Issues and Considerations in Reaching Delaware's Solar Energy Goals

Creating a Sustainable Solar Energy Strategy

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delmarva power

Agenda

Background

- Delaware's renewable portfolio standard (RPS) was established in 2005 by the enactment of Senate Bill 74, which required 10% of the state's electricity to be supplied by renewable resources by 2019. In 2007, the legislature passed Senate Bill 19, increasing the RPS requirement to 20% by 2019 and adding a new solar energy "carve-out". Although the solar carve-out begins at a very small percentage, the end target of 2% of total electricity consumption by 2019 is one of the most aggressive solar PV goals in the nation.
- Concerns have been raised regarding Delaware's ability to meet a 2% solar energy carve-out by 2019.
- Delmarva Power has evaluated several options for achieving the 2% solar energy carve-out.
- In the following presentation, Delmarva Power is recommending a sustainable path toward meeting the State's solar energy goals and possible policy changes to meet the target.

Delaware Solar Installations

- The PJM GATS system reports an increasing number of solar energy installations in Delaware.

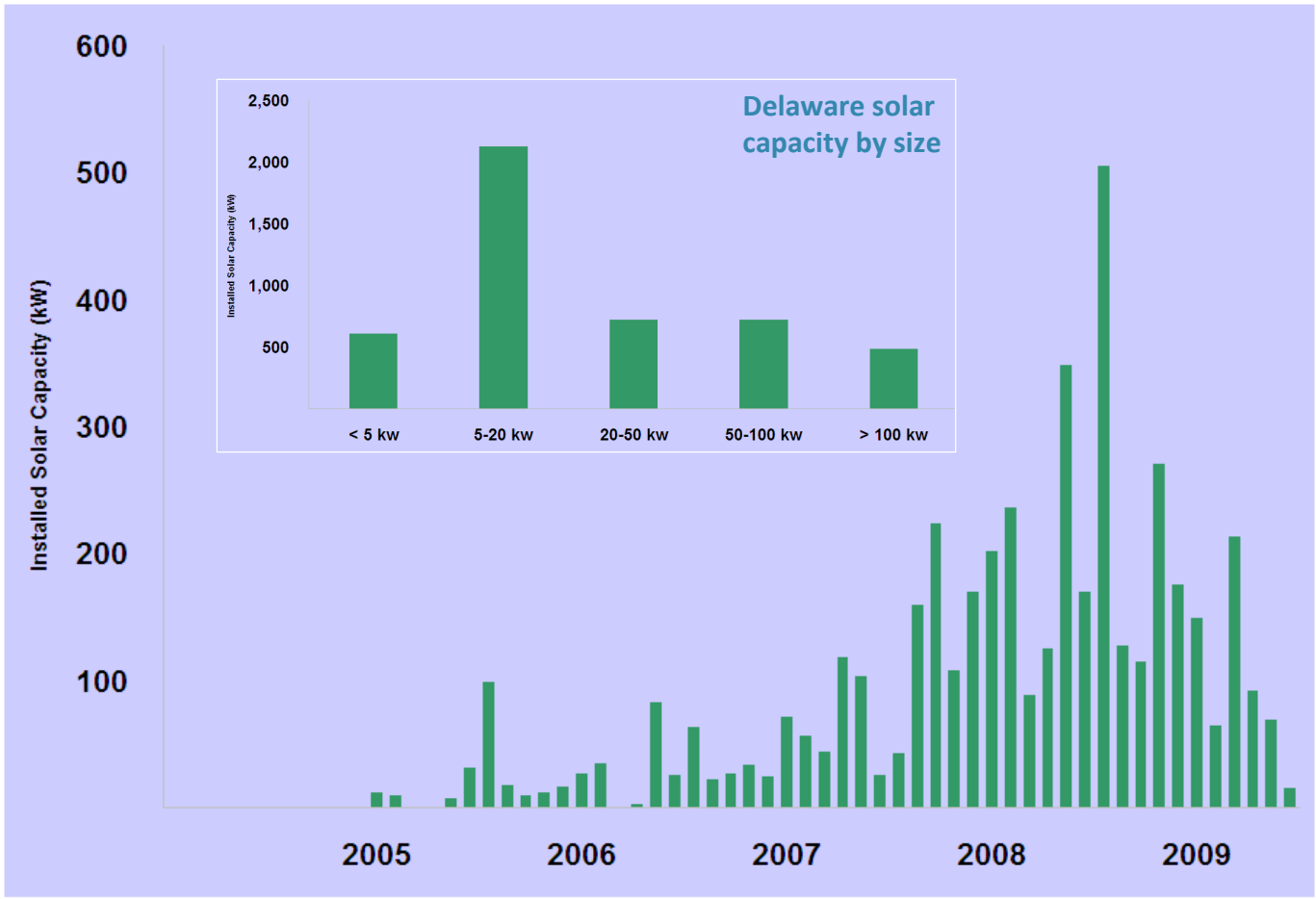
Delaware Solar Statistics

Total Solar Capacity:
4,655 kw

Average Capacity Size:
9.3 kw

Largest Installation:
342 kw

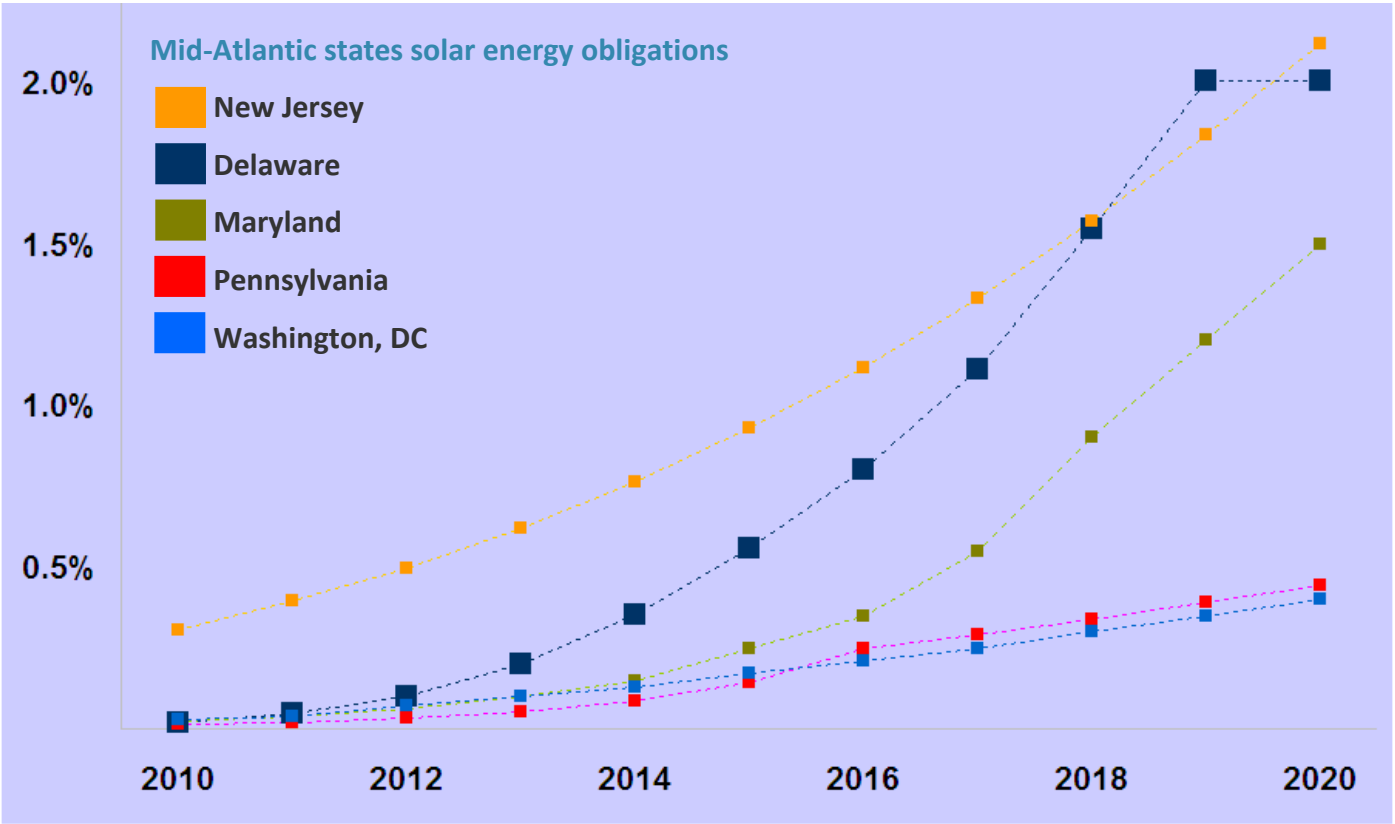
Largest Planned Installation:
9,200 kw
Dover SUN Park



Source: PJM GATS, accessed Feb. 10, 2010

Comparison of Solar RECs Targets

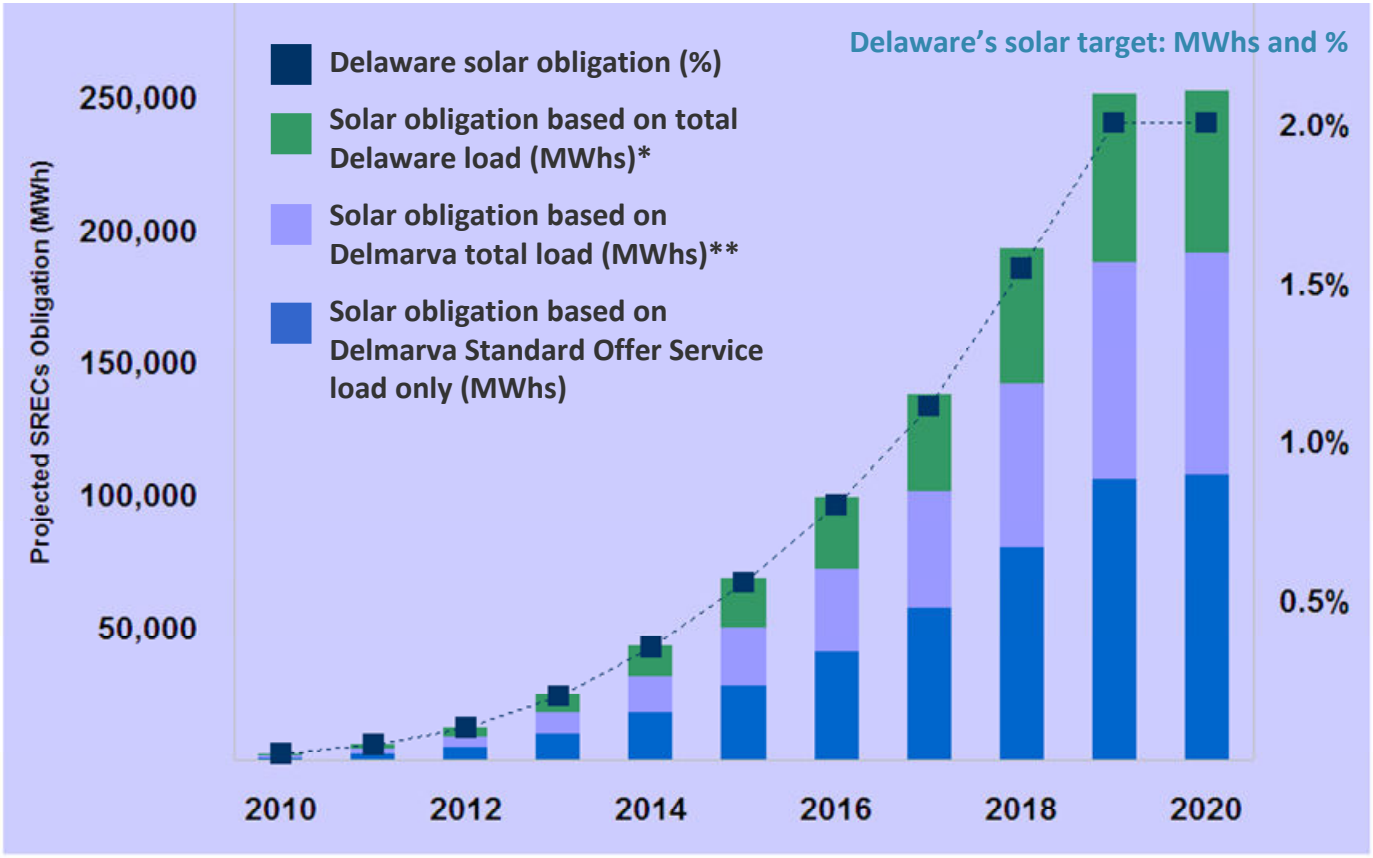
- The chart below compares the state-mandated solar energy power purchase requirements in the Mid-Atlantic region. Delaware's current solar RECs requirement is one of the most aggressive in the region.



Note: This chart shows the percent of electricity to be supplied by solar energy projects. State requirements vary in terms of the retail suppliers covered by the solar RECs (SRECs) obligation. For example, in Delaware, municipal and cooperative utilities are exempt from the requirement, and for Delmarva Power the utility is only required to supply the necessary percentage for its Standard Offer Service (SOS) customers. Non-SOS customers' solar requirements are the responsibility of the third party retail supplier.

Delaware Solar Requirement in Detail

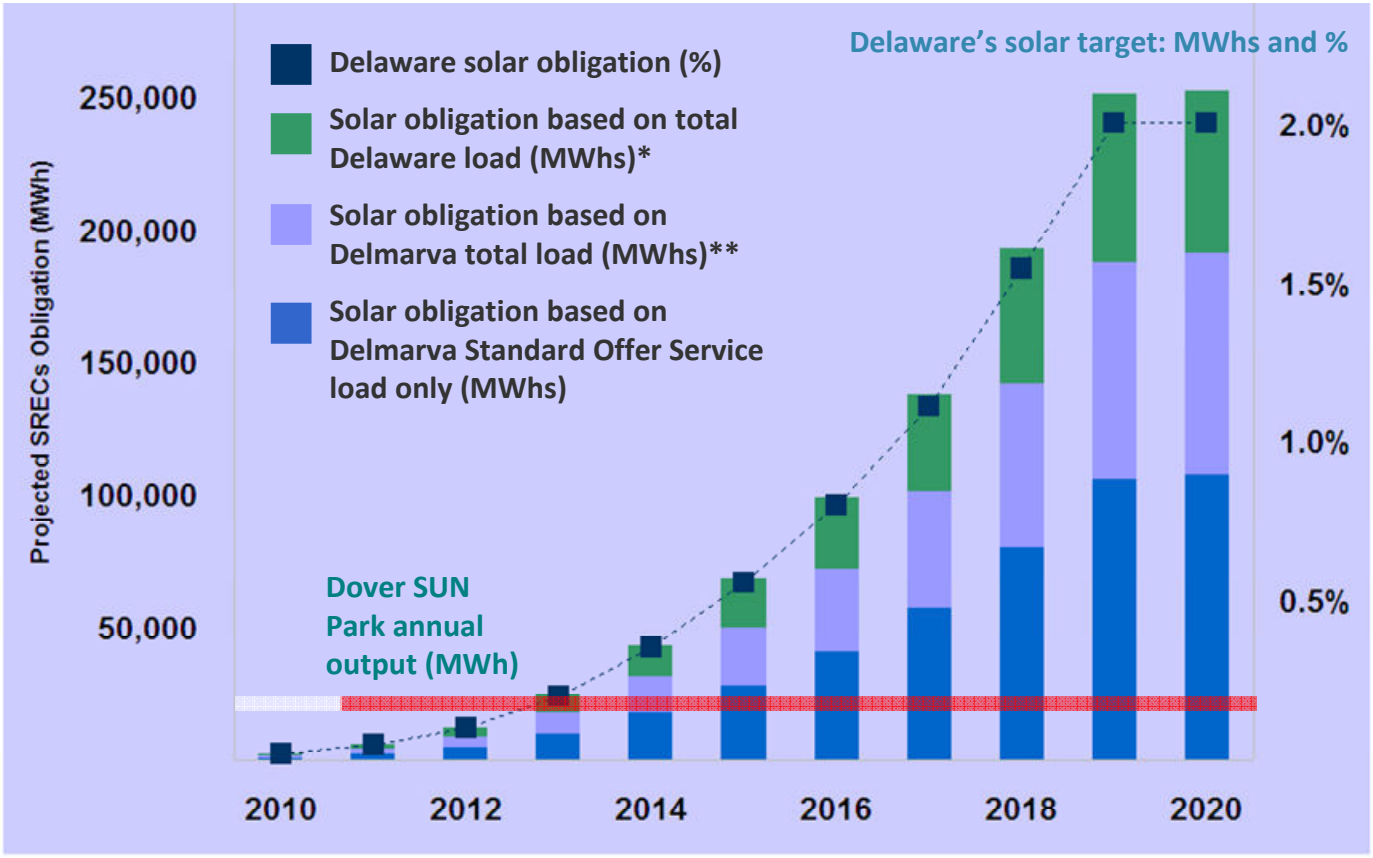
- The Delaware solar obligation currently requires the production of nearly 200,000 megawatt hours (MWh) of solar energy by 2020. If municipal utilities, cooperatives, and large industrial customers were included, the obligation would increase to more than 250,000 MWhs by 2020.



*Total Delaware retail load, including IOUs, municipal utilities, and cooperatives.
**Excludes municipal utilities, cooperatives, and certain large industrial customers exempt from the SRECs requirement. This is consistent with existing law.

Delaware Solar Requirement in Detail

- The Dover SUN Park, which is expected to deliver roughly 14,000 megawatt hours per year when it goes on-line in late-2010 or early-2011, will satisfy a large share of the Delaware solar obligation through 2014.



*Total Delaware retail load, including IOUs, municipal utilities, and cooperatives.
**Excludes municipal utilities, cooperatives, and certain large industrial customers exempt from the SRECs requirement. This is consistent with existing law.

Agenda

Compliance Scenarios

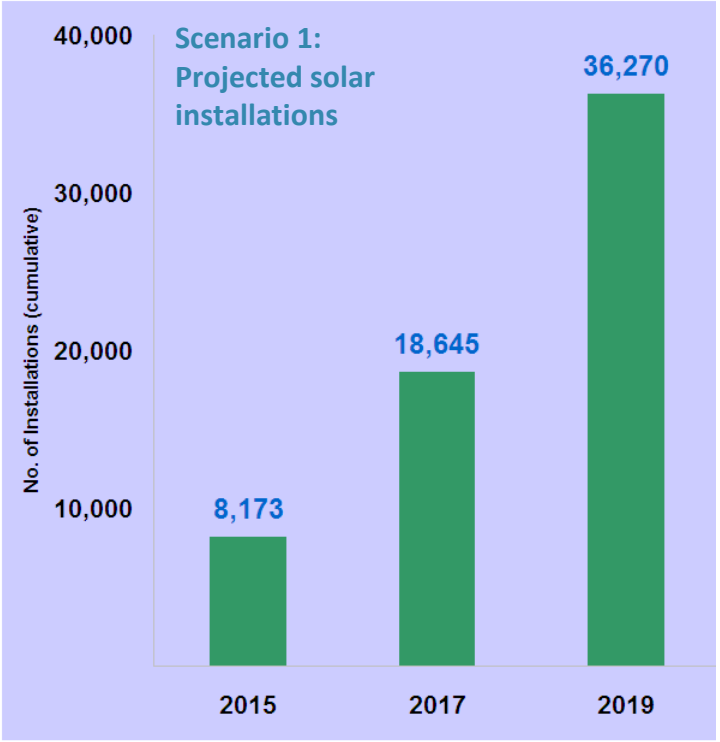
- To better understand the implications of the Delaware solar energy carve-out, two hypothetical scenarios were evaluated for achieving the state target (minus the output of the Dover SUN Park):
  - **Scenario 1** = 100% residential solar (4 kw each)
  - **Scenario 2** = 100% utility-scale solar (5.0 MW each)
- These two scenarios are intended to represent "bookends" in terms of the minimum and maximum costs and jobs impact.
- For each scenario, we calculate:
  - Number of installations
  - Installation costs
  - Direct solar employment
- After considering these two extremes we will discuss a "hybrid" scenario that aims to balance the State's multiple solar energy policy goals.

Note: In the analysis that follows, all calculations are based on the Delmarva total load.

Installations: Getting to 2% Solar by 2019

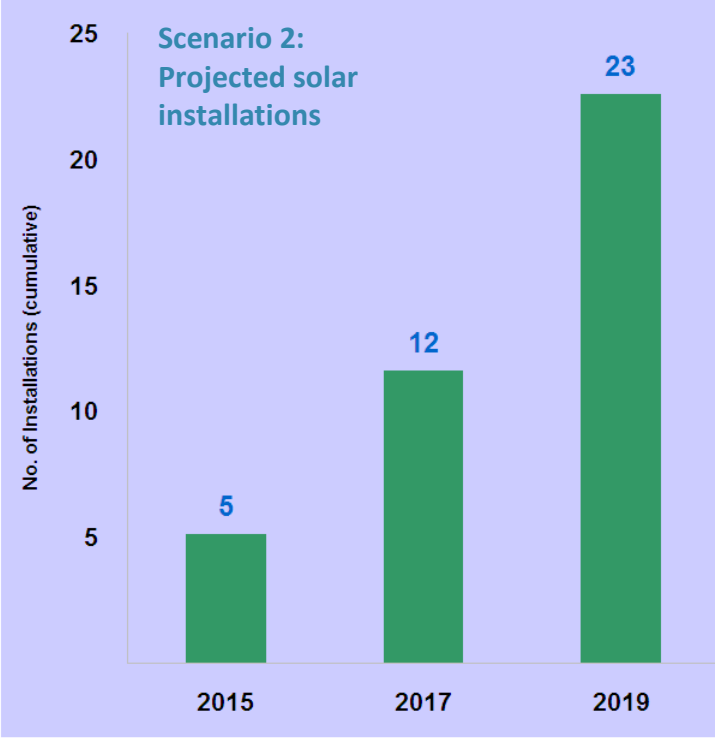
Scenario 1

All residential-scale solar installations (4 kw each). Scenario 1 is equivalent to 14% of Delmarva residential customers adding rooftop solar installations.



Scenario 2

All utility-scale solar installations (5.0 MW each). Scenario 2 is equivalent to adding an additional 12 Dover SUN Parks by 2019.



Note: All calculations are based on the total Delmarva load forecast (minus 70% of projected output from Dover SUN Park or 9,800 megawatt hours) rather than the total Delaware load. For a complete list of assumptions see Appendix C.

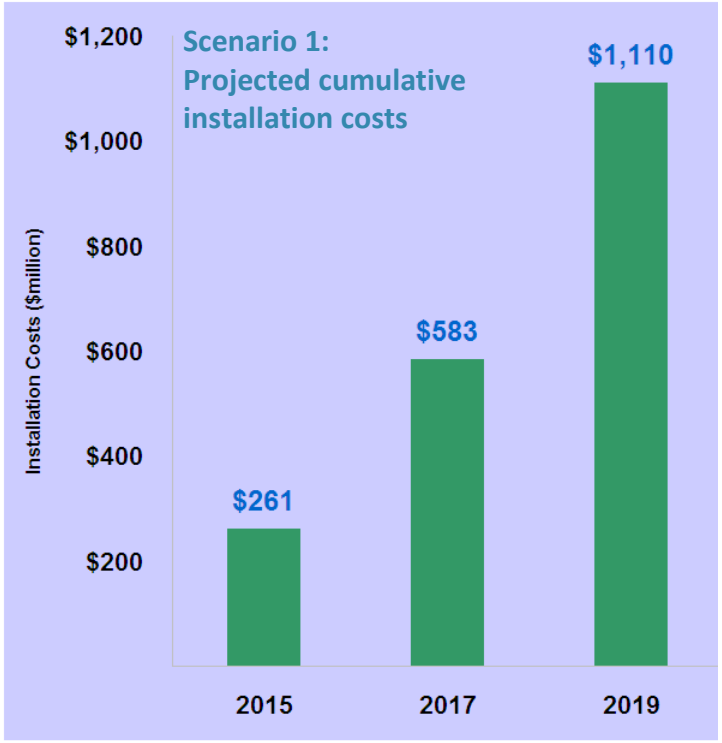
Costs: Getting to 2% Solar by 2019

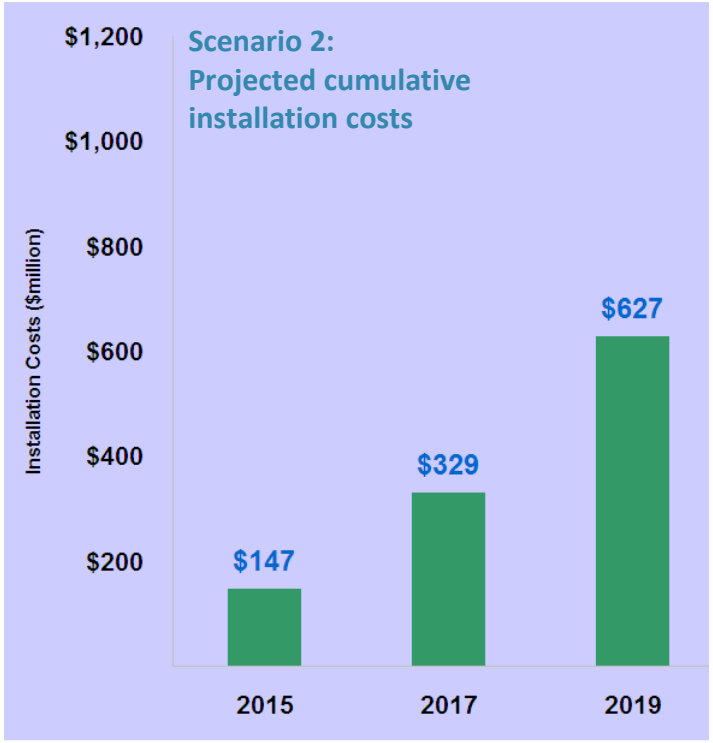
Scenario 1

Installing 36,270 residential solar projects will require a total investment of about $1.1 billion.

Scenario 2

Constructing 23 utility-scale solar installations will require a total investment of about $627 million.



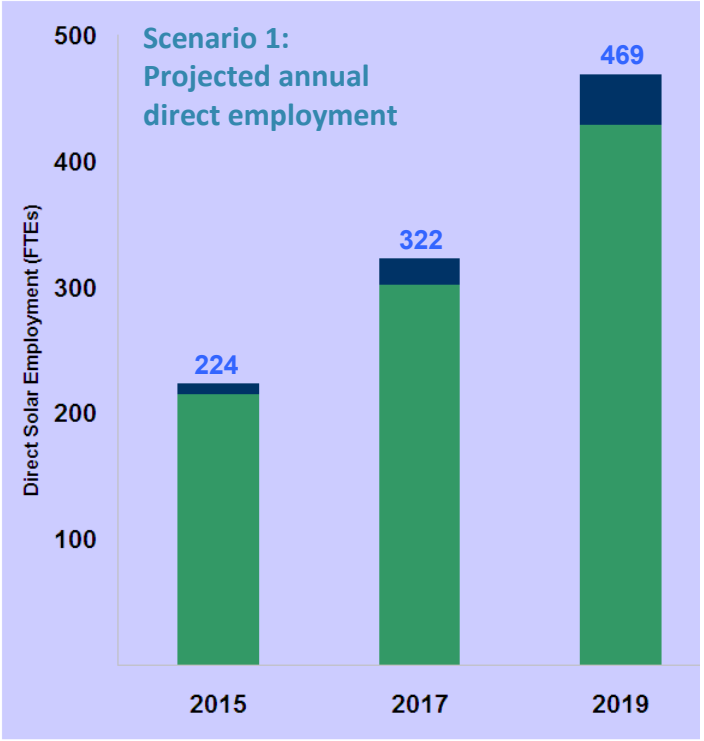


Note: All calculations are based on the total Delmarva load forecast (minus 70% of projected output from Dover SUN Park or 9,800 megawatt hours) rather than the total Delaware load. For a complete list of assumptions see Appendix C.

Jobs: Getting to 2% Solar by 2019

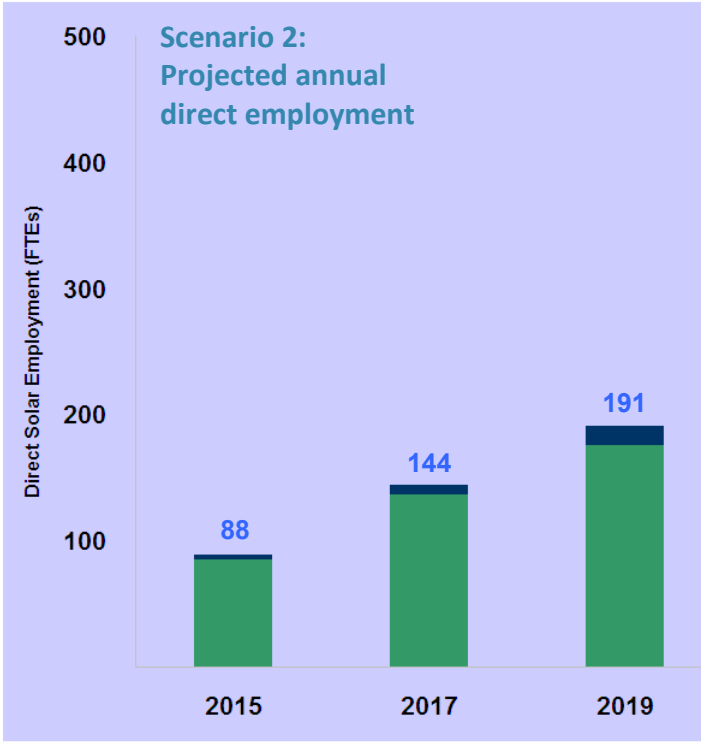
Scenario 1

The chart below presents the projected annual employment under Scenario 1. Design and construction employment would decline after 2019 when the solar obligation is met.



Scenario 2

The chart below presents the projected annual employment under Scenario 2. Design and construction employment would decline after 2019 when the solar obligation is met.



O&M

Design and Construction

Note: All calculations are based on the total Delmarva load forecast (minus 70% of projected output from Dover SUN Park or 9,800 megawatt hours) rather than the total Delaware load. For a complete list of assumptions see Appendix C.

How does DPL propose to get to 2% goal?

Delaware must balance multiple objectives:

- Meet or exceed the State's current solar RPS requirement
- Establish a robust market for solar energy
- Maintain an acceptable level of customer rate impact
- Create clean energy jobs within the State

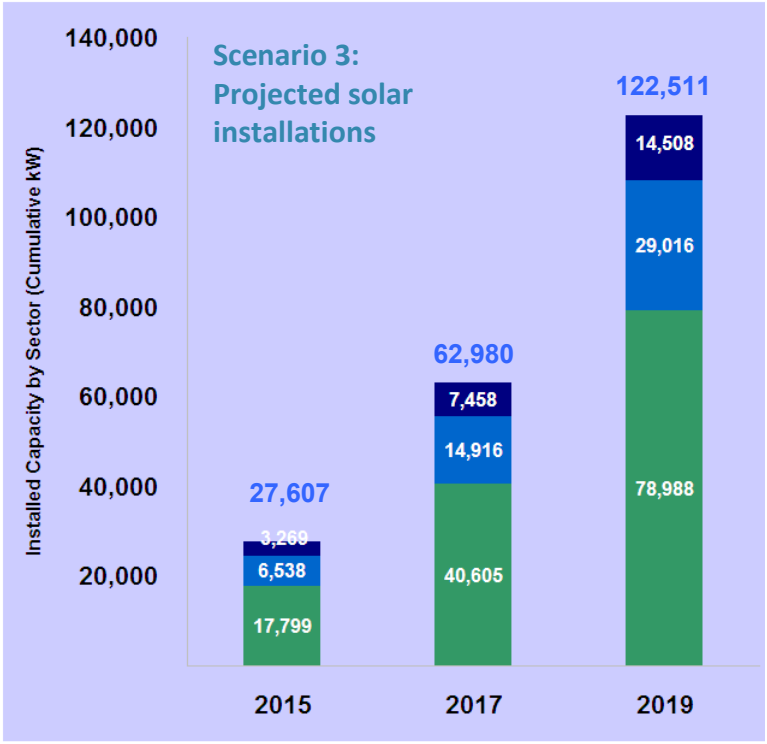
DPL evaluated a hybrid scenario in an effort to balance these objectives:

- 10% residential
- 20% commercial
- 70% utility-scale

Installations: Getting to 2% Solar by 2019

Scenario 3

Scenario 3 achieves the Delaware solar requirement with: 70 percent utility-scale installations (5.0 MW), 20 percent commercial installations (20 kW), and 10 percent residential installations (4 kW). Scenario 3 results in about 1.4 percent market penetration for residential solar, adding the equivalent of approximately 8 more Dover SUN Parks by 2019, and adding PV to nearly 750 commercial facilities.



Projected No. of Installations in 2019

Residential: 3,627

Commercial: 1,451

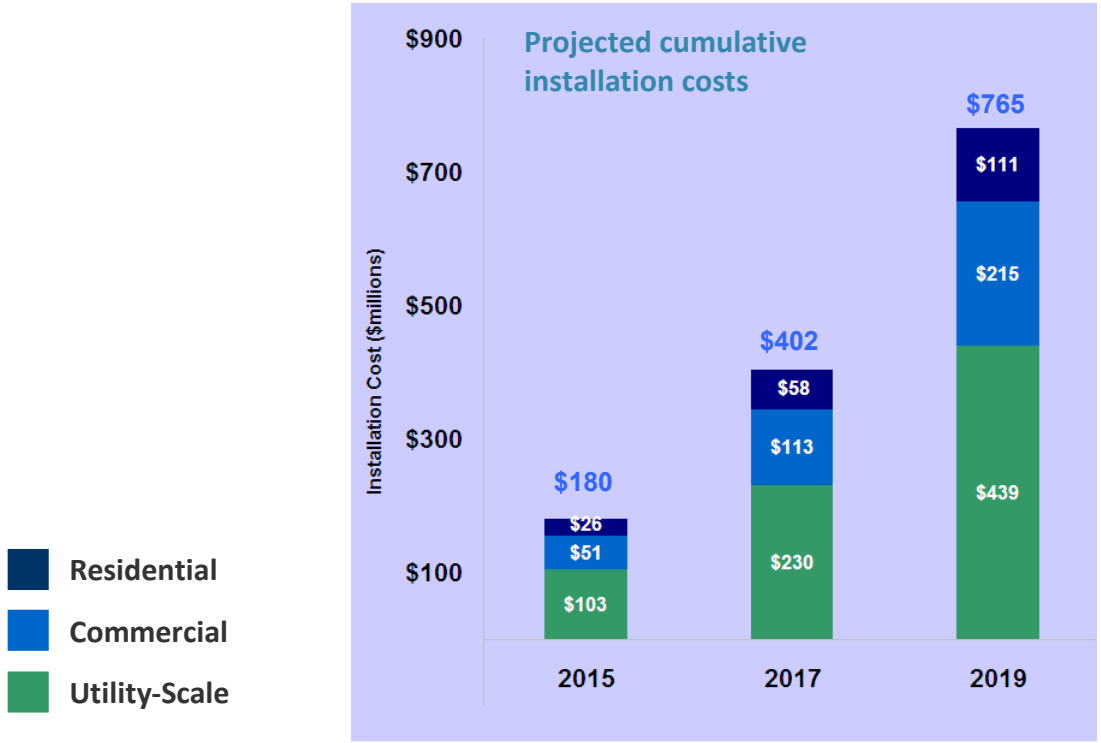
Utility-Scale: 16

Note: All calculations are based on the total Delmarva load forecast (minus 70% of projected output from Dover SUN Park or 9,800 megawatt hours) rather than the total Delaware load. For a complete list of assumptions see Appendix C.

Costs: Getting to 2% Solar by 2019

Scenario 3

Scenario 3 would require a total investment of approximately $765 million by 2019. This is approximately 20% higher than the cost estimate for Scenario 2 (100% utility-scale), and 30% lower than Scenario 1 (100% residential).

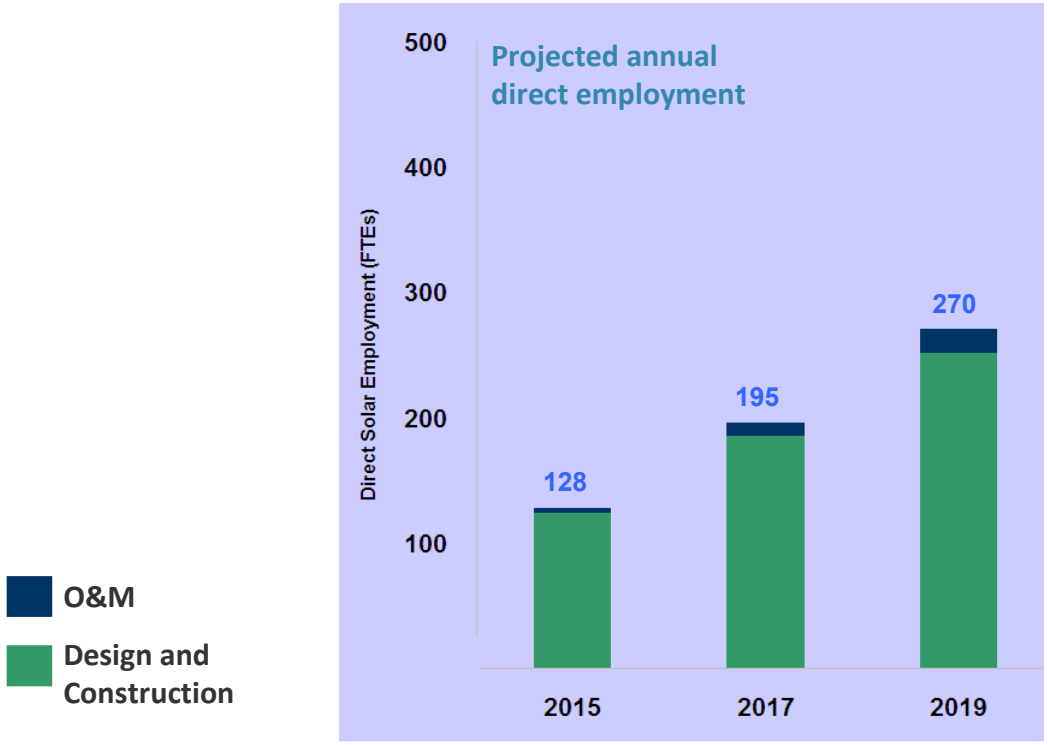


Note: All calculations are based on the total Delmarva load forecast (minus 70% of projected output from Dover SUN Park or 9,800 megawatt hours) rather than the total Delaware load. For a complete list of assumptions see Appendix C.

Jobs: Getting to 2% Solar by 2019

Scenario 3

The chart below presents the projected annual employment under Scenario 3. Design and construction employment would decline after 2019 when the solar obligation is met.



Note: All calculations are based on the total Delmarva load forecast (minus 70% of projected output from Dover SUN Park or 9,800 megawatt hours) rather than the total Delaware load. For a complete list of assumptions see Appendix C.

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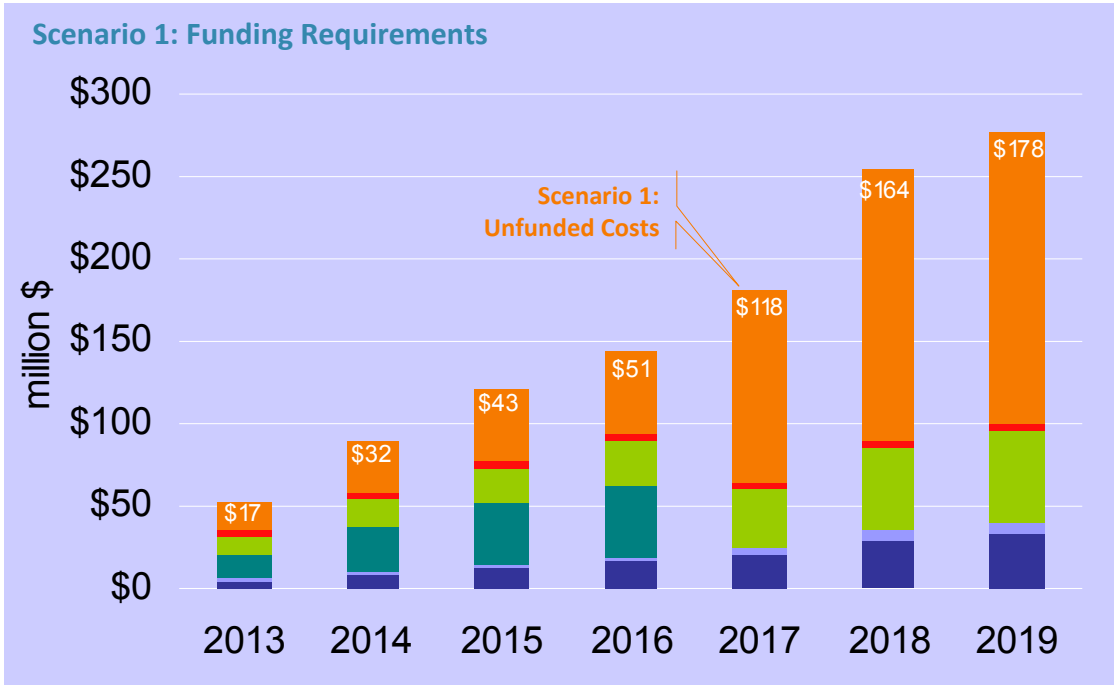
Potential Funding Streams to Help Drive Solar Investment

- Several sources of funding are available to support the deployment of solar energy in Delaware.

Funding Sources	Amount	Sources
Federal Stimulus Funds	One-time funding of $4.5 million to provide 25 percent grants for solar systems and other renewable energy projects.	Federal budget
Solar RECs	Per MWh price for solar electricity. Total funding potential depends on the solar requirement in a given year and the price of SRECs. For the purposes of this analysis, we assumed a constant price of $250/Mwh.	Delaware rate payers
Federal Investment Tax Credit	30 percent tax credit for installing PV systems. Effectively defrays 30 percent of the costs. Expires after 2016 for residential systems and reduces to 10 percent for commercial and utility-scale systems.	Federal budget
Green Fund (System Benefit Charge)	Electric customer charge of 0.0356 ¢/kWh for Delmarva customers. Customers of electric cooperatives and municipal utilities pay 0.0178 ¢/kWh. Fund supports environmental incentive programs for conservation, energy efficiency, and renewable energy. Approximately $2.1 million (annual).	Delaware rate payers
RGGI Auction Revenues	Proceeds from the sale of CO_2 emissions allowances directed to the Sustainable Energy Utility (65%). Approximately $7.4 million (annual), some of which could potentially be used for solar incentives.	RGGI affected power plant operators/Delaware rate payers

Scenario 1: Funding Requirements

- The chart below compares the costs and financial value streams that would accrue to solar energy projects under Scenario 1 (100% residential), including SRECs, federal tax credits, state rebates, and the value associated with the electricity produced by the projects.
- The unfunded costs represent the shortfall in funding required in order to achieve this level of solar deployment. Funding requirements fall well short of available State funding sources. As a result, Scenario 1 is deemed unsustainable.



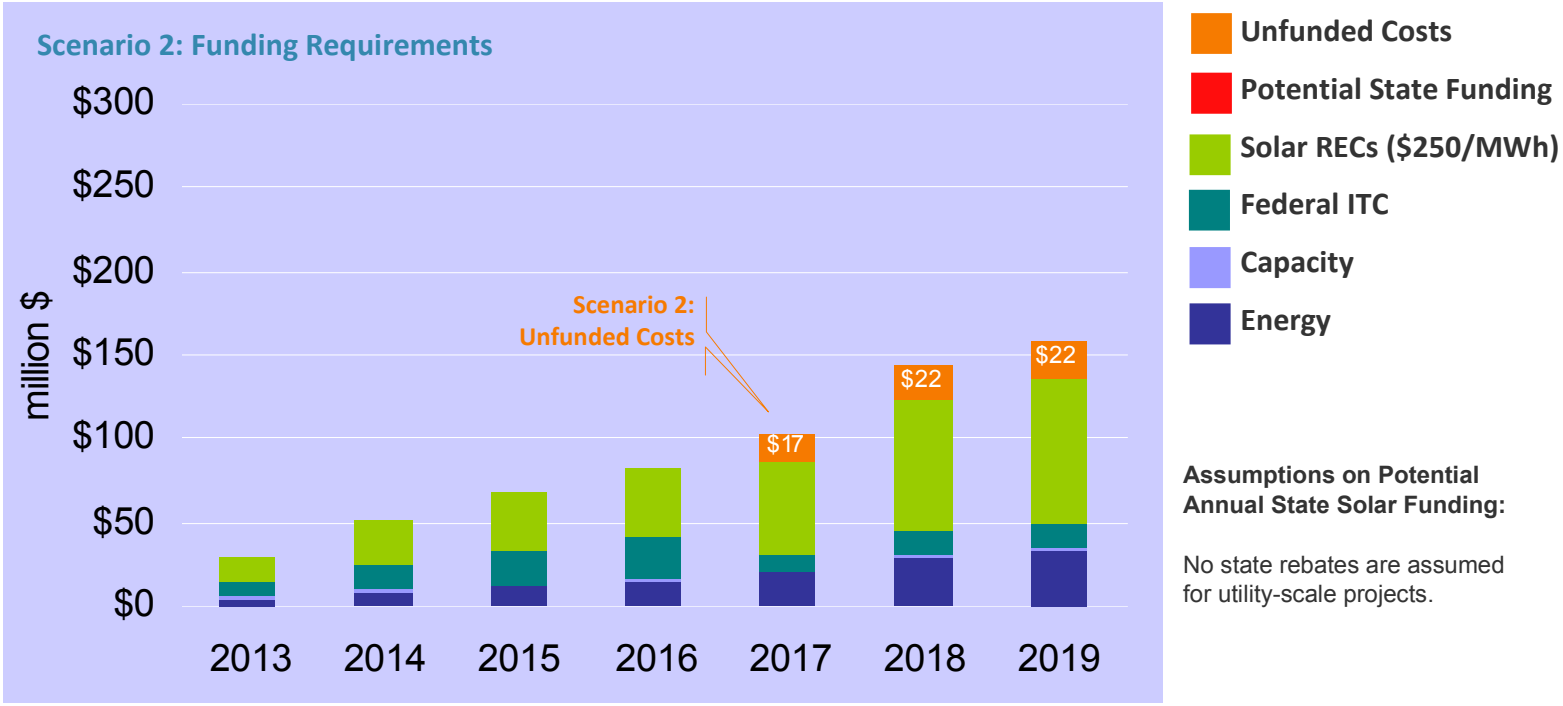
Assumptions on Potential Annual State Solar Funding:

$2.1 million (Green Fund)
$2.0 million (25% of SEU RGGI funds)

Note: Revenues are calculated on a present value basis (in the year of installation), assuming a 7, 10, and 15 year project horizon for residential, commercial, and utility-scale projects respectively and a 10% discount rate. All calculations are based on the total Delmarva load forecast (minus 70% of projected output from Dover SUN Park or 9,800 megawatt hours). For a complete list of assumptions see Appendix C.

Scenario 2: Funding Requirements

- The chart below compares the costs and financial value streams that would accrue to solar energy projects under Scenario 2 (100% utility-scale), including SRECs, federal tax credits, and the value associated with the electricity produced by the projects.
- Scenario 2 performs better in terms of its economics, relative to scenario 1. However, Scenario 2 generates less direct solar employment (Slide 12) and relies on several large projects to meet the State's solar energy goals (i.e., less diversity in the solar market).



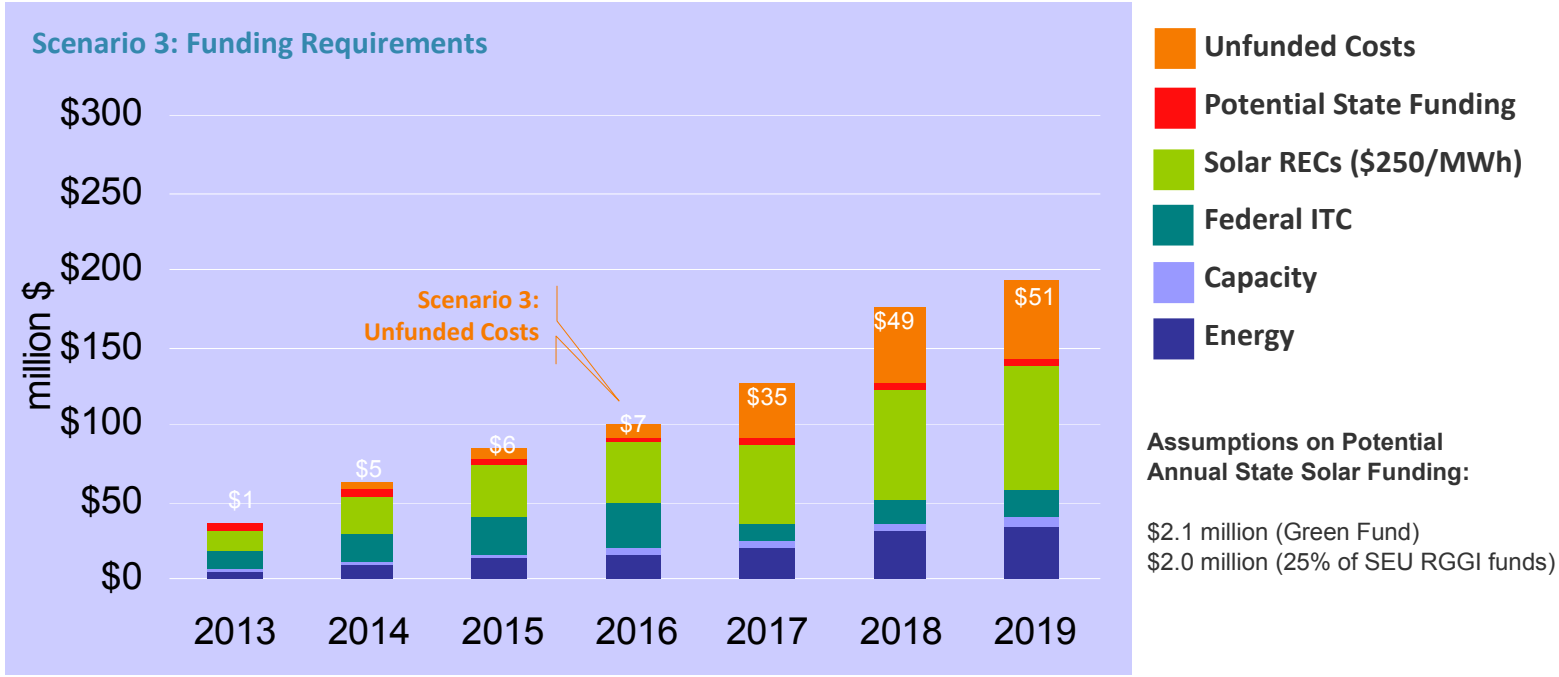
Assumptions on Potential Annual State Solar Funding:

No state rebates are assumed for utility-scale projects.

Note: Revenues are calculated on a present value basis (in the year of installation), assuming a 7, 10, and 15 year project horizon for residential, commercial, and utility-scale projects respectively and a 10% discount rate. All calculations are based on the total Delmarva load forecast (minus 70% of projected output from Dover SUN Park or 9,800 megawatt hours). For a complete list of assumptions see Appendix C.

Scenario 3: Funding Requirements

- The chart below compares the costs and financial value streams that would accrue to solar energy projects under Scenario 3 (hybrid), including SRECs, federal tax credits, state rebates, and the value associated with the electricity produced by the projects.



Assumptions on Potential Annual State Solar Funding:

$2.1 million (Green Fund)
$2.0 million (25% of SEU RGGI funds)

Note: Revenues are calculated on a present value basis (in the year of installation), assuming a 7, 10, and 15 year project horizon for residential, commercial, and utility-scale projects respectively and a 10% discount rate. All calculations are based on the total Delmarva load forecast (minus 70% of projected output from Dover SUN Park or 9,800 megawatt hours). For a complete list of assumptions see Appendix C.

Solar REC Rate Impacts

- Increasing the Alternative Compliance Payment (ACP) for the solar carve-out is one way to expand the incentives for solar. However, high ACPs would result in higher SREC prices and a greater impact on electric utility bills.
- The table below illustrates the potential impact on Delaware electricity rates (cents per kWh) and the resulting annual increase in electricity bills of various SREC prices. The impacts rise over time as the Delaware solar obligation increases.

Impact of SREC Prices ($/Mwh)		2010	2015	2017	2019
Electricity Rates Impacts (¢/kWh) Current Rate: 14.12 cents/kWh	**$250**	<0.01¢	0.14¢	0.28¢	0.50¢
	$300	0.01¢	0.17¢	0.33¢	0.60¢
	$350	0.01¢	0.20¢	0.39¢	0.70¢
	$400	0.01¢	0.22¢	0.44¢	0.80¢
Annual Utility Bill Impacts ($/year) Current Avg. Bill: $1,627 per year	**$250**	$0.52	$16	$32	$58
	$300	$0.62	$19	$38	$69
	$350	$0.73	$23	$45	$81
	$400	$0.83	$26	$51	$92

Note: Annual utility bill impacts assume monthly consumption of 960 kWh, the 2007 average for residential consumers in Delaware according to EIA.

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Comparison of State Solar Energy Policies and Incentives

- Delaware lacks many key incentive policies that have been used to promote solar energy development in other parts of the Northeast.

Key	
✓	State has a program
○	State has a partial program
×	State has no program

Incentive Mechanism	DE	NJ	MD	PA	DC	VA	MA
Net Metering	✓	✓	✓	✓	✓	✓	✓
Rebates	✓	✓	✓	✓	✓	✓	✓
RPS Solar Carve Out	✓	✓	✓	✓	✓	×	✓
Industry Recruitment	○	✓	×	✓	×	✓	✓
Interconnection Standards	○	✓	×	✓	×	✓	✓
Local Tax Credits	×	×	✓	×	×	×	✓
Long-Term Pricing Guarantee	×	✓	✓	×	×	×	✓
PACE Authorization *	×	×	✓	×	×	✓	×
Property Tax Exemption	×	✓	✓	×	×	○	✓
Sales Tax Exemption	N/A	✓	✓	×	×	×	✓
Solar Loan Programs	×	✓	✓	✓	×	×	×

*** Property-Assessed Clean Energy Financing (PACE) programs typically require authorization by the state legislature, but are implemented by municipalities.**

Solar Policy Considerations

- **Planning & General Policy:**
  - Consideration should be given to moving forward on a blended strategy to reach Delaware's 2019 solar goal, such as a ratio similar to 70% utility scale projects, 20% commercial and 10% residential.
  - The SEU should focus on commercial and residential targets with consideration given to providing a measure of SREC price certainty. For example, the SEU could act as an aggregator for customer sited facilities, reselling solar RECs to DPL and others, potentially employing 5-10 year contracts.
  - The utility should focus on the large scale projects, working in cooperation with the SEU and its ability to manage the banking of SRECs. Broader discussions should take place regarding the large scale projects as they relate to the non-SOS load for Delmarva Power and Light.
  - Because we are so early in the process of meeting our current goals, we urge caution in developing goals for beyond 2019 at this time.
  - If new goals for beyond 2019 must be developed now, customer costs and the phasing out of subsidies and ACPs should be thoroughly understood prior to setting any goals.
  - Any state policy for RPS should apply consistently to all electric utilities and cooperatives across the state.
- **Incentives:**
  - The alternative compliance payment (ACP) could be separately targeted to the three groupings: utility scale, commercial and residential.
  - The state should consider tax breaks to in-state solar projects to foster in state development, increased jobs and lower customer costs.
  - The objective should be to establish a robust and self-sustaining commercial and residential solar market such that the green fund rebates can be phased out.

In Closing

After considering all the work presented to you here today, Delmarva Power would offer the following guiding principles be used as we move forward:

- The next five years are critical to create a robust solar market place in the region, and we do firmly believe it must be a regional approach to create the market demand to jump start this industry.
  - A level of certainty to the developers around market dynamics in the short term.
  - Appropriate levels of funding (federal, state, utility, and market based RECs) to make development feasible.
  - Consistent statewide policy

- During this five year period we must be planning to make the retail markets sustainable as we reduce the levels of subsidies in the future.

- Policies that close our borders or are seen as contrary to regional cooperation will not only hurt our chances to create a strong regional solar market, but can also come back to haunt us as we seek to export off-shore wind in the future.

- Our hybrid approach that we have shown should only be considered a road map to the future, we must all realize that adjustments will have to be made as the market evolves. But it gives each of the parties a goals to strive for to meet our targets.

Agenda

Appendix A
Detailed Results: Scenario 1

Scenario Results: 100% Residential		Model Outputs 2015	2017	2019
SREC Obligation (GWh, minus 70% Dover SUN Park output)		40.1	91.5	177.9
Total # of solar installations (#)	Residential (4 kw)	8,173	18,645	36,270
	Commercial (20 kw)	0	0	0
	Utility-Scale (5.0 MW)	0	0	0
New Residential PV Market Penetration (Delmarva Customers)		3%	7%	14%
Costs and Financial Value Streams ($millions)	Installation Costs	$119	$180	$275
	O&M Costs	$1.1	$1.7	$2.7
	Federal ITC	$35.8	$0	$0
	Solar RECs value ($250/Mwh)	$22.6	$35.2	$55.4
	Energy and Capacity value	$15.3	$24.8	$40.6
	Unfunded Costs (after state solar funding of $4.1 million/year)	$42.6	$118	$178
Annual Jobs (installation and O&M)		224	322	469

Appendix A
Detailed Results: Scenario 2

Scenario Results: 100% Utility-Scale		Model Outputs 2015	2017	2019
SREC Obligation (GWh, minus 70% Dover SUN Park output)		40.1	91.5	177.9
Total # of solar installations (#)	Residential (4 kw)	0	0	0
	Commercial (20 kw)	0	0	0
	Utility-Scale (5.0 MW)	5	12	23
New Residential PV Market Penetration (Delmarva Customers)		0%	0%	0%
Costs and Financial Value Streams ($millions)	Installation Costs	$67	$102	$155
	O&M Costs	$1.1	$1.7	$2.6
	Federal ITC	$20	$10	$16
	Solar RECs value ($250/Mwh)	$35	$55	$87
	Energy and Capacity value	$13	$21	$34
	Unfunded Costs	-$0.1	$17	$22
Annual Jobs (installation and O&M)		88	144	191

Appendix A

Detailed Results: Scenario 3

Scenario Results: 70% Utility-Scale, 20% Commercial-Scale, 10% Residential-Scale		Model Outputs 2015	2017	2019
SREC Obligation (GWh, minus 70% Dover SUN Park output)		40.1	91.5	177.9
Total # of solar installations (#)	Residential (4 kw)	817	1,865	3,627
	Commercial (20 kw)	327	746	1,451
	Utility-Scale (5.0 MW)	4	8	16
New Residential PV Market Penetration (Delmarva Customers)		0.3%	0.7%	1.4%
Costs and Financial Value Streams ($millions)	Installation Costs	$82	$124	$190
	O&M Costs	$1.1	$1.7	$2.8
	Federal ITC	$25	$11	$16
	Solar RECs value ($250/Mwh)	$33	$51	$80
	Energy and Capacity value	$15	$25	$41
	Unfunded Costs (after state solar funding of $4.1 million/year)	$6.5	$35	$51
Annual Jobs (installation and O&M)		128	195	270

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Appendix B
Delaware Solar Installations

Woodside Farm
Size: 112 kw
Hockessin, Delaware
Photo credit: http://www.woodsidefarmcreamery.com

Residential PV
Size: 4.5 kw
Magnolia, Delaware
Photo credit: http://www.kwsolar.net

Residential PV
Size: 2.07 kw
Wilmington, Delaware
Photo credit: http://www.kwsolar.net

Residential PV
Size: 3.6 kw
Newark, Delaware
Photo credit: http://www.kwsolar.net

Appendix B

Issues with ACP as a Market Driver

- ACP is a blunt instrument in stimulating market activity
  - Does not set market price so therefore offers little assurance of the long-term revenue streams needed to finance installations.

- Inconsistencies between states in the region produce market distortions
  - NJ's extremely high ACP
  - PA's 150% of Market Price
  - Cooperation between DE, MD, DC, and PA in setting a consistent ACP should be considered

- Utility-scale do not need higher ACPs to stimulate the market at this time

- If raised in the near term while solar requirements are relatively low, ACP should be reduced over time before customer impacts accelerate due to rapidly growing annual solar (Which grow an average of nearly 70% per year from 2009-2019).

Appendix B
In-State Restrictions

- Competition between states insures that our compliance is met with minimal impact on customer rates
- Cross-state restrictions will limit potential revenues for in-state facilities driving up need for subsidy funding
- Reaction by other jurisdictions could limit the states potential to export SRECs and inhibit economic development

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Appendix C
Modeling Assumptions & Methodology

- Appendix C describes the modeling assumptions and methodology used in analysis presented in the above slides. The modeling methodology can be divided into the following categories:
  - Capacity and Installations
  - Costs and Jobs
  - Funding Sources and Economic Viability
- The model is intended to estimate the approximate level of investment necessary to meet Delaware's current solar carve-out requirements, which apply to the total electric load served by Delmarva Power, including energy procured by retail electric suppliers.
- **Capacity and Installations**
  - Methodology:
    1. Based on a projection of Delmarva's total electricity load, estimate the total solar requirement out to 2019 in megawatt-hours (MWh).
    2. Subtract 70% of the projected Dover SUN Park output (9,800 MWh) from the total solar requirement. 70% is the quantity of SRECs contracted for by Delmarva Power. This calculation does not account for any banking of excess SRECs produced by Dover.
    3. Given a breakdown of system type by sector (e.g., 70% utility-scale, 20% commercial, 10% residential), calculate the installed capacity required to generate the quantity of electricity needed to meet the remaining requirement, using assumed capacity factors described below.
  - Solar Requirement:
    - Delmarva Power supplied projected total load figures for its service territory out to 2019.
    - By multiplying the projected total load by the solar requirement each year, the estimated solar requirement in megawatt-hours can be calculated.
    - Sources: Delmarva Power
  - Annual Capacity Factor:
    - Capacity factor is used to estimate the total annual electricity generation from a given installed capacity of photovoltaic projects. In real-world applications the capacity factor of a system depends on the type of solar cell, the configuration of the system, location, and the exposure to sunlight, among other project specific dynamics. For the purposes of this analysis, the capacity factors of different system types were assumed to be as follows:
      - Residential/Commercial: 14%
      - Utility-Scale: 18%
    - Assumed capacity factors were originally estimated using the "PV Watts" calculator, developed by the National Renewable Energy Laboratory (NREL), which projects electricity generation from PV systems at selected longitudes and latitudes. Using the projected generation of systems of different sizes and types situated in and around Delaware, the annual capacity factors were calculated. Residential and commercial systems were assumed to be fixed-tilt with at an angle maximizing the exposure to sunlight. Utility-scale systems were assumed to be single-axis tracking, allowing greater absorption of sunlight and higher capacity factor. These figures were corroborated through a literature review and conversations with industry sources.
    - Sources: National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, Navigant Consulting, New Jersey Clean Energy Program, Industry Sources.

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- **Capacity and Installations (Continued)**
  - System Size
    - Dividing the estimated capacity requirements of each system type by the assumed average size of installations provides an estimate of the number of installations of each type required. The assumed average capacity of PV systems by type are as follows:
      - Residential: 4 kW
      - Commercial: 20 kW
      - Utility-Scale: 5.0 MW (5,000 kW)
    - The average installation capacities were estimated based on data on existing solar installations.
  - Sources: PJM Generation Attribute Tracking System, New Jersey Clean Energy Program, Conversations with Delmarva, Industry Sources.
- **Costs and Jobs**
  - Total Installed Costs
    - Total installed costs of a system is an estimate of the all-in, overnight capital costs of installing a PV system. This would include all costs associated with permitting, purchasing, and installing the PV equipment. Costs of PV systems can vary dramatically based on project specific characteristics. The estimates listed below are intended to represent average total costs for projects in and around Delaware:
      - Residential: $8,500 per kW
      - Commercial: $8,250 per kW
      - Utility-Scale: $6,171
    - Residential and commercial total installed costs were derived by compiling data from a variety of sources. In general, reported costs for residential and small commercial systems ranged from approximately $7,800 per kW to $9,000 per kW. Different sources also vary in terms of what is considered when calculating the total cost of a system. According to the National Renewable Energy Laboratory's Jobs and Economic Impact Development (JEDI) model, total costs for a residential system (4 kW) in Delaware as high as $9,800 per kW. Given the wide range of reported costs, and the lack of current pricing data, a cost of $8,500 per kW was chosen for residential systems. Since the size of our commercial class system is relatively small (20 kW), the costs associated with such as system are assumed to be much closer to those of residential systems with minor cost savings available for this size system. The costs of utility-scale projects were taken from the Energy Information Administration's Annual Energy Outlook 2010 Early Release.

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- **Costs and Jobs (Continued)**
  - Total Installed Costs (Continued):
    - Sources: National Renewable Energy Laboratory, Energy Information Administration, Lawrence Berkeley National Laboratory, New Jersey Clean Energy Program, California Energy Commission, Massachusetts Commonwealth Solar Program, Solar Buzz, Industry Sources.
  - Cost Improvements:
    - The analysis described above assumes an average annual improvement in the installation costs of PV systems to account for reduced production costs. O&M costs are held constant throughout the life of the analysis. Given the difficulty in projecting future cost improvements, the following default factor was used:
      - 1.5% annual real dollar price decline for all systems.
    - This reduction factor is assumed to be conservative, given that PV systems costs decline by approximately 30% in real dollar terms from 1998 through 2008 (Lawrence Berkeley National Laboratory). However, as discussed above, certain factors, such as the costs of input commodities, could limit the cost reductions PV systems in the future. Alternatively, new PV technologies on the horizon may offer significant cost savings relative to current systems, but projecting the availability and cost impacts of such improvements is impractical.
    - Sources: Lawrence Berkley National Laboratory, Energy Information Administration.
  - Employment Factor Estimates:
    - Utility-Scale Factor: A number of utility press releases and recent solar studies included the number of people required to deploy utility-scale solar installations. The table below summarizes the findings:

Capacity (MW)	Jobs	Time (Months)	Job-Years/MW	Owner	Solar Developer	Location	Source
22	100	12	4.5	PNM	First Solar	AZ	First Solar 2010
21	175	3	2.1	NRG Energy	First Solar	TX	First Solar 2009a
30	140	12	4.7	Tri-State Generation	First Solar	NM	First Solar 2009b
14	200	6	7.1	Air Force	SunPower	Nellis (US)	NEF 2009
25	200	12	8.0	NA	SunRay	Italy	NEF 2009
25	100	12	4.0	FPL	SunPower	Florida	NEF 2009
30	300	7	5.8	NA	T-Solar	Italy	NEF 2009
10	200	6	10.0	NA	Tecneira	Portugal	NEF 2009
		AVERAGE	5.8				

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- **Costs and Jobs (Continued).**
  - Employment Factor Estimates (Continued):
    - Utility-Scale Factor: In addition to the sources in Table 1, a June 2009 report by New Energy Finance estimated utility-scale PV construction generated about 5 jobs per year per MW (NEF 2009) and a 2008 report by Navigant Consulting estimates about 7.2 jobs per MW (NCI 2008). Navigant recently completed an analysis of the jobs created by a national renewable portfolio standard of 25% by 2025 but it did not include the unit-level job numbers required for this analysis (NCI 2010). The model includes a estimate of design jobs necessary for utility-scale projects (NCEP 2009). The final employment factors used for utility-scale projects are as follows:
      - 6 construction FTEs per MW
      - 1 design FTE per MW, applied the year prior to construction.
    - Residential and Commercial Factors: Job estimates were collected for three residential and commercial PV installers: Grosolar in Vermont, Akeena in California, and Pfister in New Jersey. Grosolar reported 5 MW of installations in 2008 with 115 employees (23 jobs per MW) (NEF 2009); Akeena Solar reported 137 employees with 4 MW estimated for 2009 (34 jobs per MW) (NEF 2009); Pfister is targeting 5-6 MW in 2010 with 80-90 employees (13 to 18 jobs per MW) (MJB&A 2010). New Energy Finance estimates about 20 jobs per MW (NEF 2009). The final factors for residential and commercial installation is as follows:
      - 24 FTEs per MW
    - Reduced Employment Factor: To account for expected improvements in installation efficiencies in the residential and commercial sectors, the model incorporates employment reduction factors for these sectors. These factors are as follows:
      - 2010 – 2015: 10% per year
      - 2016 – 2019: 5% per year
    - Operation & Maintenance (O&M) Factors: A report completed in support of the Arizona Renewable Energy Standard included O&M job estimates of 0.14 jobs per MW for utility-scale solar and 0.28 jobs per MW for distributed solar (Frisvold et al. 2009). The New Energy Finance study does not differentiate between the types of installation and instead uses a single estimate of 0.6 jobs per MW. The final employment factors used for estimating ongoing O&M jobs are as follows:
      - Residential: 0.28 FTEs per MW
      - Commercial: 0.14 FTEs per MW
      - Utility-Scale: 0.14 FTEs per MW
    - Sources: First Solar (press releases), Conversation with Pfister Energy Representative, National Commission on Energy Policy Task Force on America's Future Energy Jobs, Navigant Consulting, New Energy Finance.
- **Funding Sources and Economic Viability**
  - Methodology:
    1. Calculated the upfront cost reductions available via the Federal Investment Tax Credit and potential state funding sources.
    2. Calculate the Net Present Value (NPV) of all future revenue streams currently available to PV projects in Delaware, including energy revenues, capacity payments, and SREC values, given the project time horizons and assumptions listed below.
    3. Compare NPV of all funding sources against total costs each year.

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Modeling Assumptions & Methodology

- **Funding Sources and Economic Viability (Continued)**
  - Assumptions:
    - The project horizon for each type of system is as follows:
      - Residential: 7 years
      - Commercial: 10 years
      - Utility-Scale: 15 years
    - Construction period of a solar project is exactly 1 year i.e., all capital costs and incentives not based on energy output are expended in year 0 while variable operations and maintenance costs and energy/capacity revenues start in year 1 and last till year 10.
    - Capacity factor of residential and commercial solar projects is 14 percent while that of utility-scale projects is 18 percent.
    - Every MWh produced receives a Solar Renewable Energy Credit (SREC) valued at $250/MWh. Value of SRECs is held constant throughout the useful life of a project.
    - The Federal Investment Tax Credit is assumed to expire in 2016 for residential projects and reduce to 10% for commercial and utility-scale projects.
    - Potential State funding sources are as follows:
      - Annual Green Fund ($2.1 million annually)
      - RGGI Funding ($2.0 million annually, 25% of total funds directed towards the Sustainable Energy Utility)
    - No difference in transactional and administrative overheads is assumed in the monetary conversion of SRECs and Federal Investment Tax Credit between residential/commercial- and utility-scale projects.
    - Positive value streams during the useful life of a project include avoided energy- and distribution-related charges for residential- and commercial-scale projects and energy- and capacity-revenues for utility-scale projects. These values are estimated based on the following:

Energy Revenue / Avoided Costs											
Utility Scale ($/MWh)	$76	$74	$76	$77	$79	$80	$82	$83	$85	$87	$89
Capacity Revenue ($/MW-day)	$24	$25	$25	$26	$26	$27	$28	$28	$29	$29	$30
Residential ($/MWh)	$157	$154	$158	$161	$164	$167	$171	$174	$177	$181	$185
Energy	*$131*	*$129*	*$131*	*$134*	*$136*	*$139*	*$142*	*$145*	*$148*	*$151*	*$154*
Distribution	*$25*	*$26*	*$26*	*$27*	*$28*	*$28*	*$29*	*$29*	*$30*	*$30*	*$31*
Commercial (variable portion - $/MWh)	$159	$158	$161	$164	$167	$170	$174	$177	$181	$185	$188
Energy	*$131*	*$129*	*$131*	*$134*	*$136*	*$139*	*$142*	*$145*	*$148*	*$151*	*$154*
Distribution	*$28*	*$29*	*$30*	*$30*	*$31*	*$31*	*$32*	*$33*	*$33*	*$34*	*$35*
Fixed Portion ($/kW-Month)	$4	$4	$4	$4	$4	$4	$4	$5	$5	$5	$5

    - All cash flows after year 0 are discounted at the rate of 10 percent per annum. Present values are in the year of installation of the project.
    - All monetary values are in 2008 dollars. The analysis does not adjust for inflation.
    - Unfunded costs indicate estimated losses that initial investors (homeowners, commercial building owners, utilities) are likely to face given the value streams and their levels included in this analysis. These costs do not include any capital charges that investors may expect from such projects.