Evaluation of the Delaware SREC Pilot

Prepared for the Delaware Public Service Commission

August 3, 2012

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EXECUTIVE SUMMARY AND REPORT STRUCTURE

In April of 2012, the Delaware Sustainable Energy Utility (SEU) in coordination with its contractor SRECTrade implemented the first round of the state of Delaware's solar renewable energy credit (SREC) long-term contracting pilot (the SREC Pilot). This new initiative was jointly designed by the members of the state's Renewable Energy Task Force (RETF) during late 2011 and 2012 under its legislative mandate to recommend policies and programs that aid in the development of renewable energy markets in Delaware. The pilot program created a multi-tiered solicitation for long-term solar renewable energy credits that broadly supported multiple system sizes and ownership classes by awarding twenty-year SREC purchase contracts to PV system owners. Under the pilot program, the Delaware SEU serves as the long-term contacting agent, with Delmarva Power purchasing and retiring SRECs to meet its regulatory obligations under the state's renewable portfolio standard. This document was developed in coordination with the Delaware Public Service Commission (DPSC) to review the results of this initial solicitation and also responds to a number of key questions posed by both the Commission and other state solar market stakeholders.

The pilot program awarded twenty-year SREC contracts to 166 Delaware-sited PV systems totaling 7.68 MW of capacity with an expected first-year SREC production of 11,472. The solicitation was well subscribed, with more than 23 MW of PV capacity entering the solicitation from 548 individual systems. Pilot participants submitted bids into one of four project size categories which ranged from:

- Tier 1: Up to 50kW
- Tier 2A: Greater than 50kW to 250kW
- Tier 2B: Greater than 250kW to 500kW
- Tier 3: Greater than 500kW to 2,000kW

Contracts for the two smallest tiers were awarded through a lottery process, with projects using both Delaware labor and manufactured goods receiving lottery preference. Projects bidding into the two largest solicitation tiers were awarded contracts based on a competitive auction with winning bidders receiving as-bid long-term contract rates.

SREC contract prices for tiers 1 and 2A were set through an administrative rate setting process at $260 and $240 per SREC respectively for 10 years and $50 per SREC for contract years 11-20. The competitive Tier 2B auction resulted in a weighted average SREC contract price of $131 for the initial 10 contract years, while the weighted average contract price for Tier 3 was $154. As with the other tiers, contracts for tiers 2B and 3 included a fixed $50 per SREC price from contract years 11-20. Both projects that were already operational and those that were under development/proposed to be developed during the next year were eligible to participate under the pilot. The response to the solicitation was robust, with each of the program tiers oversubscribed by at least 2 to 1. Additionally, the legislatively mandated program adders that are designed to promote use of both Delaware source PV equipment and Delaware installation labor were very effective with more than 40 percent of all projects choosing to apply for both these adders. A complete accounting of the market response to the solicitation can be found in Chapter 1 of this report. A full accounting of the solicitation price results is reviewed in Chapter 2 along with a comprehensive analysis of the administratively set contract rates.

As part of this report, an on-line customer survey was performed to gauge system owner opinions about the solicitation process, the performance of both the SEU and SRECTrade, and other factors. 123 system owners or owners representatives completed this survey providing detailed feedback about their program experience. Many respondents expressed satisfaction with the performance of the pilot coordinators but expressed frustration with the pilot program eligibility criteria. Some respondents additionally indicated they were not made fully aware of the financial risks associated with their solar investments when they first made the decision to purchase a PV system. Chapter 3 of this report reviews the results of this system-owner survey and also

reviews SREC solicitation program structures and costs from other East Coast solar markets. A comparative analysis of the administrative costs associated with the Pilot is also discussed.

Under state law, the 30 MW Bloom fuel cell project will offset the number of SRECs Delmarva power will need to purchase from Delaware PV system owners. While the precise market dynamics of how this will impact the supply and demand for SRECs in the coming years is uncertain, the Bloom project is likely to offset a maximum of 30 percent of Delmarva's annual SREC obligation in 2018. The analysis in Chapter 4 estimates that Bloom project offsets will have a reducing impact on Delmarva's total SREC obligation on a percentage basis after 2018 as the state's solar mandate continues to grow and while the total output of the Bloom projects does not.

A number of potential alterations to the Pilot program structure could be considered by Delaware policy makers during the next program round to reduce ratepayer impacts. Potential options for creating a more competitive solicitation include:

- Reducing the total number of solicitation tiers,
- Exploring the use of an auction-based solicitations for the current Tier 2A,
- Setting administratively-set prices as a function of the competitive solicitation tiers, and
- Developing a solicitation specifically for existing systems that are unable to access the SREC market.

These potential design options are discussed in depth in Chapter 5 of this report along with a review of potential consumer protection initiatives Delaware policymakers could implement to better educate the public about the risks and benefits of the SREC market. This chapter also examines the risks and benefits to ratepayers of future policies that might encourage Delmarva or other obligated entities to enter into long-term SREC contracts.

CHAPTER 1. ANALYSIS AND EVALUATION OF PROCUREMENT TIERS AND MARKET RESPONSE

This section will evaluate several aspects of the Delaware SREC Pilot procurement related to the program solicitation tiers. Key questions that will be considered include:

- The market response to each of the procurement tiers,
- Whether the Delaware SREC program should continue to use a multi-tiered incentive structure,
- How the tiers from the pilot compare to other regional SREC programs as well as incentive programs from leading global solar markets ,
- Review of projects awarded contracts under the program, and
- The effectiveness of the Delaware equipment bonus and Delaware workforce bonus.

1.1. MARKET RESPONSE TO TIERS

The Delmarva SREC Pilot awarded contracts for a range of system sizes up to 2,000kW.[1] Under the pilot program, projects eligible for Tiers 1 (0-50kW) and 2A (greater than 50kW to 250kW) were awarded contracts with administratively set prices. Because these tiers were oversubscribed, selection for Tiers 1 and 2A was based on a lottery system with projects using Delaware manufactured components and labor receiving priority selection.[2] Tiers 2B (greater than 250kW to 500kW) and 3 (greater than 500kW to 2,000kW) were awarded contracts based on an as-bid competitive price auction. The four procurement tiers and the volume of SRECs procured in each system class are listed in Table 1 below. A fifth tier, consisting of projects larger than 2,000 kW has also been approved; however, SRECs for this tier had previously been procured by Delmarva under a long-term contract with the 11.2 MW Dover Sun Park.

Table 1. Delaware SREC Pilot Tiers and SREC Volumes

Tier	Minimum Project Size (kW)	Maximum Project Size (kW)	Pilot SREC Volume	Procurement Method
1	0	50	2,972	Lottery
2A	>50	250	2,000	Lottery
2B	>250	500	2,000	Competitive Auction
3	>500	2,000	4,500	Competitive Auction
4	>2000	N/A	0	Bi-lateral Contract

Each of the pilot procurement tiers was oversubscribed.[3] Table 2 below shows a breakdown of the number of effective SRECs bid into each tier by system type.[4] As the table illustrates, Tiers 2A and 2B were substantially

[1] Nameplate rating (DC at Standard Test Conditions)

[2] Criteria for these qualifications is described in 26 Del. C. §356: (d) A retail electricity supplier shall receive an additional 10% credit toward meeting the renewable energy portfolio standards established pursuant to this subchapter for solar or wind energy installations sited in Delaware provided that a minimum of 50% of the cost of renewable energy equipment, inclusive of mounting components, are manufactured in Delaware. (e) A retail electricity supplier shall receive an additional 10% credit toward meeting the renewable energy portfolio standards established pursuant to this subchapter for solar or wind energy installations sited in Delaware provided that the facility is constructed and/or installed with a minimum of 75% in-state workforce.

[3] Based on a survey of Delaware solar installers, the Renewable Energy Task Force (RETF) and Delmarva anticipated the procurement tiers would be oversubscribed (DPL, 2011).

[4] "Effective SRECs" is used throughout this report to describe the number of SRECs generated by a system including SRECs resulting from the Delaware equipment and workforce bonus adders.

oversubscribed with contract demand exceeding available supply by a ratio of more than three-to-one. Tiers 1 and 3 also received more bids than were available under the solicitation.

Table 2. SRECs Bid into the Pilot Program

Tier	SREC Bid	SRECs Required	Percent Oversubscribed
1	6,601	2,972	222%
2A	9,881	2,000	494%
2B	7,275	2,000	363%
3	10,220	4,500	227%

The following sections will provide a detailed accounting of bidding for each of the procurement tiers.

1.1.1. TIER 1 MARKET RESPONSE (0-50KW – LOTTERY PROCUREMENT)

Projects less than or equal to 50kW were eligible for the Tier 1 lottery-based procurement. Under program rules, projects that included both Delaware manufactured equipment and used Delaware labor were given priority in the lottery.[5] Table 3 below reviews the results of the Tier 1 procurement. 483 systems submitted applications for this tier. Of these, 148 systems totaling 2,006.5kW of capacity were awarded contracts. Of the awarded contracts, 69 systems were previously operational while 79 systems are under development. All systems awarded contracts under this tier had both Delaware manufactured components and Delaware-sourced labor.

Table 3. Tier 1 Solicitation Statistics

	Number of Systems	Effective SRECs	Capacity (kW)
Accepted	148	2,972.4	2,006.5
Under Development/Proposed	79	1,872	1,261.8
Operational	69	1,100.4	744.7
Not Accepted	335	3,628.1	2,715.6
Under Development/Proposed	90	1,133.4	830.5
Operational	245	2,494.7	1,885.2
Tier Total	**483**	**6,600.5**	**4,722.1**

More than 2,000kW of under-development projects submitted bids under the solicitation. This strong response from prospective project owners suggests that the administratively set price for Tier 1 was sufficient to support the development of new projects. Additionally, nearly 1,600kW of non-operational projects in Tier 1 stated they would qualify for both the Delaware workforce and equipment bonuses, indicating that the SREC price adders are sufficient to drive system owners to use Delaware sourced labor and panels.

Pilot participant surveys suggest that many of Tier 1 project owners who installed systems in Delaware between December 1, 2010 and the start of the SREC Pilot assumed they would be able to monetize SREC revenues at

[5] Under the lottery system, all systems using both Delaware components and labor were randomly assigned a lottery number. Projects with lower lottery numbers were sequentially awarded contracts until the total volume of SRECs under contract reached to Tier 1 2,972 limit. If projects applying for both the labor and equipment bonuses were insufficient to cover the full SREC volume of the Tier 1 solicitation, a similar lottery would have been conducted for applying systems that had used either Delaware labor or equipment (SRECTrade, 2012a).

prices not currently supported by either the Delaware or Pennsylvania SREC spot markets. At the time of the solicitation, 2,652.04kW of Tier 1-qualifying solar PV was registered in the PJM-GATS system.[6] 2,629.9kW of operational capacity applied under Tier 1, suggesting that nearly all the eligible in-state capacity submitted entries into the lottery seeking long-term contracts. Given that 744.7kW of existing in-state capacity was awarded contracts under Tier 1, this indicates that total "stranded" Tier 1 capacity in the state is likely around 1,900 kW.[7]

Figure 1 provides a breakdown of system sizes within Tier 1. The figure shows the distribution of capacity and the number of systems applying for four categories:

- Systems that were under development and awarded contracts,
- Systems that were operational and awarded contracts,
- Systems that were under development and not awarded contracts, and
- Systems that were operational and not awarded contracts.

As these figures indicate, capacity applying for the Tier 1 lottery tended to cluster in the 5-10 kW system range and the 45-50 kW range. More than thirty-one percent of the total capacity awarded contracts under the Tier 1 lottery was awarded to 13 systems in the 45-50 kW size range. Project economics for systems in this size range can differ substantially from typical residential PV systems and the relatively high number of systems in the upper range of Tier 1 suggests that developers of small commercial systems may have downsized projects in order to take advantage of higher Tier 1 contract prices. Also, several solar financing firms are listed as project owners for systems in the upper range of Tier 1 indicating that the third-party ownership model is available to projects of this size range in Delaware. Additionally, one developer submitted entries for five 48kW systems that appear to all be part of an aggregated development in the same office park. Four of these systems were awarded contracts. These four projects may benefit from economies of scale that are not available to residential system owners.

[6] Systems located in Delaware with a Delaware RPS program registration number and an on-line date of December 1, 2010 or later are included in this total (PJM, 2012).

[7] Note: This figure only includes systems that qualified under the SREC Pilot on-line date restrictions.

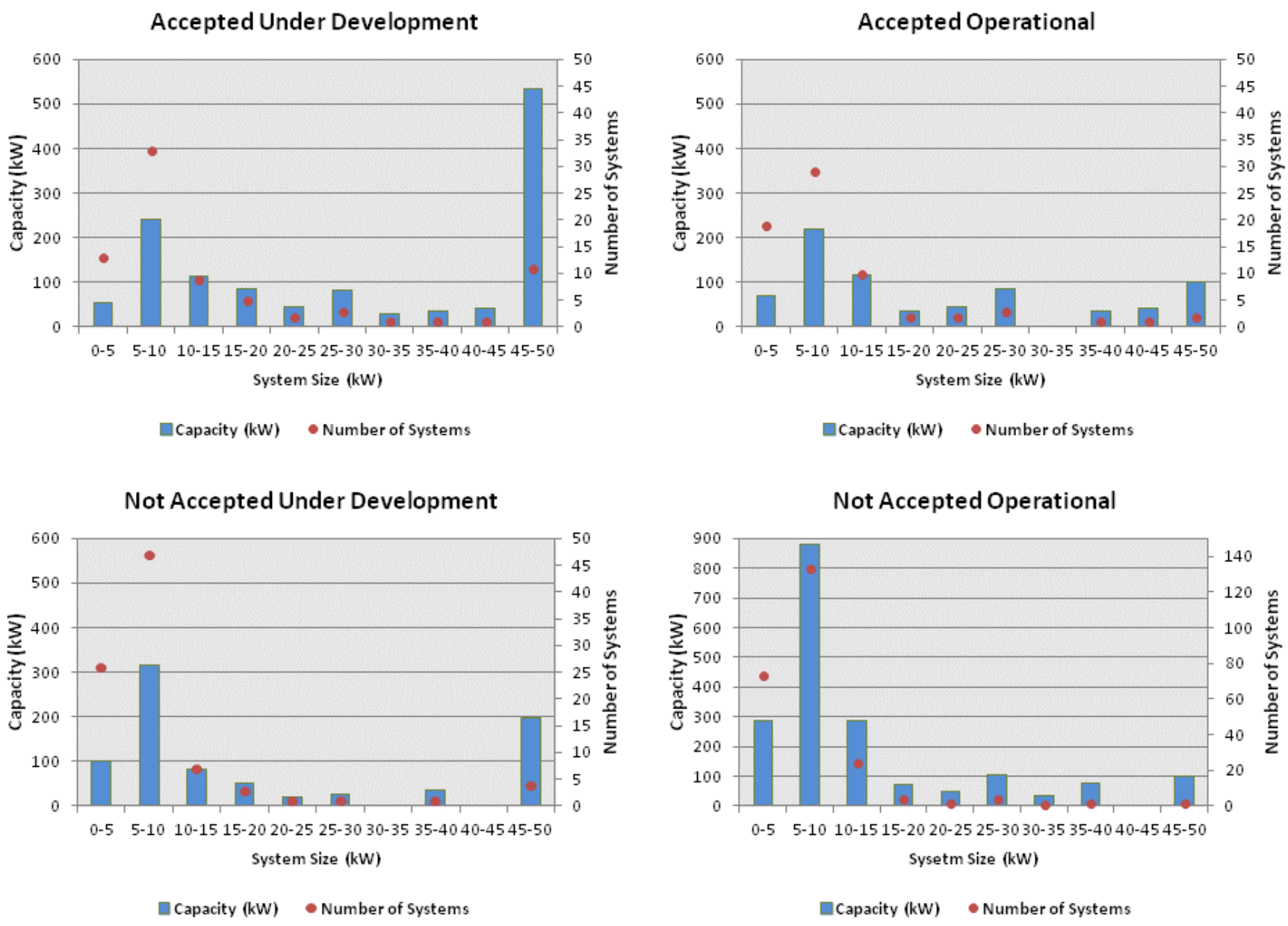

Figure 1 Tier 1 Solicitation Results

Projects that use both Delaware equipment and labor received an additional 20 percent SREC contract value (10 percent for the equipment bonus and 10 percent for the labor bonus). 183 of the 483 Tier 1 applications applied for both the equipment and labor bonuses totaling more than 3,632 SRECs. Given that lottery preference was given to projects applying for both these bonuses and that only 2,872 SRECs were procured under this tier, only projects which qualified for both adders were awarded projects in Tier 1.[8] Table 4 shows the market response to the labor and equipment adders in Tier 1.

Table 4. Tier 1 Response to Delaware Labor and Equipment Adders

	Capacity (kW)	Number of Systems
Non-Delaware Labor and non-Delaware Equipment	239.2	24
Delaware Labor and non-Delaware Equipment	2,025.8	276
Delaware Labor and Delaware Equipment	2,457.1	183

1.1.2. TIER 2A MARKET RESPONSE (>50-250KW – LOTTERY PROCUREMENT)

Projects greater than 50kW and 250kW were available for the Tier 2A lottery. Like the Tier 1 lottery, projects that included both Delaware labor and equipment were given preference in the lottery queue. Table 5 below details the results of the Tier 2A solicitation. 42 systems bid into Tier 2A. Of these, nine systems totaling 1,331.8kW of capacity were awarded contracts.[9] Of the awarded contracts one system was previously operational while eight systems are under development. All systems awarded contracts under this tier had both Delaware manufactured components and Delaware sourced labor.

Table 5. Tier 2A Solicitation Statistics

	Number of Systems	Effective SRECs	Capacity (kW)
Accepted	8.5	2,000	1,331.8
Under Development/Proposed	7.5[10]	1,911.2	1,274.7
Operational	1	88.8	57.1
Not Accepted	33.5	7,881.1	5,478.7
Under Development/Proposed	21.5	5,895.2	3,969.9
Operational	12	1,985.9	1,508.8
Tier Total	**42**	**9,881.1**	**6,810.5**

As previously mentioned, Tier 2A was substantially oversubscribed, with more than 9,800 SRECs bid into the solicitation seeking contracts for only 2,000 required annual SRECs. Given the relatively small number of SRECs

[8] Some solicitation participants that installed systems prior to the development of the SREC pilot program rules have expressed concern that lottery preference for projects with Delaware-sourced labor and equipment created a de facto Delaware sourcing requirement for the SREC market.

[9] Note: One system was awarded a partial fill as awarding the full volume of SRECs bid by that system would have exceeded the available Tier 2A volume.

[10] One project was originally a 161 kW single system. The SREC bid for this system was only partially filled due to oversubscription of the tier.

procured under this tier, this sizeable oversubscription may not be that remarkable. Two factors that may account for the sizeable Tier 2A oversubscription:

- Pent up state-wide demand for systems in this size class, and
- An administratively set price that may have been higher than necessary.

Regarding the issue of pent-up demand, the medium sized commercial PV system market in Delaware has been limited to date, with fewer than 35 systems representing less than 3,500 kW of capacity being built in the state between 2006 and early 2012 (PJM, 2012). More new PV potential capacity bid into this solicitation tier than currently exists in this size class across the entire state. This limited size of the existing Tier 2 sub-market is likely, in-part, due to the constraints of the Green Energy Fund rebate programs which only fund commercial system up to 50kW. Given that the SREC pilot is the first significant incentive program targeted at this system size class, the substantial oversubscription of the 2A tier may not be unusual.

During final program rulemaking, the PSC requested that systems in the administratively set tiers be allowed to bid into the competitively priced tiers in order to provide smaller system owners with the opportunity to compete for contracts. Several system owners with under development/proposed installations that would have qualified for inclusion in the 2A lottery chose to submit competitive bids for the 2B auction. Each of these submitted auction bids were significantly below the $240 administrative price for Tier 2A. This suggests that the oversubscription of the 2A tier could in part be attributable to an administratively set price that over-incentivized some project developers.[11] A further discussion of the administratively set prices can be found in Chapter 2.

The PJM GATs Delaware database lists 17 PV systems totaling 2,126 kW in the class 2A size range that meet the eligibility criteria of the SREC solicitation. Four operational systems totaling 475kW in the class 2A size range were awarded contracts under either the 2A lottery or the 2B auction. This indicates that there is 1,651kW of "stranded" capacity in the Tier 2A size range in Delaware after the first SREC pilot procurement.

Figure 2 provides a breakdown of system sizes within Tier 2A. The figure shows the distribution of capacity and the number of systems applying for four categories:

- Systems that were under development and awarded contracts,
- Systems that were operational and awarded contracts,
- Systems that were under development and not awarded contracts, and
- Systems that were operational and not awarded contracts.

As these figures indicate, capacity applying for the Tier 2A lottery was more evenly distributed across the size range than in Tier 1. A significant number of under-development projects in the 225-250kW range applied to the lottery but were not awarded contracts. This high concentration of under-development projects in this system size bin may suggest that developers planned projects that were near the maximum size limit for lottery participation. Additionally, few under-development projects were submitted in the smallest size range, suggesting that some project developers may have undersized their systems in order to qualify for the higher Tier 1 incentive.

[11] It should be noted that the small number of 2A-scale project bidding into the 2B auction make it difficult to draw a definitive conclusion whether 2A pricing was set too high. The individual circumstances of each of the systems that chose to bid-up to the 2B tier are not available and factors specific to each of these installations may have allowed them to bid prices substantially below the administratively set 2A price.

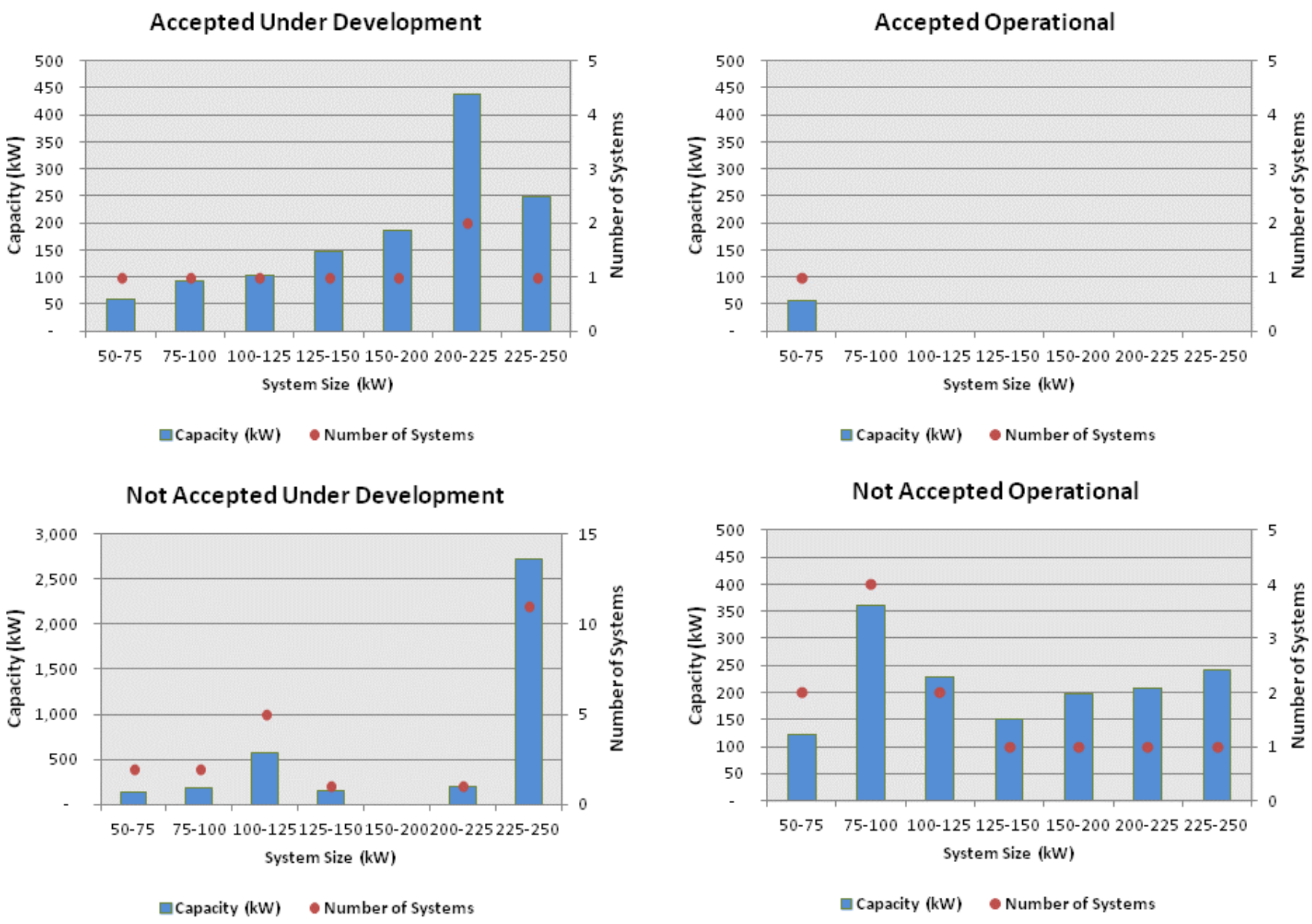

Figure 2. Tier 2A Solicitation Results

As with the Tier 1 procurement, projects in Tier 2A that use both Delaware equipment and labor received an additional 20 percent SREC contract value. 36 of the 43 Tier 2A applications had both the equipment and labor bonuses totaling more than 8,662 of effective SREC volume. Given that lottery preference was given to projects having both these bonuses, and that only 2,000 SRECs were procured under this tier, only projects which qualified for both adders were awarded projects in Tier 2A. Table 4 shows the market response to the labor and equipment adders in Tier 2A.

Table 6. Tier 2A Market Response to Labor and Equipment Adders

	Capacity (kW)	Number of Systems
Non-Delaware Labor and non-Delaware Equipment	750.5	5
Delaware Labor and non-Delaware Equipment	242.1	2
Delaware Labor and Delaware Equipment	5,8180	35

1.1.3. TIER 2B MARKET RESPONSE (>250-500KW – COMPETITIVE PROCUREMENT)

The Tier 2B solicitation was competitively bid using a pay-as-bid price auction. This tier had a maximum system size of 500kW and a lower bound of greater than 250kW. Smaller systems were permitted to submit competitive bids and forgo the Tier 1 and 2A lotteries. Fourteen systems with a total capacity of 5,182kW bid into the Tier 2B auction. Of these, five systems were awarded contracts totaling 1,518kW (one of these systems was only awarded part of its bid volume). As previously mentioned, Tier 2B was significantly oversubscribed, with more than 3,500kW of capacity not receiving contracts. Table 7 provides a breakdown of systems submitting bids for the Tier 2B auction. As discussed above, two systems that could have qualified for the Tier 2A lottery submitted competitive bids and one was awarded a contract.

Table 7. Tier 2B Solicitation Statistics

	Number of Systems	Effective SRECs	Capacity (kW)
Accepted	4.5	1,999.8	1,518.2
Under Development/Proposed	1	790.8	499.2
Operational	3.5[12]	1,209.0	1,019.0
Not Accepted	9.5	5,275.0	3,663.6
Under Development/Proposed	9	5,099.0	3,526.8
Operational	.5	176.0	136.7
Tier Total	**14**	**7,274.8**	**5,181.7**

The pricing results for Tier 2B are as follows:

- The weighted average bid price for all systems in Tier 2B was $154.02 per effective SREC,[13]
- The weighted average winning bid was $131.13 per effective SREC,
- The highest winning bid was $139.48 per SREC,
- The lowest accepted bid was $120.00 per SREC,

[12] One project was originally a 386 kW system that was split due to oversubscription of the tier.

[13] Effective SREC values include any SRECs added above the bid SREC volume as a result of either Delaware labor or equipment bonuses.

- The weighted average bid price for operational systems was $134.54, and
- The weighted average bid price for under development systems was $158.60.

Several project developers submitted multiple bids in the Tier 2B auction. One system owner won three of the five contracts and while only nine project developers submitted bids in the tier. Figure 3 shows the breakdown of systems sizes within the 2B tier. As in other tiers, bids tended to cluster towards the upper limit of the tier potentially suggesting that developers sized systems to meet the constraints of Tier 2B.

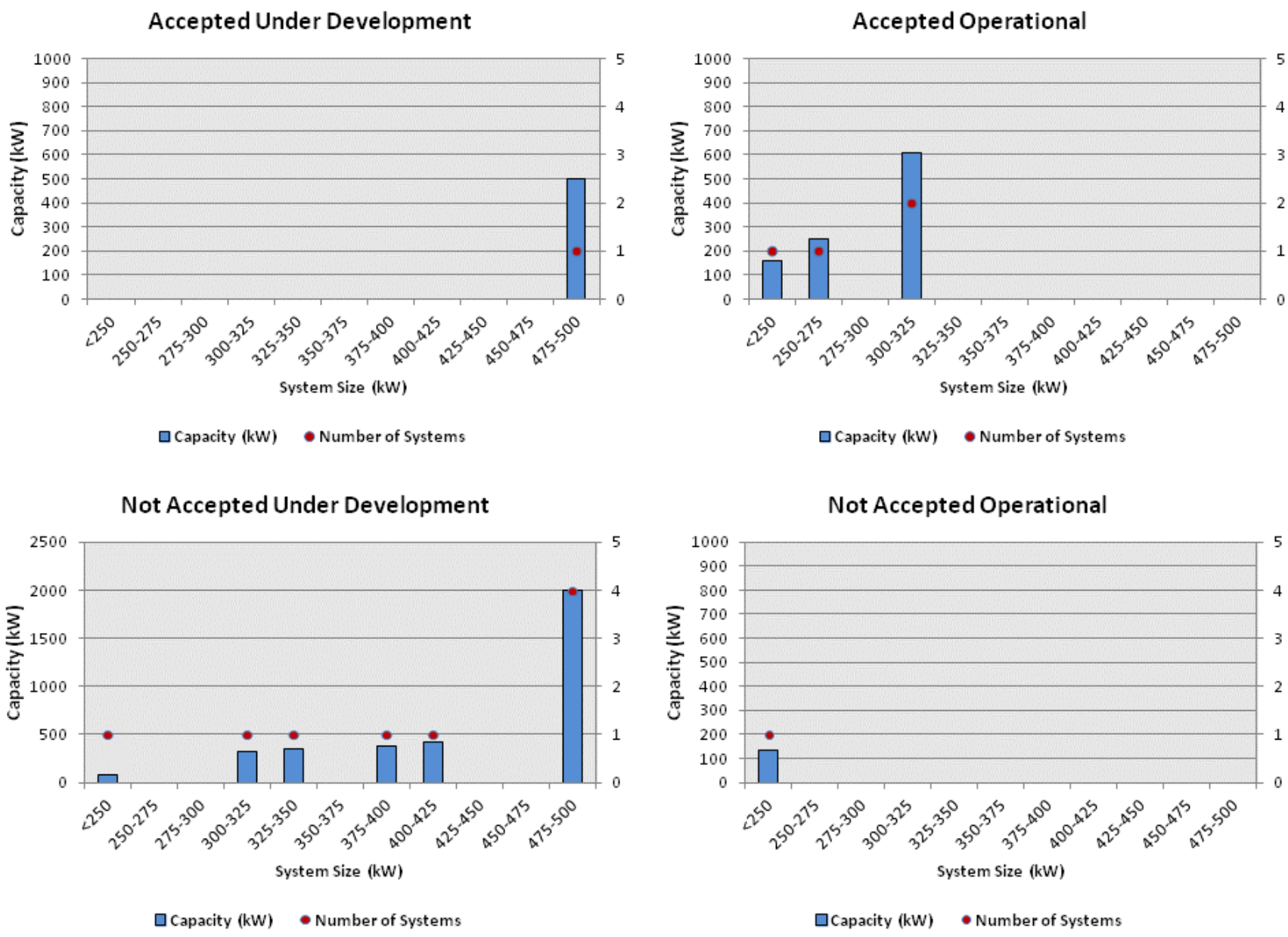

Figure 3. Tier 2B Solicitation Results

As with the other tiers, the Delaware workforce and equipment adders were utilized by a majority of the bidders. All but one of the ten under-development projects submitted for Tier 2B used both Delaware equipment and labor suggesting that these bonuses were sufficient to drive use of in-state resources. Table 8 presents the equipment and labor statistics for Tier 2B.

Table 8. Tier 2B Delaware Labor and Equipment Statistics

	Capacity (kW)	Number of Systems
Non-Delaware Labor and non-Delaware Equipment	1,155.7	5
Delaware Labor and non-Delaware Equipment	998.9	2
Delaware Labor and Delaware Equipment	3,027.1	8

1.1.4. TIER 3 MARKET RESPONSE (>500-2,000KW – COMPETITIVE PROCUREMENT)

Like Tier 2B, the Tier 3 solicitation was competitively bid using a pay-as-bid price auction. The maximum allowable system size in Tier 3 was 2,000 kW while the lower bound was greater than 500kW. Seven systems with a total capacity of 6,698.2kW bid into the Tier 3 auction. Of these, three systems were awarded contracts for the full capacity of their bids and one project accepted a partial contract. These four projects totaled 2,828.3 kW. More than 5,700 kW of capacity did not receive contracts. Table 9 provides a breakdown of systems submitting bids for the Tier 3 auction.

Table 9. Tier 3 Solicitation Statistics

	Number of Systems	Effective SRECs	Capacity (kW)
Accepted	3.5	4,500.1	2,828.3
Under Development/Proposed	3	3,986.1	2,496.9
Operational	.5[14]	514.0	331.4
Not Accepted	3.5	5,719.8	3,870.0
Under Development/Proposed	2	2,228.4	1,421.3
Operational	1.5	3,491.4	2,448.6
Tier Total	**7**	**10,219.9**	**6,698.2**

Pricing results for Tier 3 are as follows:

- The weighted average bid price for all systems in Tier 3 was $185.10 per effective SREC,
- The weighted average winning bid was $154.35 per effective SREC,
- The highest winning bid was $175.57 per SREC,
- The lowest accepted bid was $148.00 per SREC,
- The weighted average bid price for operational systems was $210.07, and
- The weighted average bid price for under development systems was $169.00.

Of note, the largest under-development system in the solicitation submitted the highest bid price. Given the limited sample size, it is difficult to characterize any clear pricing trends in the Tier 3 auction data set. Figure 4

[14] This project was originally bid as a single, 1,550 kW system, however the system was only awarded a contract for 331kW as its full bid would have exceeded the Tier 3 SREC volume limit.

provides a breakdown of system bids within the Tier 3 solicitation. While projects were submitted across the tier size range, all under-development projects were less than 1,000kW.

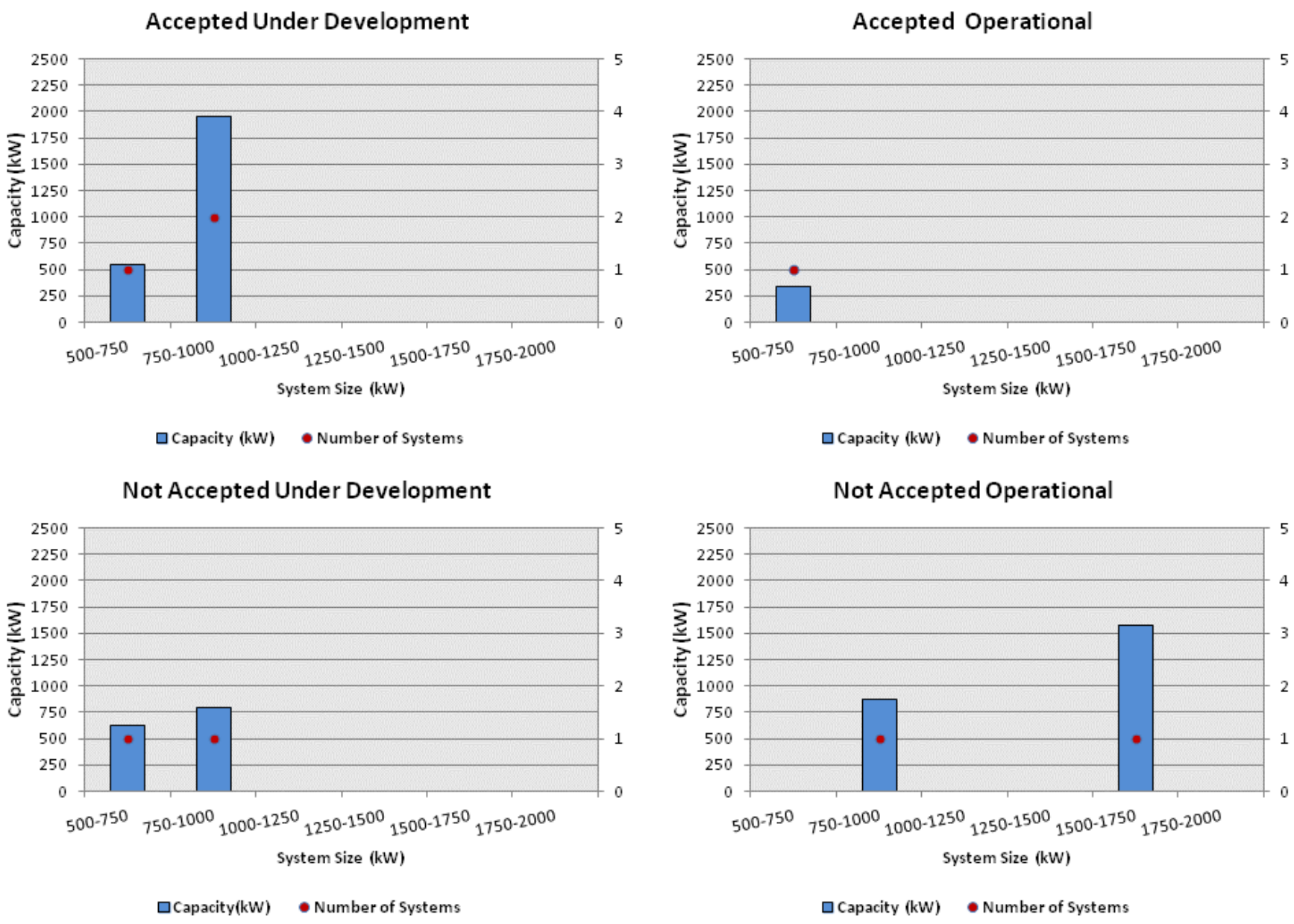

Figure 4. Tier 3 Solicitation Results

One developer was awarded three of the four contracts awarded under Tier 3, totaling 88.5 percent of the SRECs procured under Tier 3. While not a commentary on any particular developer, such a high concentration of one tier being awarded to a single project developer may present a risk to ratepayers in the event that that the developer is unable to meet their contractual obligations.[15]

As with the other pilot tiers, developers actively pursued the Delaware labor and equipment adders. Table 10 present statistics on market use of in-state resources in Tier 3.

Table 10. Tier 3 Delaware Labor and Equipment Statistics

	Capacity (kW)	Number of Systems
Non-Delaware Labor and non-Delaware Equipment	1,580	1
Delaware Labor and non-Delaware Equipment	548	1
Delaware Labor and Delaware Equipment	4,570	5

1.2. SHOULD DELAWARE HAVE A SOLAR POLICY WITH DIFFERENTIATED INCENTIVES?

The 2010 Amendments to the Renewable Energy Portfolio Standards Act (REPSA) charged the Delaware Renewable Energy Task Force (RETF) with developing recommendations to the DPSC and others for the creation of policies to support the development of diverse renewable energy markets in the state. This authorizing legislation included guidelines for how the task force should craft future renewable policies. The 2010 amendments specifically tasked the RETF with developing recommendations for policies that meet the following criteria, among others:

- Establishes REC and SREC aggregation mechanisms and other devices to encourage the deployment of solar energy technologies in Delaware with the least impact on retail electricity suppliers, municipal electric companies and rural electric cooperatives,
- Minimizes REPSA compliance costs,
- Establishes mechanisms to maximize in-state solar renewable energy generation and local manufacturing, and
- Ensures that residential, commercial and utility scale PV and solar thermal systems of various sizes were financially viable and cost-effective instruments in Delaware (Delaware State Senate, 2010).

There is an inherent tension between some of these legislative requirements. For instance, national solar market data consistently shows larger systems are able to achieve economies of scale when compared to typical residential installations. Any incentive program exclusively focused on reaching a solar renewable portfolio goal at the lowest costs to ratepayers would likely seek to encourage the development of large-scale, low-cost PV installations. However, while larger utility scale systems may be more cost effective--leading to lower overall policy costs--they are likely to have a smaller effect on direct job creation, as less unit labor is required per installed watt. As several stakeholders have noted, reaching both the cost effectiveness and job creation goals of the REPSA requires a balanced approach to solar policy design (DPL, 2011). For the same reason, the legislative

[15] The pilot program requires a bid deposit and includes a requirement that project owners commission systems under contract within 12 months (with the potential for extensions). This should deter project developers from failing to meet their SREC obligations, however unforeseen circumstances with individual vendors are possible. It should also be noted that, in the near term, the current oversupply of SRECs in the Delaware market may make this less of a concern.

mandate to create a diverse market that includes residential, commercial, and utility-scale PV systems is at odds with the requirement to minimize ratepayer cost impacts.

Several recent studies from the National Renewable Energy Labs, the Lawrence Berkeley National Labs and the U.S. Department of Energy have noted consistent difference in installed cost between residential, commercial and utility-scale PV systems, as seen in Figure 5 below (Barbose, Darghouth, Wiser, & Seel, 2011; U.S. DOE, 2011; NREL, 2011b). Given this industry consensus regarding installed cost differences between system size classes, providing differentiated incentives through a tiered SREC program is a reasonable approach to encouraging the development of a broad-based solar market.

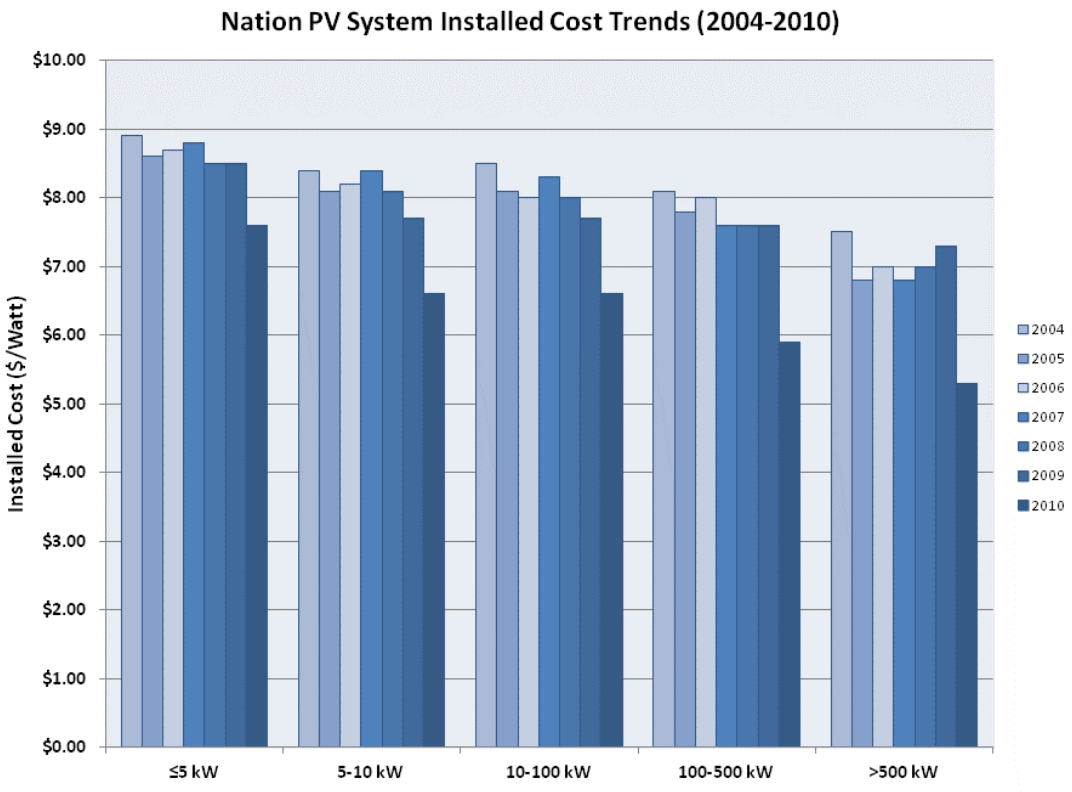

Figure 5. National PV Installed Cost Trends by System Size 2005-2010 (Barbose, Darghouth, Wiser, & Seel, 2011)

The installed cost differences found between system class sizes are not the only differences impacting PV project costs. Differences in federal incentives also affect system economics. Importantly, federal tax benefits from asset depreciation are not available to PV systems owned by residential or non-profit entities. Under current law, PV systems owned by commercial entities are eligible to depreciate their investments under the five-year MACRS (Modified Accelerated Cost Recovery System) schedule.[16] This added tax benefit can considerably improve project economics for a commercially-owned system. Federal deprecation can allow system owners to recover 26 percent of the projects installed cost (Bolinger, 2009). Because this benefit is not available to residential or non-profit PV system owners, policy makers in some states have tailored PV system incentives to account for this difference by providing added incentives for residentially-owned systems.

Given the well established installed cost differences amongst system size classes, as well as other differences that affect project economics, it is reasonable to have a solar policy that provides differentiated incentives to

[16] Additionally, systems installed in 2012 are eligible for fifty-percent bonus depreciation.

solar projects with different ownership types and/or size classes. This is in keeping with the goals of the 2010 REPSA Amendments to both develop a broad-based solar market and use renewable energy policy as a tool for economic development. Tiered incentive programs are a well established best practice, and most leading U.S. and international solar incentive programs have utilized differentiated incentives to support the growth of diverse solar markets. The following section will review the tiering strategy used in several prominent solar markets.

1.3. COMPARATIVE ANALYSIS OF DELAWARE PILOT TIERS

The following sections compare the incentive tiering structure of the Delaware SREC Pilot to incentive programs in leading national and international markets.

1.3.1. U.S. STATE POLICIES

As with the Delaware Pilot, a number of U.S. states have sought to encourage the development of a diverse solar market that allows wide participation amongst system types and sizes. Some of these states have chosen to provide differentiated incentive levels within a single policy type (i.e. creating tranches within a competitive SREC auction), while others have chosen to provide rebates to residential systems while allowing all systems to sell credits into a non-differentiated SREC market. Table 11 below lists several East Coast solar incentive regimes and the breakdown between incentive size classes within these markets.

The Connecticut solar incentive strategy provides rebates and performance-based incentives for residential systems, differentiating between resident-owned and third-party owned systems. Connecticut also has a utility long-term contracting program that is differentiated into three tiers. In Massachusetts, all PV system owners are eligible to take part in the state's SREC market on an equal footing, however the state provides a rebate program for residential and small commercial systems funded through a utility systems benefit charge.

Each New Jersey utility operates a long-term SREC contracting program. Three of those utilities (ACE, REC and JCP&L) operate a three-tiered long-term contract auction solicitation.[17] PSE&G operates a separate program for long term contracts for larger systems and also operates a residential solar loan program that uses an innovative SREC repayment mechanism. Pennsylvania utilities operate occasional SREC auctions for systems larger then 200kW and also have been authorized to negotiate bi-lateral contracts for systems smaller than 200 kW. Finally, Rhode Island has a distributed generation long-term contracting auction program that is run through National Grid.

[17] It has been noted that the solicitation tiers for this program mirror the tiers of the Delaware SREC pilot.

Table 11. East Coast Solar Incentive Policies

State	Incentive Program	System Size (kW)
Connecticut	Residential – Direct Ownership Rebate Program	Any residential
	Residential – Third Party Performance Based Incentive	Any residential
	RPS ZREC Carve Out	up to 100 100-250 250-1,000
Massachusetts	Commonwealth Solar II Rebate Program	<15 (5kW rebate limit)
	RPS SREC Carve Out	<6,000
New Jersey (PSE&G)	Non-residential Long Term Contract Program	up to 150 150-500 500-2000
	Residential System Loan Program	Residential Systems
New Jersey (ACE, JCP&L, REC)	Non-Residential Long Term Contract Program	< 50 50 to 500 500 to 2,000
Pennsylvania	Small Scale Utility Procurement	<200
	Long Term SREC Utility Procurement	>200
Rhode Island	Distributed Generation Contract Procurement	10-150 150-500 500-5,000

Some of these policies, such as PSE&G in New Jersey and the incentive programs in Connecticut, have chosen to make a distinction between residential and commercial system incentives, while others, such as Massachusetts, have chosen to provide added incentives to smaller systems regardless of ownership type. As the chart indicates, there is no common approach across the East Coast solar policies as to the appropriate number of incentive tiers or the most appropriate size categories within tiers.

1.3.2. INTERNATIONAL POLICIES

Most of the largest global solar markets are supported by tiered standard offer programs. Table 12 shows the incentive tiering breakdown from Germany, Spain, Italy, and Ontario. These standard-offer markets represent nearly 60 percent of global PV installations in 2011 (EPIA, 2012).

Table 12. International Solar PV Incentive Policies

Country	Incentive Tier	System size (kW)
Germany	Ground Mount	<30
		30-100
		100-1,000
		>1,000
	Rooftop	<30
		30-100
		100-1,000
		>1,000
Ontario, Canada	Rooftop	<10
		10-100
		100-500
		>500
	Ground Mount	<10
		10-500
		500-5,000
		>5,000
Spain	Ground Mount	All
	Rooftop	<20
		>20
Italy	Ground Mount	1-3
		3-20
		20-200
		200-1,000
		1000-5,000
		>5000
	Rooftop	1-3
		3-20
		20-200
		200-1,000
		1,000-5,000
		>5,000

As the table shows, each of these solar markets provides a differentiated incentive for a range of system sizes and types. One notable difference between the U.S. state incentive programs and these international policies is the consistent differentiation between incentives for ground mounted and rooftop PV installations. As with the previously reviewed East Coast markets, the international markets have a wide variety of tiering classifications, although the international programs tend to have lower upper-bounds for the smallest system size classes. It should be noted that these global markets are each significantly larger than the East Coast markets reviewed in the previous section. For instance, the German and Italian markets installed 7.5 GW and 9.3 GW of solar respectively in 2011 compared to 305 MW for the New Jersey market (EPIA, 2012; New Jersey Clean Energy Program, 2012). These more developed solar markets may have the breadth to support robust participation in each of the tariff pricing tiers.

1.4. COMMENTS ON THE SREC PILOT TIERS

As seen by the examples from both the East Coast and international markets, tiered solar incentive programs are a common practice and have become the norm for leading solar policies. Some East Coast markets have chosen to provide differentiated incentives for residential PV systems. Project economics for residential installations are markedly different than commercially owned systems, as residential owners cannot take advantage of the

benefits of accelerated depreciation.[18] Given this, state policy makers may wish to consider whether a single administratively set price is appropriate for both residential and small commercial systems in the smallest program tier, or whether incentive programs such as the Green Energy Fund should be specifically designed to overcome the differential between federal incentives between residential and commercial systems.[19] State policy makers may also wish to explore lowering the smallest incentive tier in the next SREC solicitation round, as project economics for 7.5kW residential systems are markedly different from 50kW commercial installations.

Successful solar policies can have widely varying tiering structures with a diversity of system size classes and number of tiers. Given the oversubscription of each of the pilot tiers, it can be concluded that future procurements using a similar tiering structure and SREC allocation would lead to a broad-based and diverse solar market in Delaware. However, the five-tiered Delaware pilot is unique amongst the East Coast incentive programs reviewed for this report. Given the relatively small size of the Delaware SREC market, a reduction in the number of procurement tiers may be warranted to both improve regulatory simplicity and create a more competitive auction process. While each of the pilot tiers were oversubscribed, the number of projects bidding into Tiers 2B and 3 was limited. Eight projects bid into Tier 3. These eight projects were owned by only five individual owners. A similarly limited number of projects and owners bid into Tier 2B, with 15 projects bidding into that auction tier representing nine individual owners. The limited number of owners and projects bidding into these tiers may be a potential cause for concern for regulators. While the prices awarded under the competitive tiers are in line with other East Coast markets (See Chapter 2), and there is no indication of collusion in bidding, future solicitations with similarly limited number of participants in the competitive tiers could present opportunities for project owners to game the system.

As previously noted, the average weighted SREC prices for accepted contracts in Tier 2B was lower than the winning average weighted price for Tier 3 ($131.13 and $154.35 respectively). In addition, several systems that were not awarded contracts under Tier 2B submitted bids would have been awarded contracts had they entered the Tier 3 auction. The overall policy cost of the program would have been reduced by creating a single competitive procurement tier for all systems greater than 250 kW (although this would have led to only one Tier 3 project receiving a SREC contract for its full bid volume). Given the limited number of SREC that will be procured by Delmarva in the coming years, policymakers may wish to consider reducing the number of procurement tiers in order to create a more competitive solicitation.

A straw proposal for revising the solicitation tiering has been submitted to the RETF by the Delaware Solar Energy Coalition (DSEC). This proposal maintains the four-tiered approach of the previous solicitations, but adjusts the thresholds between tiers. Table 13 shows the tiering structure from the DSEC proposal. A full review of the proposed structure is beyond the scope of this analysis. However, the suggested approach reduces the upper bound for the smallest program tier from 50kW to 25kW. This adjustment would benefit residential system owners, as systems between 40 and 50 kW reserved a significant proportion of the SREC volume in the last solicitation. Lowering commercial system participation in this tier may also be warranted as the administratively set rates for Tier 1 were modeled using a residential system that cannot take advantage of depreciation tax benefits.

[18] Third-party owned residential PV systems can benefit from accelerated depreciation and any differentiated policy that seeks to provide added incentives for residential systems in order to compensate a residential owner's inability to take the federal depreciation benefit may wish to factor this into the policy making process.

Table 13. DSEC Tiering Proposal and Pilot Program Tiering

	Pilot Solicitation	DSEC Proposal
Tier 1	0-50	0-25
Tier 2A	50-250	25-100
Tier 2B	250-500	100-300
Tier 3	500-2000	300-2000

Table 14 below shows the capacity and number of projects submitted in each tier under the existing program rules and also applies the DSEC tiering proposal to the data from the pilot solicitation. Under the DSEC-proposed strategy, the recently completed pilot procurement would have had significantly more systems and capacity taking part in the competitive tiers. Assuming SREC allocations between tiers were held constant, this approach would also have led to a lower weighted average Tier 3 SREC contract price ($138.18 vs. $154.35), potentially reducing the cost of the overall policy. While pricing data does not exist for Tier 2A systems that would have been included in Tier 2B under the alternative DSEC proposal, the increase in the number of systems bidding into the competitive 2B tier may also have resulted in a lower average contract price.

Table 14. Pilot Program Data and the DSEC proposal

	Pilot Solicitation		DSEC Proposal	
	Capacity (kW)	Number of Systems	Capacity (kW)	Number of Systems
Tier 1	4722.2	483	3163.2	444
Tier 2A	6810.5	43	2652.1	53
Tier 2B	5181.7	15	6337.0	33
Tier 3	6698.2	8	11260.3	19

CHAPTER 2. ANALYSIS AND EVALUATION OF PILOT PRICES

Under the SREC Pilot, projects eligible for Tier 1 (50 kW and under) and Tier 2A (greater than 50 kW and less than 250 kW) were awarded contracts with administratively-set prices recommended by the RETF. The prices were determined through an iterative cash-flow modeling process. This section will review key modeling assumptions and will also benchmark Tier 1 and Tier 2A's administratively-set prices against the auction-determined prices from Tier 2B and Tier 3 as well as against long-term contracting programs in other states.

2.1. REVIEW OF THE PV PLANNER TOOL

The University of Delaware's PV Planner software tool was used by the RETF to determine the administratively-set SREC prices for Tier 1 and Tier 2A. Developed by the university's Center for Energy and Environmental Policy (CEEP), PV Planner can be used to model a range of potential solar PV installation variables and allows users to develop highly customized s system performance forecasts and financial pro forma.

Because PV Planner is not publicly accessible, the sensitivity analyses conducted for this chapter used the National Renewable Energy Laboratory's (NREL) System Advisor Model (SAM) as an alternative modeling tool. SAM is a flexible spreadsheet modeling program that uses industry standard financial modeling methodologies to evaluate a range of renewable energy project types, including solar PV (NREL, 2012b). For this analysis, an Excel version of the SAM model was adapted to match how PV Planner was used by the RETF to determine administratively-set prices. The SAM Excel model replicated the PV Planner results with only minor differences.[20] The negligible difference in PV Planner and SAM Excel modeling outputs are largely attributable to factors such as input rounding and slight differences in modeling approaches to tax effects. Given that SAM and PV Planner were able to produce similar results, this further confirms that the PV Planner cash-flow modeling methodology is consistent with standard modeling approaches.

2.2. REVIEW OF MODELING ASSUMPTIONS & EVALUATION OF FINANCIAL MODEL USED TO SET PRICES

The determination of administratively-set prices requires policy makers, regulators, and other stakeholders to develop consensus model inputs that best reflect current market conditions and policy objectives. During the price setting process, the RETF worked to develop modeling inputs for a range of market metrics. These metrics were drawn from national surveys, datasets from state incentive programs, and feedback from local experts. Table 15 below list some of the modeling inputs used to develop the Tier 1 and Tier 2A administratively-set prices.

Tier 1 and 2A SREC prices were set based on target project financial metrics. For the Tier 1 residential system, the SREC price was set to result in a target 9.55 year project payback. The Tier 2A SREC prices were set to return a 12.69 percent internal rate of return (IRR) for the modeled system. This target IRR is similar to target IRRs used in other PV long-term contract rate setting proceedings.[21]

[20] Modeled results for Tier 1 using PV Planner found a system payback of 9.55 years. This result was replicated in the SAM Excel model with only de minimus changes to the provided inputs (largely due to rounding). Tier 2A PV Planner modeling reported an expected internal rate-of-return (IRR) of 12.69 percent with a minimum debt service coverage ratio (DSCR) of 1.22. Using the SAM Excel model with the same inputs and minor alterations resulted in an IRR of 12.71 percent and a minimum DSCR of 1.22, closely matching the PV Planner model.

[21] The recent Rhode Island DG Standard Offer used a target 13 percent IRR while the Vermont SPEED modeling project used a 12.13 percent IRR (Rhode Island Office of Energy Resources, 2011; Vermont Public Services Board, 2009).

Table 15. Prices Setting Modeling Inputs

Inputs	Residential (Tier 1)	Commercial (Tier 2A)
Size of PV Array (kWp)	7.5	250
Slope of Array	25°	10°
Array Orientation	South	South
PV System Cost in $/W$_p$	**5.80**	**4.75**
Inverter Replacement Year	13	13
Inverter Replacement Costs in $/kW	$700	$534
Annual Maintenance and Insurance Costs	**$175**	**$8,375**
Annual Cost Escalation Rate	2%	2%
Debt Fraction (before ITC or Treasury Grant)	**56%**	**51%**
Loan Interest Rate	**6%**	**7%**
Loan Duration (years)	10	10
Combined Incremental Federal and State Tax Rate	33%	40%
Evaluation Period (years)	25	25
Transaction Costs for Treasury Grant Monetization	**0%**	**10%**
State Grant (Green Energy Fund)	$7,131	-
Net Metering Rate (cents/kWh)	**14**	**10.5**
Annual Net Metering Rate Escalation	**2.00%**	**2.50%**
Is Income from SRECs Taxable?	Yes	Yes
SREC Price Year 10 through 20	$50	$50
SREC Multiplier for Instate Labor	1.1	1.1
Ownership Structure	Direct ownership	Power purchase agreement
Property Tax Included	N	N
Federal Depreciation	N/A	5-Yr MACRS (no bonus depreciation)
State Depreciation	N/A	5-Yr MACRS
Residential Loan Interest Deductible	Y	N/A
First Year SREC Production	9.6	308.5
Modeled project payback/return	9.55 year payback	12.69% IRR

Many of these variables, such as system costs and performance, can vary widely even within single state solar markets. The following sections will examine several of the modeling inputs that were used to set the Tier 1 and Tier 2A SREC prices and compare those modeling assumptions to either actual data from the SREC Pilot or to data from other comparable state solar markets. Where appropriate, sensitivity analyses are conducted to determine how project economics might be affected by changes to the modeled variables.

2.2.1. SYSTEM COSTS

Modeling assumptions related to installed system costs are among the most influential factors in a cash flow model. Datasets from many of the mid-Atlantic solar markets with current 2012 costs are not publicly available. This is particularly challenging as PV module costs have declined nearly thirty percent over the course of the last

year, meaning historical installed cost datasets from even twelve months in the past are unlikely to be representative of current local market conditions.

The RETF looked at a number of datasets to determine system cost assumptions for its PV Planner model including:

- The Berkeley Lab's Annual *Tracking the Sun* report,
- New Jersey's CORE Rebate Program,
- The Pennsylvania Sunshine Program,
- The California Solar Initiative,
- The Delmarva and Delaware Electric Co-op rebate programs, and
- The Massachusetts Commonwealth Solar II program.[22]

These datasets were used to estimate representative installed costs for a 7.5 kW and 250 kW PV system installed in Delaware. The New Jersey and Pennsylvania databases are no longer current as the rebate programs they catalogued have expired, and the most recent *Tracking the Sun* report includes costs data until the end of 2010. Of these sources, the California Solar Initiative and an alternative Massachusetts price database provide current 2012 installed cost data. The rebate databases from the Delmarva and Delaware Electric Co-op were also reviewed as part of this report. The following sections will compare the cost assumptions for both the Tier 1 and Tier 2A to these datasets.

2.2.1.1. TIER 1 SYSTEM COST REVIEW

Table 16 below shows installed average and weighted average installed costs for 2012 from the Delaware, California and Massachusetts databases for PV systems that are less than or equal to 50 kW. The Tier 1 administratively-set price was modeled using a $5.80 per watt assumption. This modeled value is within the range of installed costs for both the Massachusetts and California datasets[23] and is slightly higher than the cost data from the Delaware market.

Table 16. Average 2012 "Tier 1" System Prices in Delaware, Massachusetts and California (Mass. DOER, 2012; California Solar Initiative, 2012; Delaware Green Energy Program, 2012)

	Massachusetts	California	Delaware
Number of "Tier 1" Systems	412	2,518	74
Total "Tier 1" Capacity (kW)	3,021	13,490	468
Weighted Average Cost $/Watt	$5.74	$5.90	$5.38
Simple Average Cost $/Watt	$5.93	$6.25	$5.58
Standard Deviation	$1.31	$1.62	$1.23

The table also reports the standard deviation for system installed costs in these datasets. As indicated by these values, there are a wide range of installed cost prices found in these markets, with standard deviations in excess of $1.23 per watt for all three datasets.

[22] Note: The Commonwealth Solar II database only includes residential and small commercial PV systems that have received state rebate funding. The Massachusetts Department of Energy Resources maintains a database of all SREC-eligible systems that includes installed costs data for most systems (Mass. DOER, 2012).

[23] It is important to note that both these databases consist of installer-provided pricing data. The accuracy of installer-provided cost data from incentive program databases may reflect elevated pricing levels based on alternative price calculation methodologies related to the federal Investment Tax Credit (ITC) and treasury grant program.

Figure 6 below show scatter plots, by system size, for the installed costs of PV systems less than 50 kW installed in 2012 in Massachusetts and California. As these figures show, there is significant price variability for systems less than 50 kW in these markets. The regression lines on each graph also show the limited economies of scale associated with larger system sizes within this size class.[24]

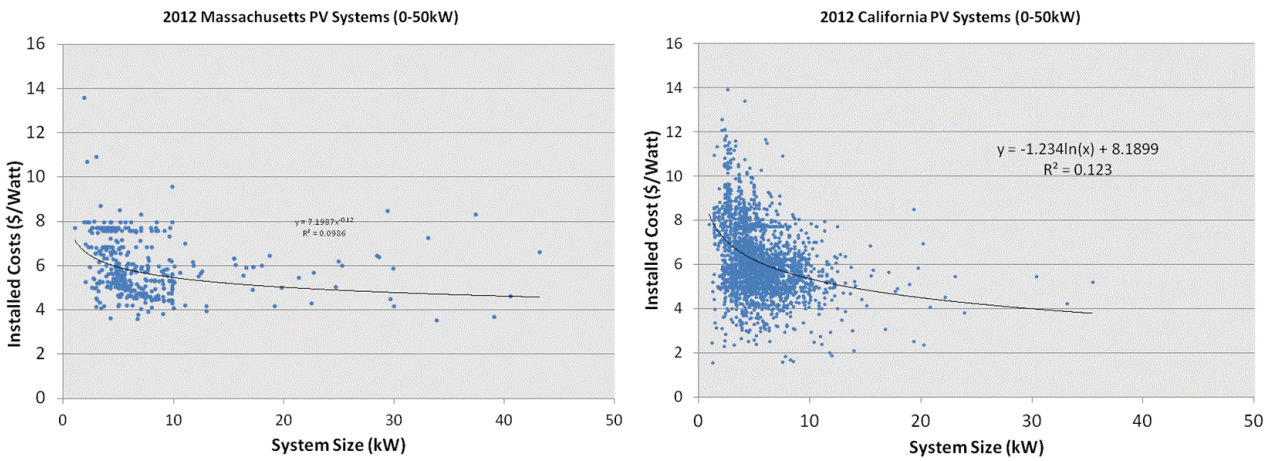

Figure 6. Installed Costs for PV Systems Less than 50 kW Installed in 2012 in Massachusetts and California (Mass. DOER, 2012; California Solar Initiative, 2012)

Given this wide system cost variability, project owners in the Tier 1 lottery that may have been at the lower end of the installed cost range could capture substantially better returns than owners at the average modeled cost. The sensitivity analysis in Table 17 below shows the investment paybacks for Tier 1 systems at the $5.58 average Delaware installed costs and also at $1.23 per watt increments above and below that value. As the table indicates, system owners with installed costs at the lower end of the range would see financial paybacks below three years (holding all other modeling assumptions constant).

Table 17. Tier 1 Model Installed Cost Sensitivity Analysis

	Installed Cost ($/watt)	Modeled Payback
Tier 1 Assumption	**5.80**	**9.55**
Average +$1.23	6.81	15.15
2012 Delaware Average Installed Costs	5.58	7.11
Average -$1.23	4.35[25]	2.65

The substantial variability in solar PV installed costs, and the potentially significant swings in project economics that result from this variability, illustrate the challenge in accurately modeling and setting incentive prices that meet specific financial thresholds. It also suggests that policy makers may wish to consider setting prices using

[24] The trend line on each graph shows the modest price discounts associated with increasing system sizes in each dataset. As the low R^2 value indicate, system size only minimally explains the installed cost variances within this size classification in these markets.

[25] Note: While this value may seem well below market average costs, 36 percent of installations in the Delaware Green Energy Program databases have costs below $5 per watt. Similarly, 25 percent of installations in the Massachusetts database are below $5 per watt while 23 percent of systems in the California database are below $5 per watt.

installed cost assumptions that are below market average prices in order to limit financial returns for low-cost installations.[26]

2.2.1.2. TIER 2A SYSTEM COST REVIEW

Limited market cost data exist for Tier 2A scale systems either from Delaware or from other U.S. markets. Of the previously discussed data sets, only the Massachusetts SREC database has a substantial number of recently installed Tier 2A sized systems. Table 18 lists developer-reported installed cost metrics for the 35 systems installed in Massachusetts in 2012 in the Tier 2A size class (50 kW to 250 kW). As the table indicates, the market for projects in this size class in Massachusetts shows similar cost variability as the Tier 1-sized market.

Table 18. 2012 50-250kW PV Systems Installed in Massachusetts

	Massachusetts
Number of "Tier 2A" Systems	35
Total "Tier 2A" Capacity	4,251.5
Weighted Average Cost $/Watt	$5.57
Simple Average Cost $/Watt	$5.44
Standard Deviation	$1.51

While it is difficult to draw conclusions from other state markets, data from Massachusetts suggest that the Tier 2A modeled cost of $4.75 could be below market average installed costs in Delaware. However, the limited Massachusetts dataset also has a number of systems with costs well below the $4.75 modeled costs suggesting that systems in this cost range could be possible in the Delaware market.

Table 19 below shows expected IRRs for systems with installed costs $0.75 above and below the $4.75 used for PV Planner for Tier 2A systems. As with the Tier 1 systems, modeled financial returns are highly sensitive to system installed costs.

Table 19. Tier 2A Modeled Installed Cost Sensitivity Analysis

	Installed Cost ($/watt)	Modeled IRR
Modeled Cost +$0.75	5.50	6.9%
Modeled Average Cost	4.75	12.7%
Modeled Cost -$0.75	4.00	21.1%

2.2.2. ARRAY SIZE

The modeling assumptions for the administratively-set prices included a representative 7.5 kW Tier 1 system. This system size is in line with a typical residential PV system in the Green Energy Fund program. However, the average system size for projects entering the Tier 1 lottery was 13.6 kW. As mentioned in Chapter 1, a number of systems just below the 50 kW system size limit submitted entries for Tier 1, and these 13 systems impacted the Tier 1 average system size. For reference, the average system size for Tier 1 lottery entrants 25kW and smaller (one proposed size limit for the next pilot round) was 8.23 kW. The average system size for the Tier 2A lottery was 158.4 kW, almost 100 kW smaller than the representative system modeled as part of the prices setting exercise.

[26] The Rhode Island DG standard offer tariff rate setting process explicitly sought to set rates based on lower-than-average market installation costs (Rhode Island Office of Energy Resources, 2011).

The size of the system modeled as part of the administrative price setting exercise was considerably different than the average system size entering the lottery; however, it is unlikely that the differences between the modeled system and the applicant systems made a material difference in the returns seen by project owners as most of the modeled input factors tend to scale with project size.

2.2.3. CAPACITY FACTOR, SLOPE AND AZIMUTH

System capacity factors are a key driver of project financial returns, and system tilt and azimuth are two of the major factors that affect installation capacity factors. The modeling assumptions included a due-south system orientation for both classes and a 25 degree and 10 degree tilt for Tier 1 and Tier 2A respectively. As Table 20 shows, average tilts and azimuths for Tier 1 closely matched modeling assumptions (25 degrees and 180 degrees). Averages for Tier 2A submissions closely matched the modeled azimuth (180 degrees) but differed on system tilt (10 degrees). This higher-than-expected value may, be a result of a significant number (11) of ground mounted systems entering the Tier 2A lottery.

Prices were set based on a modeled 14.6 capacity factor for the Tier 1 system and a 14.1 percent capacity factor for the Tier 2A system. Systems entering the Tier 1 lottery reported an average 13.7 percent capacity factor, while systems submitting applications for Tier 2A reported an expected 14.25 percent capacity factor. For the modeled Tier 1 7.5kW system, this difference in capacity factor would result in a reduction of more than 400 kWh in the first year of production. Conversely, the modeled Tier 2A system would be expected to produce about 1,385 kWh less than a 250kW system with the average capacity factor reported by Tier 2A applicants.

Table 20. Average System Sizes, Tilts and Azimuths for Tiers 1 and 2A

	Tier 1		Tier 2A	
	Modeled	Actual	Modeled	Actual
Average System Size	7.5 kW	13.6 kW	250	161 kW
Tilt	25	26.4	20	19.1
Azimuth	180	181.4	180	181.3
Capacity Factor	14.6 (1,283 kWh/kW)	13.7 (1,202 kWh/kW)	14.25 (1,248 kWh/kW)	14.1 (1,234 kWh/kW)
Reported Capacity Factor Standard Deviation		±0.92%		±0.98%

Differences between modeled and expected capacity factors can affect project paybacks and IRRs. Table 22 and Table 21 below show the expected system paybacks and IRRs for modeled PV systems using the self-reported capacity factor information from the SREC Pilot dataset. The first line of each table reports the modeled capacity factor value. The remaining rows of each table provide a sensitivity analysis that shows financial metrics for the average system reported capacity factor along with capacity factor values that are one deviation above and below the values average value reported in each tier.

Table 21. Capacity Factor Sensitivity Analysis for Tier 1 Systems

	Capacity Factor	Payback (Years)
Modeled Value and Reported Value Plus One Standard Deviation	**14.6%**	**9.55**
Reported Value	13.7%	11.20
Reported Value Minus One Standard Deviation	12.8%	14.05

Differences between modeled average capacity factors and reported capacity factors are likely partially attributable to a significant number of PV systems which applied to the Tier 1 lottery that had azimuths near either due-east or due-west.[27] Because system production drops off non-linearly as azimuths approach 90 or 270 degrees, these systems can disproportionately impact the average system capacity factor in the dataset.

Table 22. Capacity Factor Sensitivity Analysis for Tier 2A Systems

	Capacity Factor	IRR
Modeled Value	**14.1%**	**12.7%**
Reported Value Plus One Standard Deviation	15.2%	16.8%
Reported Value	**14.3%**	**13.5%**
Reported Value Minus One Standard Deviation	13.3%	9.8%

As previously mentioned, differences between modeled and reported capacity factors for Tier 2A are likely due to the significant number of ground-mounted systems applying for this Tier.[28] As would be expected, the ground mounted system in the Tier 2A applicant database reported higher system tilts than the roof-mounted systems in the same tier.[29]

Compared with other factors evaluated in this chapter, differences between reported and modeled capacity factors have a relatively slight impact on project financial returns.

2.2.4. ANNUAL OPERATIONS, MAINTENANCE, AND INSURANCE

There are relatively few comprehensive studies of representative PV system operations and maintenance (O&M) costs available. The National Renewable Energy Laboratories recently compiled a list of fixed O&M costs for a range of energy technologies including solar PV (NREL, 2011a). Information from this dataset formed the basis for the O&M costs used for the PV Planner model. The final modeled value annual O&M costs assumption ($20.70 per kW-yr) is well cited and is also in line with installer-reported O&M costs from proceedings in Rhode Island.[30]

[27] 81 systems reported azimuths either greater or equal to 230 degrees or less than or equal to 130 degrees.
[28] 11 of the 41 system entering the 2A lottery were ground mounts.
[29] Average reported capacity factors for ground mounted systems were 14.77 percent while roof mounted systems had an average capacity factor of 14.20 percent.
[30] An installer survey during the Rhode Island DG standard offer rate setting proceedings estimated O&M costs for 150 kW PV systems of around $20/kW-yr. This value did not include insurance costs (Rhode Island Office of Energy Resources, 2011).

The Tier 2A model also included an additional annual cost for insurance set at 0.25 percent of installed costs. Like the O&M cost value, the insurance cost value was drawn from a National Renewable Energy Labs study (Speer, Mendelsohn, & Cory, 2010). The analysis in the cited study was based on a survey of national installers, and while this may or may not reflect market conditions in Delaware, the NREL study provides one of the few data points available on PV insurance costs.

2.2.5. INVERTER REPLACEMENT YEAR AND INVERTER REPLACEMENT COST

For both the Tier 1 and Tier 2A price setting exercises, an inverter replacement at the end of project year 13 was modeled. As mentioned in the report detailing the PV Planner input assumptions, inverters typically include 10-year standard warranties. However an inverter replacement in year 13 was modeled to avoid two inverter replacements during the 25 year project life. The assumption that an inverter will live past its warranted life is a reasonable assumption and replacing the inverter in year 13 instead of year 10 does not significantly affect project economics.

Inverter cost assumptions were based on a 2012 price of $700 per kW for the Tier 1 residential system and $534 per kW for the Tier 2A commercial system. A two percent inflation rate was applied to these costs for a projected year-13 cost of $906 and $691 per kW for the residential and commercial systems respectively. These values are in line with current inverter market surveys and area reasonable model inputs (SolarBuzz, 2012). This value did not attempt to forecast potential inverter price declines related to industry expansion. This is understandable given the challenges associated with predicting technology costs more than a decade in the future.

Another growing market trend that could influence the accuracy of this modeling assumption is the more widespread use of long-term warranties for PV system inverters. A number of leading inverter manufacturers are now offering extended warranties of up to 20 years (SMA, 2012; Fronius, 2012). No reliable market data exists as to what portion of system owners are choosing extended warranty options. However if a sizeable number of Delaware solar project developers are opting for this added warranty protection, then project owners will not bear the costs of inverter replacement during the first 20 years of the project life. A recent survey of industry experts estimated that extended inverter warranties can range from $150 per kW for small residential systems to $100 per watt for large utility-scale projects (NYSERDA, 2012). Under the modeling assumptions used in the administratively prices-setting process, a Tier 2A project with an upfront extended warranty cost of $125 per kW and no inverter replacement during the project life would have an IRR of 14.3 percent.

2.2.6. OTHER INCENTIVES: TREASURY GRANT MONETIZATION COSTS AND STATE REBATE

Inputs to the administratively-set prices included a DNREC Green Energy Fund rebate of $7,131 for residential systems. This value is discounted from the current rebate levels as it accounts for extended time delays in receiving program funds. This modeled discount was set to account for financing costs associated with long rebate wait times. Green Energy Fund rebates are a key factor in the economics of residential systems in Delaware even with the administratively set SREC prices. Without the availability of Green Energy Fund rebates, the payback for the modeled residential system exceeds 15 years – a value that will likely not support a significant residential solar market.

The modeled commercial system includes a discount for monetization costs for the federal Treasury Grant/Investment Tax Credit. This assumption is in line with findings from the National Renewable Energy Labs' renewable energy finance survey regarding tax equity transaction costs (NREL, 2012a). Removing this 10 percent discount for the monetization costs of the federal incentives increases the project IRR from 12.71 percent to more than 18 percent, indicating that project developers that are able to efficiently use tax credits generated from PV projects would likely be able to achieve returns in excess of the target IRRs.

2.2.7. DELAWARE LABOR AND MANUFACTURED EQUIPMENT ADDERS

As discussed in Chapter 1, the Delaware labor and equipment adders were used by all of the contract awardees in both Tier 1 and Tier 2. Given the SREC volume bid by project owners applying for both these adders exceeded the total volume of SRECs in each tier, the workforce and equipment adders served as a de facto requirement for being awarded a contract under the lottery tiers.

The administratively-set-pricing modeled projects for both Tier 1 and Tier 2A that included the Delaware workforce adder, but did not include the bonus for Delaware equipment. Table 23 below shows representative IRRs and payback for hypothetical systems that included (1) no bonuses, (2) only the labor adder, and (3) both the workforce and equipment adders.

Table 23. Sensitivity Analysis for Delaware Workforce and Equipment Bonuses

SREC Adder	Tier 1 Payback (Years)	Tier 2A IRR
1.0	10.9	9.8%
1.1	9.6	12.7%
1.2	6.9	15.8%

As the table indicates, the inclusion of both adders increases project returns, though not as substantially as some other variables evaluated in this chapter. Given these values, and the high adoption rate of both Delaware labor and equipment in the first round of the pilot, it is likely that the existing legislatively mandated SREC multipliers will continue to drive demand for Delaware sourced labor and equipment.[31]

2.2.8. FEDERAL AND STATE DEPRECIATION

For both federal and state tax purposes, the Tier 2A representative system was modeled using the 5-year MACRS schedule. Under current law, systems commissioned in 2012 are eligible to take a first-year federal depreciation bonus of 50 percent. This tax benefit was not modeled as part of the administrative price setting exercise as stakeholders felt that many commercial system owners would not have the tax appetite to use all the available tax credits. Table 24 below provides representative project IRRs for systems using standard 5-Year federal depreciation both with and without the 50 percent bonus.

Table 24. Sensitivity Analysis of 50 Percent Bonus Depreciation

Federal Depreciation	IRR
5-Year MACRS	12.7%
5-Year MACRS with Bonus Depreciation	17.8%

As the table indicates, the 50 percent bonus deprecation is a substantial tax benefit for PV system owners that are able to fully monetize it. Given the existing data, it is unclear what proportion of the Tier 2A contract awardees will be able to take advantage of bonus depreciation.

2.2.9. OWNERSHIP STRUCTURE

While Tier 1 was modeled assuming the residential ownerships model, a significant portion of the total contracted capacity was awarded to larger-scale commercial systems. Several of these systems appear to be owned by third-party developers. Given the significant differences in types and availability of incentives between commercial and residential PV systems, allowing relatively large commercial PV systems to compete in the same lottery for the same level of incentive may not be warranted. This issue is partially mitigated by the

[31] Note: This assumes that supply constraints do not affect the single Delaware manufacturer currently supplying qualifying panel.

state Green Energy Fund grant that, if awarded to residential system owners, can level economic returns between small commercial and residential systems.[32] For reference, a 50 kW commercial system receiving the Tier 1 $0.26/kWh SREC price would receive a rate of return around 15 percent, assuming similar modeling inputs as the Tier 2A administratively-set model. Policy makers may wish to monitor this issues going forward, particularly as the residential third-party ownership model is now common in many of the largest state solar market and residential third-party systems benefit from the same tax incentives as any commercially-owned PV system.[33]

2.2.10. CONCLUSIONS ON MODEL INPUTS

The modeling inputs and assumptions used in PV Planner are generally in line with metrics from available datasets and assumptions used in standard offer price setting processes in other states. While these values are well within the bounds of typical assumptions, it is important to note that sensitivity analysis suggests that owners that are able to develop systems that slightly deviate from these averages on – even a few metrics – may be able to capture substantially higher rates of return than the target of 12.69% IRR or paybacks periods lower than the 9.55 years target. Future price setting exercises might consider using inputs that are towards the lower bound of each input metric or assume that project developers will be able to take advantage of all reasonably available incentives. Experience from other states shows that administratively set standard offers have typically been oversubscribed and, given that, regulators may wish to set prices based on "low-cost" modeled systems instead of "average-cost" modeled systems in order to incentivize market cost efficiencies.

2.3. HOW ADMINISTRATIVELY SET PRICES COMPARE TO TIER 2B AND TIER 3 AUCTION PRICES

Table 25 below lists price statistics for the Tier 2B and Tier 3 competitive auctions. As the table indicates, average winning bid prices for both the competitive tiers were significantly lower than for the administratively set prices. While drawing definitive conclusions from such a small data set can be misleading, the significant difference between the Tier 2A administrative pricing and the average winning Tier 2B pricing suggests that Tier 2A sized systems may be financially viable with lower SREC contract prices.

Table 25. Administratively Set Prices and Competitive Auction Prices.

Tier	SREC Price
Tier 1	$260.00
Tier 2A	$240.00
Tier 2B	
Tier 2B Minimum bid	$120.00
Tier 2B Weighted Average Bid Per Effective SREC	$154.02
Tier 2B Weighted Average Winning Bid Per Effective SREC	$131.13
Tier 2B Maximum Bid	$195.00
Tier 3	
Tier 3 Minimum Bid	$148.00
Tier 3 Weighted Average Bid Per Effective SREC	$185.10
Tier 3 Weighted Average Winning Bid Per Effective SREC	$154.35
Tier 3 Maximum Bid	$240.00

[32] Note: Green Energy Fund rebates are available for small commercial systems; however program caps provide a lower maximum effective incentive than for smaller-scale systems.

[33] It is also important to note that energy revenue from third-party owned commercial systems are also subject to federal and state taxes that residential systems are not subject to.

Of note, the Tier 3 average winning bid price was above the average winning price from the Tier 2B auction. This result runs counter to empirical evidence that larger systems are able to leverage economies of scale resulting in lower overall project cost (Barbose, Darghouth, Wiser, & Seel, 2011). It is important to note that given the small number of individual systems bidding into the competitive auctions it is difficult to extrapolate conclusions about the Delaware PV market. Developers likely had a widely varying set of bidding strategies based on a number of project- and company-specific factors and, given the small number of bids received, fully understanding these factors would be necessary to draw conclusions about system prices relative to system sizes.

As mentioned in Chapter 1, two systems that would have been eligible for the Tier 2A lottery decided to submit competitive bids in the Tier 2B auction. One of these projects was accepted and the other had a bid price that was well under the Tier 2A administratively set price. This further suggests that pricing for Tier 2A may have been higher than necessary to stimulate market growth.

2.4. HOW ADMINISTRATIVELY SET PRICES COMPARE TO LONG-TERM CONTRACT PRICES IN OTHER STATES

Comparing long term SREC contract prices across jurisdictions is challenging as every state or utility program has unique program design features. Contract lengths, state tax treatments, net metering rates, and other incentives vary across jurisdictions and these variables can have a considerable affect on competitive auction results or administratively-set pricing models. Despite these caveats, benchmarking SREC Pilot contract prices against other leading solar markets provides important context for evaluating the overall success of the initiative. This section will compare results from the Delaware pilot to:

- The New Jersey multi-utility SREC auctions,
- The PSE&G Solar Loan Program,
- The Rhode Island Distributed Generation Standard Offer,
- Pennsylvania utility SREC long-term contract procurements.

It is also important to note that contract failure rates for competitive renewable energy auctions have been reported in some jurisdictions to be as high as 50 percent (Kreycik, Couture, & Cory, 2011). No publicly available data on the number of procured systems that have competed construction could be found for any of the solicitation programs reviewed for this section. This is an important caveat when reviewing auction price results, as winning bidders in some solicitations may not have adequately accounted for all project risks and may not be able to construct their projects at their winning contract price. [34]

2.4.1. NEW JERSEY (ATLANTIC CITY ELECTRIC, JERSEY CENTRAL POWER & LIGHT, AND ROCKLAND ELECTRIC COMPANY)

Between August 2009 and September 2011, three investor-owned utilities (Atlantic City Electric, Jersey Central Power & Light and Rockland Electric Company) in New Jersey operated eight auctions for 10-year SREC contracts. Like the Delaware SREC Pilot, system owners were paid as-bid contract prices. The utilities auction results for the final, September 2011, auction are listed in Table 26 below. As mentioned previously, the tier sizes for this procurement program mirror the procurement tiers from the SREC Pilot.

[34] In an effort to increase the likelihood that awarded projects are completed, the Delaware SREC Pilot included a $100/kW bid deposit. State policymakers may wish to evaluate the effectiveness of the bid deposit mechanism once after the 12-month installation window has concluded.

Table 26. September 2011 New Jersey Utility SREC Procurement Results (New Jersey BPU, 2011)

Market Segment	Price Type	SREC Contract Equivalent Price
Small (0-50 kW)	Average Price	$232.98
Small (0-50 kW)	Low Price	$115.91
Medium (50-500 kW)	Average Price	$221.18
Medium (50-500 kW)	Low Price	$146.89
Large (500-2,000 kW)	Average Price	$214.92
Large (500-2,000 kW)	Low Price	$174.87

As the table shows, prices under this solicitation varied widely, with low bids in some size classes at half the price of the average bid in the same tier. It is also important to note that average prices for each of the tiers were in the same range, with the average SREC price for the small tier only $18.06 per SREC more than average prices in the largest tier.

2.4.2. NEW JERSEY (PSE&G)

Between December 2009 and the end of 2011 PSE&G operated a unique long-term solar loan program that allowed system owners to repay utility-provided loans through long-term SREC contracts. Under the program, homeowner or businesses could receive a loan from PSE&G for up to 60 percent of the installed cost of a PV system. System owners repaid their loans by transferring SRECs to PSE&G at a fixed rate. Repayment contract rates were fixed at 15-years, effectively providing system owners with a 15-year guaranteed SREC offtake agreement. Table 27 provides the fixed price loan repayment terms for the program.

Table 27. SREC Rates for PSE&G Solar Loan Programs (PSE&G, 2011)

Segment	Dec 2009-Jun 2010	Jul 2010-Dec 2010	Jan 2011-Jun 2011	Jul 2011-Dec 2011
Residential	$450	$435	$420	$400
Small Non-Residential (up to 150 kW DC)	$410	$395	$380	$360
Large Non-Residential (>150 - 500 KWDC)	$380	$365	$350	$330

As the table indicates, long-term SREC prices in this program were notably higher than any of the SREC prices from the Delaware SREC Pilot.

2.4.3. RHODE ISLAND

In the fall of 2011, the Rhode Island Office of Energy Resources used a stakeholder-based rate setting process to establish administratively set-contract prices for a range of PV system sizes. Contracts awarded under this program are for a fixed rate and 15-year term. Table 284 lists contract "Ceiling Prices" for the three system class sizes in the program. Projects 500kW and smaller are awarded contracts at the "Ceiling Price" listed below on a first-come first-served basis. Large systems are awarded contracts based on a competitive auction (though no contracts are awarded to projects exceeding the $289.50 ceiling price). National Grid, the largest utility in Rhode Island has conducted two solicitations using these prices.

Table 28. Rhode Island Distributed Generation Standard Offer Contract Prices (National Grid, 2012)

System Size	Ceiling Price ($/MWh)
Small PV (10-150 kW)	$333.50
Medium PV (151-500kW)	$316.00
Large PV (501-5,000kW)	$289.50

2.4.4. PENNSYLVANIA UTILITY LONG-TERM CONTRACT SOLICITATIONS

Pennsylvania utilities have been granted the authority to procure SRECs through long-term contract solicitations. Table 29 below reports contract rates, volumes and terms for several of these solicitations.

Table 29. Pennsylvania Utility Long-term Contract Solicitation Results (FlettExchange, 2010; FlettExchange, 2011; PPL, 2011a; PPL, 2011b)

Utility	Date	Contract Term	Contract Volume	Price
PECO	March 2010	10 Years	80,000	$265.57
Penn Power	March 2011	9 Years	2,200	$199.09
PPL Electric Utilities	June 2011	8.5 Years	25,500	$149.00
PPL Electric Utilities	August 2011	8 Years	24,000	$107.83

Given publicly available data, the scale of PV projects under these solicitations is unclear. SRECs procured through this utility long-term contracting mechanism may be from large, utility-scale installations making comparison with Delaware pilot program prices imperfect at best.

2.4.5. CONCLUSIONS

As the previous section has indicated, SREC prices for both the competitive price auction and the administratively-set pricing in the SREC Pilot are either near or below prices for similar programs in the Northeast. It should be noted that each of these programs has unique features that make direct comparison with the SREC Pilot challenging. However, this data can confirm that the results of the Delaware program are within the pricing bounds found in other nearby states.

CHAPTER 3. EVALUATION AND ANALYSIS OF THE SUSTAINABLE ENERGY UTILITY (SEU)

This chapter evaluates the performance of the SEU as the SREC Pilot administrator. The first section of provides a summary of the feedback received from a survey of SREC Pilot applicants regarding the administration of the program. The second section of the chapter provides an analysis of the program structure and administrative costs, comparing it to similar solicitations in New Jersey, Rhode Island, and Connecticut.

3.1. APPLICANT FEEDBACK ON THE SEU'S PERFORMANCE

A web-base survey was sent to the 446 applicants and owner-representatives who took part in the SREC Pilot solicitation. The survey assessed the SEU and their contractor's (SRECTrade) performance in administering the program. The survey was designed to answer the questions posed by Staff and the RETF as presented on page 33 of the PSC's pilot program staff report (DPL, 2011).

A total of 123 respondents completed the survey during the two-week open period. These included both system owners and owners representatives. At least 50.5 percent[35] of the total projects applying for the program were represented in the survey. While the survey was not designed to account for all potential sampling biases, this response rate is sufficiently large to provide insight into the applicants' experience with program. This section will summarize the results of the survey and provide key metrics to understand the feedback from the respondents. The entire survey questions and results are available in the Appendix.

3.1.1. OVERVIEW OF SURVEY RESPONDENTS

Out of the 123 respondents that completed the survey, 95 of these respondents were single system owners and 28 were owner representatives. The following sections profile each of these respondent classes.

3.1.1.1. SINGLE SYSTEM OWNERS

System owner response rates closely match the actual results of the solicitation. Table 30 below shows the breakdown of applicants between tiers compared to the solicitation results. As the figure shows, the survey was able to capture opinions from each of the tiers, with respondents completing the survey roughly in proportion to the actual solicitation results.

Table 30: System Owners: What Tier Did You Apply For?

	Respondents	Actual Solicitation *(All Applicants)*
Tier 1	86.2 %	88.5%
Tier 2A	9.8 %	7.7 %
Tier 2B	1.6 %	2.6 %
Tier 3	2.4 %	1.3 %

Seventy-five percent of respondent projects were existing systems at the time of the solicitation, as seen in Figure 7 below. Additionally, over two-thirds of the respondents were not awarded a contract.

[35] The representation may actually be higher than 50.5%. Six Owner Representatives responded to the survey indicating they represented "more than 20" systems. These Owner Representatives were assumed to represent 21 systems each.

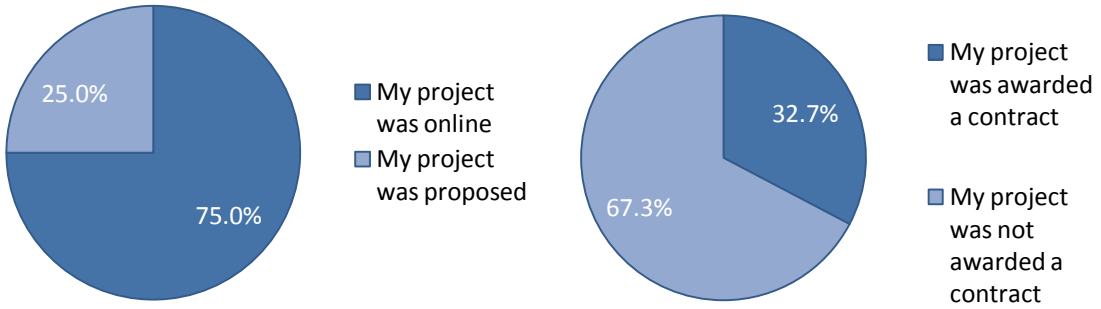

Figure 7. Was your project online at the time you submitted your application? Was your project awarded a contract under the SREC pilot?

3.1.1.2. OWNER REPRESENTATIVES

Similar to the respondents with a single system, a majority of the projects represented by Owner Representatives were applying for Tier 1.

Table 31: Owners Representatives: What Tier Did You Apply For?

	Respondents	Actual Solicitation *(All Applicants)*
Tier 1	82%[36]	88.5%
Tier 2a	12%	7.7 %
Tier 2b	5%	2.6 %
Tier 3	1%	1.3 %

Like the single system owner respondents, a majority of the respondents who were Owner Representatives applied with projects that were already online. The data collected in this survey was not granular enough to determine exactly how many projects were awarded contracts from the Owner Representative respondents who completed the survey.

3.1.2. SURVEY RESULTS

The survey was designed to seek input on several key program areas:

- Equipment and workforce bonuses,
- Effectiveness of marketing and messaging around the solicitation,
- Preference of the respondents on whether Tier 1 and Tier 2A pricing should be set through a price auction,
- Question and answer process, and
- Respondent's overall satisfaction with the administration of the program.

Each of these topics is discussed below. A full list of the questions asked is available in Appendix A of this report.

[36] This percentage may be higher, as there were six instances where the applicant responded with "more than 20 projects". These Owner Representatives were assumed to represent 20 systems each.

3.1.2.1. THE IN-STATE EQUIPMENT AND WORKFORCE BONUSES

As discussed in Chapter 1, all of the Tier 1 and Tier 2A projects that were awarded a contract through the SREC Pilot qualified or stated they would qualify for the Delaware equipment and workforce bonuses as did a majority of the projects awarded a contract through Tier 2B and Tier 3. Given the preferential treatment that these bonuses provided applicants in the lottery, questions were posed in order to better understand why the applicants, who did not apply for the bonuses, chose not to do so.

Many of the 93 respondents that did not qualify for one or more of the bonuses provided reasoning as to why their project did not qualify. Table 32 below shows the responses from those that did provide an answer to this question.

Table 32. If The Project Was Not Eligible For The Delaware Workforce and/or Equipment Bonus, Why Not?

Answer Options	Responses
Bonus was not financially sufficient to offset cost increase	9
Equipment/workforce did not meet technical requirements for projects	8
Equipment/workforce was not available	15
Other	30

A number of survey respondents provided direct feedback as they did not feel that the provided multiple choice answer options sufficiently answered this question. Below are some representative comments[37]:

> "Didn't know it would matter at the time the project was designed."
>
> "At time of construction, we were not aware of the equipment bonus. Had we known we would've used both Delaware labor & equipment."
>
> "Unaware of product made in Delaware"
>
> "I chose DE workforce but not DE equipment. At the time I was told I would get a 10% bonus on my RECs but no one could explain how I would get the extra money or who would pay the extra 10% in the open REC market. Since the panels were on the front of my house, I chose all black panels instead of the DE blue/silver panels that would not have looked as good in the neighborhood."
>
> "My project was too small."
>
> "I never saw the requirements. The installer was from MD, but the galvanized tubing, and concrete to put up the ground mount racking system was all purchased in Delaware."

These and other comments provided by the respondents indicate that there was confusion around the availability of the bonuses, their purpose, and how to qualify for them. Additionally, many respondents felt that the these criteria prevented their existing systems from receiving fair consideration in the lottery, particularly as the lottery rules were not understood when they were making decisions regarding panel options.

[37] Note: In the interest of clarity, spelling and punctuation have been edited for some responses. The content of each response has not been changed.

3.1.2.2. EFFECTIVENESS OF MARKETING

Respondents were asked to indicate how they learned about the solicitation. The results of the survey showed that almost 60 percent of the respondents learned about the solicitation through their installer. The results are displayed in Table 33 below.

Table 33. How did you learn about The SREC Pilot program solicitation?

Answer Options	Response Percent
Solar Installer	58.1%
Owner Representative	16.9%
SRECDelaware.com	12.9%
SRECTrade	12.9%
Delaware Public Service Commission (DE PSC)	8.1%
Division of Energy and Climate (Delaware Energy Office)	6.5%
Friend/Colleague	4.8%
Delaware Sustainable Energy Utility	4.8%
Newspaper or Magazine	1.6%
Online Social Network	0.8%
Online Blog	0.0%
Delmarva	0.0%

In regards to a separate but related question, almost 60 percent of the respondents believe that SEU and SRECTrade did an adequate job of notifying them about the solicitation. Figure 8 below provides the responses to this question.

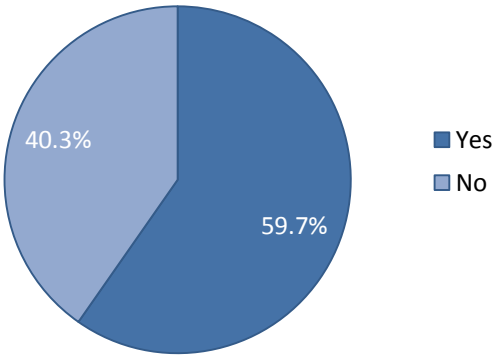

Figure 8. Do you think SRECTrade/Sustainable Energy Utility (SEU) did an adequate job of notifying the solar community about the solicitation?

Respondents were asked to provide suggestions as to how SRECTrade/SEU could better notify the solar community for future solicitations. Some of these responses included:

> "Ads in the paper, billboards, and TV spots"
>
> "Learned about it only days before auction. Advertise or put in paper. It was not in the paper until one week before closing."

"I personally know of at least 2 other people who are interested installing solar and I informed them of it. It needs more radio and maybe TV and newspaper spreads."

"We received nothing from the SREC Trade/SEU. Anything would have been helpful."

"The SEU should have used the GEP refund account information to establish a communications list."

"There are a lot of people who still do not even know about the solicitation or they did not really understand it. The state knows everyone's names and contact information, why weren't they notified and properly informed."

These responses indicate that some survey respondents felt that the program coordinators could have more actively advertised the solicitation or could have directly reached out to system owners in the state.

3.1.2.3. PREFERENCE FOR A COMPETITIVE BID PROCESS FOR TIER 1 AND TIER 2A

When asked whether a pay-as-bid price auction for Tier 1 and Tier 2A would be preferred over administratively-set prices in future solicitations, over 70 percent of the respondents said they would rather continue with administratively-set pricing. This response is not surprising as the analysis of the rates set for the lower tiers discussed in Chapter 2 suggests that on average system owners were receiving higher SREC prices than what was necessary to make the projects financially feasible.

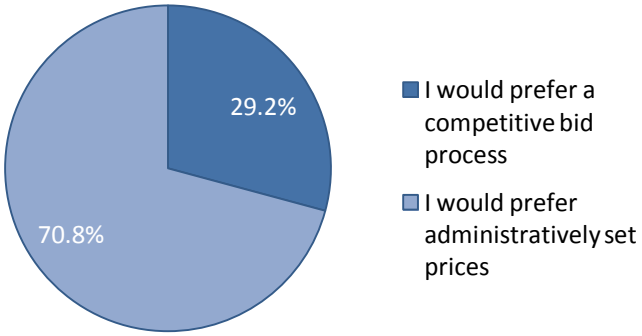

Figure 9. Would you prefer a competitive process or administratively set prices?

3.1.2.4. PERCEIVED RISK ASSOCIATED WITH CONTRACTING THROUGH THE SEU

During the program development process, some stakeholders expressed concerns that system owners and financiers may perceive an added risk when contracting with the SEU instead of contracting directly with Delmarva. When asked whether there was any additional perceived risk with signing contracts through the SEU, an overwhelming majority of respondents said they did not perceive any risk.

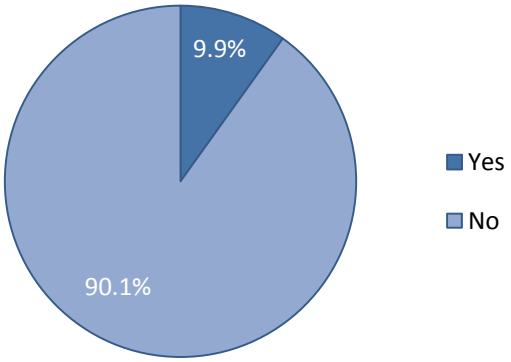

Figure 10. Did you perceive any additional risk associated with contracting through the Sustainable Energy Utility instead of directly through Delmarva?

3.1.2.5. QUESTION AND ANSWER PROCESS

Respondents were asked to rate their experience with the following attributes of the SRECTrade-administered question and answer process:

- Length of question and answer period,
- Timeliness of response,
- Quality of response, and
- Overall satisfaction with the Q&A process.

Figure 11 below shows the responses to these questions. Overall, there was limited dissatisfaction with the question and answer process, with almost 70 percent of respondents indicating that they were very satisfied, satisfied, or neutral about their experience on all of the survey questions.

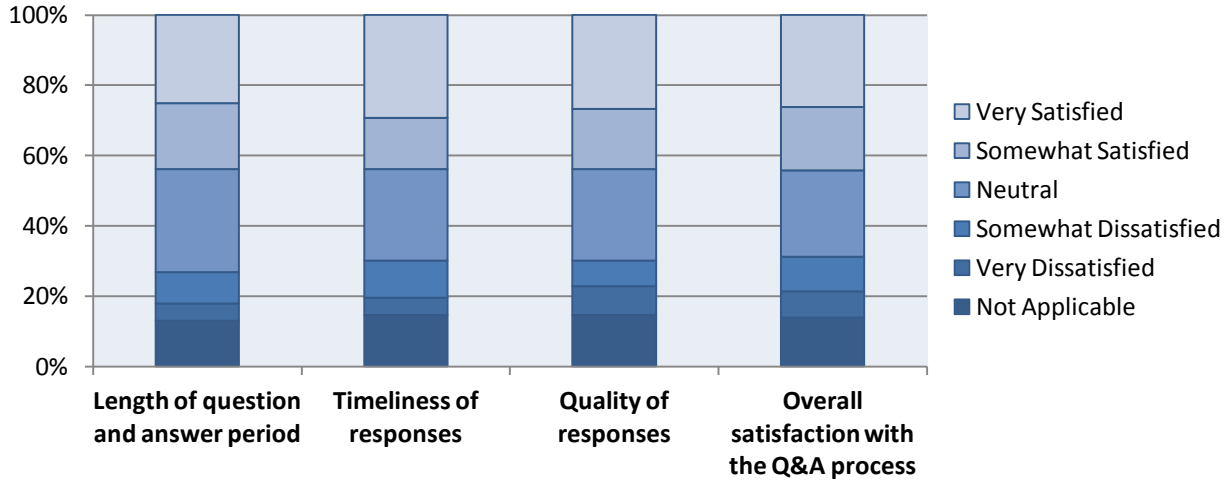

Figure 11. Please rate your experience with the following attributes of the question and answer process.

3.1.2.6. OVERALL SATISFACTION

Respondents were also asked to rate their experience with the following attributes of the solicitation administration:

- Solicitation timeline,
- Clarity of eligibility criteria,
- Fairness of eligibility criteria,
- Ease of filing application,
- Quality of online systems, and
- Terms of SREC transfer agreement.

Figure 12 below provides respondent opinions on each of these program aspects. For most of the questions pertaining to administrative logistics, such as the ease of filing an application and quality of online systems, a majority of respondents were satisfied or neutral. Most of the dissatisfaction focused on the clarity and fairness of the eligibility criteria, with 35 percent of respondents dissatisfied with the clarity of the eligibility criteria and 48 percent of respondents dissatisfied with the fairness of the eligibility criteria.

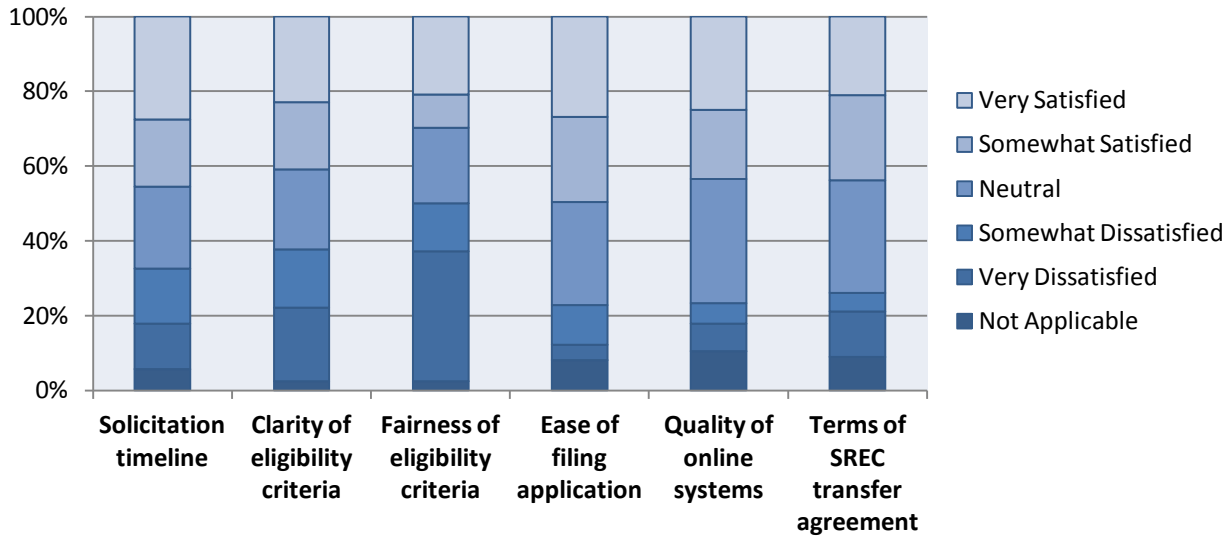

Figure 12. Please rate your experience on the following attributes of the solicitation administration

In the next question, respondents were asked to submit feedback on was whether they believed the program was fairly and effectively administered. Responses to this question were evenly split, with 51.2 percent of respondents saying that they do not believe the program was fairly and effectively administered. Figure 13 below shows the breakdown for this question.

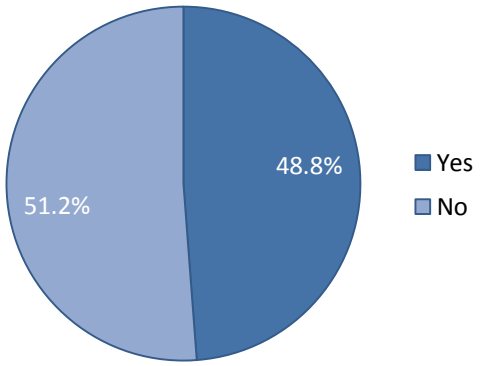

Figure 13. Overall, do you think the program was fairly and effectively administered?

As might be expected, respondents were more likely to respond that the program was not fairly or effectively administered if they were not awarded a contract under the program. Figure 14 below shows the respondent breakdown to this question based on whether they were awarded a contract.

Figure 14. Respondent's evaluation of the program based on whether they were accepted into the program

Respondents who were not satisfied with the program were given the opportunity to provide comments. These comments had several common themes, which are summarized below:

Frustration that only projects that qualified for the Delaware bonuses were accepted into the program: The most common feedback focused on the priority given to projects that used in-state equipment and labor. Selected comments include:

> "I do not feel the award process was fair because those who purchased equipment made in Delaware moved ahead of those who did not. My Delaware installers had no panels to offer me to buy. If they had I would considered their purchase. In fact, I would like to know what Delaware produced equipment qualified. I am not aware of any solar power equipment made in DE."

> "… Just do a first come, first serve basis. No solar panels or equipment are built in the US anymore, but all the people doing the work in DE still contribute to the local economy. And if you did not make the last cut, you should be guaranteed to make the next cut before any new systems are created unless there is no room in the next cut. If I keep getting pushed back, I am removing my panels and taking them to the DEU and dropping them off."

> "There should not be a preference for the equipment bonus."

> "Eliminate the prejudicial first consideration of Delaware materials and labor."

One commenter did offer the opinion that giving priority to in-state equipment and labor was a positive component of the program:

> "[S]olar installations using DE based workforce & materials should be included in the SREC program before others, since this is using DE tax revenues, etc. It is a good program."

The belief that existing systems should be given priority: A number of respondents expressed discontent that the program placed existing systems and under development/proposed systems in the same pool, or that under development/proposed systems were considered at all. Select comments include:

> "On line systems should only be qualified NOT proposed systems"

> "SRECs should have been available to all online projects and not offline projects"

> "Older, smaller, and operational systems should have priority in the selection process. Without a viable SREC market, I, as the owner of a 9[k]W single system, face a real financial hardship if I can't get a reasonable return on my SRECs. You need to be able to satisfy more small systems with this type of program…"

> "I am extremely disappointed with the Delaware SREC program, having been totally left out. I find [the] State program could certainly have been more fair in the allocation especially to those who have already invested in Solar Power rather than those who don't even have a system running. Poorly executed and totally unfair."

> "… allowing a system that is not 100% connected and online to get contracted is a major flaw. If they fail to get connected, those SRECS are lost. Would you leave the barber shop with only a half finished haircut?"

Confusion around how this project relates to the overall SREC program. There were a few comments that suggested that the respondent did not understand how the SREC Pilot related to the overall SREC market:

> "We feel in the dark about what has happened with this program. We were told we would be in the first group that went into the program and then politics got in the way and we still are not in the program when we were online as of December 2010. We don't feel that we've had adequate education about the program and this survey was answered by guessing as we don't really understand what the questions are all about. The first question on the size of our project was the only question that we can answer adequately. How about putting the folks that have the connections aside and deal with those of us who have been online and should be in the program."

> "Take care of those that have spent the money first not those just thinking about it. You put out a rate per SREC and the builder used that for guarantees and we based a $35,000 decision on it ... Some heads are going to roll."

"Novice system owners like myself have a hard time understanding how the entire SREC system works. All of the info needs to be broken down into simple terms for people who are novices to the solar industry. Put in steps what new owners need to do in the order they need to do them after having their system installed."

"Give more information re: the % of people who could be awarded a contract .. We are very upset over this whole process so far. We have just this month be on line of 1 year ... we would like to get something for our 10+ RECs!"

"I have received federal and state credits, but I still do not have SEU explanation of why I cannot yet get into the program. You have my email address as an owner, so send me information, Please."

"Never received any notice until this second survey. Have been waiting since Feb.2011 to receive a payment. We were told initially that we would be paid quarterly. To date nothing."

"SEU assisted the installers in marketing the solar systems and we the consumer purchased with the understanding that SREC's were going to assist us in getting some of our money back. So far I haven't received a single SREC penny. You should be reported to a consumer fraud agency. It is a disgrace that we were told if we bought the solar panels we could be reimbursed in a suggested amount of time. Some solicitations should be made available to us. We are definitely saving somebody some money; we are producing electricity and not getting paid for it."

The necessity of Owner Representatives: A few single system owners commented on their inability to represent themselves in the process:

"… Also the requirement to have two systems in order to represent yourself is unfair. I'm fully able to transfer my SRECs from GATs to a broker for sale. Why do I need an aggregator in the middle …"

"Require individual participation and communication instead of representative system."

"… Very disappointed that home owners could not directly apply, but had to work through representatives. They delayed / confused the application process and inappropriately used their "middle man" roles to establish far reaching contractual agreements, which was not necessarily our goal / intent. This was totally unnecessary."

It is important to note that 84 percent of respondents did express that they were satisfied or held a neutral position on their experience with their Owner Representative, as seen in Figure 15 below.

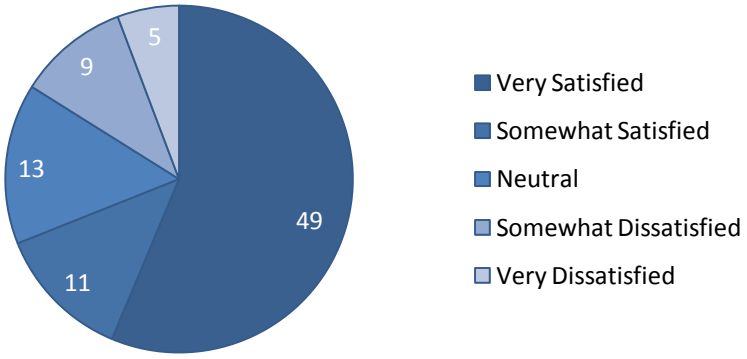

Figure 15. Overall, how satisfied were you with your Owner Representative?

3.2. COMPARISON OF ADMINISTRATIVE STRUCTURE TO OTHER PROGRAMS

The Sustainable Energy Utility (SEU), a non-profit organization tasked with managing the state's energy efficiency and renewable energy services, was selected to manage the solicitation process for the SREC Pilot and be the SREC contracting party. With the program originally conceived to include three utilities (Delmarva Power & Light Company, the Delaware Municipal Electric Corporation, and the Delaware Electric Cooperative), having a single entity to contract SRECs through was expected to potentially save on administrative costs and increase the program efficiency. The SREC Pilot ultimately only included Delmarva, raising questions about the necessity of utilizing the SEU as the solicitation administrator instead of Delmarva Power directly administering the program. This section will explore this question by assessing Delmarva's rational behind moving forward with the SEU as the solicitation administrator and comparing this strategy to similar programs in New Jersey, Rhode Island, and Connecticut. Additionally, the analysis will assess whether utilizing the SEU had a significant impact on the administrative costs of the program. In Order No. 8093, Delmarva was told that when it seeks recovery of Pilot Program costs, it will be required to establish that using the SEU was no more expensive than if Delmarva had performed the administrative duties itself.

3.2.1. OVERVIEW OF DELMARVA SREC SOLICITATION DESIGN

3.2.1.1. ADMINISTRATIVE STRUCTURE

Delmarva adopted a unique administrative structure when they selected the SEU as the SREC contracting party and program administrator. The SEU subsequently subcontracted most of the administrative tasks to SRECTrade, who set up the front end systems though which system owners and owner representatives were able to enter the lottery and/or competitive bid process. This administrative structure is shown in Figure 16 below.

Figure 16: Administrative Structure of the SREC Pilot

3.2.1.2. ADMINISTRATIVE COSTS

The administrative costs associated with the SREC Pilot are listed in Table 34 below.

Table 34: Delaware Pilot Program Administrative Costs

SEU	
Setup Fee	$ 61,495[38]
Annual Fee	$ 71,402[39]
SRECTrade	
Platform	$ 45,000[40]
Auction	$ 43,682[41]
Monthly Fee	$ 11,000[42]
Estimated Year 1 Cost	**$ 320,579[43]**
Year 2 to Year 20 Total Cost	**$ 3,864,638**

3.2.1.3. DELMARVA'S RATIONALE FOR UTILIZING THE SEU

In Delmarva's pilot filing before the PSC, the company outlined the key reasons why it decided to move forward with the SEU as the program administrator (DPL, 2011). These included:

Administrative Costs: The program may expand to include additional utilities moving forward, including the Delaware Municipal Electric Corporation and the Delaware Electric Cooperative. If this happens, utilizing the SEU to administer the program and contract the SRECs with system owners would be more cost effective than having each utility administer the program separately.

Experience: The SEU has prior experience with SREC contracting. The Dover SUN Park, a 10 MW solar facility on 103 acres in the City of Dover, for which Delmarva contracted with the SEU to bank the SRECs from the project so as to not flood the market and cause a collapse in SREC prices (LS Power, 2010).

Administrative Burden: With the SEU as the program administrator, Delmarva would not have the administrative burden of managing individual contracts.

Banking Rights: While Delmarva is only allowed to bank SRECs for up to three years, the SEU can bank SRECs indefinitely. Similar to the situation with the Dover SUN park, having the ability to bank SRECs provides flexibility in deciding when Delmarva wants to retire them (DPL, 2011).

In an initial study of Delmarva's application, New Energy Opportunities, Inc. and La Capra Associates, Inc. question the relevance of these arguments given the state of the SREC Pilot. The authors point out that Delmarva already has experience with managing solicitations and contracting SRECs. Additionally, they note

[38] One time cost
[39] Estimated based of the $6.224/SREC fee and assuming 11,472 SRECs procured through the SREC Pilot.
[40] One time cost
[41] One-time cost
[42] This monthly cost applies only to the contracts under this solicitation. Future solicitations through SRECTrade would likely have additional monthly fees.
[43] Formula used: SEU Setup Fee + Annual Fee + SRECTrade Platform Fee + Auction Fee + (Monthly Fee x 9 months)

that the SEU does not have much of the infrastructure, such as in-house accounting systems, that Delmarva already has in place, potentially adding to the cost and complexity of the program. Finally, they questioned the need to utilize the banking rights of the SEU based on the estimated SREC purchase requirements and expected purchases through the program (New Energy Opportunities, Inc., 2011b). These questions are still relevant going forward.

Whether or not the experience, administrative burden, and banking rights are sufficient reasons to utilize the SEU in this role, the decision to continue with this structure for future procurements is likely to be primarily driven by whether additional costs were incurred as compared to a more traditional procurement structures. The next section will explore how other states have designed their renewable energy procurement programs and how the administrative costs of these programs compare to the costs of running the Delaware pilot program.

3.2.2. COMPARISON TO OTHER STATE-LEVEL PROGRAMS

3.2.2.1. ADMINISTRATIVE STRUCTURE

The administrative structure of SREC procurement programs in New Jersey, Rhode Island, and Connecticut were reviewed as part of this study. The following sections provide details on each of these program structures.

3.2.2.1.1. NEW JERSEY'S LONG-TERM CONTRACTING PROGRAM

In August 2008, the New Jersey Board of Public Utilities issued an order requiring three investor-owned electric distribution companies (EDC) to offer SREC purchase contracts for 10-15 year terms to system owners. Starting in August 2009, the three EDCs, Atlantic City Electric (ACE), Jersey Central Power and Light (JCP&L), and Rockland Electric Company (RE), began soliciting long-term SREC contracts through a competitive process. During the period this program was active, solicitations occurred three times per year and were subject to a number of restrictions (DSIRE, 2012):

- Projects had to be 2 MW or smaller;
- Both residential and commercial projects were eligible;
- Projects that received rebates through the Customer On-site Renewable Energy (CORE) program were not eligible for the solicitations;
- Existing projects were not eligible; and
- Output needed to be measured with a utility-grade generation meter.

New Jersey's Renewable Portfolio Standard (RPS) differs in that the requirements dictating the purchase of renewable energy falls on the suppliers, not the EDCs. The EDCs hold quarterly auctions to sell the SRECs they purchase through the long term contracts to load serving entities active in the state.

Even with the regulatory differences, the New Jersey solicitations are similar in scope with the Delaware program. To administer the program, the three utilities coordinate their efforts through the same SREC-based financing program. Rather than using an entity like the SEU to act as the contracting party, however, these three utilities have chosen to execute contracts individually. NERA Economic Consulting, a private consulting firm, has been retained by all three organizations to manage the solicitation and perform a similar role as SRECTrade did in the Delaware pilot. NERA does not provide contracting services, as the SEU does as part of the Delaware pilot. Figure 17 below outlines the structure of the New Jersey utility program.

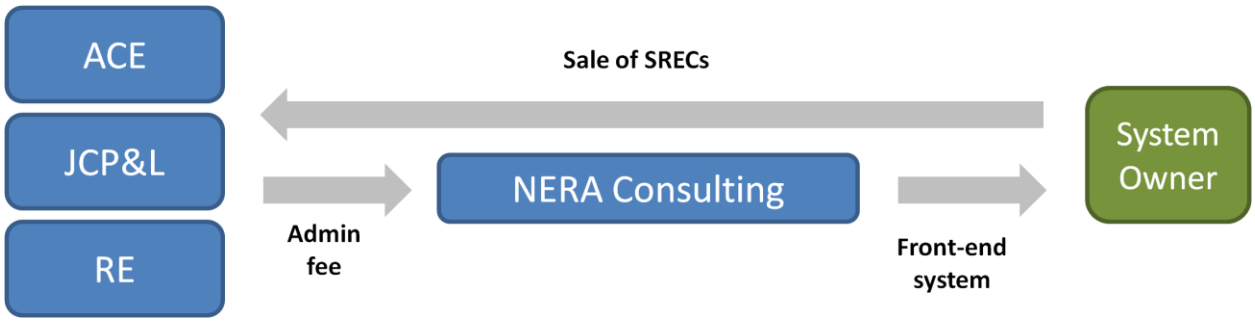

Figure 17: NJ Solicitation Administrative Structure

3.2.2.1.2. RHODE ISLAND'S STANDARD OFFER DISTRIBUTED GENERATION PROGRAM

In June 2011, Rhode Island established a feed-in-tariff program to procure long term contracts for 5 MW in aggregate capacity from solar PV or wind technologies by the end of the year and set a timetable to procure up to 40 MW in aggregate capacity by the end of 2014. These standard contracts set a predetermined rate for the electricity and RECs based on the system size with a 15-year term.

National Grid, which is the only investor-owned utility (IOU) in Rhode Island and serves 99 percent of the state's mainland customers, is mandated by law to fulfill annual minimum capacity targets (DSIRE, 2011). Like New Jersey, National Grid contracts with the system owner directly. Unlike New Jersey, however, National Grid is also directly managing the solicitation.

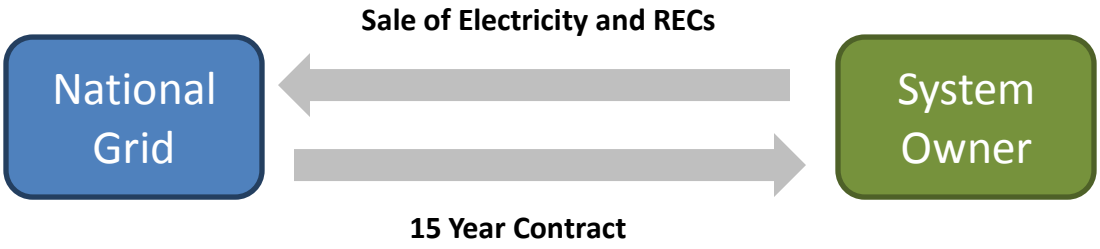

Figure 18: Rhode Island Standard Offer Administrative Structure

3.2.2.1.3. CONNECTICUT'S ZREC PROGRAM

A Connecticut law enacted in 2011 created a new RPS requirement for the state's two IOUs – United Illuminating (UI) and Connecticut Light and Power (CL&P) – to solicit long term contracts for renewable energy credits from "zero emission" generation facilities (ZRECs). These zero emission facilities include solar, wind, and hydro generators.

In December 2011, UI and CL&P jointly released a solicitation plan outlining the program procurement methodology and administrative structure. The utilities will solicit ZREC contracts valued at $120 million per year for six years. The ZRECs are split into three size classes:

- Projects up to 100 kW – Small ZRECs
- Projects between 100 kW and 250 kW – Medium ZRECs
- Projects between 250 kW and 1 MW – Large ZRECs

The utilities plan to jointly offer a single RFP to competitively solicit Medium and Large ZRECs. Small ZRECs will be administered through a tariff rider, which will be valued as the average of the awarded bids for Medium ZREC projects plus 10 percent, subject to a price cap of $350. Eighty percent of the procurement will be allocated to CL&P, with the remaining 20 percent going to UI. The utilities will jointly manage the solicitation, and will directly contract with the system owners (CL&P, 2011).

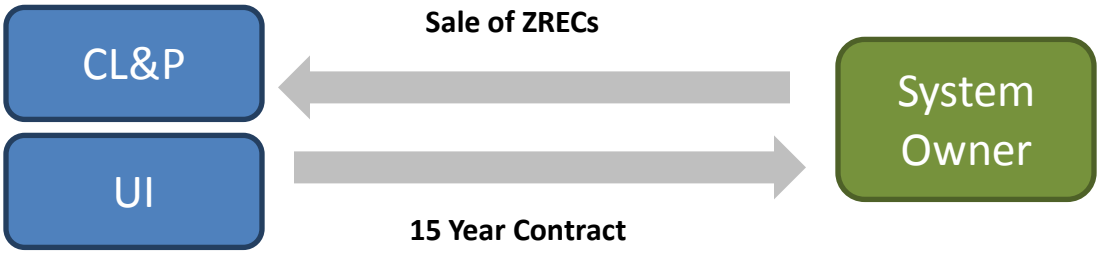

Figure 19: Connecticut Long Term ZREC Procurement Administrative Structure

3.2.2.2. ADMINISTRATIVE COSTS

In order to better understand whether the SEU's role had a significant impact on overall program costs, the following section will benchmark the known administrative cost of the solicitation against other similar programs. Little publicly available data exists for auction implementation costs, and the data that is available is

frequently not granular enough to draw a direct comparison. Therefore, this section is intended to provide an "order of magnitude" level comparison of the pilot's administrative costs compared to other programs.

3.2.2.2.1. COMPARISON WITH NEW JERSEY'S LONG TERM CONTRACTING PROGRAM

Administrative costs associated with the Delaware pilot include costs for both the initial SREC solicitation and for ongoing SREC contract management services. Table 35. Pilot Procurement Costsbreaks down these costs showing the costs associated with the conducting the initial auction as well as the annualized costs Delmarva will pay both SREC Trade and the SEU for ongoing contract management services. The following sections will examine these administrative costs types separately.

Table 35. Pilot Procurement Costs

Cost Type	Cost Line	Pilot Cost
Solicitation Cost	SEU Setup Fee	$61,495
Solicitation Cost	SREC Trade Platform Fee	$45,000
Solicitation Cost	SREC Trade Auction Fee	$43,682
Annual Costs	SEU Annual Fee	$71,402
Annual Costs	SREC Trade Monthly Fee (Annualized)	$132,000

3.2.2.2.1.1. Direct Solicitation Costs

Of the four state programs assessed for this report, only New Jersey's long term contracting program had readily available administrative costs information related to solicitation costs. In May 2012, the Center for Energy, Economic and Environmental Policy (CEEEP) at Rutgers University released an analysis of the New Jersey program to determine net ratepayer cost exposure. Table 36, 37 and 38 below outline the administrative costs for each EDC published in the CEEEP report (CEEEP, 2012). These tables show the total costs each of the New Jersey EDCs paid to NERA for operating the SREC solicitation.

Table 36. ACE Administrative Costs

Energy Year	NERA Solicitation Manager Costs	Solicitation Costs per SREC	MW Contracted
2010	$ 237,220	$9.17	2.1
2011	$ 164,680	$1.60	8.4
2012	$ 222,226	$2.01	9.0
Total/Average	**$ 624,126**	**$2.61**	**19.5**

Table 37. JCP&L Administrative Costs

Energy Year	NERA Solicitation Manager Costs	Solicitation Costs per SREC	MW Contracted
2010	$ 584,014	$4.37	10.9
2011	$ 542,345	$2.73	16.2
2012	$ 390,863	$2.47	12.9
Total/Average	**$ 1,517,222**	**$3.09**	**40.0**

Table 38. RE Administrative Costs

Energy Year	NERA Solicitation Manager Costs	Solicitation Costs per SREC	MW Contracted
2010	$ 47,642	$42.77	0.1
2011	$ 46,134	$2.80	1.3
2012	$ 35,078	$1.16	2.2
Total/Average	**$ 128,854**	**$2.70**	**3.6**

As these tables note, the average solicitation costs per SREC ranged from $2.61 for ACE to $3.09 for JCP&L. A direct comparison between the solicitation administration costs on a per-SREC basis is not appropriate as the Delaware pilot procured 20-year SREC contracts while the New Jersey solicitations procured 10-year SREC contracts, however a comparison between the New Jersey solicitation and the total number of SRECs procured during the first ten years of the Delaware pilot solicitation is a useful benchmark. Table 39 below shows the solicitation average costs per SREC for the New Jersey solicitations and also shows the costs per SREC for the total number of SRECs procured under the first ten years of the Delaware pilot.[44] Administrative costs associated specifically with the Delaware solicitation include the SREC Trade setup fee and platform fee as well as the SEU setup fee but do not include ongoing contract management fees (see Table 35 above).

Table 39. Comparison of Solicitation Costs between New Jersey and Delaware

SREC Solicitation	Solicitation Cost per first 10 years of SRECs
ACE	$2.61
JCP&L	$3.09
RE	$2.70
Delaware Pilot	**$1.31**[45]

As the table indicates, the direct solicitation costs of the Delaware SREC program compare favorably to the costs seen in New Jersey. This is notable particularly as this was the first solicitation of the pilot program and first-round solicitation costs for the New Jersey programs were significantly higher than the three-year average solicitations costs presented in this table.

3.2.2.2.1.2. Ongoing Contract Management Costs

As Table 35 indicates, the majority of the program administrative costs are associated with ongoing contract management fees for both the SEU and SREC Trade. According to Delmarva representatives, the work funded through these administrative fees significantly reduced the utility's in-house SREC contract management administrative burden. These fees also replace costs that SREC sellers would likely have incurred had they attempted to sell their credits on the open market. The costs reported as part of the New Jersey solicitations do not include ongoing contract management fees and therefore directly benchmarking these costs against a similar program is not possible. Table 40 below shows the expected cost of these fees during the first year of the program on a per-SREC basis.

[44] For consistency, this analysis did not assume any system production degradation over the course of the SREC contract life.

[45] Calculation: $61,495 (SEU Setup Fee) + $45,000 (SREC Trade Platform Fee) + $43,682 (SREC Trade Auction Fee) / 114,723 (10-year pilot SREC volume) = $1.31 / SREC

Table 40. Calculated SREC Management Fees

SEU Annual Fee	SREC Trade Monthly Fee (Annualized)	First-year SREC production	Estimated $/SREC (A+B)/C
$71,402	$132,000	11,472	**$17.73**

These fees substitute for range of services that both SREC sellers and buyers would typically incur in the open market and also displace costs Delmarva would incur managing SREC contracts. Total annual costs for these are estimated to be more than $200,000 per year.[46] This equates to several full-time employees providing contract management services. Assuming these charges will continue for the 20-year life of the contract, it may be in the interest of ratepayers to either explore alternative strategies for ongoing contract management or to seek discounted contract management costs during future pilot program rounds.

[46] This is more than nine percent of total aggregated first-year SREC contract values. ($203,402/$2,154,288 = 9.44%)

CHAPTER 4. BLOOM FUEL CELL IMPACTS ON SREC PURCHASE OBLIGATIONS

This chapter will briefly review the regulatory background of the Bloom fuel cell projects and provide context for their potential impacts on the Delaware SREC market. A high-level projection of the potential impact of SREC offsets from the Bloom projects is also provided from 2012 to the 2025 RPS compliance year.

4.1. BLOOM FUEL CELL PROJECTS REGULATORY BACKGROUND

In July 2011, Governor Markell signed into law Senate Bill No. 124, which was intended to encourage the development of Bloom Energy fuel cell projects in Delaware. This bill amended REPSA to allow Delmarva to reduce its REC and/or SREC obligations with energy delivered by a Qualified Fuel Cell Provider Projects if such projects were approved by the Commission. On October 18, 2011, the Commission approved Delmarva's proposed electric and natural gas tariffs allowing the utility to pass through costs and revenues associated with the output of a 30 MW Qualified Fuel Cell Provider Project proposed in association with a planned fuel cell manufacturing plant to be built by Bloom Energy Corporation (New Energy Opportunities, Inc., 2011b). Delmarva's approved tariff allows for a monthly customer surcharge over the next 21 years.

Under the original Senate Bill No. 124 language, Delmarva was permitted to reduce its RPS REC obligation by one REC for every MWh of energy produced under the Bloom fuel cell tariff. Alternatively, Delmarva could elect to offset one MWh of its SREC obligation for every six MWh of energy produced by the Bloom projects. Under the REPSA amendments, the Secretary of DNREC, in consultation with the Commission and Delmarva, was permitted to adjust these REC and SREC offsets allowance ratios in order to lower cost impacts of the Bloom Energy projects (Delaware State Senate, 2011). In his August 19, 2011 testimony to the Commission as part of Docket 11-362, Secretary O'Mara proposed allowing two MWh of generation from the Bloom fuel cell projects to potentially offset one REC of Delmarva's annual RPS obligation during the first 15 years of the project.[47] In addition, Secretary O'Mara proposed that six MWh of fuel cell generation should be permitted to offset one MWh of solar obligation during the project's first 15 years while three MWh of fuel cell production will be equivalent to one SREC during the remaining six years of the Bloom contract. The Secretary also proposed to limit fuel cell impacts on the state's SREC market by only allowing Delmarva to meet:

- 25 percent of its SREC obligation with qualifying fuel cell offsets during years 1-5,
- 30 percent of its SREC obligation with qualifying fuel cell offsets during years 6-15,
- 35 percent of its SREC obligation with qualifying fuel cell offsets during years 16-21 (O'Mara, 2011).

On December 1st, 2011, the Commission promulgated Order 8079 adopting the Secretary's proposed treatment of RPS offsets from the Bloom fuels cell projects (Delaware PSC, 2011).

Because the authorizing legislation give the Secretary the authority to define whether RECs or SRECs will be offset from the Bloom projects, there is no legislative or regulatory certainty as to what proportion of the Bloom contract production will be used to offset either REC or SREC obligations. During his testimony, Secretary O'Mara noted that the annual reductions in Delmarva's REC and SREC obligations would be determined through a collaborative process established by the Commission. According to Secretary O'Mara, both Delmarva and DNREC would be party to this process. Decisions about SREC and REC obligation offsets would prioritize the following factors:

- Minimizing customer impact,
- Avoiding ACP payments, and

[47] Each MWh of fuel cell production would qualify for only qualify to offset one REC during the remaining years of the project.

- Ensuring sufficient opportunity for in-state renewable energy market development (O'Mara, 2011).

As with other regulatory priorities, the above listed goals may be in tension. For instance, minimizing customer impacts may suggest first applying the Bloom project offsets to the higher priced Delmarva SREC obligation, while applying any excess offsets to the utility's main-tier REC obligation. However this policy choice may not maximize opportunities for in-state renewable energy market, as most main-tier RECs tend to be generated by out-of-state generators while the state's SREC program rules support in-state generators over out of state generators.

4.2. EXPECTED BLOOM FUEL CELL PROJECTS SREC OBLIGATION REDUCTIONS

Under the Commission-approved tariffs, Bloom energy will construct one 3 MW fuel cell unit in Newark and a second, multiphase 27 MW project in New Castle. Expected project timelines are provided below (New Energy Opportunities, Inc., 2011a):

- Brookside (Newark)—3.0 MW (Q2 2012)
- Red Lion I (New Castle)—5.4 MW (Q4 2012)
- Red Lion II (New Castle)—3.0 MW (Q2 2013)
- Red Lion III (New Castle)—8.0 MW (Q3 2013)
- Red Lion IV (New Castle)—10.6 MW (Q4 2013)

Table 41 provides maximum projected potential SREC offset from the Bloom projects for the 2012 to 2025 compliance years. This schedule assumes that each of the Bloom projects are commissioned during the final month of the above listed quarter and also assumes that the maximum Bloom offsets are applied to Delmarva's SREC obligation each year. For each MWh produced by the Bloom projects, six potential SREC offsets are created, this value is in the "Total SREC Offset Equivalent" column. The "Maximum SREC Obligation Reduction" column is calculated as the lesser of either the maximum allowable offset (see percentages above) or the total available Bloom SREC offset output. Other assumptions are discussed in the footnotes.

Table 41. Estimated Maximum Reduction in Delmarva SREC Obligations from Bloom Projects (2012-2025)

Compliance Year	Estimated Bloom Project Generation (MWh)[48]	Total SREC Offset Equivalent (MWh)[49]	Estimated Delmarva SREC Obligation[50]	Maximum SREC Obligation Reduction[51]	Equivalent Reduced Generation (MW)[52]
2012	47,935	7,989	21,650	5,413	3.6
2013	190,898	31,816	38,810	9,703	6.5
2014	252,288	42,048	59,399	14,850	9.95
2015	252,288	42,048	75,486	18,872	12.6
2016	252,288	42,048	95,773	23,943	16.0
2017	252,288	42,048	116,651	34,995	23.4
2018	252,288	42,048	138,135	41,441	27.8
2019	252,288	42,048	160,237	42,048	28.2
2020	252,288	42,048	182,970	42,048	28.2
2021	252,288	42,048	206,350	42,048	28.2
2022	252,288	42,048	230,389	42,048	28.2
2023	252,288	42,048	255,104	42,048	28.2
2024	252,288	42,048	280,508	42,048	28.2
2025	252,288	42,048	306,617	42,048	28.2

As the table indicates, the maximum reduction in SREC obligation is projected to reduce total in-state PV installations by 28.2 MW starting in the 2019 compliance year. According to projection by SREC Trade, this would reduce the total installed capacity in Delaware by 12.7 percent in 2019.[53] Figure 20 below shows the relative size of the maximum Bloom-related SREC obligation reduction against the total projected Delmarva SREC obligation between 2012 and 2025.

[48] During tariff approval proceedings for the Bloom projects, PSC staff consultants assumed the Bloom projects would attain an average capacity factor of 96 percent (New Energy Opportunities, Inc., 2011a).

[49] Total Bloom project generation divided by 6 for all presented years

[50] 2012-2014 are based on SREC Staff Report Pg 11. 2015-2025 projections are based on 60 percent of estimated statewide SREC obligation estimated by SREC Trade (SREC Trade, 2012b).

[51] Minimum of either 25 percent of SREC obligation from 2012-2016 or 30 percent of SREC obligation for 2017-2025 and total available SREC offsets

[52] Based on "effective SREC" capacity factor a 17 percent from pilot solicitation. This added capacity factor accounts for the likelihood that future PV systems in the state will continue to qualify for some combination of the Delaware workforce or equipment bonuses. The value used in this analysis was derived from the average "effective SREC" capacity factor for winning bidders in the Pilot program.

[53] SREC Trade estimates that the Delaware SREC program will support 425.9 MW of PV during the 2025 compliance year.

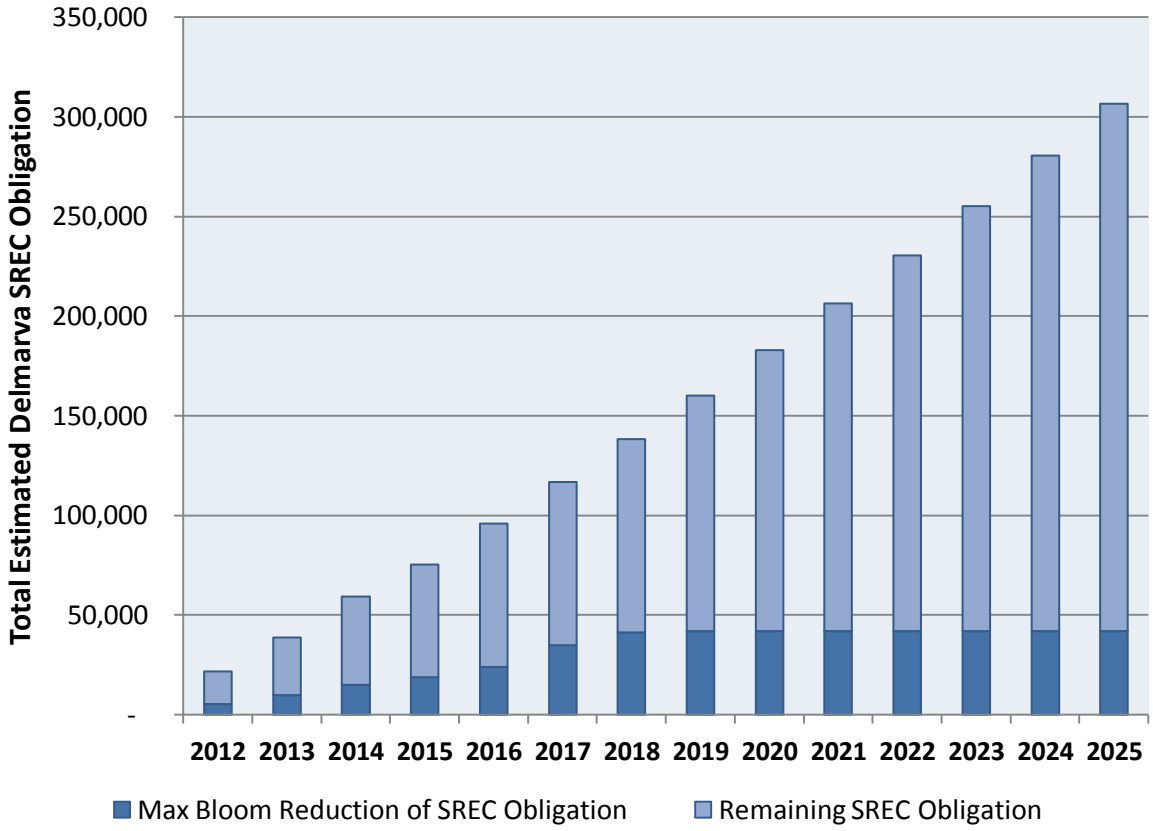

Figure 20. Estimated Annual Delmarva SREC Obligation and Maximum Bloom SREC Offset

As the figure shows, the maximum potential impact of the Bloom project on the SREC market increases every year from 2012 to 2018. Starting in 2019, the maximum annual offset from the Bloom project is reached for the 2012-2025 analysis period.

In 2027 the maximum potential SREC offset from the Bloom projects will be doubled when three MWh from the fuel cell projects will be allowed to offset one SREC.[54] During the period starting in 2027, the 30 and 35 percent limits on SREC obligation offsets from the Bloom projects are unlikely to be reached as total energy production from the fuel cells will not be sufficient to reach this cap.

[54] Compliance years 2026-2032 were not addressed in this analysis as SREC obligations for this period are not yet defined.

CHAPTER 5. PROGRAM DESIGN ANALYSIS

This chapter will examine a series of key questions posed by the Commission and other RETF members regarding the design of the Delaware SREC Pilot. Where possible, this program analysis will evaluate the Pilot based on the taskforce's legislative mandate to:

- Establish a balanced market mechanism for Renewable Energy Credit ("REC") and Solar Renewable Energy Credit ("SREC") trading;
- Establish REC and SREC aggregation mechanisms and other devices to encourage the deployment of solar energy technologies in Delaware with the least impact on retail electricity suppliers, municipal electric companies and rural electric cooperatives;
- Minimize the cost for complying with REPSA;
- Establish revenue certainty for appropriate investment in solar renewable energy technologies, including consideration of long-term contracts and auction mechanisms;
- Establish mechanisms to maximize in-state solar renewable energy generation and local manufacturing; and
- Ensure that residential, commercial and utility scale photo voltaic and solar thermal systems of various sizes are financially viable and cost-effective instruments in Delaware.

This chapter will be organized around three critical top areas: the first section will evaluate program cost effectiveness issues, the second will highlight issues related to consumer protection and the third will examine the impacts of the job-related aspects of the pilot. Where direct questions have been provided by the Commission or by RETF members, those questions are quoted in section headings.

5.1. PROGRAM COST EFFECTIVENESS QUESTIONS

The Commission and RETF members asked for responses to two specific questions related to program cost effectiveness. These are addressed in this section.

5.1.1. COMPARE THE COST EFFECTIVENESS AND RISKS OF THE COMPETITIVE BIDDING PROCESS TO THE ADMINISTRATIVELY SET PRICES IN TIERS 1 AND 2A?

As previously mentioned, the pilot used two separate methods for establishing SREC contract prices. The Tier 1 and Tier 2A standard offer rate was based on an administratively set price that was determined through financial modeling of a representative system. Tiers 2B and Tier 3 used a competitive auction with winners receiving contacts at as-bid prices. Each of these price setting approaches present potential risks and advantages for Delmarva ratepayers, project owners and policymakers. Table 42 presents some of the pros and cons of each approach from the perspective of each of these market participants.

Table 42. Pros and Cons of Administrative and Competitive Rate Setting from Different Market Participant Perspectives

	Ratepayers	Project Owners	Policy Makers
Administrative Rate Setting Pros	• Limited collusion risk • Lower risk of contract failure	• Lowered administrative burden • Potential for higher-than-market pricing • Potentially earlier incentive price certainty for proposed systems	• Limited collusion risk • Simplified solicitation process
Administrative Rate Setting Cons	• Potential above spot market SREC pricing • Potential for lower-cost projects to receive windfall price levels	• Lottery systems disfavors more competitive and efficient developers	• Potentially complicated rate-setting process • Lack of accurate and timely data for rate model inputs
Competitive Rate Setting Pros	• Rates follow market trends • Projects awarded rates based on specific project economics	• Rewards competitive project developers • Bid complexity may reduce number of market entrants (pro and con)	• Can be more confident in incentive price levels
Competitive Rate Setting Cons	• Increased risk of contract failure	• Complexity and uncertainty may discourage some developers	• Collusion risk requires market monitoring • Potential costs of administering auctions

As the table indicates some of the pros and cons for one stakeholder group are either in direct opposition with or in substantial agreement with the pros and cons of other stakeholder perspectives. Additionally, some of these general stakeholder categories could be further divided to include sub-groups (i.e. third-party system owners vs. local owners, or utilities vs. state energy offices vs. utility regulators) with each group having its own interests or mandates. Given the potential complexity involved with these diverse perspectives, the following section is limited to a discussion of the ratepayer perspective.

5.1.1.1. COMPETITIVE BIDDING

Evaluated from a ratepayer impact perspective, SREC contract pricing through competitive bidding provides several potential advantages over administratively set pricing, including:

- Market price responsiveness and more reliable price discovery
- As-bid contract pricing leading to minimum threshold project returns, and
- Simplified administrative processes.

Each of these will be discussed briefly below.

5.1.1.1.1. MARKET PRICE RESPONSIVENESS AND MORE RELIABLE PRICE DISCOVERY

Market prices from solar technology can change rapidly. As previously mentioned in this study, solar module prices have declined nearly thirty percent over the last twelve months, and industry analysts and government entities are expecting further declines in both the near-term and long-term (SolarBuzz, 2012; U.S. DOE, 2011). Establishing administratively set prices that reflect current market conditions in rapidly changing market environments can be challenging.[55] Administratively set prices that do not fully account for market cost declines risk paying above-market prices for SRECs, reducing policy cost effectiveness. Competitive bidding in a well-subscribed auction can avoid this issue by awarding SREC contracts that reflect current market conditions. Depending on how auctions are designed, however, prices can also be delivered that are "too high" or "too low" as a result of strategic, collusive, or poorly informed bidding.

Additionally, under an administratively set pricing process, model inputs must frequently be determined through interviews and surveys of project developers as independent, third-party information is often not available for many model inputs. While there is no indication that this was an issue during the Delaware rate-setting process, project developers may have conflicting interests in providing market data that is eventually used to establish administratively set rates. This is not an issue with competitively established SREC contract rates.

5.1.1.1.2. AS-BID CONTRACT PRICING AND MINIMUM RETURN THRESHOLDS

Under administratively set pricing, all selected projects are awarded the same SREC contract price, while under the auction mechanism used in Tiers 2B and 3, projects were awarded SREC contracts at the project owner's bid price. As previously mentioned in Chapter 2 most market databases indicate that installed costs and other critical project factors can show significant variance within a single state market meaning that low-cost projects awarded contracts through an administratively set process may receive higher than necessary returns. If a primary state-level policy goal is for Delmarva to acquire a limited volume of SRECs at the least costs to ratepayers, awarding competitive contracts to lowest-cost bidders should result in lower overall compliance costs.

5.1.1.1.3. POTENTIALLY SIMPLIFIED ADMINISTRATIVE PROCESSES

One potential advantage of competitive auctions is that they may avoid the need for a stakeholder negotiated rate setting process and potentially complicated regulatory rate approval. In some jurisdictions final approval of administratively set rates can be an administratively burdensome process requiring extensive regulatory commission involvement and independent analysis.[56] The administratively set prices for the Delaware pilot were developed over several months with multiple pricing iterations in an effort to respond to changing market dynamics.[57] This was followed by the required regulatory approvals by the Commission. Under the competitively-priced tiers, the rate approval administrative process may be either avoided or significantly shortened.

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[55] Germany, which has regularly had the world's largest solar market, uses administratively set prices as its main solar incentive. Unlike the Delaware Pilot, the German incentive program does not include a volume cap. The Germans have instituted volume-responsive incentive triggers that reduce incentive levels as the market grows.

[56] It should be noted that developing auction program rules may also require a lengthy regulatory rulemaking processes.

[57] For reference, the Rhode Island DG standard offer rate setting process took two months to complete while rate setting for the Vermont SPEED standard offer took more than six months.

5.1.1.2. ADMINISTRATIVE PRICING

Administratively-set price setting is the most widely used method for established standard offer solar incentive rates in the world. Most of the leading global solar markets have used administratively-set prices. Some of the potential ratepayer advantages of this method include:

- Limited collusion risk, and
- Lower risk of contract failure.

Each of these will be discussed briefly below.

5.1.1.2.1. LIMITED COLLUSION RISK

Administratively set contract pricing effectively avoids the risk that market participants will collude in an auction process to drive up clearing prices. Thinly subscribed competitive auctions may not produce the most cost-effective outcomes if participants are able to collaboratively bid pricing. In a worst-case scenario, collusive bidding could result in auction prices that exceed aggressively-set administratively determined prices. This potential issue was cause for enough concern in New York that it led policy makers to abandon plans for a competitive REC auction (Kreycik, Couture, & Cory, 2011). Collusion and the potential ratepayer impacts of collaborative bidding may be of particular concern in a relatively small solar market such as Delaware where there are a limited number of market participants.

5.1.1.2.2. LOWER RISK OF CONTRACT FAILURE

A number of studies have reported that contract failure rates for competitively bid renewable energy projects can be as high as 50 percent (Kreycik, Couture, & Cory, 2011). This phenomenon may in large part be due to project developers bidding prices that are too aggressive in an effort to win solicitation while not having a complete understanding of final project costs. Developing an accurate competitive bid price can require significant effort in order to fully quantify all relevant project costs. Given solicitation deadlines, project developers may not have either the time or the resources to complete all the necessary due diligence required to submit an accurate bid. This can result in developers under-bidding into auctions. During the project development stage, owners may be forced to abandon their plans when actual project costs exceed those assumed as part of the competitive bid.

Delaware SREC pilot rules include a requirement for a bid deposit of $100/kW[58] that is forfeited in the event a project is not commissioned within twelve months of contract signing.[59] This provision is intended to deter developers from entering speculative bids in the auction tiers. State policy makers and the Commission may wish to evaluate the effectiveness of the bid deposit at the end of twelve months to better understand issues around contract failure rates specific to the Delaware SREC market.

Administratively set prices may create a financial cushion for many of the awarded projects. In the event that developers discover that actual project costs are above costs anticipated at the time of the solicitation, some projects may be able to still proceed.

In the near term, with spot market SREC prices at all-time lows, high SREC contract failure rates may be less of an issue for Delmarva ratepayers. If solicitation winners are unable to deliver their expected SRECs, Delmarva should be able to make up any shortfall through low-cost spot market purchases; however, during periods when

[58] For reference, bid deposits for the New Jersey EDC contracting program were $75/kW with a $20,000 cap (N.J. BPU, 2009) and $20/kW for systems smaller than 5MW in the Californian Renewable Auction Mechanism program (California PUC, 2016).

[59] This deadline can be extended as a result of utility interconnection delays or Force Majeure events.

spot market prices may be near the alternative compliance payment levels, SREC contract failures may have a significant ratepayer impacts.

5.1.1.3. CONCLUSIONS REGARDING TIER 1 AND 2A ADMINISTRATIVE PRICES VS. COMPETITIVE BIDDING

Future iterations of the SREC pilot procurement may be able to lower ratepayer costs by competitively bidding one or both of the administratively set tiers. This would have several advantages including:

- More responsiveness to current market conditions,
- Incentivizing only the lowest cost installations, and
- Reduced regulatory administrative burden.

While these advantages are clear benefits of competitive bidding process, competitively bidding the Tier 1 size class may present some challenges. Survey results indicate that some of the homeowners targeted in this tier may not have a clear enough understanding of the SREC program regulations and PV project economics to submit fully informed competitive project bids.[60] The state, through the RETF, may wish to explore options for setting Tier 1 standard offer pricing at some multiple of the Tier 2 competitively bid prices. This may be one way to ensure that Tier 1 pricing is responsive to market dynamics without creating a burdensome competitive bidding process.

5.1.2. HOW CAN THE PROGRAM BE DESIGNED TO MINIMIZE RATEPAYER COSTS GIVEN THE OTHER OBJECTIVES SET FORTH IN REPSA?

The RETF could explore a number of changes to the existing pilot structure in order to minimize ratepayer costs. These could include:

- Implement a more competitive tiering structure,
- Tie administratively set pricing to competitive tiers, and
- Address issues surrounding stranded systems.

Each of these topics will be discussed below.

5.1.2.1. IMPLEMENT A LESS GRANULAR TIERING STRUCTURE

The tiering approach used in the pilot program may have increased the total ratepayer program costs, and a less granular tiering structure during the next solicitation round could result in more competitive pricing. As mentioned in Chapter 1, the weighted average price for SRECs awarded under Tier 2B was lower than the weighted average for Tier 3. Additionally, several systems that bid into Tier 2B that were not awarded contracts could have bid the same prices into Tier 3 and been awarded contracts. Similarly, two systems that could have qualified for the Tier 2A standard offer chose to submit competitive bids in Tier 2B and one of these systems was awarded a competitive contract.[61] As Figure 21 shows, in the competitively bid tiers there was a positive correlation between system size and price bid, indicating that bid prices increased as project sizes increased.[62]

[60] The state could also be presented with a challenging scenario if a high percentage of winning competitive Tier 1 projects fail requiring a large number of homeowners to forfeit their bid deposits.

[61] The second system was not awarded a contract under Tier 2B, but, had this system submitted the same bid into the Tier 3 auction, it would have been awarded a contract.

[62] This positive correlation is significantly reduced if the large outlier system is removed from the data set, however a positive correlation is still seen even without this outlier.

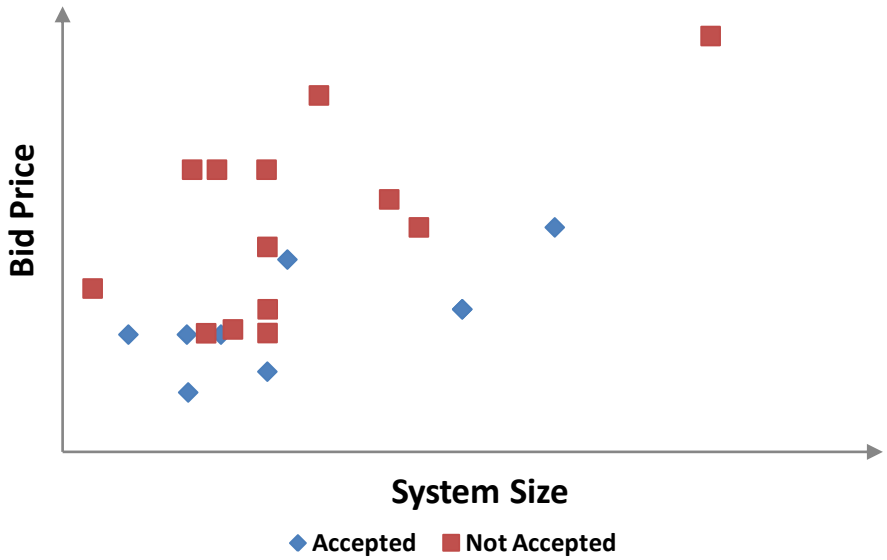

Figure 21. Tier 2B and Tier 3 Bid Prices vs. System Sizes (Note: Axes scale removed to anonymize data)

This counterintuitive result may indicate that either:

1) the assumption behind the tiering decisions--that smaller systems are unable to compete with larger systems--was incorrect or,
2) the number of bids in the solicitation was insufficient to demonstrate the expected economies of scale in the market.

Regardless of which of these conclusions if correct, one potential program solution that could prevent future solicitation from having this issue while reducing ratepayer impacts would be to decrease the number of program tiers.

Given that the RETF's legislative mandate specifically mentions creating a market for residential, commercial and utility-scale system sizes, the next solicitation could, at a minimum, have as few as two tiers. One tier could be dedicated to residential systems, while the second tier could be dedicated to all systems larger than the residential tier cap but less than 2MW. The third Tier, for utility-scale systems, has already been allocated to the Dover Sun Park project. This approach would likely create the most competitive market while still meeting the RETFs legislative mandate. This approach may also be attractive as Delmarva projections for the next pilot program round suggest that an even smaller volume of SRECs will be procured, if any.[63] This simplified tiering approach would, however run the risk that bids in the next solicitation showed the economies of scale expected in the market and that a few large systems would dominate the solicitation leaving no SREC available for roof-top commercial systems. Policy makers may wish to weigh this risk against the program's cost minimization goals during the next program design round.

5.1.2.2. TIE ADMINISTRATIVE PRICES TO COMPETITIVE TIER PRICES

As noted previously, one potential approach to lowering overall ratepayer costs associated with the SREC pilot program would be to tie prices for future administratively set tiers to costs in the competitively bid solicitations.

[63] If the volume of SREC to be procured in the next round is lower than in the previous round, the RETF may wish inquire about how and if other SREC obligated entities in the state could be included in the next solicitation round.

This would ensure that administratively set prices are responsive to market trends while still providing the administrative streamlining that may be necessary to best serve system owners in this tier. This potential approach has been discussed at recent RETF meetings and may be a promising solution to a number of problems.

A number of potential options could be explored for establishing what, if any, price premium Tier 1 should be granted above the auction tiers. A full account of these potential methods is beyond the scope of this study, however some potential approaches could include:

- Offer standard price contracts for Tier 1 at the highest winning bid price for the Tier 2 auction,
- Determine a consensus price multiplier based on a cash flow model analysis of the difference between residential and commercial systems economics, accounting for all available incentives, or
- Set the Tier 1 rate to the weighted average winning price for the Tier 2 auction. If the program is under-subscribed after an opening round, raise the rate by a fixed percentage and re-open the lottery.[64]

There are likely many other potential options for ensuring that administratively set prices are more responsive to market conditions and, in the interest of Delmarva ratepayers, the RETF and the Commission should explore these during the next program development round.

5.1.2.3. COMPETITIVELY PROCURE SREC FROM EXISTING SMALL SYSTEMS

The Delaware SREC market is currently oversupplied, with spot market prices from 2011 SRECs consistently below $60 (SRECTrade, 2012f). Owners of existing systems in the state may not be able to find buyers for their SREC in the near term. Many of these owners applied for but were not awarded contracts under the first round of the pilot program. Given the current oversupply and the significant number of "stranded" systems, these system owners may be willing to sign long term SREC contracts between the spot market price and the Tier 1 and Tier 2A administratively set prices. Additionally, these systems have already completed construction and have financed their projects. Given the policy thesis behind the long-term contracting program is that bankable SREC offtake contracts are a necessary precursor to financing solar projects, these existing stranded systems may deserve fundamentally separate treatment than under-development system, as they have already received sufficient financing.

One potential means of lowering long-term compliance costs of the SREC program would be to hold a separate auction for contracts exclusively for existing systems. Residential existing system owner may be better candidates for a competitive auction, as they have do not need to account for unknown construction costs since their projects are already commissioned. These system owners may view another auction as a final opportunity to gain a long-term revenue stream from their PV systems potentially resulting in very competitive SREC pricing. This approach could have several benefits:

- Lower long-term ratepayer impacts,
- Bring the state solar market back into balance by clearing the backlog of stranded systems, and
- Reduce consumer resentment resulting from being locked out of the SREC market.

Instituting such a policy could result in a slow-down in the development of new systems in Delaware as new system would likely have to wait for another SREC procurement round to receive contracts. This would conflict with the RETFs mandate to maximize in-state economic growth. While this may be the case, it should be noted that the legislatively mandated SREC market growth rate is currently the fundamental limiting factor to the growth of the state's solar market and implementing policies that further exacerbate the existing oversupply by encouraging new installations will benefit installers to the detriment of existing system owners.

[64] This strategy could be vulnerable to collusion between applicant entities and any similar policy should be carefully monitored to ensure that market actors are not driving up market clearing prices.

5.1.3. COMPARE THE COST EFFECTIVENESS AND RISKS OF THE LONG-TERM CONTRACTS RELATIVE TO PURCHASES OF SRECS ON THE SPOT MARKET

Pure REC and SREC markets without price support mechanisms are inherently volatile. In a typical REC market, demand is inelastic, as it is a legislatively mandated function of consumer electricity consumption. Similarly, REC supplier typically have limited information about other market actors and may not make well informed decisions about market dynamics leading to oversupplied markets. These and other factors lead to inherent market oscillations, with markets seeing periods of high costs related to market scarcity quickly shifting to extended periods of oversupply characterized by low credit prices (Ford, Bogstad, & Flynn, 2007).

While the current Delaware SREC market is in a state of oversupply, there is no guarantee that this market state will continue as Delmarva's compliance requirement continues to grow. If current market conditions lead to under investment in solar projects, the Delaware SREC market could quickly revert to an undersupplied state with Delmarva having to pay near-ACP prices for SRECs. In addition to this inherent market volatility, legislators in a number of states have actively sought to "fix" oversupplied SREC market by attempting to pass legislation accelerating compliance schedules, shifting oversupplied markets back to under-supply. Legislators in Delaware, Pennsylvania, Maryland and New Jersey have either passed or proposed legislation to accelerate SREC compliance schedules supporting SREC market prices (SRECTrade, 2012d; SRECTrade, 2012e; SRECTrade, 2012c; Delaware Senate, 2012). It is unclear whether these efforts will result in long-term market stability or will only temporarily reset the inherent boom-bust market dynamic.

A utility SREC procurement strategy that relies primarily on spot market can be an advantage to ratepayers during periods of market oversupply, but can also be a burden during periods of market scarcity. Long-term SREC contracts are one fundamental means utilities can use to reduce ratepayer exposure to SREC market volatility.

Table 43 below illustrates the potential protection long-term contracts can afford to ratepayers. This table provides a hypothetical example of two simplified utility SREC purchase strategies: spot market purchases and long-term contracting. Under the spot market scenario, the market is undersupplied in the early years as the obligation is insufficient to support existing installations. During later years, the market oscillates between oversupply ($30) and under supply ($390) with two years of oversupply for every year of under-supply.[65] Under the long-term contracting scenario, the utility has contracted for 20-year SRECs contracts at just under $147 per SREC (the average weighted SREC price for the competitive pilot tiers). The hypothetical SREC obligation follows the current annual ramp rate under REPSA.

[65] Note: this scenario is only presented to illustrate how long-term contracting can be used to hedge against SREC market volatility. These assumptions are for illustrative purposes only. A more thorough model of SREC price volatility risk is beyond the scope of this analysis. Alternative spot market scenarios would result in different results.

Table 43. Comparison of Two Utility SREC Compliance Strategy Costs

	Utility SREC Obligation	SREC Spot Prices	Spot Market Strategy Annual Cost	SREC Contract Prices	Contract Strategy Annual Cost
2011-12	14,224	**$30**	$426,726	$147	$2,093,944
2012-13	28,876	**$30**	$866,268	$147	$4,250,777
2013-14	43,963	**$30**	$1,318,896	$147	$6,471,823
2014-15	59,497	**$30**	$1,784,898	$147	$8,758,494
2015-16	75,486	**$30**	$2,264,580	$147	$11,112,294
2016-17	95,773	**$390**	$37,351,548	$147	$14,098,773
2017-18	116,651	**$30**	$3,499,542	$147	$17,172,253
2018-19	138,135	**$30**	$4,144,050	$147	$20,334,853
2019-20	160,237	**$390**	$62,492,274	$147	$23,588,430
2020-21	182,970	**$30**	$5,489,100	$147	$26,935,014
2021-22	206,350	**$30**	$6,190,488	$147	$30,376,725
2022-23	230,389	**$390**	$89,851,788	$147	$33,915,594
2023-24	255,104	**$30**	$7,653,114	$147	$37,553,830
2024-25	280,508	**$30**	$8,415,234	$147	$41,293,553
2025-26	306,617	**$390**	$119,580,552	$147	$45,137,059
Total Cost			$351,329,058		**$323,093,417**
NPV of Total			$164,087,684		**$161,452,339**

Using a seven percent discount rate, the costs of these two scenarios is $164 million for the spot-market strategy and $161 million for the long-term contracting strategy.[66] Under the spot market scenario, ratepayers are exposed to high potential total ACP charges if the market is short in the later years. The higher SREC volume requirements in these later years pose a significant ratepayer costs risk. The long-term contracting scenario effectively mitigates this risk by eliminating ratepayer exposure to these costly price spikes. Under the existing pilot structure, contracts include a significant step-down in SREC prices after year ten. This contracting mechanism will allow Delmarva access to a steady stream of low-cost SRECs during a period of time when spot market volatility has a significant potential impact on ratepayers.

While the numbers presented in this example are hypothetical, they illustrate the substantial impacts that periodic, cyclical SREC shortages can have on policy compliance costs.[67] Given this, and the relatively low costs seen in the competitive tiers of the SREC pilot, state policy makers may wish to consider encouraging obligated entities to pursue long-term SREC contracts for a proportion of their compliance requirements in order to hedge against future market volatility.[68]

[66] This example is not intended to illustrate that one strategy is inherently more cost effective than another, but is intended to illustrate how an SREC market that is undersupplied only one quarter of the time can result in total ratepayer costs that are nearly the same as under a competitively-priced long-term contracting strategy.

[67] It should be noted that long-term contracting can also present a risk to ratepayers if legislative or regulatory changes reduce utility SREC obligations. Utilities may be able to mitigate this risk through contract provisions that protect ratepayers in the event of major regulatory changes.

It is also important to note that long-term SREC contracting has also been reported to substantially lower developer project financing costs (Baratoff, Black, Burgess, Felt, Garratt, & Guenther, 2007). Potential bank lenders are typically unwilling to provide capital to solar projects with uncertain future SREC revenue streams as volatile SREC markets can present a significant risk that project developers will be unable to service their debt obligations. Long-term contracting removes this risk, lowering overall project financing costs. At a state-wide scale, the phenomenon could also help reduce total policy compliance costs by reducing required project investment returns.

5.2. CONSUMER PROTECTION

Many of the survey respondents expressed frustration with their system installer and suggested that they felt that they were misled about their ability to benefit from the Delaware SREC market.[69] Given the current market oversupply and the high number of "stranded" systems in the state, Delaware policy makers may wish to evaluate if appropriate consumer protections are in place related to the SREC market.

Many residential PV installers sell their systems, in part, by highlighting the financial returns associated with solar investments. Unlike most other home improvements, solar project proposals frequently include cashflow projections and investment return calculations.[70] The Delaware SREC program is a complex regulatory market, and some homeowners may not be following state energy policy developments closely enough to properly evaluate the risks associated with this dynamic market. Consequently, solar installers may be a homeowner's primary or only source of information regarding market conditions, expected returns, and potential future changes to state-level policies. This could be a cause for concern amongst state regulators as PV installers may not be in the best position to explain the downside risks associated with the Delaware SREC market to potential customers.[71]

To date, no state surveyed as part of this report has implemented a strong consumer protection program related to its SREC markets. If Delaware were interested in moving forward on this issue, the state could be the first to establish national best practices. Some approaches Delaware policymakers could consider include:

- Requiring all system owners to sign an acknowledgement that highlights the risks associated with the SREC market,
- Creating an SREC market educational guide for homeowners,
- Establishing state-wide standards for modeling assumption solar installers can use when developing project financial projections for homeowners, or
- Holding state-sponsored educational sessions to educate homeowners about the risks and benefits of the SREC program.

In the interest of consumer protection, the Commission and the Task Force may wish to carefully consider how the next rounds of the pilot program are structured. One of the primary advantages of a solicitation-supported SREC market is the ability to match market demand with market supply through a competitive tender. It is an open question whether, given current SREC market conditions, the state should design policies that encourage homeowners to install systems in advance of having won an SREC contract. This approach risks further

[69] One disgruntled system owner suggested in the survey that they were prepared to file a fraud lawsuit against their system installer.

[70] Note: A recent survey of residential solar project proposals in Massachusetts from several nationally prominent installers revealed cash flow modeling assumptions that greatly overestimated potential homeowner savings.

[71] Additionally, risks associated with changes to the regulatory environment are extremely difficult to assess and major changes to state policies may be unforeseeable even for installers who closely follow state solar policymaking.

exacerbating the current market oversupply and would likely lead to even more "stranded" residential installations.

Solar PV installations make more financial sense in Delaware with the ability to access the SREC market, and homeowners would be less likely to invest in $35,000 systems without the ability to recoup their investment through SREC sales. With that, the state may wish to carefully consider program structures in which a homeowner installs a system and then "takes a chance" that they will be awarded access to the SREC market through future Pilot solicitation. Given the uncertain nature of the SREC lottery system (in an over-scribed market), homeowners need to fully understand the risks associated with the program in advance of the solicitation.

5.3. HOW CAN THE PROGRAM BE DESIGNED WITH REGARD TO THE OBJECTIVE OF MAXIMIZING IN-STATE SOLAR RENEWABLE ENERGY GENERATION AND LOCAL MANUFACTURING?

Eighty-four percent of all capacity entering the solicitation claimed the Delaware workforce bonus, while sixty-eight percent of all capacity entered claimed the Delaware manufactured equipment bonus. Of projects that were awarded contracts, all winning Tier 1 and Tier 2A entrants claimed both bonuses. In the competitive tiers, where applicants were not granted a selection preference based on Delaware labor and manufactured content, Seventy-six percent of total winning capacity claimed the workforce bonus while sixty-four percent of winning capacity claimed the manufacturing adder.

From these results, it is clear that the pilot program, and the existing legislatively established multipliers, provided significant incentive for system owners to hire Delaware installers and use Delaware-manufactured panels. In fact, given that lottery preference was given to systems that claimed both multipliers and that the volume of SRECs entering the lottery from systems claiming both multipliers exceeded total contract availability, winning a Tier 1 or Tier 2A contract required that the system include both Delaware labor and manufactured content. Beyond implementing similar preference-based selection criteria for the competitive tiers, it may be difficult to design a policy that more effectively encourages use of Delaware products under the mandate of the RETF.

One potential issue raised in the participant survey specific to the Tier 1 and Tier 2A lotteries related to consumer's available panel choices. Some respondents commented that their preferred Delaware installer did not have access to panels that qualified for the Delaware equipment bonus, effectively preventing systems from those installers from participating in the program. Installers may have long-term panel supply agreements with particular module manufacturers and some Delaware installers may not have a relationship with Motech, the only panel manufacturer currently in Delaware. Given current program rules and legislative restrictions, installers that cannot procure Motech manufactured panels may have a challenging time working in Delaware. Limiting the pool of installers serving the Delaware solar market could also have the effect of raising system costs in the state.

Another potential issue related to the pilot and the creation of a de facto Delaware equipment requirement for Tier 1 and Tier 2A systems includes state-level market risks. The upstream solar market has experienced significant consolidation in the past few months with dozens of manufacturers declaring bankruptcy, and many analysts expect this trend to continue for the foreseeable future (Greentech Media, 2012). System owners with panels from firms that have declared bankruptcy may have a challenging time claiming product warranties in the event that their systems do not meet guaranteed performance requirements. While this is a general risk all PV system owners take when installing a system, in a typical state the market-level risk related to this issues is minimal as many panel manufacturers sell products in the state. However, current Delaware policy could highly

concentrate this risk if the state effectively requires that only panels from in-state manufacturer (which there is currently one) are used to comply with its RPS. If the Delaware market develops such that only panels from a single in-state manufactured source are installed in the state, in the event of a financial or quality disruption, it is unknown if Delaware residents and businesses would be able to take advantage of warranty protections should their systems perform below guaranteed output levels. Policy makers may wish to weigh whether the benefits of in-state manufacturing outweigh the market concentration of this risk across most of the state's SREC eligible PV systems.

One effect of the existing, legislatively mandated SREC multiplier method of encouraging in-state economic development is that it reduces the total number of systems installed in the state. Given the high number of systems qualifying for these multipliers, the actual installed capacity resulting from the pilot's first solicitation will be 16 percent lower than had the multipliers not been available.[72] This has the effect of reducing the required total installed capacity in the state by nearly 1,300 kW.[73] It is likely that a high proportion of this avoided capacity would have been installed using Delaware labor and may have used Delaware-manufactured panels. This avoided capacity could also have reduced the number of stranded system in the state. A more formal analysis would be required to determine whether this loss of installed capacity was a net job-creator for Delaware or whether this reduced installed capacity actually reduces beneficial economic activity in the state. The structure of the economic development multipliers in REPSA is a legislative matter, and is beyond the purview of either the Commission or the RETF.

Other jurisdictions have explored ways to incentivize the use of in-state labor or manufactured equipment. For instance Massachusetts provides an adder for using equipment manufactured in-state as part of its Commonwealth Solar II rebate program. The Canadian province of Ontario has developed a more aggressive policy, only allowing PV systems that meet a certain local-content threshold to qualify for its feed-in tariff. This policy has lead several inverter manufactures to establish manufacturing facilities in the province. While this approach has, to a degree, been successful in Ontario, the size of the Delaware market may not be sufficient to attract new manufacturing capacity under a similar policy regime.

[72] Actual first-year SRECs expected from solicitation winners totaled 9,872 while "effective" expected annual SRECs (ie. total expected SRECs generated after all multipliers are included) are 11,472.

[73] Note: This is roughly equivalent to 170 average-sized residential PV systems.

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APPENDIX A. SURVEY QUESTIONS

Questions to Ask	Question Type	Answer Choices
Applicant Overview		
Did you participate in the SREC Procurement Pilot Program's solicitation for a single system or as an Owner's Representative?	Multiple Choice	• Single System • Owner Representative
[Owner's Representative] Project Information		
How many projects did you complete applications for?	Drop down menu	1 -20+
At the time the applications were submitted, how many of the projects were proposed, and how many were commissioned?	Drop down menu	Proposed projects: 1-20+ Commissioned projects: 1-20+
Please identify the number of projects you submitted in each size category	Drop down menu	• > 50 kW • 50 kW – 250 kW • 250 kW – 500 kW • 500 kW – 2000 kW • < 2000 kW
Please identify the number of projects you submitted for each tier	Drop down menu	• Tier 1 • Tier 2a • Tier 2b • Tier 3
Would you prefer a competitive bid process for Tiers 1 and 2a instead of administratively set pricing?	Single Select Multiple Choice	• I would prefer a competitive bid process • I would prefer administratively set prices
How many of your applications were accepted?	Drop down menu	1-20+
Please identify how many of your projects were eligible for the Delaware workforce and/or equipment bonus.	Drop down menu	Delaware workforce bonus: 1-20+ Delaware equipment bonus: 1-20+
If one or more of your projects were not eligible for the Delaware workforce and/or equipment bonus, why not? (check all that apply)	Multiple Select Multiple Choice	• Bonus was not financially sufficient to offset cost increase • Equipment/workforce did not meet technical requirements for project • Equipment/workforce was not available • All of my projects were eligible • Other (please specify)
[Single System] Project Information		

Project Size	Single Select Multiple Choice	• > 50 kW • 50 kW – 250 kW • 250 kW – 500 kW • 500 kW – 2000 kW • < 2000 kW
What tier did you apply for?	Single Select Multiple Choice	• Tier 1 • Tier 2a • Tier 2b • Tier 3
For future solicitations, would you prefer a competitive bid process for Tiers 1 and 2a instead of administratively set pricing?	Single Select Multiple Choice	• I would prefer a competitive bid process • I would prefer administratively set prices
Was your project online at the time you submitted your application?	Single Select Multiple Choice	• My project was online • My project was proposed
Was your project accepted into the program?	Single Select Multiple Choice	• My project was accepted • My project was not accepted
Was your project eligible for the Delaware equipment bonus?	Single Select Multiple Choice	• My project was eligible for the equipment bonus • My project was not eligible for the equipment bonus
Was your project eligible for the Delaware workforce bonus?	Single Select Multiple Choice	• My project was eligible for the workforce bonus • My project was not eligible for the workforce bonus
If the project was not eligible for the Delaware workforce and/or equipment bonus, why not? (check all that apply)	Multiple Select Multiple Choice	• Bonus was not financially sufficient to offset cost increase • Equipment/workforce did not meet technical requirements for project • Equipment/workforce was not available • My project was eligible for both bonuses • Other (please specify)
Who was your owner representative?	Text Field	
Overall, how satisfied were you with your owner representative?	Single Select Multiple Choice	• Very satisfied • Somewhat satisfied • Neutral • Somewhat dissatisfied • Very dissatisfied
Effectiveness of Marketing		
How did you learn about the SREC pilot program solicitation?	Multiple Select Multiple Choice	• Delaware Public Services Commission (PSC) • Delaware Energy Office

		• SRECDelaware.com • Delmarva • Delaware Sustainable Energy Utility • Solar installer • Owners representative • Newspaper or Magazine • Online Blog • Online Social Network • Friend/Colleague • SRECTrade • Other (specify)
Do you think SRECTrade/Sustainable Energy Utility (SEU) did an adequate job of notifying the solar community about the solicitation?	Single Select Multiple Choice	• Yes • No
If you answered no to the previous question, please explain how SRECTrade/SEU could have done a better job of notifying the solar community.	Text field	
Customer Satisfaction		
Please rate your experience on the following attributes of the solicitation administration: • Solicitation timeline • Clarity of eligibility criteria • Fairness of eligibility criteria • Ease of filing application • Quality of online systems • Terms of SREC transfer agreement	Rate items on a scale	• Very satisfied • Somewhat satisfied • Neutral • Somewhat dissatisfied • Very dissatisfied • Not applicable
Please rate your experience with the following attributes of the question and answer process: • Length of question and answer period • Timeliness of responses • Quality of responses • Overall satisfaction with the Q&A process	Rate items on a scale	• Very satisfied • Somewhat satisfied • Neutral • Somewhat dissatisfied • Very dissatisfied • Not applicable
How do you feel the administrative requirements for this program compare to similar programs in other states?	Single Select Multiple Choice	• Fewer administrative requirements • Average administrative requirements • More administrative

		requirements • I do not have experience with other state procurement programs
Did you perceive any additional risk associated with contracting through the Sustainable Energy Utility instead of directly through Delmarva?	Single Select Multiple Choice	• Yes • No
In general, do you think the program was fairly and effectively administered?	Single Select Multiple Choice	• Yes • No
If not, why not?	Text field	
Please tell us how we can improve the program for future solicitations.	Text field	