JUNE 2015

DELAWARE GOES SOLAR

A GUIDE FOR RESIDENTIAL CUSTOMERS

Prepared by the NC Clean Energy Technology Center

For the Delaware Department of Natural Resources & Environmental Control

TABLE OF CONTENTS

GLOSSARY

Avoided Cost: price the utility would have to pay to purchase another unit of energy based on their current generation portfolio; avoided cost is lower than the retail rate because it does not include delivery (transmission and distribution) or customer charges

Buy-All, Sell-All: arrangement in which a PV owner sells all of the electricity produced by their system to the utility and purchases all of the electricity they consume from the utility

Flat Rates: rates that do not fluctuate based on time of day or day of week; the same price is charged for all energy used

Kilowatt (kW): unit of power; how much power is being consumed or produced at a single instant in time

Kilowatt-hour (kWh): unit of energy; amount of power used or generated over time

Net Metering: arrangement in which a homeowner with solar panels uses the energy produced by his or her system and sells any extra energy back to the grid at the retail rate for others to use *kW versus kWh*

Off-Peak Energy: energy produced or consumed during periods of low demand (in the middle of the night and on weekends, for example)

On-Peak Energy: energy produced or consumed during the periods of highest demand (time when people are using the most energy, such as summer days when many people are using air conditioners)

Renewable Attributes: a quality of energy based on the fact that it was generated from renewable sources; the renewable attributes of energy can be financially separated from the physical energy and traded as RECs

Renewable Energy Certificate (REC): accounting mechanism for the renewable attributes of energy generated from renewable sources; one REC represents one megawatt-hour of renewable energy

Renewable Portfolio Standard: Delaware law requiring retail electricity suppliers to obtain 25% of the electricity sold within the state from renewable and energy efficiency sources by the year 2026

Solar Renewable Energy Certificate (SREC): accounting mechanism for the environmental attributes of energy generated from solar resources; one SREC represents one megawatt-hour of solar energy

Retail Rate: the price at which a kWh of energy is selling for on a given tariff

Tariff: a utility's publicly posted schedule of rates; some utilities have multiple tariffs for residential customers to choose from, such as a standard flat rate tariff and a time-of-use tariff

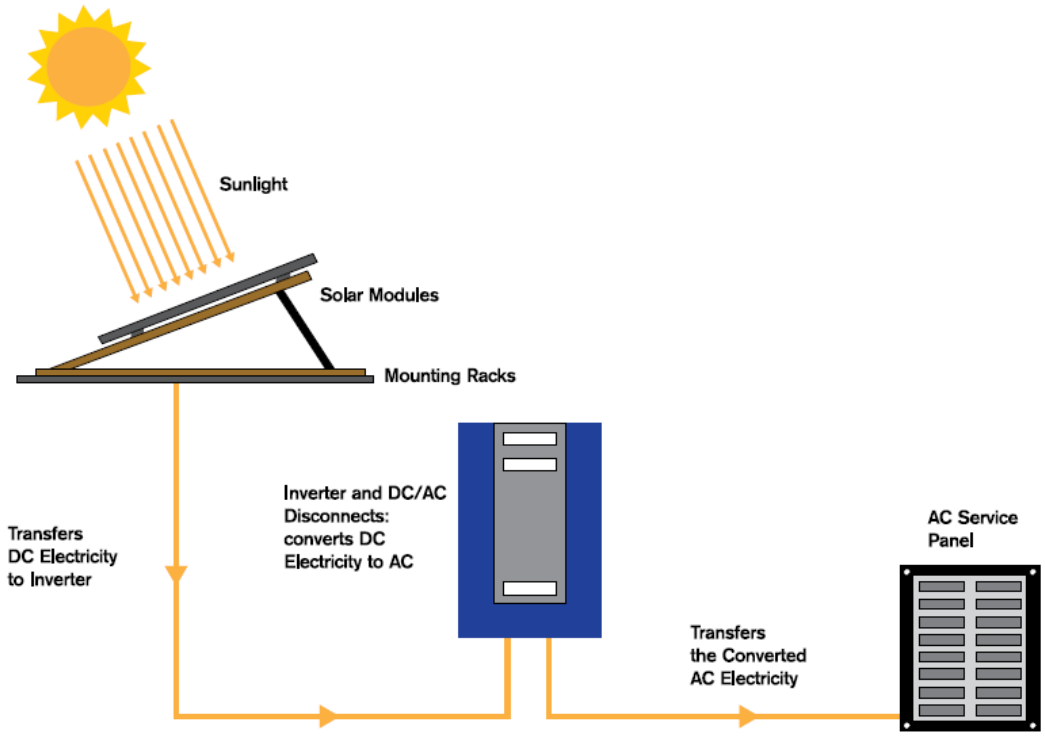
Time-of-Use (TOU) Rates: rates that vary based on time of day and day of week; energy used during "on-peak" hours costs more than energy used during "off-peak" hours

WHAT ARE THE SOLAR TECHNOLOGY BASICS?

A residential solar PV system consists of three major components: (1) solar panels (modules), (2) an inverter, and (3) mounting racks. Today there are many trusted brands of solar panels, with limited differences in quality, features, and performance between most typical-efficiency panels. Most reputable panels will come with a 25-year power warranty that generally guarantees that the panels will still produce at least 80% of their initial nameplate rating 25 years from now. A great resource to learn more about current products and technologies is *Home Power* magazine, which offers many free articles on its website, www.homepower.com.

Traditionally, a group of solar panels are connected in a series (to form a "string" of panels) and then connected to a string inverter. String inverters are still the lowest cost option, but are more sensitive to partial panel shading than microinverters or inverters with DC optimizers. Good quality inverters typically carry a 10-year to 15-year warranty. Solar PV systems are quite sensitive to shading, even partial shading, but both microinverters and DC optimizers limit the effect of shade to only the shaded panel, instead of the entire string of panels. This can result in 20% greater annual energy output in some situations.

Figure 1: Solar PV Technology Basics (Credit: SEPA 2015)[1]



[1] Campbell, Becky, and Daisy Chung. *Solar Fundamentals: Volume 1: Technology*. Washington, DC: Solar Electric Power Association, 2015.

DO I NEED A BATTERY?

In most cases, a homeowner <u>does not</u> need a battery to go solar. Connecting a PV system to batteries may make sense for customers in remote locations who are not connected to the grid or for customers whose utility does not offer net metering. However, batteries can add substantial cost to a system and require a level of maintenance that would be unattractive to most homeowners. In general, net metering (described in greater detail below) offers a more economic option for PV system owners in Delaware than a battery.

HOW MUCH ENERGY DO SOLAR PANELS GENERATE?

A homeowner does not need an ideally faced and sloped roof to produce a lot of solar power. In fact, in Delaware, panels installed on east- or west-facing roofs receive about 82% as much solar energy as an ideally oriented south-facing roof.[2] The impact of less than ideal roof pitch is even lower. The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) has a very useful tool called PVWatts (http://pvwatts.nrel.gov) that allows a homeowner to see their roof in a satellite photo and draw in the area for a solar system. PV Watts will then estimate how much energy the PV system will produce in a typical year and provide a monthly breakdown.[3]

The average household in Delaware used an average of 948 kWh per month in 2014.[4] Assuming a southeast or southwest facing roof with no shade, an approximately 8.5 kW PV system[5] is required to generate 100% of this average home's electricity use in a typical year.[6] Thus, the 6.5 kW system used as an example in this guide would provide about 77% of the annual electricity needs for an average Delaware home.

HOW CAN I SAVE MONEY BY GOING SOLAR?

Generally, there are three possible ways a home can use the power generated by a PV system: (1) using the electricity on-site and selling any excess back to the utility via net metering, (2)

[2] Calculated from the PVWatts tool using the National Renewable Energy Laboratory's System Advisor Model.
[3] Note that PVWatts is a calculator designed to produce reasonable estimates of the energy output of a system, and as such, it does not account for all location- and system-specific factors that affect the actual electricity produced. For example, PV Watts assumes essentially no shading of the system, which may lead to an overly optimistic projection.
[4] "Monthly Electric Utility Sales and Revenue Report with State Distributions: Form EIA-826." *U.S. Energy Information Administration.* Accessed June 15, 2015. http://www.eia.gov/electricity/data/eia826/
[5] System capacity sizes are given in direct current (DC) throughout this guide.
[6] Calculated from the PVWatts tool using the National Renewable Energy Laboratory's System Advisor Model.

selling all the electricity and renewable attributes produced to the utility or other entity, and (3) using the PV system to supply an energy storage system (such as a battery backup system). **Most residential customers in Delaware will find that net metering is the most viable of these three options.** While some states, local governments, or utilities offer customers a feed-in tariff or production-based incentive for selling all the electrical output of the system, no such incentives exist in Delaware. Without "buy-all/sell-all" programs designed specifically for residential customers, Option 2 would be very burdensome and not very lucrative. Connecting a PV system to batteries (Option 3) may make sense for customers in remote locations that are not connected to the grid.

An Efficient *and* Renewable Home

On average, Delaware residents consume 2% more energy than the national average.[7] While this may not sound like much, it means the typical Delaware household is paying an extra $145 a year on electricity compared to the average in the U.S. The upside is that there is ample opportunity to financially benefit from energy-saving measures. Improving efficiency before or simultaneous to installing solar panels allows a PV system to be smaller in size and make a greater impact on the owner's electric bill, saving the homeowner more money.

As customers are deciding whether or not to install solar PV, they should also consider having a full-spectrum home energy audit completed. An energy audit is a professional examination of how a customer's home uses energy and where efficiency improvements can be made. Homeowners in Delaware may receive an ENERGY STAR home energy audit for a deeply discounted $100 through the Energize Delaware program. The audit also provides free energy-savings devices such as light bulbs, showerheads, faucet aerators, pipe insulation, and small power strips. Rebates for additional efficiency upgrades are also available. For more information on the program, visit http://www.energizedelaware.org/Home-Performance-with-Energy-Star/.

WHAT IS NET METERING?

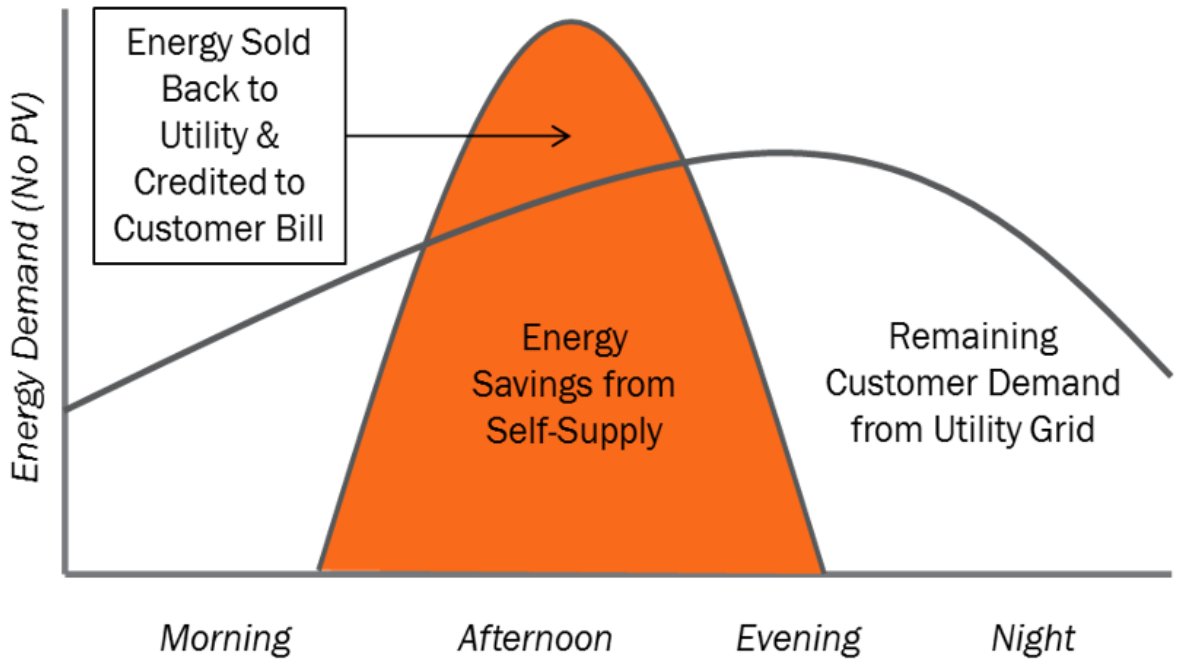
Net metering is a billing arrangement with a utility that allows customers to power their homes with solar while remaining connected to the electric grid. When extra electricity is produced by the solar PV system, it is exported to the grid for others to use, "spinning the meter backwards" by crediting the customer at the retail rate for the electricity. When the sun

[7] Calculated using information from "Monthly Electric Utility Sales and Revenue Report with State Distributions: Form EIA-826." *U.S. Energy Information Administration.* Accessed June 15, 2015. http://www.eia.gov/electricity/data/eia826/

is not shinning or the customer is using more electricity than their solar panels are generating, the customer can meet their electricity needs by getting electricity from the grid. The solar PV customer's utility bill at the end of the month reflects the net amount of electricity used, or the difference between the total amount of energy the customer consumed and what the customer's PV system generated.

If the system produces more electricity than it uses in a given month, the "net excess generation" is carried forward into the following month like rollover minutes in a cell phone plan. In Delaware, net excess generation credits can be carried forward from month-to-month indefinitely. The customer *may* request a payment for unused credits at the end of a 12-month period, though the payment will be valued as the energy portion of the per-kWh rate only, excluding the distribution portion of the rate. The customer may take this payment as an electricity bill credit if it is $25 or less. The 12-month annual period begins by default when the customer's system is interconnected with the grid, but the customer may choose to change the start and end dates of the period if he or she desires.

Figure 2: Electricity Consumption and Generation under Net Metering



Delaware's net metering laws state that customers retain ownership of the Solar Renewable Energy Credits (SRECs) generated by the customer's solar energy system. The value of SRECs is discussed below.

Due to the treatment of net excess generation credits, customer retention of SRECs, the ability to aggregate meters and inclusion of shared renewable energy systems (see below), Delaware's net metering policy can be viewed as favorable for solar customers. Freeing the Grid, a project of the Interstate Renewable Energy Council and the Vote Solar Initiative that scores states' net metering and interconnection policies, gave Delaware an "A" in its 2015 report card, calling it **"one of the best net-metering policies in the country."**[8]

Utility Rate Schedules Available for Net Metering Customers

Delmarva Power & Light *(DP&L or Delmarva)* offers two main residential rate schedules for customers who want to participate in net metering: the standard flat rate schedule and a time-of-use (TOU) rate schedule. PV owners may participate in net metering under either of these rate schedules. Under the standard schedule, customers pay a single rate for all electricity consumed. Under the TOU schedules, the rate varies by both the time of day and the day of the week. Electricity consumed during hours classified as "on-peak" costs more than electricity consumed during "off-peak" hours.

The Delaware Electric Cooperative (DEC) offers several residential rates to customers who participate in net metering, though most will be on the standard flat rate.[9] Under the standard schedule, customers pay a single rate for all electricity consumed. Under the TOU schedules, the rate varies by time of day and day of the week. Electricity consumed during hours classified as "on-peak" costs more than electricity consumed during "off-peak" hours. Under the load management rate, eligible customers agree to allow DEC to adjust the energy use of water heaters and air conditioning units during periods of especially high peak demand in exchange for bill credits.

The City of Dover only has one residential rate schedule, a flat rate, available to net metered customers.

The City of Newark also only has one residential rate schedule. This schedule is a flat rate during winter months, but is a tiered rate that increases with greater electricity use during summer months.

[8] Freeing the Grid. "Delaware." Accessed June 5, 2015. http://freeingthegrid.org/#state-grades/delaware

[9] In addition, DEC has a TOU rate, but this tariff is only available to a limit of 500 customers, who must consume at least 1,000 kWh a month to be eligible for the rate. There are also load management rates and a separate flat rate and TOU rate for customers with electric heat. These alternative rate options are not examined in the analyses below.

The above rate schedules are presented in more detail in tables in the Appendix. More information, including net metering availability at other Delaware utilities not included above, is available by contacting the utility or visiting its website.

Community Net Metering

Delaware's net metering laws also include community solar projects. Customers hosting a community solar project may receive bill credits valued at the retail electric rate for any excess power produced by the system. If all participating customers to the project are located on the same distribution feeder, all participants will also receive the full retail rate credit. Community solar customers participating in a remote project may receive bill credits equal to the energy portion of the retail electricity rate for any excess power produced by the system. If the community requests a payment for net excess generation credits at the end of the annualized period, the payment will be made to the host account. All other net metering rules apply to community solar projects.

Meter Aggregation

Delaware's net metering policy also allows for meter aggregation, meaning that a customer with multiple electricity meters can offset the use on one meter with production from a PV system connected to another meter. For example, a farm with a barn metered separately from other buildings on the property could put a PV array on the barn, and apply excess generation credits to electricity use from the other buildings on the property, even though they are not physically connected. The credits are applied at the full retail rate.

HOW MUCH DOES IT COST TO GO SOLAR TODAY?

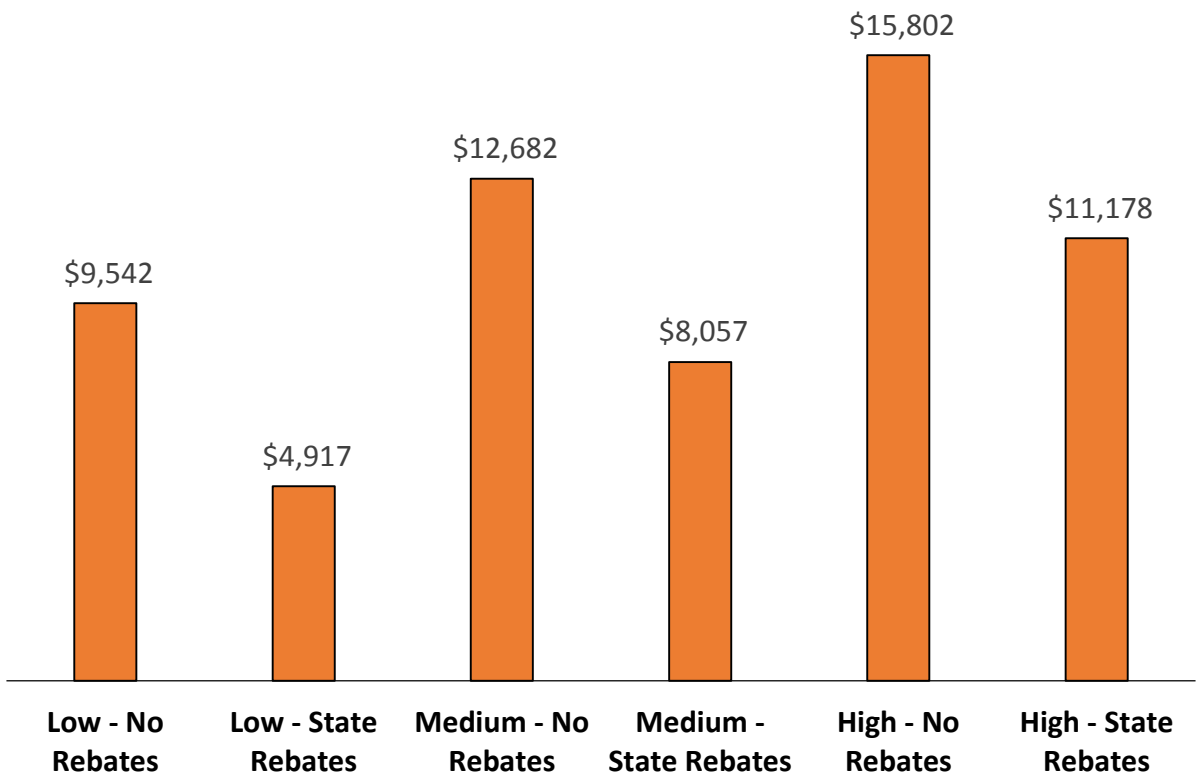
A common misperception is that solar is prohibitively expensive for most residential customers. In fact, solar PV system costs have fallen by 12-15% per year in recent years and are now less than 50% what they cost in 2008.[10] **The average cost of an average-sized system in Delmarva's territory ranges from just $9,500 - $15,800 without the state rebate program, or as low as $5,000 - $11,200 with the state rebate program**.[11]

[10] Barbose, Galen, Samantha Weaver, and Naim Darghouth. *Tracking the Sun VII: An Historical Summary of the Installed Price of Photovoltaics in the United States from 1998 to 2013*. Berkeley: Lawrence Berkeley National Lab, 2014. http://eetd.lbl.gov/sites/all/files/tracking_the_sun_vii_report.pdf

[11] Assumes a 6.5 kW system size. Low cost is $2.74/W, medium cost is $3.43/W, and high cost is $4.12/W. Subtracts value of SREC incentives, assuming participation in the Sustainable Energy Utility procurement program, and the Federal Investment Tax Credit. Cost data from Delmarva is from applications for Delaware's Green Energy Program. Assumed state energy program rebates remain at most recent rates.

Total installed system costs tend to be higher in the rural areas served by DEC, and range from $16,800 - $26,600 without the state rebates and $12,200 - $22,000 with state rebates. Data specific to the Newark and Dover municipal utilities are not available.

Figure 3: Estimated Costs (Post-Incentives) of a 6.5 kW PV System for Delmarva Customers



WHAT INCENTIVES ARE AVAILABLE?

There are several key federal, state, and utility incentives that help to reduce or "buy down" the upfront cost of a residential rooftop PV system or provide a short-term credit on a household's utility bill. These incentives are described in detail below. Up-to-date information on specific policies and incentives and links to program websites are available at www.dsireusa.org.

Federal Incentives

The residential Renewable Energy Tax Credit, often simply called the "investment tax credit" (ITC), provides a taxpayer with a federal *tax credit* (a dollar-for-dollar reduction in the amount

of income tax a taxpayer would otherwise owe) in the amount of 30% of the installed cost of a solar energy system.

There is no cap on the amount of this tax credit for systems installed after 2008, and it is available for solar installations placed in service before January 1, 2017. While solar rebates from state governments or non-profit organizations do not reduce the amount of the tax credit, utility rebates often must be subtracted from the installation costs before calculating the tax credit.

More information on the tax credit can be found in the *Homeowner's Guide to the Federal Investment Tax Credit for Solar PV* factsheet, available at www.solaroutreach.org.

State Incentives

In 2005, the Delaware Legislature passed a law requiring all electric utilities in the state to purchase a certain portion of electricity they sell in the state from renewable energy, with an additional requirement that a specific portion come from solar energy. This *renewable portfolio standard* and solar carve-out provision means Delaware utilities must get 1% of their electricity from solar energy systems located in the state in the 2015-2016 compliance year, increasing annually to 3.5% in 2025-2026. For each 1000 kilowatt-hours of electricity generated by solar, one Solar Renewable Energy Credit (SREC) is created.[12] Utilities demonstrate compliance with the solar requirements of state's RPS by purchasing SRECs. **A 6.5 kilowatt solar PV system installed in Delaware will generate approximately 8.75 SRECs per year.**

Consequently, households that install solar PV systems can earn additional financial incentives based on the amount of electricity they generate by selling the SRECs created by their solar energy system. There are three options for selling SRECs: the Sustainable Electric Utility SREC Purchase Program, the SREC Procurement Program, and the SRECs Spot Market Program. Residents leasing their solar PV systems are cautioned to ensure they own the rights to associated SRECs generated.

Sustainable Electric Utility (SEU) SREC Purchase Program

Many residential customers will find that the SEU SREC Purchase Program is the simplest of the three options. This program offers owners of solar energy systems an upfront payment of $450 per kilowatt in exchange for the first 20 years of SRECs generated by the solar energy system. For example, a household that installs a typical 6.5-kilowatt solar PV system would earn a financial incentive of $2,925.

[12] Fuel cells can also be used to create SRECs.

SREC Procurement Program

The SREC Procurement Program is an open market for SRECs that uses a public solicitation process. Residential customers installing solar can submit an application with a fixed dollar amount bid for the first ten years of SRECs they generate. Contract lengths for winning bids are 20 years, and a standard price of $35 per SREC will be paid out in years 11 through 20. The 2015 weighted average for winning bids was $60.40 per SREC.

SREC Spot Market Program

To produce SRECs for the Spot Market Program, residents must be certified by the Delaware Public Service Commission (PSC) as an eligible generator. Once issued a certification number, they create an account with the PJM-EIS[13] Generation Attribute Tracking System (GATS), which tracks the generation and transfer of SRECs. The GATS records SRECs generated based on energy production meter readings uploaded to the system by the generator. As of October 2014, sales of SRECs tracked by SRECTrade[14] averaged $55.[15]

Property Tax

While Delaware does not have property tax laws specific to solar PV, state law prohibits counties and other political subdivisions from taxing tangible or intangible personal property. Since Sussex County and Kent County classify all PV equipment as personal property, it is exempt from property taxes in these counties.

Utility Incentives

Green Energy Fund (DP&L)

Delmarva Power and Light offers grants to offset the cost of installing solar PV systems. This incentive is for $0.85 per watt for the first 5 kilowatts, and $0.25 per watt after that (up to 50 kilowatts or a $15,000 maximum incentive for residential systems). A typical 6.5-kilowatt residential solar PV system can earn a $4,625 grant through this program.

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[13] PJM-EIS provides environmental information services ("EIS") by reporting and tracking emissions data and RECs in part or all of 13 states and the District of Columbia that are part of the PJM Interconnection. The PJM Interconnection is a Regional Transmission Organization that started as a power pool among electric companies with electric service areas in Pennsylvania, New Jersey, and Maryland (PJM).

[14] SRECTrade is a SREC transaction and management firm that facilitates brokerage of spot and forward contract SREC transactions.

[15] NC Clean Energy Technology Center. "Solar Renewable Energy Credits (SRECs) Spot Market Program." *Database of State Incentives for Renewables and Efficiency*. Accessed June 12, 2015. http://programs.dsireusa.org/system/program/detail/5690

As of June 2015, however, there is a delayed payment queue of more than 12 months. The Delaware Division of Energy and Climate is conducting a comprehensive review and program evaluation to improve the program processes and determine appropriate incentive levels.

Municipal Green Energy Program (DEMEC)

Residents of Dover, Milford, and Newark were previously eligible for a grant for 33.3% of the cost of a solar PV system (up to $15,000); however, these programs are currently undergoing changes. The Dover and Milford PV grant programs have been suspended while they consider revising the incentives. Newark allocated its funds to a community solar project in 2012, and new applicants for the solar PV grant will be placed in a queue, with grants paid when funds become available.

Renewable Resource Program (DEC)

The Delaware Electric Cooperative program offers grants to offset the cost of installing solar PV systems. This incentive is $0.85 per watt for the first 5 kilowatts, and $0.25 per kilowatt after that (up to 50 kilowatts or a $15,000 maximum incentive for residential systems). A typical 6.5-kilowatt residential solar PV system can earn a $4,625 grant through this incentive. However, new applications will not be accepted until the 2016 program opens, and the small program budget relative to the number of applications means there is a waitlist of three years as of February 2015.

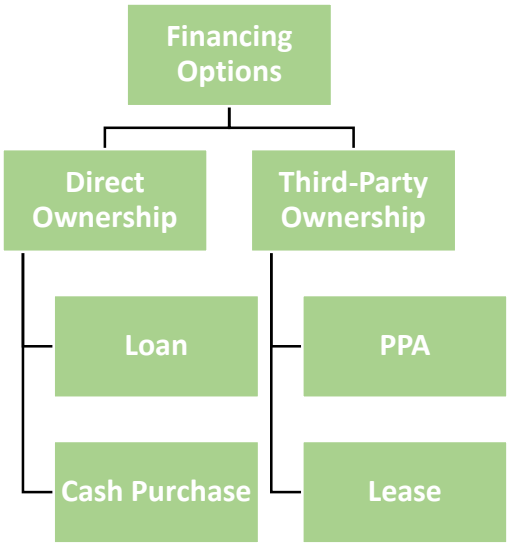
WHAT FINANCING OPTIONS ARE AVAILABLE?

A residential solar customer may either purchase their PV system directly, or enter into an arrangement with a third-party that retains ownership of the system. Customers will need to weigh several factors to determine which ownership and financing option best suits their individual needs.

Direct Ownership

If a customer decides to own the PV system outright, he or she also benefits from the tax credits and incentives the system qualifies for. In the long run, direct ownership can result in larger savings for the customer for this reason. However, many homeowners will not be able to pay the full upfront costs of the system with cash, and will therefore need a loan to finance the system.

Solar loans allow homeowners to borrow money for the upfront cost of solar and pay it back over time. Loan sources include local and national banks and credit unions. Another loan option is a home equity loan, which allows customers to take advantage of home interest federal tax credits.



While a loan can reduce or eliminate the upfront costs of solar, it is important to note that taking out a loan will increase the total cost of owning the system, due to interest on the loan. However, loans make solar an accessible option for more people, including people without spotless credit histories.

Loans

Home equity loans and personal lines of credit are available through most local and national banks and credit unions. In addition, some lenders have developed loan offerings specifically designed for solar energy systems.

Many solar installers provide financing options for their customers. For example, SolarCity, the largest residential solar installer in the nation, has loan options available to its customers who wish to own their systems. SolarCity advertises loans starting at a 4.5-4.99% interest rate with a 30-year term.[16]

Other banks that work with contractors and installers have designed solar-specific loans structured to take advantage of the federal tax credit and other incentives. Admirals Bank and Service Financial, for example, offer loans with a same-as-cash, no payments for 18 months component for 30% of the system value, allowing the customer to exclude the value of the federal tax credit from the financing. Such loans are among the most popular for residential solar customers, and the analysis in this guide is based on typical terms for these loans.[17] The remainder of the system balance is financed through a secured loan. Step down or buy down loans are also available that allow a customer to re-amortize the loan within the first two years,

[16] "How Much Does a Solar System Cost?" *SolarCity*. Accessed June 5, 2015. http://www.solarcity.com/residential/how-much-do-solar-panels-cost

[17] Personal communication from Service Finance Company on March 20, 2015 and Admirals Bank on March 31, 2015.

allowing the customer to pay down part of the loan with incentives and tax credits and lower monthly payments for the remainder of the loan.[18]

Third-Party Ownership

Alternatively, a homeowner may wish to utilize a PV system without having to pay the full costs of system ownership. In Delaware, residential customers are able to either lease their solar panels from a third-party or enter into an agreement to purchase the power from the third party who owns the panels.

Third-Party Leasing

A lease is a type of third-party ownership, where (usually) a solar company owns the solar panels and is responsible for installation and maintenance. A homeowner pays the third-party a monthly fee to use the solar panels and the energy produced from them. The homeowner receives a financial benefit from the system through either net metering (or a buy-all, sell-all arrangement where available).
While leases allow customers to save immediately on their bill with no money down, the customer cannot claim the federal ITC, which is available only to PV system owners, not lessees. The value of the tax credit may be passed through, at least in part, to the lessee in the form of lower lease payments, however.

Power Purchase Agreements

Power purchase agreements, or "PPAs," are a third-party ownership option in which a customer purchases the power the solar panels produce directly from the owner of the panels (often a solar company). The customer purchases the power at a set price per kWh for the length of the agreement (typically 15-20 years), which often increases over the term of the agreement.

While the financial value of a PPA and a lease are very similar, the difference is that the price paid per month under a PPA depends upon the system's production (kilowatt-hours), while a lease payment is constant every month.

HOW DO ALL OF THESE OPTIONS COMPARE?

This section compares available options for financing a PV system using the energy usage patterns of a typical household located in Wilmington (Delmarva), Dover, Newark, and a prototypical town served by DEC. While actual savings will vary widely depending upon how

[18] Examples of such loans are Admirals Solar StepDown Loan (source: personal correspondence) or EGIA Geo*Smart* Flex Loan (source: accessed June 5, 2015 at http://www.egia.org/Marketing/emails/geosmart/CL/geosmartProgramUpdate-201310.html)

much electricity customers use and when they use it, these estimates provide a good example of bill savings for a typical household with an average-sized residential PV system in the portions of Delaware served by Delmarva, DEC, and the municipal utilities in Dover and Newark.

The savings shown in the tables below were calculated using typical energy usage data and PV output data for a 6.5 kW system in Wilmington (Delmarva), Dover (Dover Municipal Utility and DEC), and Newark. PV output data are from NREL's PVWatts tool, and energy usage data are from NREL's dataset.[19] More information on the financial model, assumptions, and sources of data are presented in the Appendix.

There are both advantages and disadvantages to the different financing options, incentive structures, and rate schedules available. For customers in Delmarva territory who have the option of a TOU schedule, those who use a lot of electricity at once or use most of their electricity during on-peak hours will see higher electricity bills on a TOU rate schedule than with flat rates. People who stagger the use of appliances that consume a lot of energy, use natural gas for space or water heating, or use most of their electricity at night or on the weekend can see lower electricity bills with TOU rates. Therefore, savings are highly dependent upon individual energy usage patterns. Savings will also depend on the customer's system size and overall energy usage—a larger system that offsets a larger electricity load will result in greater total savings, though smaller systems on homes with lower electricity use may result in the same percentage savings relative to the customer's original bill.

DISCLAIMER: The figures presented below are estimates based on average PV output and energy usage data. Individual customer savings may vary significantly from those in the example below.

Estimated Savings for a Typical Customer

Figure 4 shows the estimated *average monthly* bill savings in the *first year* after installing a net-metered PV system for each of the utility territories and under the flat and TOU schedule for Delmarva customers. Savings for each option are based on what the customer would otherwise be paying under the standard schedule with no PV system in place. Note that electric bill savings will vary considerably from month-to-month based on factors like weather and hours of direct sunlight. Customers of all utilities and rate schedules shown here are estimated to save substantially on their electric bills, with savings of $80-$111 per month on average in the first year.

[19] OpenEI. "Commercial and Residential Hourly Load Profiles for all TMY3 Locations in the United States." *U.S. Department of Energy.* Accessed June 5, 2015. http://en.openei.org/doe-opendata/dataset/commercial-and-residential-hourly-load-profiles-for-all-tmy3-locations-in-the-united-states

Figure 4: Average Monthly Electric Bill Savings in the First Year from a 6.5 kW PV System

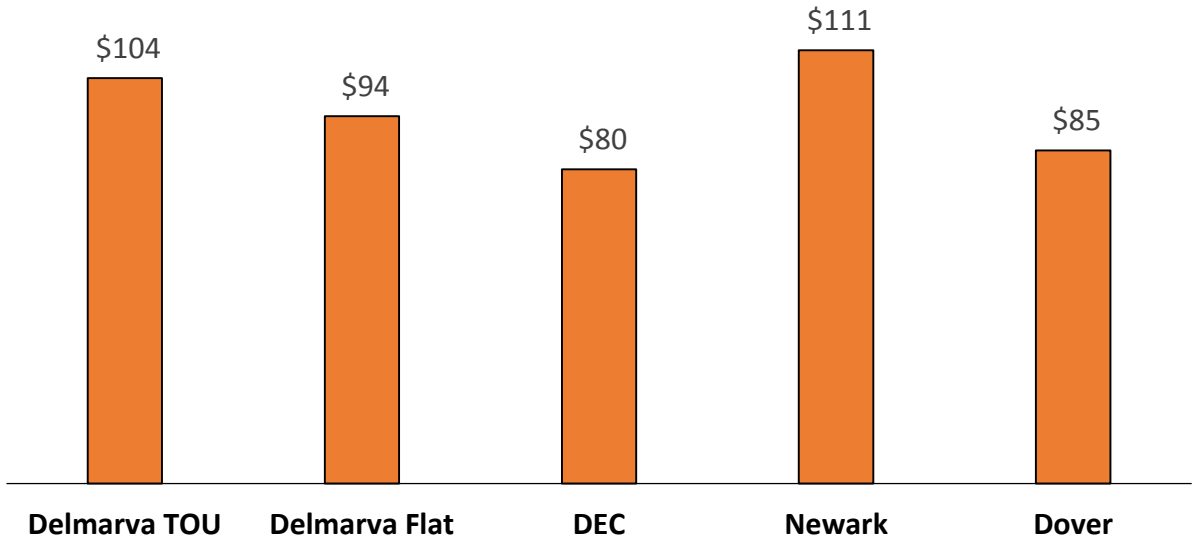


Table 1 shows the estimated *average monthly* bill savings over the *entire lifetime* of a net-metered PV system for each of the utility territories and under the flat and TOU schedule for Delmarva customers. The figures in Table 1 are averages of monthly savings calculated over the entire life of the PV system (conservatively assumed to be 25 years). Since the savings are averaged over 25 years and assume a 1% annual increase (above inflation) in electricity costs, the bill amounts are higher than an average customer's bill today, and the average savings in Table 1 (average monthly savings over the PV system life) are larger than those in Figure 1 (average monthly savings in the first year after installing a PV system).

Table 1: Average Monthly Bill Savings over 25-Year PV System Life in Delaware

Utility and Rate Schedule	Average Monthly Bill – *Before PV*	Average Monthly Bill – *With PV*	Average Monthly Bill Savings	Percentage Savings
Delmarva - Flat	$235	$98	$136	58%
Delmarva - TOU	$221	$71	$151	68%
Newark	$258	$97	$161	62%
Dover	$202	$78	$124	61%
DEC	$198	$82	$116	59%

The magnitude of monthly savings depends on how much of the customer's energy use is offset by the system and how high the customer's utility rates are. Delmarva customers on the TOU

rate schedule can expect to see greater savings than those on the flat rate, as much of the energy the PV system generates coincides with the peak period when rates are higher.

Table 2 displays estimated *total* savings for a PV system in each of the utility territories. These figures factor in the upfront cost of the system, so savings will vary based on the actual total installed costs. "Medium System Cost" is the average cost of a 6.5 kW PV system in the applicable regions of Delaware in 2014.[20] The "Low" and "High" cost scenarios assume total PV system costs that are 20% less or more than the calculated "Medium" cost, respectively.

Systems at the median price range produce positive net savings in all territories, though systems in the upper range in the DEC territory do not. Price data for existing installed systems in the DEC service area are significantly (~58%) higher than those in the Delmarva service area, likely because DEC serves more rural areas that require higher transportation costs for installers.

Table 2: Net Savings over 25-Year PV System Life in Delaware

Utility and Rate Schedule	Net Savings*		
	Low System Cost	Medium System Cost	High System Cost
Delmarva - Flat Rate	$22,910	$19,028	$15,145
Delmarva - TOU	$27,177	$23,294	$19,411
Newark	$29,118	$24,930	$20,741
Dover	$17,884	$13,695	$9,507
DEC	$7,902	$1,789	-$4,369

* Does not apply any discounting to net savings in future years.

Total net savings will also depend on the incentives available to the customer, as well as how the customer chooses to monetize SRECS. Table 3 shows total lifetime savings depending on whether the customer participates in the state's Sustainable Energy Utility procurement

[20] Cost data for 2014 installed systems was provided by the Delaware Department of Natural Resources and Environmental Control. The median Delmarva cost was $3.43/W and the median DEC cost was $5.42/W. Due to small sample sizes for Dover and Newark, a national average of $3.70/W was used for these cities.

program, which offers a one-time, upfront payment based on the system size, or participates in the SREC Procurement Program, which is set up like an auction and offers annual payments based on the system's output. Residential customers would also have the option of participating in the SREC Spot Market, but that option is not modeled here due to its increased complexity and historically low participation by residential customers.

Table 3: Net Savings over 25-Year PV System Life in Delaware with Incentives

Utility and Rate Schedule	Net Savings Over 25-Year System Lifetime			
	SEU SREC Purchase	SREC Procurement Program	SEU SREC Purchase + Green Energy Program Rebate	SREC Procurement Program + Green Energy Program Rebate
Delmarva - Flat Rate	$19,028	$22,452	$22,138	$25,562
Delmarva - TOU	$23,294	$26,718	$26,404	$29,829
Newark	$24,930	$28,354	$30,315	$33,740
Dover	$13,695	$16,940	$18,655	$21,900
DEC	$1,789	$5,034	$4,899	$8,144

* Does not apply any discounting to net savings in future years.

Table 3 also includes results with the current incentive levels offered under the Green Energy Program. The Green Energy Program is not included in the base model because it is currently oversubscribed and under review. **At this time, future incentive levels under the program are uncertain.**

As the results in Table 3 show, the presence of the state-level rebate (at its most recent incentive levels) increases the total savings of installing a PV system by approximately $3,000 - $5,000. Table 3 also demonstrates that participating in the SREC Procurement program, rather than receiving the upfront payment from SEU, tends to provide a greater value under typical system performance. Of course, customers may still prefer the upfront payment for other reasons, such as the simplicity, convenience, and immediate financial payment it offers.

Table 4 compares the total savings (i.e., "returns") over the system lifetime against the upfront costs of the system. The resulting "return on investment" can be used to compare against other financial investments a customer may be considering, such as the stock market, mutual funds, retirement savings, or others. An important factor to consider with PV systems, as with any investment, is risk. Because a PV system provides relatively stable and predictable bill savings over the long-term, it could be considered a less risky investment than some other types of investments.

Table 4: Inflation-Adjusted Return on PV System Investment

Utility and Rate Schedule	System Cost			SREC Procurement Program	Green Energy Rebate	SREC Procurement + Rebate
	Low	Medium	High			
Delmarva - Flat	9.60%	6.80%	4.78%	7.49%	9.36%	9.92%
Delmarva - TOU	10.93%	7.97%	5.86%	8.54%	10.77%	11.10%
Newark	10.76%	7.85%	5.77%	8.39%	12.85%	13.01%
Dover	7.40%	4.85%	2.99%	5.62%	8.60%	9.21%
DEC	2.60%	0.51%	-1.12%	1.37%	1.54%	2.42%

The returns for Delmarva flat rate customers installing a PV system range from just under 5% to just under 10%. For Delmarva customers on the TOU rate, the returns are slightly higher, from just under 6% to about 11%. Newark customers could see returns from just under 6% to about 13%, while Dover customers could see returns of about 3% to 9%. The returns for customers in the DEC customer are much lower, again stemming from 2014 data showing higher PV system costs for DEC customers, and range from a loss of about 1% to a return of about 2.5%.

For comparison purposes, the 25-year annualized return of the S&P 500 is currently 9.6%, and a treasury bond that matures in 30 years currently offers a return of about 3.1%.[21]

[21] Barchart. "Treasury Interest Rates." Accessed June 12, 2015. http://www.barchart.com/economy/treasuries.php

Financing vs. Cash Purchase

Whether the customer purchases the PV system outright with cash or takes out a loan to finance it, the monthly electricity bill savings will remain the same. However, the total savings over the 25-year system lifetime will be lower under a loan, as the customer incurs interest costs over the period of the loan.

Table 5: Total Net Savings with Cash Purchase or Loan

Utility and Rate Schedule	Net Savings - Cash Purchase	Net Savings - Loan	Interest Payments (Loan)
Delmarva - Flat	$19,028	$13,934	$7,575
Delmarva - TOU	$23,294	$18,200	$7,575
Newark	$24,930	$19,374	$8,261
Dover	$13,695	$8,140	$8,261
DEC	$1,789	-$6,700	$12,623

The loan modeled in these results is a 10-year loan at 6.5% interest, with tax deductible interest payments. Many installers offer loans with no payments due in the first year, allowing customers to avoid including the amount of the federal tax credit in the loan amount. Such loan structures decrease the total interest due, therefore increasing total savings compared to the options above.

The total interest payments and resulting total savings will again be dependent on the total installed cost of the PV system. Lower system costs decrease the loan amount and the total amount paid in interest, resulting in even greater savings than just the difference between the actual and average system costs.

Customers in Delaware also have the option of leasing a solar system or entering into a PPA with a third-party owner. The total savings for these options are not modeled due to a lack of data on PPA and lease costs. However, the average monthly energy bill savings under these options will be comparable to self-owned systems, and total savings will be those bill savings less the lease or PPA costs.

Key Takeaways

The results above show that residential customers in Delaware can benefit significantly from investing in a rooftop solar energy system. The model results indicate that:

1. Customers will realize the greatest savings if system costs are low and they can take advantage of state rebate program.
2. The financial benefits from participating in the SREC Procurement Program tend to be higher than the SEU SREC Purchase Program.
3. If customers are able to cover the system costs with cash, they will have greater total savings than if taking out a loan.
4. For customers with typical usage patterns in the Delmarva territory, solar savings are higher under the TOU rate schedule than the flat rate.

WHAT DO I HAVE TO DO TO GET STARTED?

Customers ready to realize these solar savings can contact local installers for quotes and details on the solar installation process. Solar installers will perform the bulk of the work, including completing the site assessment, building and electrical permits, interconnection applications, incentive payment applications, and of course, the installation itself.

There are numerous online resources to find local installers. Customers may visit www.solar-delaware.org, www.mdvseia.org, or www.mseia.org for a directory of local installers and more information about installing solar.

When selecting an installer, it is important to ensure the company is properly licensed and insured. In Delaware, these licenses include an electrician's license to do the PV electrical work and a contractor's license. Customers may also ask for a Certificate of Insurance to make sure the installer has liability and worker's compensation insurance in good standing.

The Solar Electric Industries Association published the *SEIA Residential Consumer Guide to Solar Power* in June 2015. This useful resource is available to download for free at www.seia.org.

DISCLAIMER

This material is based upon work supported by the U.S. Department of Energy under Award Number DEEE0003525. The guide was produced by the NC Clean Energy Technology Center with the support of the following team of organizations: ICLEI – Local Governments for Sustainability; International City/County Management Association (ICMA); Interstate Renewable Energy Council, Inc. (IREC); Meister Consultants Group, Inc. (MCG); Solar Electric Power Association (SEPA); The Solar Foundation (TSF); American Planning Association (APA); and National Association of Regional Councils (NARC).

APPENDIX

Table A-1: Financial Analysis Assumptions and Data Sources

Parameter	Value	Source
Statewide Inputs		
Loan Terms	10 Year term 6.5% interest Tax deductible interest payments	Mid-range values from quotes received from banks and installers
Electricity Rate Escalation	1%	EIA Annual Energy Outlook 2015, "Energy Prices by Sector and Source"
System Size	6.5 kW_{dc}	Average system size of all 2014 residential PV applications to Green Energy Grant Program
SEU SREC Payment	$450/kW upfront payment	Current SEU SREC Purchase Program rates
SREC Procurement Program Prices	$0.0604/kWh for first 10 years, $0.035/kWh for second 10 years	Based on 2015 winning bids for tier 1 systems
Annual PV Degradation Rate	0.5%	Default SAM Parameter
DC to AC ratio	1.1	Default SAM Parameter
Interest Rate	2.5%	Default SAM Parameter
System Life	25 Years	Default SAM Parameter
Delmarva		

System Cost Range	Base = \$3.43/W_{dc} Low = \$2.74/W_{dc} High = \$4.12/W_{dc}	Base - Median of installed system costs for 2014 residential PV applications to Delmarva Green Energy Grants. Low - 80% of median; High - 120% of median.
Green Energy Grant	\$4,625	Based on currently listed incentive rates of \$0.85/kW for first 5 kW and \$0.25/kW thereafter (6.5 kW system)
DEC		
System Cost Range	Base = \$5.416/W_{dc} Low = \$4.33/W_{dc} High = \$6.50/W_{dc}	Base - Median of installed system costs for 2014 residential PV applications to DEC Green Energy Grants. Low - 80% of median; High - 120% of median.
Green Energy Grant	\$4,625	Based on currently listed incentive rates of \$0.85/kW for first 5 kW and \$0.25/kW thereafter (6.5 kW system)
Newark		
System Cost Range	Base = \$3.70/W_{dc}	Base - National average of installed system costs as of September 2014, courtesy of EnergySage. Low: 80% of median; High: 120% of median.
Green Energy Grant	33.3% of Installed System Costs	Based on currently listed incentive rates.
Dover		
System Cost Range	Base = \$3.70/W_{dc}	Base - National average of installed system costs as of September 2014, courtesy of EnergySage. Low: 80% of median; High: 120% of median.
Green Energy Grant	\$7,375	Based on last published incentive rates of \$1.25/W for first 5kW and \$0.75/W thereafter.

Additional Assumptions and Data Sources:

- PV system output and energy usage data from Dover was used for all DEC models due to data availability. While Dover is not in DEC's service territory, it is nearby, so this data should closely approximate actual PV system output and energy usage by DEC customers.

- Energy use (kWh) and monthly peak demand (kW) include monthly variation, but no annual variation. Future household energy use may decrease due to greater efficiency or may increase due to new loads. As it is therefore uncertain in which direction energy use will move, the analysis assumes constant usage and demand.
- The analysis assumes most customers are on a utility's standard residential rate, and savings are based upon the assumption that the customer was previously on the same rate schedule prior to investing in solar as after. Savings are thus in relation to what the customer would be paying under the same rate tariff with no PV system, all things being equal. Rates were culled from the Utility Rate Database, and were checked against current tariffs filed on the Delmarva, DEC, Dover, and Newark utility websites.
- Energy usage data comes from NREL's dataset, "Commercial and Residential Hourly Load Profiles for all TMY3 Locations in the United States" (http://en.openei.org/datasets/node/961). Figures represent estimated average household hourly load.

Table A-2: Retail Rate Schedule Choices for Delmarva Customers

Rate Schedule	Key Features	Customer Charge (per month)	Monthly Energy Charge – Summer* (per kWh)	Monthly Energy Charge – Winter** (per kWh)	Distribution charges (per kWh)	RPS Charge (per kWh)	Total Cost of Riders*** (per kWh)	On-Peak Details
Schedule R: Standard Residential	Flat rate; winter and summer rates differ	$11.71	$0.087140	$0.087706	$0.029955	$0.003448	$0.007252	N/A
Schedule R-TOU-ND:	Rate varies based on time of day, day of week, and season	$18.08	on-peak: $0.139720 off-peak: $0.050544	on-peak: $0.134243 off-peak: $0.056313	on-peak: $0.047647 off-peak: $0.005724	$0.003448	$0.007252	9:00 am to 8:00 pm during Standard Time, 10:00 am to 9:00 pm during Daylight Savings Time, Monday - Friday

Notes: * Summer is June-September. ** Winter is October-May. ***The current Transmission Service Charge is $2.545253 per kW-month.

Table A-3: Residential Rate Schedule for Delaware Electric Cooperative Customers

Rate Schedule	Key Features	Customer Charge (per month)	Energy Charge – Summer * (per kWh)	Energy Charge – Winter ** (per kWh)	Distribution Charge (per kWh)	Renewable and Energy Efficiency Charges (per kWh)	Available bill credits	On-Peak Details
Standard Residential Schedule "R"	Flat rate in the summer, a declining tiered rate for winter.	$7.95	$0.06939	First 700 kWh: $0.06439 Over 700 kWh: $0.04909	$0.02729 + $0.0240 Power Adjustment Charge	$0.001078	N/A	N/A
Residential Load Management Schedule "R-LM"	Similar to Schedule R, with different rates and a monthly bill credit for making appliances available for de-energization	$7.95	$0.063140	First 700 kWh: $0.06439 Over 700 kWh: $0.04909	$0.02729	$0.001078	$2.00 per month for water heater available $2.00 per month for AC Compressor available $2.00 per month AC unit is de-energized	N/A

Table A-3, *Continued*: Residential Rate Schedule for Delaware Electric Cooperative Customers

Rate Schedule	Key Features	Customer Charge (per month)	Energy Charge – Summer * (per kWh)	Energy Charge – Winter ** (per kWh)	Distribution Charge (per kWh)	Renewable and Energy Efficiency Charges (per kWh)	Available bill credits	On-Peak Details
Residential Time of Use Schedule "R-TOU"	Rate varies based on time of day, day of week, and season	$9.95	On-peak: $0.41705 Off-peak: $0.03117	On-peak: $0.16755 Off-peak: $0.03117	$0.02729	$0.001078	N/A	Oct 1 - Apr 30: 6:00 am - 8:00 am and 5:00 pm to 9:00 pm Monday - Friday May 1 - Sep 30: 3:00 pm to 6:00 pm Monday-Friday

*Notes: * Summer is June-September. ** Winter is October-May.*

Table 4: Residential Rate Schedule for City of Dover

Rate Schedule	Key Features	Customer Charge (per month)	Energy Charge (per kWh)	Green Energy Fund Rider (per kWh)	Other Charges
Residential "R" Schedule	Flat rate for all electricity used	$5.00	$0.12040/kWh	$0.000178/kWh	Monthly bills subject to "power purchase adjustment" to reflect any changes in city's actual power purchase costs from base amount.

Table 5: Residential Rate Schedule for City of Newark

Rate Schedule	Key Features	Customer Charge (per month)	Summer Energy Charges (per kWh)	Winter Energy Charges (per kWh)	Green Energy Fund Rider (per kWh)	Other Charges
Residential "R" Schedule	Rates vary by season. Flat rate in winter months. In summer, tiered energy rates that increase as customers use more electricity within a billing period.	$10.00	First 250 kWh: $0.145 Next 750 kWh: $0.1565 Over 1000 kWh: $0.1700	$0.145	$0.000356	Monthly bills subject to "revenue stabilization adjustment" to reflect any changes in city's actual power purchase costs from base amount.