



Incentivizing Solar Energy: An In-Depth Analysis of U.S. Solar Incentives

Executive Summary

As part of Consumer Energy Alliance’s all-of-the-above approach to meeting our nation’s growing energy needs, we strongly support the expanded use of solar power. Diversifying our energy portfolio and improving options for families and small businesses will help further reduce energy prices, improve our individual and national energy security, and expand the U.S. energy revolution.

Solar technology is currently reshaping modern electricity generation, and the number of large-scale, community, and residential rooftop solar systems in the United States have been growing rapidly. In addition to the declining cost of solar photovoltaic (PV) systems over the past several years, federal and state tax credits, state rebates, utility rebates, and other indirect incentives from net energy metering programs have led to the significant expansion of solar power across the country.

The combination of these incentives has reduced the net costs of installing solar PV systems significantly. In fact, many states have total incentives that exceed the lifetime costs of a rooftop solar PV system. Given current solar PV market dynamics and technological maturity, many states are now reviewing their policies to find an appropriate level of financial incentives.

In 2016, Consumer Energy Alliance released a report entitled *Incentivizing Solar Energy: An In-Depth Analysis of U.S. Solar Incentives* report. The 2016 report provided a comparison of the incentives available in 15 selected states: Arizona, California, Connecticut, Florida, Georgia, Illinois, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, New Jersey, and North Carolina.

Because of the rapid transformations in both the economics of solar PV systems and the policy dialogue over solar incentives in the states, CEA has commissioned ScottMadden, Inc. to update its 2016 report and provide additional analysis of the total incentives available to customers installing rooftop solar PV systems in an additional 10 states. Like our 2016 report, this analysis is intended to aid policy and decision makers by quantifying current incentives provided for solar PV systems.

In order to accelerate the installation of solar PV systems, local, state and federal governments have provided several incentive programs for rooftop solar owners. The combination of these incentives – along with the declining cost of PV systems over the past several years – has led to significant increases in the use of rooftop PV systems across the country.



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This report is designed to inform policymakers who are evaluating state solar incentives by quantifying the total incentives available to residential PV users as a percentage of the installed cost of a typical residential solar facility. This analysis covers 25 selected states, including: Arizona, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Illinois, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oregon, Rhode Island, South Carolina, Texas, and Utah. These states were selected to capture diversity in location, state incentive policies, retail tariff designs and wholesale electricity prices.

Direct Incentives

A variety of direct incentives are available for consumers who install residential solar PV systems or third-party owners who lease systems to consumers. This report compares five categories of these incentives: 1) federal tax incentives, 2) state tax credits, 3) state rebates, 4) utility programs, and 5) Renewable Energy Certificates. While there are additional direct incentives one could consider, such as county and city tax credits, state and local sales and property tax credits, and other public utility commission programs, these five categories are considered the most common. To simplify the analysis, this report only includes these five areas of direct incentives; consequently, the results of the analysis can be considered conservative estimates of the total incentives that residential customers with solar PV might receive.

Net Energy Metering Incentives

Forty-four states and the District of Columbia offer Net Energy Metering (NEM) programs for their residential customers with solar PV. These programs bill the customer for the net amount of electricity consumed (what the customer consumes less the amount the customer produces onsite) and provide a credit for any excess energy which flows back to the utility which is applied to future bills.

Net energy metering incentives occur, in general terms, when PV owners receive credit at the retail rate instead of the lower avoided cost rate for the energy their PV system produces. In more specific terms, the analysis calculates the amount a residential consumer would save by using a solar PV system rather than using electricity from the representative utility in their state. The amount of the incentive varies by the amount of energy that the system is able to produce (which varies by state) and the applicable tariff for electricity (which varies by state), less the utility's avoided costs (which also varies by state).

Residential solar PV systems rely on the use of the utility's distribution system to "buy" power when household energy consumption exceeds solar system production (e.g., at night) or "sell" power when solar system production exceeds household energy consumption (e.g., during the day). However, current utility rate structures do not separately charge distribution costs to solar system owners. Such costs include capital expenditures for the poles, conductor, transformers, switches, and metering devices, as well as additional operation and maintenance expense to operate the system safely and reliably. To the extent utilities are not allowed to recover these costs directly from residential solar system owners, utilities may seek to recover these costs from other consumers through increased rates.





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It is also possible to generate additional incentives if the total solar energy put onto the grid by a residential system exceeds total energy usage for the home. However, the average residential consumer typically consumes more energy than is produced by the average residential solar PV system, so these additional benefits were not included in this analysis.¹ The analysis assumes that the residential rooftop solar PV installation is appropriately sized to meet the homeowner's energy needs.

Analytical Approach

In this analysis, the total incentives available for owning and installing a solar PV system are calculated based on the median 6.1 kilowatt sized system on a present value basis over the 25-year economic life of the residential solar PV facility. The analysis employed a Microsoft Excel model to calculate the present value of total incentives for direct-owned and third-party-owned (TPO) solar PV systems. The Excel model calculates the annual streams of incentives over the 25-year life of the system, then discounts them to obtain their respective present value as of January 1, 2017. The analysis starts by calculating energy production and net energy metering incentives on an hourly basis, then aggregates these amounts on an annual basis over the life of the system.

New to this year's analysis is the inclusion of system operation and maintenance (O&M) expense in total system costs. Multiplying the average installation cost by the median system size results in an average installation cost. To calculate total installed cost, ScottMadden added the annual stream of O&M expense, inflated annually over the 25-year life of the system, to the average installation cost, and then discounted the sum to the present value using a discount rate. The full methodology can be found in Appendix A.

Note that this report also does not attempt to put a total value on distributed solar energy as there are many societal and political considerations which have not been evaluated. Rather, this analysis focuses solely on the available incentives related to installing a residential solar PV system.

Total Incentives for Residential Direct-Owned Solar Systems

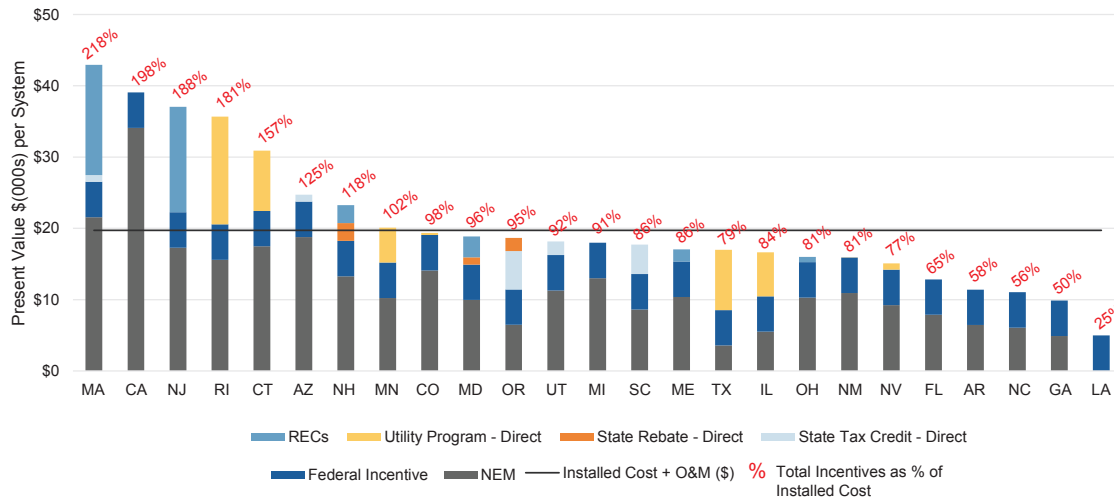
The total incentives available for installing a direct-owned solar PV system under standard electricity rates by selected state are depicted in Figure 1.

¹ ScottMadden analysis; typical household energy consumption was compared to typical solar PV system output, by state.



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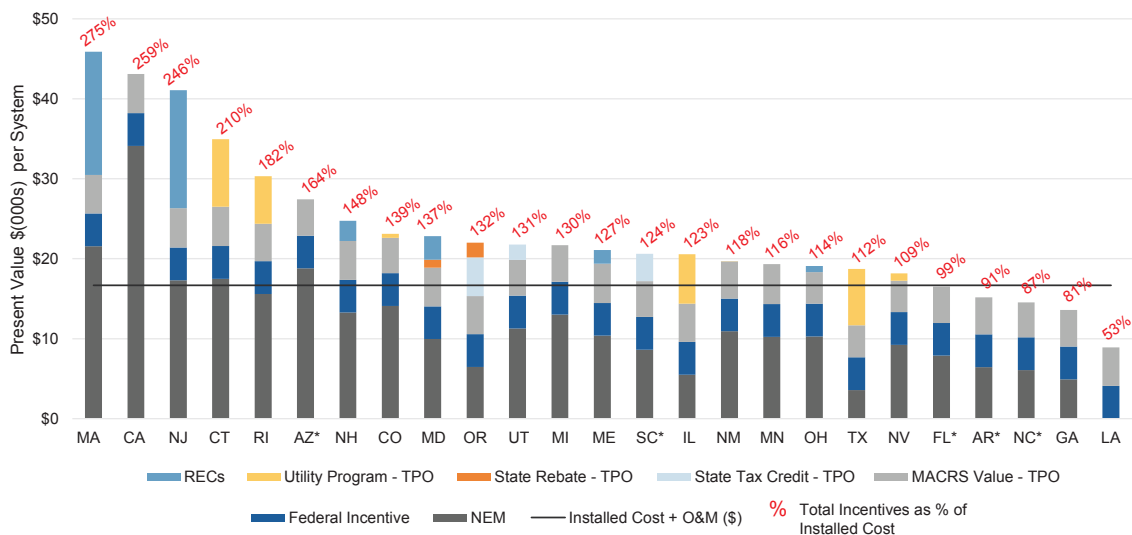
**Figure 1. Total Incentives for a Direct-Owned Solar PV System²
(6.1 kW System) (Standard Rate)**



Total Incentives for Residential Third-Party-Owned Solar Systems

Figure 2 below provides an illustration of total incentives compared to average installed cost for third-party-owned solar systems.

**Figure 2. Total Incentives for a Third-Party-Owned Solar PV System³
(6.1 kW System) (Standard Rate)**



*Third-party solar power purchase agreements disallowed or otherwise restricted by law for residential customers.⁴

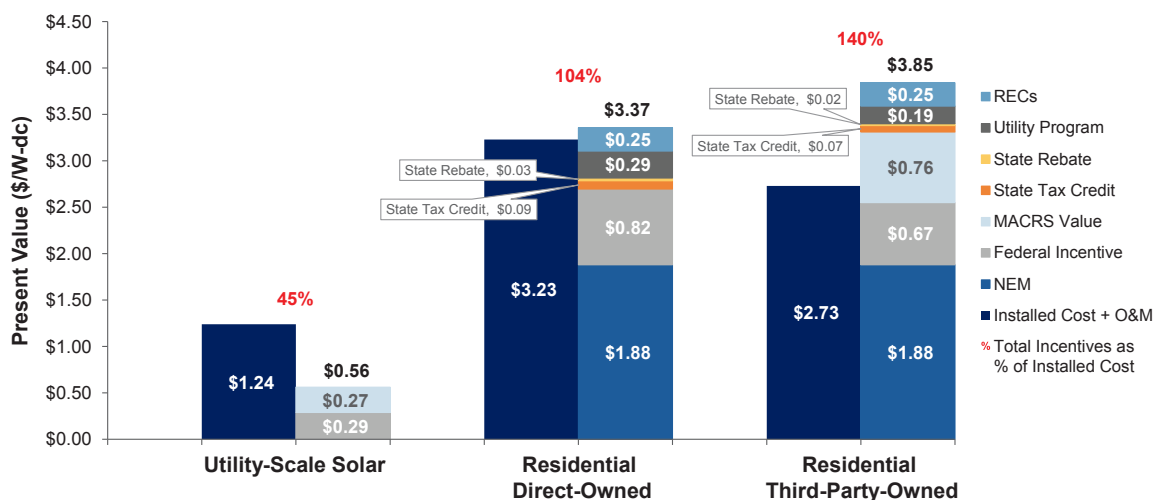
2 ScottMadden analysis.
3 Ibid.
4 DSIRE, 3rd Party Solar PV Power Purchase Agreement (PPA); April 2017.

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Comparison to Utility-Scale Solar

While this report primarily focuses on residential rooftop solar PV, it is also important to compare the total incentives available to residential solar PV systems to those available to utility-scale solar. Figure 3 shows that the total cost of utility-scale solar is less than half of the total cost of residential solar PV systems. Residential solar PV systems receive, on average, between 104% and 140% of total system costs in incentives. Utility-scale solar installations only receive about 45% of total system costs in incentives.

Figure 3. Residential Solar Versus Utility-Scale Solar⁵
(\$ per watt-dc)



Policy Implications for Solar Incentives

In considering the policy implications of current solar incentives, one must also understand which constituent groups bear the true costs of installing residential solar PV systems. The report analyzes the percentage of the cost of a residential solar system which is borne by taxpayers and consumers in addition to the system owner.

Through the 30% federal tax credit, various state tax credits, state rebates, and the additional tax deductions provided by the depreciation of the solar assets for third-party-owned systems, taxpayers, as a whole, are covering a significant portion of the cost of an individual's residential solar PV system in the United States. Depending on the state, the share of incentives funded by taxpayers varies from approximately 10% to 65% under standard tariffs (excluding Louisiana). Through utility programs and utility purchases in renewable energy certificate (REC) markets, utility ratepayers in all customer classes also share the cost of residential solar PV systems. While consumer contributions do not occur in every state, in at least five states, such as Massachusetts, New Jersey, Rhode Island, Texas and Illinois, consumers pay approximately 30% of the costs of residential solar PV systems.

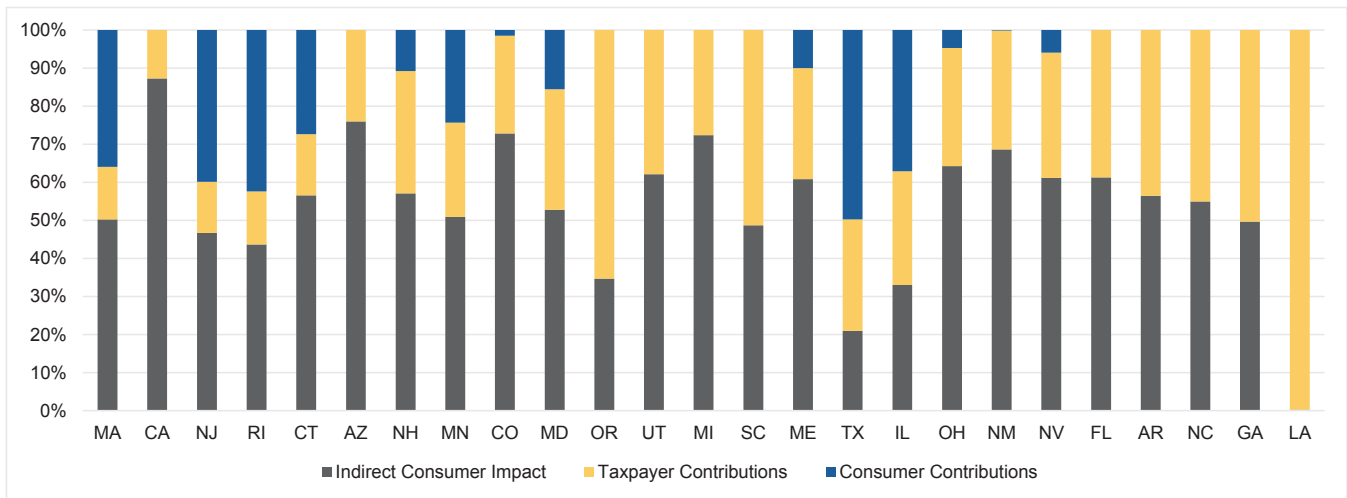
⁵ ScottMadden analysis.



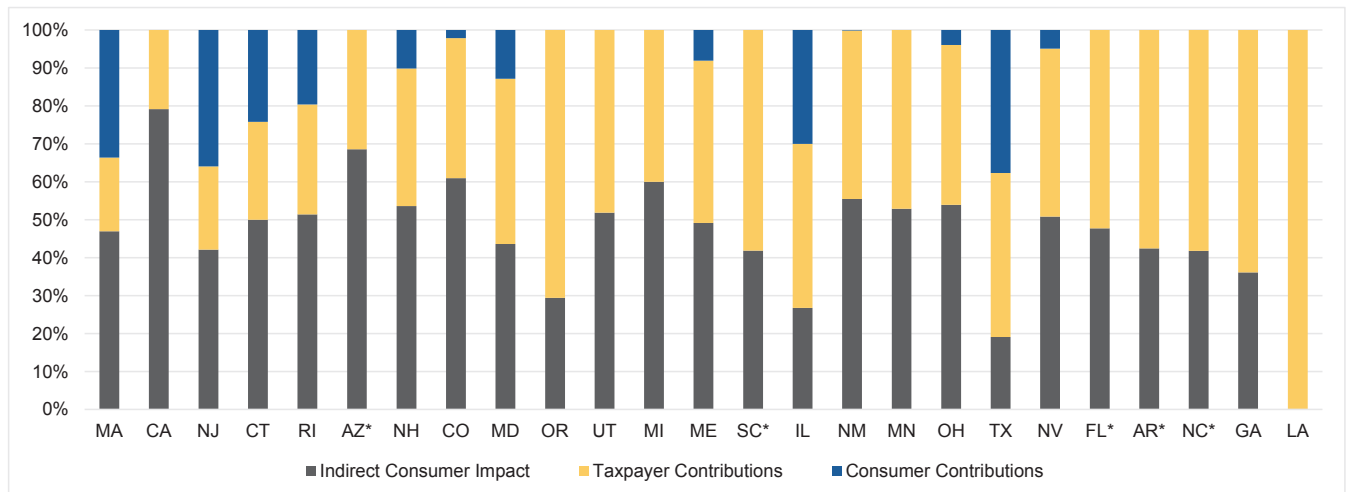
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Figures 4 and 5 show the percentage of incentives to solar system owners borne by each group. The indirect consumer impact shown in this analysis represents the net energy metering incentive (or bill savings minus utility avoided costs).

**Figure 4. Taxpayer and Consumer Contributions – Direct-Owned Systems⁶
(6.1 kW System) (Standard Rate)**



**Figure 5. Taxpayer and Consumer Contributions – Third-Party-Owned Systems⁷
(6.1 kW System) (Standard Rate)**



***Third-party solar power purchase agreements disallowed or otherwise restricted by law for residential customers.⁸*

6 Ibid.

7 Ibid.

8 DSIRE, 3rd Party Solar PV Power Purchase Agreement (PPA); April 2017.



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Taxpayer Contributions

Through the 30% federal tax credit, various state tax credits and state rebates ranging between 10% and 65%, and the additional tax deductions provided by the depreciation of the solar assets for third-party-owned systems, taxpayers as a whole are covering a significant portion of the cost of an individual's residential solar PV system in the United States.

Electric Customer Contributions

Through utility programs and utility purchases in REC markets, utility customers in all customer classes share the cost of residential solar PV systems. Customers currently contribute directly in about half of the states analyzed and, in at least five states, customers pay approximately 30% of the costs of residential solar PV systems.

Indirect Customer Impact

Residential solar PV systems rely on the use of the utility's distribution system to "buy" and "sell" power from the grid. In the majority of jurisdictions, utility rate structures currently do not separately charge distribution costs to solar system owners. Such costs include capital expenditures for the poles, conductor, transformers, switches, and metering devices, as well as additional operation and maintenance expense to operate the system safely and reliably. If these costs are not paid for by solar PV system owners, they may be passed on to other customers through increased rates.

Conclusions

This report provides a foundation and context for policymakers to make well-informed, well-reasoned decisions regarding solar policy within their jurisdiction, and a better understanding of who is paying the installed cost of rooftop solar PV. The various incentives and certificates at the federal, state, and local levels offered to solar PV rooftop users demonstrate the following conclusions:

- Existing Incentives for Residential Solar PV are Significant

Based on this analysis of total available incentives, in many of the states studied, residential solar remains incentivized in amounts that exceed the installed cost of a solar PV system. In eight states examined, direct owners receive more than the total system costs in total incentives under a standard rate structure. In all but five states, direct owners receive at least 75% of total system costs in total incentives under a standard rate structure.





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- Utility-Scale Solar Installations are Incentivized at Lower Rates Per Watt Than Rooftop Solar PV Systems and are Less Expensive to Install

Although the total incentives for residential solar PV systems exceed the incentives available for utility-scale solar, utility-scale solar installations have significantly lower total costs (installed cost plus operation and maintenance expense) than residential PV systems. Residential solar PV systems receive, on average, between 104% and 140% of total system costs in incentives. Utility-scale solar installations only receive about 45% of total system costs in incentives; therefore, the ratio of absolute incentives for utility-scale to rooftop is greater than 5-to-1.

- Third-Party-Owned Solar PV Owners Receive the Most Significant Incentives

In contrast to direct-owned solar, third-party solar owners are able to utilize accelerated depreciation, which generates additional tax benefits for the third-party system owner. In all but five states (Florida, Arkansas, North Carolina, Georgia, and Louisiana), total incentives exceed total system costs under standard rate structures. Under TOU rates, total incentives also exceed total system costs in all but six states (Georgia, New Mexico, Nevada, Florida, Arkansas, and North Carolina). In other words, while the non-economic value of rooftop solar is identical for direct-owned and third-party-owned, the third-party-owned systems receive considerably greater incentives.

- Solar PV Installation Incentives May Shift Costs to Other Customers

Some net metering programs, which pay residential PV solar customers full retail rates for their excess electricity production, may shift fixed utility infrastructure costs onto non-solar customers. As a result, CEA remains concerned that these net metering incentives may also shift costs onto less-affluent customers.