-DC. Utility scale installations in 2014 were 2.3 MW-DC on average and between 5 – 15 MW-DC in 2015. The reported average dropped slightly in early 2016 to 3.1 – 4.4 MW-DC, though average installation size up to 20 MW-DC was reported. This could indicate an early flood of large utility scale projects in late 2015 when utilities issued Request for Proposals (RFP) to comply with the utility scale requirements of Act 236.

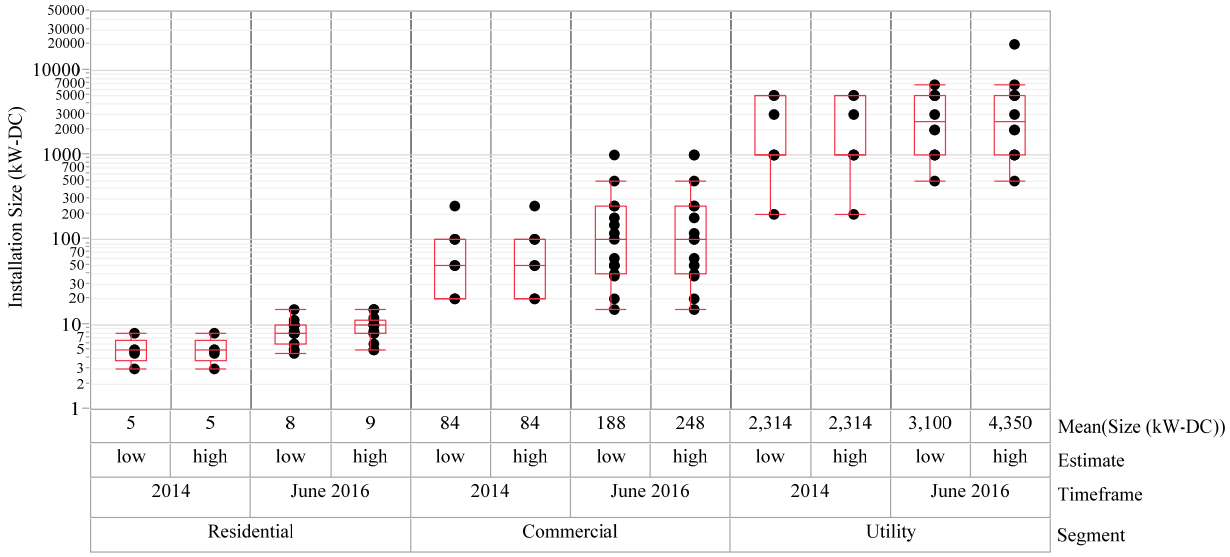


Figure 3-2. Average PV Installation Size (kW-DC), by Sector Served in 2014 and June 2016.

3.3 Average Cost ($/W-DC) by Type of Installation

Respondents were asked to provide information on the total cost in dollars per watt of direct current ($/W-DC) by installation type. In an effort to fully represent the range of values provided in the responses, both low-end and high-end total cost values were established for each respondent. These low- and high-end estimates in $/W-DC as reported by respondent and industry segment along with the average value for the total cost by segment in Figure 3-3. Residential installations averaged $4.30/W-DC in 2014. This is in line with the reported cost of $4.30/W-DC for residential systems install by year end 2014 reported by Barbose, et al. [3]. Residential systems cost $3.42 – $3.54/W-DC with a range of $2.50 – $4.00/W-DC in 2015 [2] and dropped slightly to an average of $3.33 - $3.35/W-DC in mid-2016. This would indicate a 22% drop in total cost for residential systems over the 18 month period. Commercial systems cost, on average, $3.23/W-DC in 2014 and dropped to between $2.65 – $2.70/W with a range of $1.85 – $3.50/W-DC in 2015. These costs fell slightly during the first six months of 2016 to an average of $2.44 - $2.51/W-DC with a total range of $1.50 - $4.00/W-DC. This indicates a 23% drop in total cost of commercial scale systems, closely mirroring the trend in residential systems. Utility scale total costs averaged $2.39/W-DC in 2014 and dropped to an average of $1.70 - $1.76 with a range of $1.10 –

$3.00/W-DC in 2015. Prices further dropped to an average of $1.65/W-DC in six months. Utility scale prices dropped 31% over the eighteen month period, faster than residential or commercial costs.

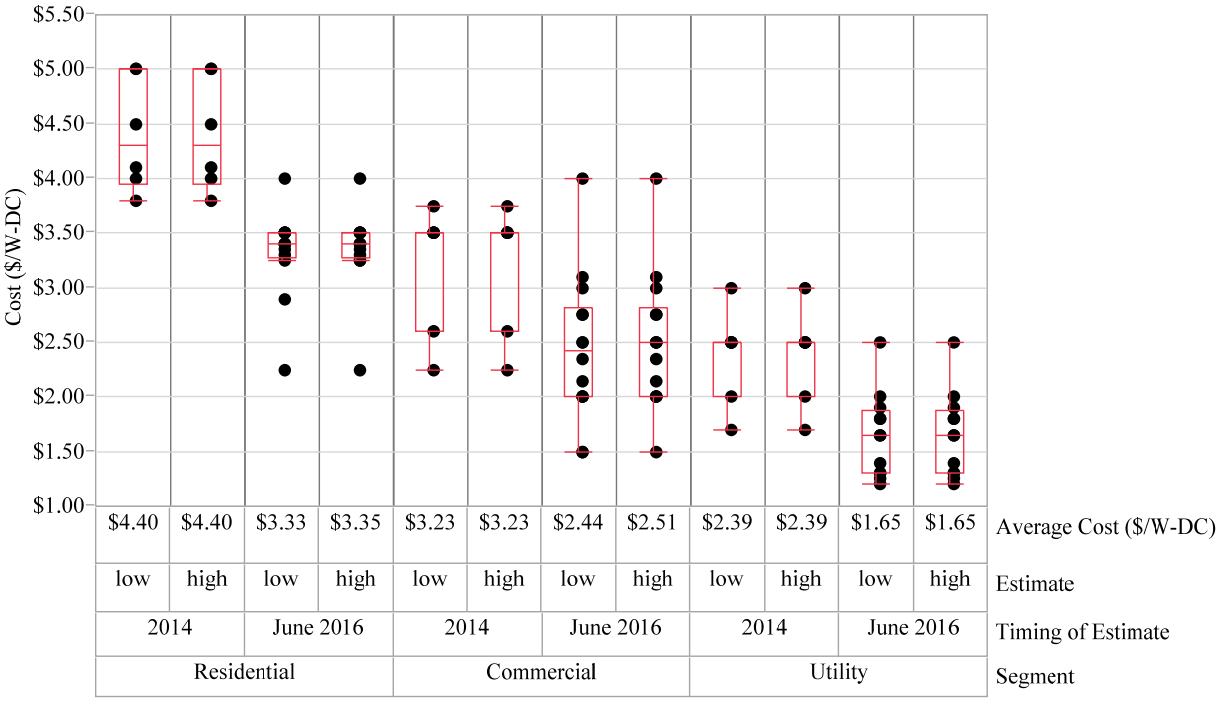


Figure 3-3. Cost of PV Installations in $/W-DC, by Respondent for 2014 and mid-2016.

3.4 Average Hardware Cost ($/W-DC) by Type of Installation

Respondents were asked to provide the percent of the total cost attributable to hardware by installation type. The resulting estimated costs of hardware as total dollars are provided in Figure 3-4. The average cost of hardware for residential systems was $2.32/W-DC or 53% of the total cost in 2014. Hardware costs in 2015 were determined to be $2.10/W-DC or 61-63% of the total cost. The hardware cost in mid-2016 was determined to be $2.16/W-DC or 53% of the total cost. Hardware for commercial systems was $1.85/W-DC in 2014 or 57% of the total cost in 2014. The costs fell in 2015 to $1.67/W-DC or 62-63% of total cost in 2015. [2] Hardware costs dropped further to $1.47/W-DC or 60% of the total cost in mid-2016. Utility scale system hardware costs were found to be $1.41/W-DC or 59% of the total cost in 2014. These dropped to $1.20/W-DC, or 69-70% of the total cost in 2015. Hardware costs further fell to $0.99/W-DC, or 60% of the total cost, in mid-2016. A trend of hardware cost percentage of total cost increasing from 2014 to 2015 then decreasing again mid-2016 may be due to increased competitiveness during the initial implementation of Act 236. It is possible that installers aggressively cut costs temporarily to establish marketplace shares, but these were found to be unsustainable for long-term business health. In general, the results suggest that the total costs across all three sectors have trended downward since 2014 with a similar trend in hardware costs for this period.

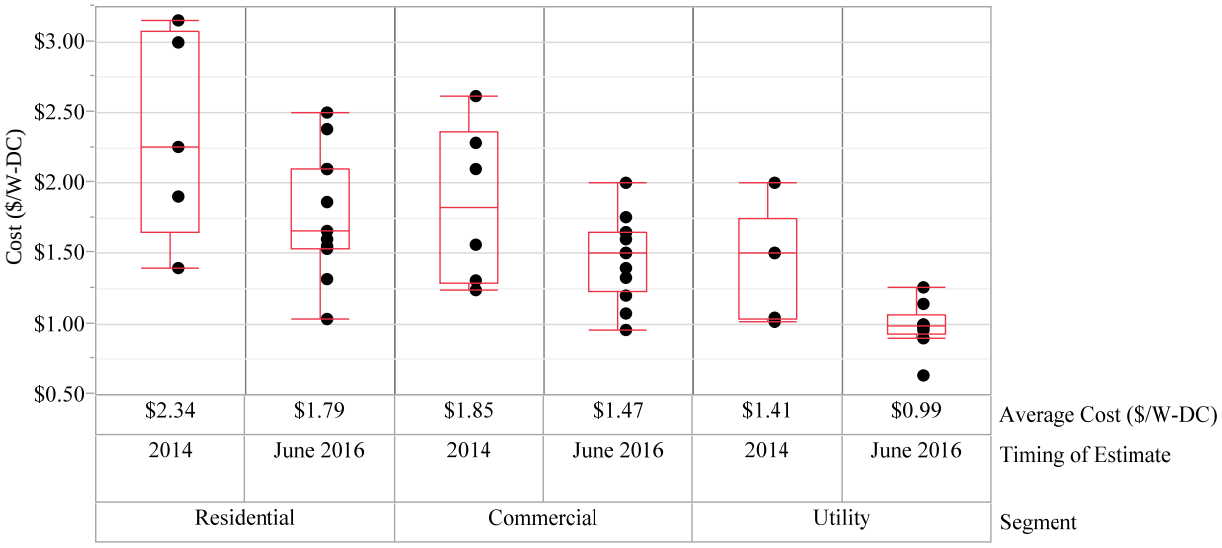


Figure 3-4. Cost attributed to hardware only for 2014 and mid-2016.

3.5 Average Soft Cost ($/W-DC) by Category by Type of Installation

Respondents were asked to provide information on the percent of the total cost attributable to several soft-cost categories by installation type. Four categories of soft costs were considered: 1) marketing, lead generation, and sales, 2) permitting and interconnection, including all fees and administrative labor costs, 3) installation, including design, engineering, and construction labor, and 4) profit, overhead, and taxes. These percentages of the total costs were developed into estimates of soft costs in $/W-DC as given in Table 3-2 for residential installations. Soft costs for commercial and utility scale systems can be found in Table 3-3 and Table 3-4, respectively. Summary statistics for these soft costs are provided in Figures B-1 through . B-6 of Appendix B. In 2014 the highest cost for all sectors was marketing and sales. In 2015 and mid-2016 marketing dropped to third place out of four. This may indicate that Act 236 helped the industry curb marketing costs, likely due to the excitement for the new utility programs for residential customers and the efforts of utilities to meet utility scale requirements.

Table 3-2. Average Cost by Soft Cost Category for Residential Installations from 2014 to 2016.

	2014		2015 [2]		mid-2016	
Type of Soft Cost	**$/W-DC**	**% of soft costs**	**$/W-DC**	**% of soft costs**	**$/W-DC**	**% of soft costs**
Installation, etc.	$0.50	26%	$0.59	41%	$0.46	28%
Marketing, etc.	$0.66	34%	$0.21	15%	$0.43	26%
Overhead, etc.	$0.61	31%	$0.43	30%	$0.63	38%
Permitting, etc.	$0.17	9%	$0.20	14%	$0.15	9%
Total	$1.94	100%	$1.43	100%	$1.67	100%

Table 3-3. Average Cost by Soft Cost Category for Commercial Installations from 2014 to 2016.

	2014		2015 [2]		mid-2016	
Type of Soft Cost	**$/W-DC**	**% of soft cost**	**$/W-DC**	**% of soft costs**	**$/W-DC**	**% of soft costs**
Installation, etc.	$0.40	30%	$0.52	44%	$0.38	32%
Marketing, etc.	$0.45	34%	$0.14	15%	$0.29	25%
Overhead, etc.	$0.39	29%	$0.36	30%	$0.42	36%
Permitting, etc.	$0.10	7%	$0.16	14%	$0.09	8%
Total	$1.34	100%	$1.18	100%	$1.18	100%

Table 3-4. Average Cost by Soft Cost Category for Utility Installations from 2014 to 2016.

	2014		2015 [2]		mid-2016	
Type of Soft Cost	**$/W-DC**	**% of soft costs**	**$/W-DC**	**% of soft costs**	**$/W-DC**	**% of soft costs**
Installation, etc.	$0.22	24%	$0.29	43%	$0.23	32%
Marketing, etc.	$0.37	40%	$0.09	13%	$0.21	29%
Overhead, etc.	$0.26	28%	$0.19	28%	$0.21	39%
Permitting, etc.	$0.08	9%	$0.11	16%	$0.07	10%
Total	$0.93	100%	$0.67	100%	$0.72	100%

In 2015 installation jumped to the largest soft cost expenditure in all categories, whereas in mid-2016 overhead, profit, and taxes became the largest share of soft costs. From 2014 to mid-2016, total soft costs fell 14% for residential installations, 12% for commercial installations, and 23% for utility scale installations. By comparison, hardware costs fell 24% for residential installations, 21% for commercial installations, and 30% for utility scale installations. These results follow anticipated trends that hardware costs are easier to control and reduce than soft costs.

3.6 Workforce Needs

In October 2015, survey respondents were asked to identify anticipated short and long term job needs. It was projected that between November 2015 and June 2016 between 199 – 217 new positions were expected to be created by 27 responding businesses. Of these, the largest needs were in installers (69 positions or 35% of the total) and in sales and marketing (70 positions or 35% of the total). Engineering and general business needs were expected to add 31 (16%) and 29 (15%) positions, respectively. In order to confirm if job growth had met expectations, a follow up survey was distributed in June 2016 that included questions related to job growth. The results from the follow-up survey for the six month are summarized in Table 3-5, representing eleven different employers.

Table 3-5. Short and long-term job needs by job type, total reported by 11 respondents.

	Design/Engineering	Electricians/Installers	Gen. Business	Sales	Total
[1]October 2015	9	45-50	24-29	36	114-124
[2]Projected 6 month growth	31-32	69-77	29-39	70-76	199-224
[1,3]Actual growth	3	97	38	42-47	180-185
[1]Growth in the next six months	11	74-90	18-20	48	151-169

1. As reported by respondents in this survey.
2. As reported in October 2015. [2]
3. For the period of June 2016- December 2016

Our results find that these eleven companies met the six month expected job growth of 27 originally reporting companies. If we extrapolate the data to 27 respondents to directly compare with the Part 1 survey, we could expect up to 238 new hires for electricians and installers since October 2015. There would also be an expected additional 182-221 new hires by December 2016 in this job catagory. In the general business category, new job growth met expectations. Extrapolating these data to 27 companies indicates that up to 93 new hires occurred over the previous six month period and an additional 44-49 new general business employees could be hired by December 2016. In design and engineering, we found that the eleven responding companies grew by 33% or 10% of the expected total reported in Part 1. If this is extrapolated to 27 companies, we could expect 7 new hires over the previous six months or 27 new design and engineering jobs by the end of 2016. This is considerably lower than the original 29 that were projected from October 2015. These eleven companies also doubled their sales workforce, which is equivalent to 60% of the original projection. Extrapolating this to 27 companies indicates that there were potentially 103-115 additional hires in sales. This number could also be doubled again by the end of 2016.

The reported growth of 180-185 additional full time positions since October 2015 could potentially be as large as 441-453 total positions. This indicates a robust and rapidly growing sector of the economy that exceeded expected job growth in two out of four categories. The only job category that grew slower than expected was design and engineering. These are positive signs of a growing industry and trends should continue to be monitored as utility incentive programs expire in order to determine long term effects of the industry on the state.

3.7 Soft cost reduction effort focus areas

Respondents to the Part 2 survey were asked to rank soft cost reduction efforts in the order of importance between: model ordinance development, model permitting development, state licensing for PV installers, public/consumer education, inspector education, homeowners association (HOA) guidelines, and other (which they could specify). This question was also given to the South Carolina Municipal Association which distributed it to each municipality with a City Manager and it was also distributed to the South Carolina Building Code Officials (BCOs). After Part 2 was released, but before the Municipalities and BCOs were surveyed, it was determined that Consumer Protection should be added to the list, thus no data for this category is included for the installers in these results. A ranking of 1 was given to the item of

greatest importance, hence the lower the number the higher the importance. The responses were given a weighted average to determine the ranking of each need found in Table 3-6. Data are further broken down in Figures B-7 to B-9 in Appendix B.

Table 3-6. Order of importance for soft cost reduction strategies, by respondent type.

Need	Installers	Municipalities	BCO
Consumer protection	N/A	6	6
HOA guidelines	5	6	6
Inspector education	6	5	**1**
Model ordinance development	4	**1**	5
Model permitting development	**1**	2	3
Public/consumer information	**1**	4	4
State licensing for PV installers	3	3	1
We do not have any concerns	N/A	8	8
Other	7	-	9

All respondent types indicated that model permitting development and state licensing for PV installers fall within the three most important needs for soft cost reduction. This is likely due to the large variability in permitting needs, which can differ in every single municipality across the state. The ability to unify or streamline these processes would reduce the likelihood that the permit applications are returned for additional documentation or information, thereby decreasing the time period for permit approval. Likewise, requiring state licensing for PV installers will enable the state to remove the license to operate from installers that engage in deceptive practices, take advance of the elderly or low income communities, or who provide poor installation quality. Currently, the state has an approval process for companies that lease PV, but does not have one for PV installers that sell directly to homeowners. Creating a licensing process would add an important consumer protection element to the growing solar economy.

Interestingly, the highest priority for the solar industry differed based on the role of the participants. Building code officials felt that inspector education and state licensing were most important. The BCOs likely feel that there is an education gap for their inspectors of PV systems between what they expect versus what they encounter as part of their reviews. This is not surprising considering that in some areas of the state, residential installations remain quite scarce and some inspectors likely have very little to no experience qualifying these installations. The expressed need for licensing is likely due to an expected level of qualification for installers that remain licensed. Licensing also allows the building inspectors a path forward to removing improperly qualified installers or those that continue to have building code violations.

Municipalities felt that model ordinance development for the state should be highest priority. This could help the municipalities set minimum guidelines for residential, commercial, and utility scale installations and would help reduce a backlog of variance requests that have to be approved for installations to occur. It could also help streamline expectations across the state. Installers would benefit from already knowing whether or not there are any potential restrictions for a proposed installation. It would also help municipalities maintain a consistency from project to project.

Conversely, installers felt that consumer education and model permitting development should have highest priority. Even though consumer education has had a renewed push at both the state and federal level, the installers indicate that there may still be a basic lack of knowledge on how photovoltaics work, what incentives exist, and benefits to the consumer. Consequently, this incurs large sale associated costs

contributing to the overhead costs borne by the installers. If basic consumer education is increased, the time associated with costumer negotiations is decreased, which will result in either a lower cost for the consumer or a larger profit margin for the installer per project. Though permitting typically makes up less than 10% of the soft costs, or less than 4% of the total cost for a residential installation, it remains one of the largest areas of contention for installers. This is likely due to the varying requirements for each municipality. This leads to increased time spent preparing the permitting package and ensuring that all requirements are met.

4.0 Conclusions

In 2015, the total cost of a residential system averages between $3.42 - $3.54/W-DC, while commercial and utility scale systems average $2.65 - $2.70/W-DC and $1.70 - $1.76/W-DC, respectively, which was on par with nationwide reported costs. Additionally, soft costs within SC were found to be approximately 40% of the total cost for residential and commercial systems and 30% for utility scale systems. The largest portion of these costs was attributed to labor costs for installation. While permitting accounted for approximately 14% of the reported soft costs, it was the area of largest concern for respondents. By mid-2016 costs for all scale systems fell by a minimum of 22%. Residential systems could be purchased for an average of $3.34/W-DC, commercial systems for $2.48/W-DC, and utility scale installations for $1.65/W-DC. Soft cost percentages increased from 2015, but remain on par with those seen in 2014. This is likely due to extreme cost cutting measures to obtain market shares that were proven to be unsustainable in the long run. Businesses and consumers both benefit from the rapidly falling hardware costs which enable .the customers to continue to see the price fall, but installers are better able to offer competitive pricing while stabilizing long term business operations.

The solar workforce in SC was expected to grow rapidly in the six month period from October 2015-April 2016. Nearly 200 additional jobs, primarily in installation and sales, were expected, though growth was anticipated to slow down, but continue over the three year period of October 2015 – October 2018, where approximately 480 new jobs were expected. Based on current hiring confirmations, 180-185 FTEs had been hired since October 2015. Extrapolating these data to the original twenty-seven respondents indicates that up to 462-473 positions may have been filled. This is close to the original three year job projection. If these hiring trends continue, the market within South Carolina could double the original three year growth projections. However, it is likely that once utility incentives expire, hiring will slow down or decrease and smaller installers who have not been able to establish a market share will either expand to emerging markets in other states or close and pursue other business opportunities.

Though installers, building code officials, and municipalities disagreed on the top priority for the solar industry, all three interest groups felt that model permitting development and developing a state licensing program for PV installers should be within the top three priorities. The need to develop model permitting likely stems from the large variability in permitting processes from county to county and town to town. If a more streamlined process can be developed it will help reduce the amount of time needed to develop and analyze the permits for all stakeholders. Licensing will also provide an avenue to prevent businesses that engage in deceptive practices or who provide poor or unqualified installations from continuing operations. Licensing is an important consumer protection and also helps better define where complaints should be addressed. Overall, the solar market in SC is experiencing robust growth and rapid cost decreases. This is enabled by Act 236, which served to help open the market to residential consumers. Costs are expected to further decrease even as utility incentives are phased out or expire.

5.0 References

1. SAS Institute, I., *JMP Pro Version 11.2.1*. SAS Institute, Inc.: Cary, North Carolina.
2. Fox, E.B. and T.B. Edwards, *2015 South Carolina PV Soft Cost and Workforce Development Part 1: Inital Survey Results.* DOE Technical Report, 2016. **SRNL-STI-2016-00177**.
3. Barbose, G., et al., *Tracking the Sun VII: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States.* DOE Technical Report, 2015. **LBNL-188238-1**.

Appendix A. Follow-up Survey Completed in May and June 2016

South Carolina PV Soft Cost and Workforce Development Survey: Part 2

Savannah River National Laboratory™
OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

The Savannah River National Laboratory (SRNL) has received funding from the Department of Energy's SunShot Initiative to help reduce PV soft costs in South Carolina over the next three years. South Carolina's solar PV installed costs are currently estimated to be at least 25% higher than the rest of the nation. In order to help develop cost reduction strategies and recommendations, we must first adequately define current estimates. Your assistance will help us identify your most pressing needs along with recommended solutions and is a direct follow up of the survey handed out in October 2015. Please direct questions or concerns about this survey or this project to Elise Fox at SRNL (elise.fox@srnl.doe.gov or 803-507-8560). *All information provided will be kept confidential and is considered business sensitive. Thank you for your assistance with this survey. This survey may also be filled out electronically at: https://www.surveymonkey.com/r/T7H3RQS*

Part I. Confirmation of Previously Reported Estimation of Soft Costs

1. **What segment of the solar PV industry does your company serve? Circle all that apply.**

   Residential Commercial Utility Not Applicable

2. **What is the typical size of type of installation in South Carolina now?**

watts-DC	watt-DC	watt-DC
Average Residential	Average Commercial	Average Utility-Scale

3. **What is the typical total installed cost (in dollars per watt-DC) for each segment in South Carolina now?**

$ per watt-DC	$ per watt-DC	$ per watt-DC
Residential	Commercial	Utility-Scale

4. **What was the typical total installed cost (in dollars per watt-DC) for each segment in South Carolina in 2014?**

$ per watt-DC	$ per watt-DC	$ per watt-DC
Residential	Commercial	Utility-Scale

5. **What percent of the typical installed cost is attributable to hardware only, now?**

%	%	%
of Residential installed cost is hardware	of Commercial installed cost is hardware	of Utility-Scale installed cost is hardware

Appendix A (continued)

6. What percent of the typical installed cost is attributable to hardware only in 2014?

%	%	%
of Residential installed cost is hardware	of Commercial installed cost is hardware	of Utility-Scale installed cost is hardware

7. Of the remaining, non-hardware costs, what percent of the cost is, now:

%	%	%	%
of non-hardware cost is marketing, lead gen, and/or sales	of non-hardware cost is permitting, inter-connection (incl. fees and admin. labor cost)	of non-hardware cost is installation (incl. design, engineering, and construction labor)	of non-hardware cost is profit, overhead, tax

8. Of the remaining, non-hardware costs, what percent of the cost in 2014:

%	%	%	%
of non-hardware cost is marketing, lead gen, and/or sales	of non-hardware cost is permitting, inter-connection (incl. fees and admin. labor cost)	of non-hardware cost is installation (incl. design, engineering, and construction labor)	of non-hardware cost is profit, overhead, tax

9. Please rank the following needs in order of importance (1 = highest)

Model ordinance development _____

Model permitting development _____

State licensing for PV installers _____

Public/consumer education _____

Inspector education _____

Homeowner Association (HOA) guidelines _____

Other (please specify) _____

Appendix A (continued)

Part II. Workforce needs

1. **How many employees (FTE) did you have in each category in October 2015:**

#	#	#	#
a. Additional sales and marketing FTEs	b. Additional electrician and installer FTEs	c. Additional general business admin FTEs	d. Additional design, engineering FTEs

2. **How many employees (FTE) do you currently have in each category:**

#	#	#	#
a. Additional sales and marketing FTEs	b. Additional electrician and installer FTEs	c. Additional general business admin FTEs	d. Additional design, engineering FTEs

3. **How many employees (FTE) do expect to hire in the next six months:**

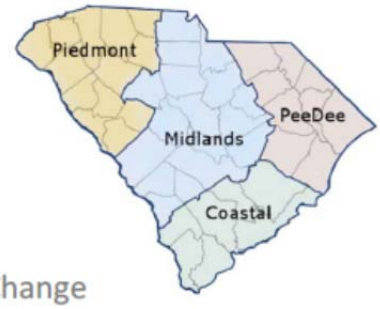
#	#	#	#
a. Additional sales and marketing FTEs	b. Additional electrician and installer FTEs	c. Additional general business admin FTEs	d. Additional design, engineering FTEs

Part III. Tell us how your business has changed in the last six months (since October 2015). Do you serve any additional new territories?

1. **In what Southeastern states have you focused your business so far? Circle all that apply.**

No Change

2. **In what regions of South Carolina have you focused your business so far? Circle all that apply.**



No Change

3. **Has your company changed its business focus? What segment of the PV market do you concentrate your time on today? Please note any business changes below.**

Appendix A (continued)

No Change

Business Focus	RESIDENTIAL	COMMERCIAL	UTILITY-SCALE
Long-term PV lessor or owner			
Project finance			
Install, EPC			
Customer development and/or site acquisition			
Equipment supply			
	Segment focus		

4. **Please provide your contact information so that we may contact you in the future. Again, all information provided will be kept confidential and is considered business sensitive. Thank you for your assistance with this survey.**

Name _____

Company _____

Title/Role _____

Mobile # _____

Email _____

All information provided will be kept confidential and is considered business sensitive.
Thank you for your assistance with this survey.

Appendix B. Supplemental Information

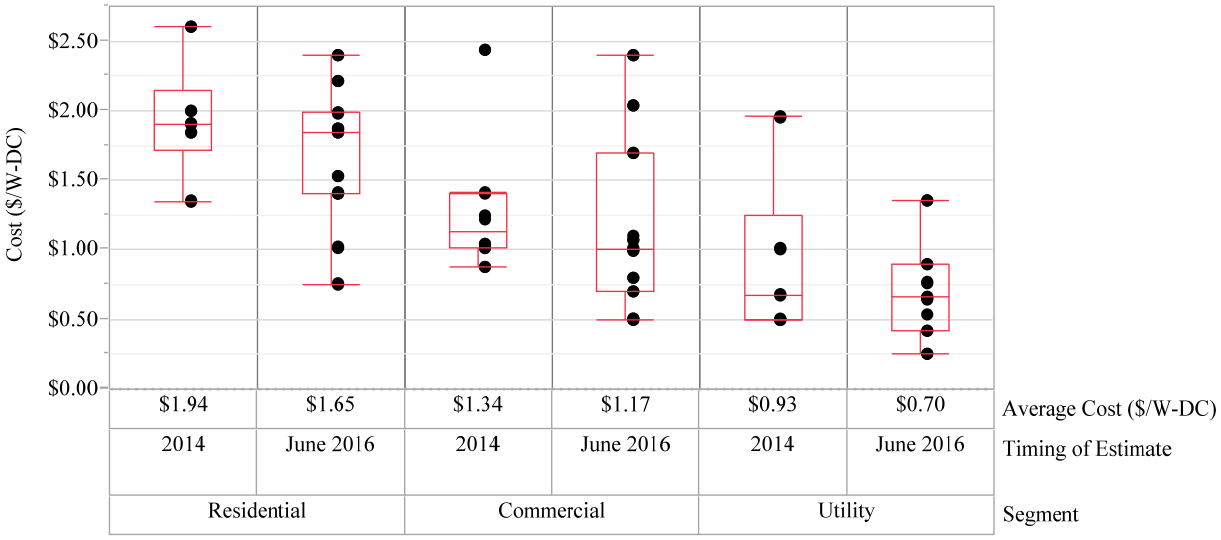


Figure B-1. Total soft cost of systems by sector in 2014 and mid-2016.

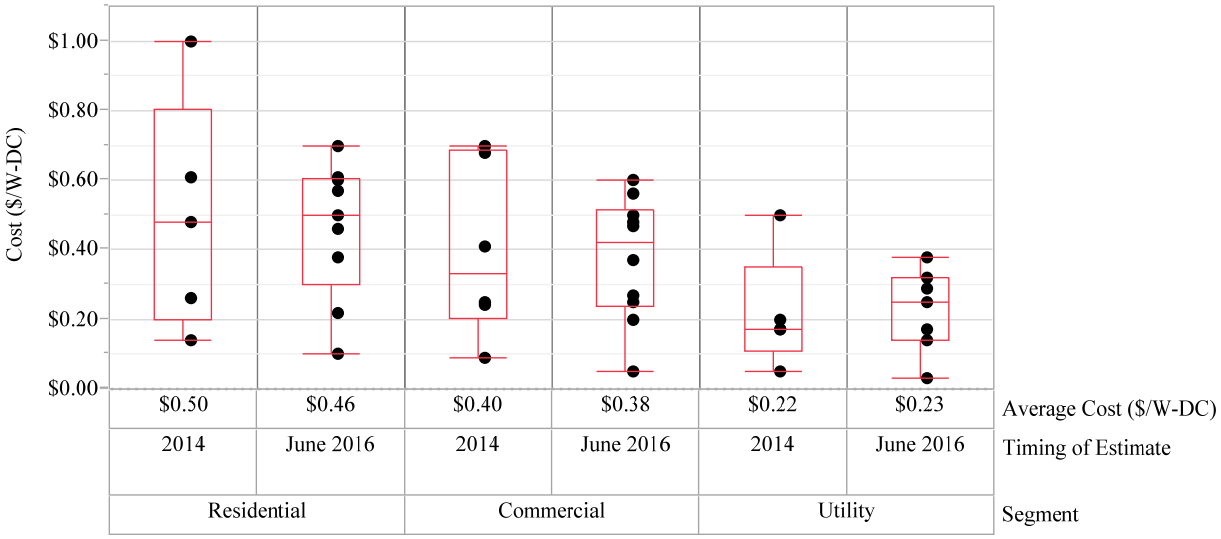


Figure B-2. Average cost of installation.

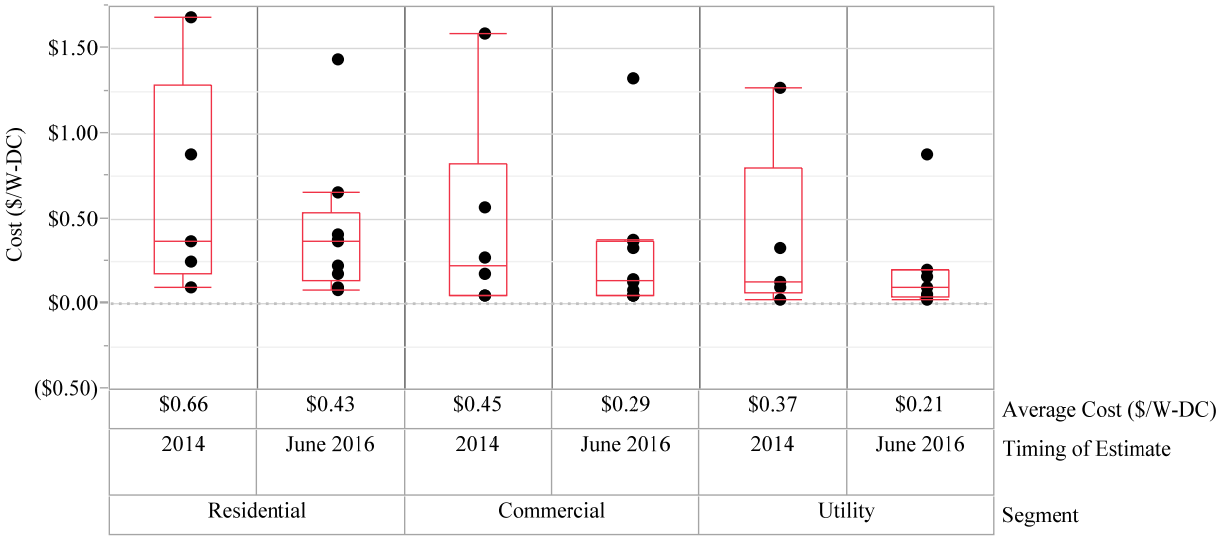


Figure B-3. Average costs for marketing and sales, in $/W-DC.

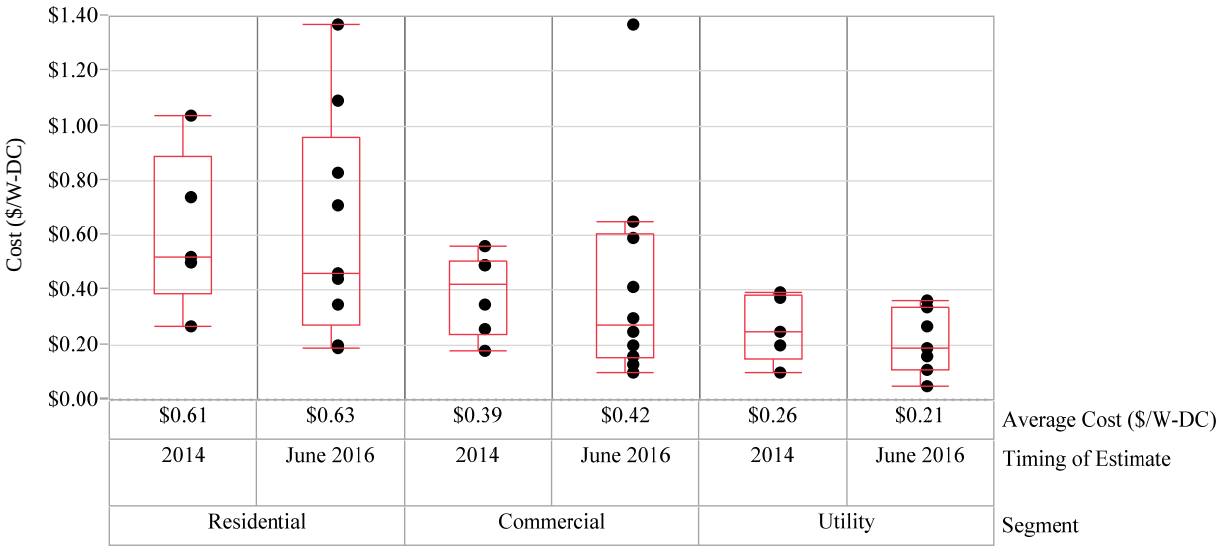


Figure B-4. Average costs for overhead and business expenses, in $/W-DC.

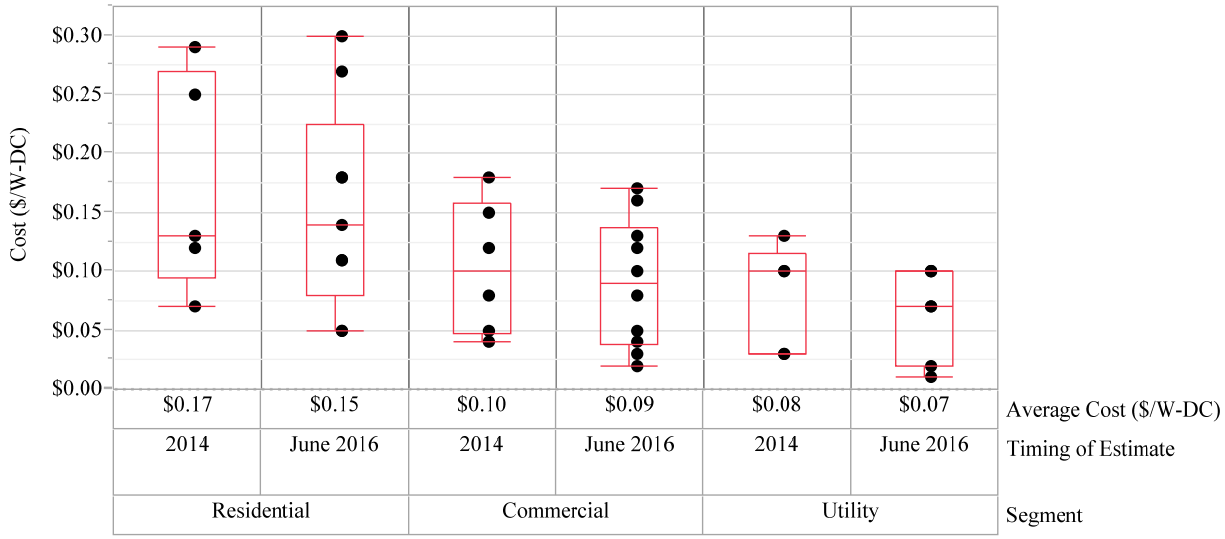


Figure B-5. Average costs for permitting expenses, in $/W-DC.

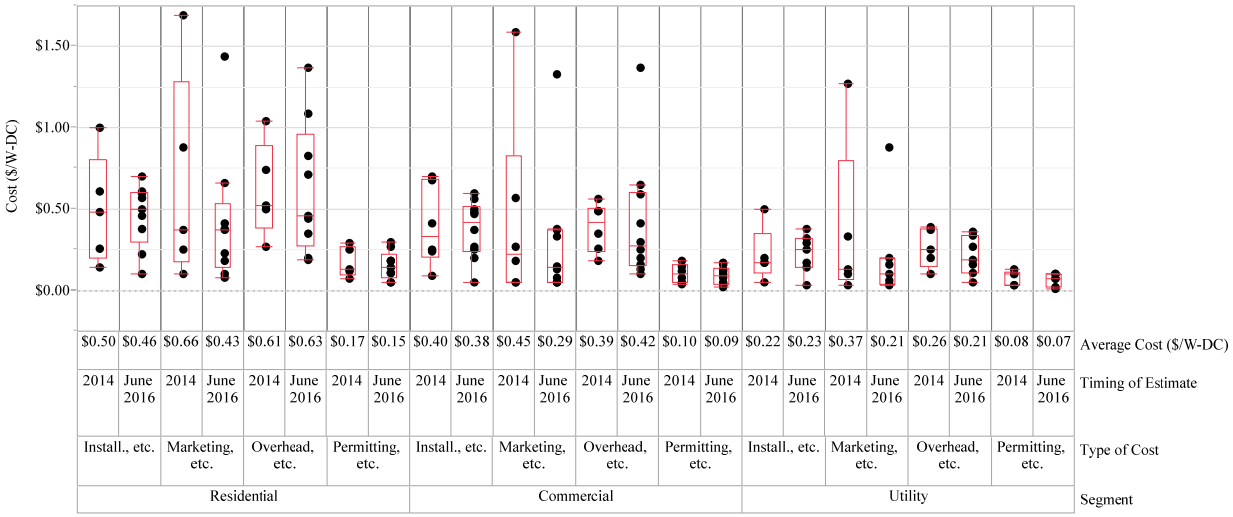


Figure B-6. Soft costs based on business segment, in $/W-DC.

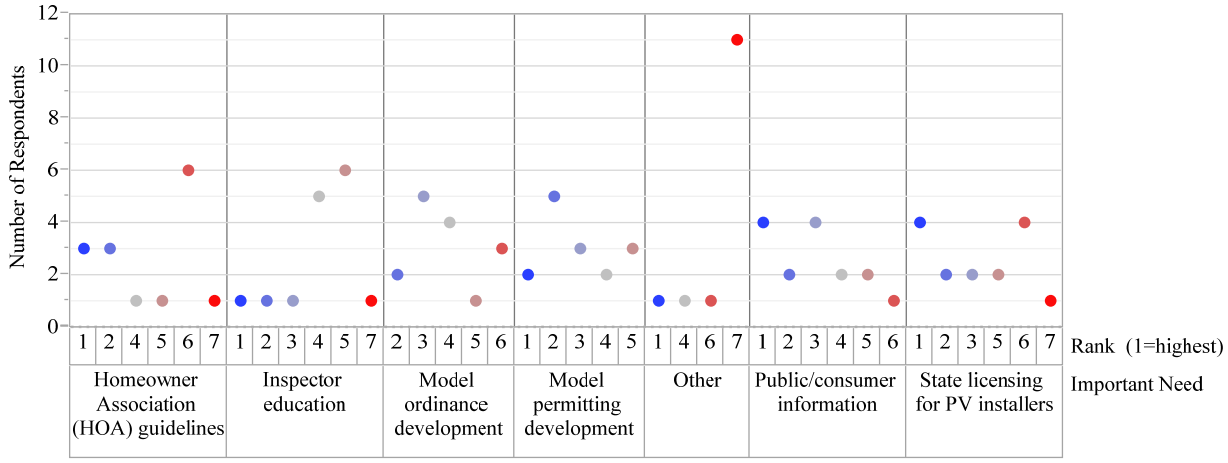


Figure B-7. Response data from participants of this survey on order if importance.

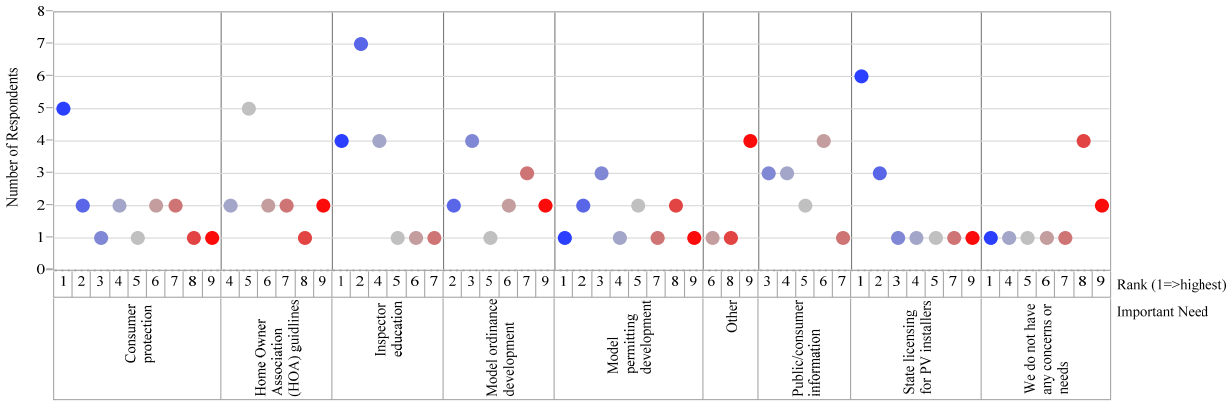


Figure B-8. Response data from Building Code Officials on order if importance.

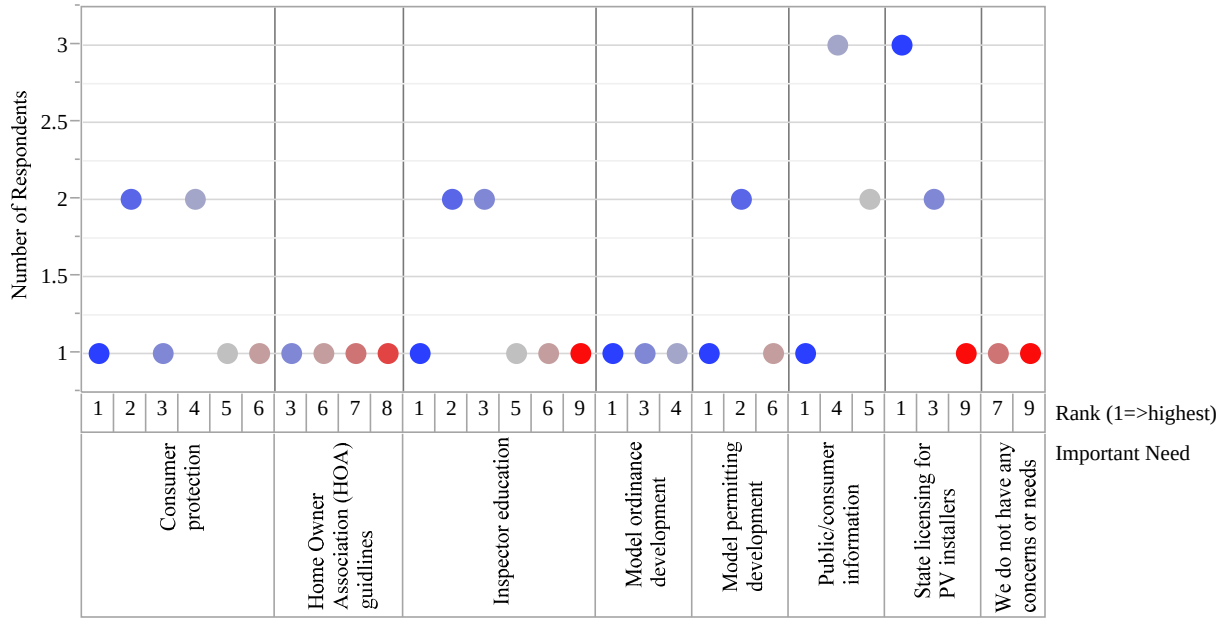


Figure B-9. Response data from municipalities on order if importance.