AN END USER PERSPECTIVE ON THE COST OF SOLAR PHOTOVOLTAIC ENERGY SYSTEMS INSTALLED BY COMMERCIAL ORGANIZATIONS

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ABSTRACT

Depending on what one reads the financial returns available from solar photovoltaic energy systems (solar PV systems) have already become competitive with grid produced electricity or, at the other extreme, are still far from parity with grid produced electricity. This leaves end users who are considering the installation of solar PV systems confused as to whether such investments make economic sense.

These contrasting views are not surprising for two important reasons. First, many of the analyses of the financial returns from solar PV systems use assumptions incorrectly, or ignore important factors impacting the potential return from such systems. Second, the factors impacting returns such as levels of solar radiation, government and utility incentives, and the cost of grid produced electricity vary dramatically based on location, and across time.

The purpose of this article is to compare the financial returns from solar PV systems to grid produced electricity for specific locations across the US for 2012. The financial returns are calculated after taking into account local solar radiation, and all available tax incentives and rebates. The results are valuable in identifying the factors that are likely to make installed solar PV systems economically viable in some locations, but still more expensive than grid produced electricity in other locations. The method used to complete this analysis is capital budgeting, which is a standard method used for analyzing potential capital expenditures by organizations. Capital budgeting can be used by businesses and other organizations to determine whether the installation of a solar PV system makes sense in the organization’s specific set of circumstances.

1. HOW ORGANIZATIONS MAKE CAPITAL BUDGETING DECISIONS

In making a solar PV system purchase decision, businesses have little interest in generalized discussions of potential parity between such systems and grid produced electricity. Rather, the organization wants to make a specific comparison between its present and future grid produced electricity costs, and the net cost of a solar PV system over its useful life. Simple parity with grid produced electricity is not enough. This is because the organization will have to commit capital to purchasing the solar PV system. Since capital is limited companies need to invest in those projects that produce the greatest return. Thus, an investment in a solar PV system must provide a return that compares favorably to other investment opportunities.

1.1 Selecting a Method for Analyzing Capital Investments

A variety of methods are available for analyzing and comparing potential capital investments and, in aggregate, these are normally referred to as capital budgeting techniques. The net present value (NPV) method discounts future cash flows to their present value using the organization’s cost of capital as the discount rate. The present value of the future cash flows is then compared to the initial investment. A positive NPV occurs when the present value of the future cash flows exceeds the initial investment. When the present value of the future cash flows equals the initial investment, the NPV is zero. A zero NPV means that the project’s future cash flows are exactly sufficient to repay the invested capital and to provide the required rate of return on the capital. Thus, a positive NPV means the project’s future cash flows exceed the amount.
necessary to repay the invested capital and to provide the required rate of return on the capital.

A popular way of presenting the present value of the cost of a solar PV project is the levelized cost of electricity (LCOE). LCOE is the estimated present value of the cost of one kilowatt-hour of electricity. A review of the methodology of calculating LCOE is provided in Branker et al. (2011). They discuss the “lack of clarity or reporting assumptions, justifications and degree of completeness in LCOE calculations” and attempt to correct these miscalculations. The article, however, contains its own set of problems. For instance, the paper compares the LCOE of a solar PV system to current electricity prices from grid produced electricity. Making such a comparison is critical in an organization’s decision process because they are interested in identifying the least expensive source of electricity. The specific comparison in Branker, however, is actually a comparison of apples and oranges. An appropriate comparison would be to compare the LCOE of the solar PV system to the LCOE of grid produced electricity, not its current cost. To arrive at the LCOE from the grid it is necessary to determine the after-tax\(^3\) present value of the expected future costs of grid produced electricity in the calculation. That is, future inflation of the cost of grid produced electricity cannot be ignored.

The internal rate of return (IRR) method is closely related to the NPV method. The IRR method provides a rate of return from an investment, rather than using a cost of capital in the calculation, and it is defined as the rate of return, or discount rate, that forces the NPV of the investment to equal zero. For the capital budgeting cases presented in this article two types of results are presented for comparing the lifetime cost of a solar PV system to the cost of grid produced electricity. The results provide both a comparison of the LCOE for the PV system to the LCOE of grid produced electricity, and the IRR of the solar PV system in comparison to grid produced electricity.

1.2 Considering Loans in the Capital Budgeting Analysis

The literature on LCOE calculations often includes loan payments in the analysis. For instance, Branker (2011) states that one of the costs to be considered in the LCOE calculation is the interest payments. In capital budgeting the financing is normally separated from the analysis of the return on the asset being purchased, except for the determination of the cost of capital used in the discounting of future cash flows. So, for instance, the availability of low-interest financing impacts the potential return of the project indirectly, by lowering the firm’s cost of capital. Bierman, et al. (2007) states “Cash disbursed for interest is normally excluded from the cash flow computation used in analyzing investments. The interest factor is taken into consideration by the use of the present value procedures. To include the cash disbursements for interest would result in double counting” (p. 64).\(^4\)

A firm’s cost of capital is the weighted average cost of each type of capital including both debt and equity. The cost of each type of capital is multiplied by the ratio of the market value of the securities (debt or equity) representing that source of capital to the market value of all securities issued by the company.\(^5\) The cost of capital is the rate the company would generally use in its capital budgeting analyses. Projects that provide a rate of return equal to, or exceeding, the weighted average cost of capital are acceptable, and those that have a rate of return that is less than the weighted average cost of capital are not acceptable.

For the case studies in this article a weighted average cost of capital of 7.0% is used. This rate is taken from Damadoran Online, which provides the weighted average cost of capital across 5,891 US companies for January 2012.\(^6\)

2. FACTORS TO CONSIDER IN SOLAR PV INVESTMENT ANALYSIS

The information needed for analyzing a solar PV system investment decisions can be divided into four general categories. These are:

- **Cost of electricity**: The electricity costs, both present and future, that will be saved by installing a solar PV system.
- **Sunlight**: The amount of sunlight, or solar radiation, available to provide power for the solar PV system.
- **PV system costs and performance**: The cost and performance of photovoltaic panels and related components of the solar energy system.
- **Financial incentives**: The tax and other incentives provided by federal, state, and local governments, and by utility companies.\(^7\)

Each of the factors listed above can vary dramatically based on location, and across time. That is, to accurately estimate the rate of return on a solar PV system the devil really is in the details of the circumstances in each location. To illustrate the impact of these factors on the financial return from the installation of a solar PV system case studies are provided for 2012 installations in four different locations across the US.

3. CASE STUDIES – GENERAL INFORMATION
Case studies are performed for the commercial installation of a 50-kilowatt solar PV system in the following locations:

- Honolulu, Hawaii
- Newark, New Jersey
- Phoenix, Arizona
- Minneapolis, Minnesota

For each case it is assumed that the system is installed by a corporation with a marginal federal income tax rate of 35%, and the maximum state corporate income tax rate for the state in each case study. The installed cost of the system is assumed to be $5.25 per DC watt, or a total cost of $262,500 before incentives. Other assumptions used in the case studies are described below. A complete summary of assumptions is also provided in Table 1.

3.1 Cost of Electricity

The Energy Information Administration (EIA; www.eia.doe.gov) provides statistics on the average retail price of electricity in each US state. The information is updated monthly. The price of electricity used in each case study is the average retail electricity price for commercial and industrial customers for the first ten months of 2011 in the state where the solar PV system is installed.

Since solar PV systems have useful lives of 20 to 30 years it is also necessary to consider future changes in the price of electricity. The EIA forecasts the expected price of electricity in the US for 25 years into the future. In its Annual Energy Outlook 2011, the EIA predicts a nominal average annual increase of only 1.6% per year through 2035.

3.2 Solar Radiation

The fundamental requirement for a successful solar PV system is the availability of sunlight, or solar radiation. The reality is that different parts of the US receive dramatically different levels of sunlight. For instance, in Anchorage, Alaska the average daily hours of solar radiation is 3.0 kWh/m²/day for a flat-plate collector pointed south with a fixed tilt angle equal to the site’s latitude. This compares to Phoenix where the average daily hours of solar radiation are 6.5, more than double the level of solar radiation in Anchorage.

The National Renewable Energy Laboratories (NREL) PVWatts calculator is used to determine the annual level of solar radiation in each case study location. The calculation assumes the use of a flat-plate collector pointed south with a fixed tilt angle. In addition, A 77% DC-to-AC derate factor is assumed.

3.3 Solar Photovoltaic System Costs

Solar panels require little maintenance and should last a long time. A manufacturer’s guarantee typically provides that the panels will produce at least 80% of its original capacity for at least 25 years. The other critical piece of hardware in a solar electric system is the inverter. It is a relatively small part of the entire system, making up approximately 9.5% of the total cost. Inverters do not last as long as solar panels and the case studies assume that they must be replaced after 13 years.

3.4 FINANCIAL INCENTIVES

There are a variety of financial incentives available for businesses investing in PV systems. These include federal tax incentives, state tax incentives, state and local government rebates, and utility rebates.

3.4.1 Federal Income Tax Incentives

One of the biggest incentives for installing solar energy systems in the US is the business energy credit described in IRC Sec. 48 and which is part of the investment tax credit. The amount of the credit is 30% of the cost of property placed in service during the year, and the credit is available through December 31, 2016.

Businesses can also benefit from depreciation of solar energy property. When the business energy credit is taken for this property, the property’s basis for depreciations must first be reduced by one-half the amount of the credit. Solar energy property described in IRC Sec. 48 is five-year property for purposes of federal tax (MACRS) depreciation. For 2012, solar energy property is also eligible for 50% bonus depreciation under IRC Sec. 168(k).

3.4.2 State, Local Government and Utility Incentives

State and local government tax incentives for solar energy system installations generally consist of income tax credits, property tax exemptions, and sales and use tax exemptions. For state income tax credits the percentage of the credit varies widely by state, and can make a dramatic difference in the net cost of an installed solar PV system.

States, local governments, and utilities also offer a myriad of grants and rebates to promote the installation of renewable energy systems. The form of the grant or rebate is typically either an upfront payment to reduce the initial cost of the system, or a performance-based incentive (PBI), in which the producer is paid based on electricity production. Solar energy producers participating in a PBI program receive a double bonus: the incentive payment plus the electricity costs saved by using a solar energy system.
Fortunately, there is an online comprehensive database of state and local incentives called the Database of State Incentives for Renewables & Efficiency (DSIRE), at www.dsireusa.org. Funded by the US Department of Energy, DSIRE is an ongoing project of the North Carolina Solar Center and the Interstate Renewable Energy Council.

3.4.3 Solar Renewable Energy Certificates

Policymakers in several states, including New Jersey, have created Solar Renewable Energy Certificates (SRECs) to ensure that a certain amount of solar energy capacity is installed in a designated area. States with SREC programs have a renewable portfolio standard (RPS) that requires utilities to secure a portion of their electricity from solar generators. In order to demonstrate that they meet this requirement, the utility is required to earn or purchase SRECs.

One SREC represents one megawatt-hour of production. The SREC is separate from the value of the electricity itself. In states with these programs, SRECs provide an additional incentive to invest in solar PV systems over and above the electricity savings. This is because SRECs generated by a solar PV system can be sold to a utility needing to meet its solar RPS requirement.

In order to produce SRECs, a solar PV system must first be certified by state regulatory agencies. Once the system is registered, SRECs can be issued based on electricity production. SRECs are not assigned a monetary value. Instead, prices are set in the marketplace and are a function of supply and demand. Utilities can purchase SRECs in the marketplace or pay a penalty instead. The penalty is referred to as a solar alternative compliance payment (SACP), and the amount of the penalty sets an effective cap on the market price of a SREC.

4. CASE STUDIES

Using the assumptions discussed above, case studies for a solar PV system installation were created for Honolulu, Newark, Phoenix, and Minneapolis. The results demonstrate the dramatic variation in the financial return from the installation of a solar PV system depending on location.

4.1 Honolulu, Hawaii

There are a number of factors that make Hawaii an ideal location for solar PV systems. The average annual solar radiation is high, the cost of electricity is high, and the state offers substantial income tax credits for installing solar PV systems. Honolulu gets an annual average of 5.7 hours of solar radiation per day. The average retail price of electricity in Hawaii for the first ten months of 2011 for commercial and industrial business sectors was $0.301/kwh, and the state offers a 35% income tax credit on the cost of commercial solar PV systems, up to a maximum of $500,000.\(^\text{15}\)

The maximum state corporate income tax rate in Hawaii is 6.4%.\(^\text{16}\) Solar PV systems are also subject to an excise tax of 4.0% at the time of purchase, and in Honolulu there is an additional excise tax of 0.5% for a total of 4.5%.\(^\text{17}\) The 4.5% excise tax must be added to the cost of a solar PV system. In Honolulu, solar PV systems are exempted from property taxes.\(^\text{18}\)

Consider an installation of a 50-kilowatt PV system in Honolulu. The federal tax credit on a $274,313 ($262,500 + $11,813 excise tax) solar PV system amounts to $82,294 and the state income tax credit is $96,010. Thus, the net cost of the system after tax credits is only $96,009. As indicated in Table 2 this combination of incentives results in a 33.32% IRR over the assumed 25-year life of the system! The LCOE of the system is $0.038/kwh versus a grid provided LCOE of $0.202/kwh. Clearly, the installation of a solar electric system in Honolulu is likely to provide a substantial economic return.

It is worth noting that the state income tax credit has a dramatic impact on the return of the PV system. If the $96,010 state income tax credit were not available in the example just described, the IRR would be reduced to 9.83%, and the LCOE of the system would increase to $0.159/kwh. But even without the state tax credit, the solar PV system has a better rate of return than grid produced electricity.

4.2 Newark, New Jersey

Despite the fact that New Jersey has less solar radiation than states farther south, it is a good place to invest in solar energy systems because of the SRECs that are available. The average annual solar radiation per day in Newark is 4.5 hours.

Organizations installing solar PV systems in New Jersey receive SRECs that can be resold in the marketplace. Under New Jersey law, solar PV systems can qualify to generate SRECs for 15 years from the date of installation. The amounts received from the sale of SRECs are in addition to the electricity cost savings from installing a PV system. The State of New Jersey Board of Public Utilities sets the SACP payment for each year. In a recommendation dated September 21, 2011, the Board recommended a declining set of SACP payments for the next 15 years. For the six
months ended January 31, 2012 New Jersey SREC\textregistered s sold for an average of 58.5\% of the SACP. These assumptions are used in the Newark case study.\textsuperscript{19}

Consider the installation of a 50-kilowatt PV system in Newark at a total installed cost of $262,500. In New Jersey the maximum corporate income tax rate is 9.0\%.\textsuperscript{20} Solar PV systems are exempt from state sales taxes and state property taxes.\textsuperscript{21}

The federal income tax credit amounts to $78,750. There are no state income tax credits but the benefits from selling the SREC\textregistered s are substantial. For the system described in this case study the SREC\textregistered s sold in the first year would amount to revenue of approximately $22,750. The result is that the IRR for a solar PV system installed in Newark, using the assumptions described here, is 10.16\%. The LCOE of the system is $0.042/kwh versus a grid produced LCOE of $0.081/kwh. That is, installing a 50-kilowatt solar PV system, as described, should pay off in New Jersey.

4.3 Phoenix, Arizona

Located in the Southwest, Phoenix, Arizona receives significantly more sunlight than most other parts of the US. The average annual solar radiation per day is 6.5 hours. While this high level of sunlight would seem to make solar PV systems a good bet, there are other factors in Phoenix that reduce the potential financial benefits. For instance, the average 2011 retail price of electricity in Arizona for commercial and industrial businesses was just $0.082/kwh.

Arizona provides a 10\% state income tax credit for nonresidential solar PV system purchases, up to $25,000 in any one year.\textsuperscript{22} This is a great benefit, but it is much less than the income tax credit Hawaii offers. Utility companies in Arizona, however, also have rebate programs. APS, one of the utilities serving the Phoenix area, offers both upfront grants and performance based incentives (PBIs). The PBI offered for 50-kilowatt solar PV systems is $0.08/kwh up to a total incentive of $105,000.\textsuperscript{23} The maximum state corporate income tax rate in Arizona is 6.968\%.\textsuperscript{24} Solar PV systems are exempted from sales taxes and property taxes.\textsuperscript{25}

The IRR from a 50-kilowatt system installed in Phoenix over the 25 year life of the system is 5.36\%. This is a positive IRR, but it is less than the weighted average cost of capital used in these case studies of 7.0\%. The result is that the LCOE of the solar PV system is $0.068/kwh while the LCOE of grid based electricity is $0.055. Thus, even with the high level of sunlight in Phoenix the financial return of such a system does not beat the return of grid based electricity. This is because grid based electricity in Phoenix is inexpensive, and state income tax incentives are limited.

All is not lost however. If the installed cost of a 50-kilowatt PV system drops to $4.50 per DC watt, all else being equal, the IRR would rise to 7.91\%. The LCOE of such a system would be $0.048/kwh compared to a $0.055/kwh LCOE for grid based electricity. At this price the installation of a solar PV system would begin to make economic sense in Phoenix.

4.4 Minneapolis, Minnesota

Making a solar PV system pay is difficult, if not impossible, in Minnesota. The average annual solar radiation per day in Minneapolis is 4.6 hours, and the average cost of electricity in 2011 for commercial and industrial users was only $0.076 per kilowatt-hour.

Consider the installation of a 50-kilowatt PV system in Minneapolis. In Minnesota the maximum corporate income tax rate is 9.8\%. Solar PV systems are exempt from state sales taxes and state property taxes.\textsuperscript{27}

The federal income tax credit amount is $78,750. But the state provides no state income tax credits or rebates for installing solar PV systems. Combining this with the low cost of electricity and the limited sunlight, results in an IRR for a solar PV system installed in Minneapolis of -4.59\%. The LCOE of the solar PV system is $0.16/kwh and the LCOE of grid provided electricity is only $0.048.

To make matters worse, a 50-kilowatt solar PV system is not eligible for net metering in Minnesota.\textsuperscript{28} Thus, if the organization installing such a system cannot use all of the electricity generated from the PV system, some of the savings are lost.

5. SUMMARY AND DISCUSSION

The results from the four case studies demonstrate that financial returns from solar PV systems vary dramatically depending on the location where they are installed. At one extreme, the case study for Honolulu has an IRR of 33.32\%, while at the other extreme the case study for Minneapolis has an IRR of -4.59\%. The differences in the returns from the solar PV systems case studies is a result of variations in state incentives, electricity prices, and the level of solar radiation.

The results also demonstrate that detailed, site specific, information about incentives, grid produced electricity rates, and levels of solar radiation are needed to determine whether the installation of a solar PV system makes economic sense in a particular location.
The case studies include the following assumptions, unless otherwise noted.

**System:**
- The PV system is pointed due south and tilted at an angle equal to the latitude of its geographic location.
- The system is tied to the utility grid and net metering is permitted.
- The performance of the system degrades 20% over its 25-year useful life. Degradation takes place in equal increments each year.
- The system inverters must be replaced after 13 years, and the replacement cost is 9.5% of the initial cost of the PV system, adjusted for inflation.
- The DC-to-AC derate factor is 77%. That is, the actual AC output of the PV system is 77% of its DC power rating.
- The system has a zero scrap value at the end of its 25-year useful life.

**General:**
- The cost of electricity in year 1 is the average retail price of electricity for commercial and industrial users for the state in which the system is installed, for the first ten months of 2011.
- The annual cost of electricity increases by 1.6% per year.
- The annual maintenance and insurance cost is 0.5% of the initial cost of the PV system, adjusted each year for inflation.
- There is no incremental cost for the space occupied by the system.

**Taxes:**
- All grants and rebates are fully taxable in the year received.
- The federal income tax rate for the taxpayer is 35%.
- The PV system is depreciated for income tax purposes using normal MACRS depreciation over five years. In the first year 50% bonus depreciation is taken as allowed by IRC Sec. 168(k). No IRC Sec. 179 expensing election is made.
- SRECs received by the taxpayer are sold as they are received and are taxable at ordinary income rates.
TABLE 2: SOLAR PV SYSTEM RETURNS - FOUR CASE STUDIES

<table>
<thead>
<tr>
<th></th>
<th>Honolulu $5.25/DC Watt</th>
<th>Newark $5.25/DC Watt</th>
<th>Phoenix $5.25/DC Watt</th>
<th>Minneapolis $5.25/DC Watt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installed system cost per DC watt</td>
<td>$5.49</td>
<td>$5.25</td>
<td>$5.25</td>
<td>$5.25</td>
</tr>
<tr>
<td>Initial system cost before rebates and credits</td>
<td>$274,313</td>
<td>$262,500</td>
<td>$262,500</td>
<td>$262,500</td>
</tr>
<tr>
<td>Federal income tax credit</td>
<td>$82,294</td>
<td>$78,750</td>
<td>$78,750</td>
<td>$78,750</td>
</tr>
<tr>
<td>State income tax credit</td>
<td>$96,010</td>
<td>$0</td>
<td>$25,000</td>
<td>$0</td>
</tr>
<tr>
<td>Maximum state corporate income tax rate</td>
<td>6.4%</td>
<td>9.0%</td>
<td>6.968%</td>
<td>9.8%</td>
</tr>
<tr>
<td>Utility rebates/performance-based payments</td>
<td>$0</td>
<td>SREC*</td>
<td>PBI*</td>
<td>$0</td>
</tr>
<tr>
<td>Average annual hours of solar radiation per day</td>
<td>5.7</td>
<td>4.5</td>
<td>6.5</td>
<td>4.6</td>
</tr>
<tr>
<td>Initial price of electricity per kilowatt-hour</td>
<td>$0.301</td>
<td>$0.127</td>
<td>$0.082</td>
<td>$0.076</td>
</tr>
<tr>
<td><strong>Outputs:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCOE of PV system after all incentives</td>
<td>$0.038</td>
<td>$0.042</td>
<td>$0.068</td>
<td>$0.162</td>
</tr>
<tr>
<td>LCOE of grid produced electricity</td>
<td>$0.202</td>
<td>$0.081</td>
<td>$0.055</td>
<td>$0.048</td>
</tr>
<tr>
<td>Internal rate of return (IRR) over 25-year life</td>
<td>33.32%</td>
<td>10.16%</td>
<td>5.36%</td>
<td>-4.59%</td>
</tr>
</tbody>
</table>

*See the article for details of the specific benefits of the performance-based incentives (PBIs) in Phoenix, and the solar renewable energy credits (SRECs) in New Jersey.

REFERENCES

3 Commercial organizations can deduct grid produced energy costs as a normal business deduction. Thus, there is a tax benefit equal to the combined federal and state income tax rate of the business entity
4 Bierman, H., Jr., S. Smidt, 2007. The Capital Budgeting Decision: Economic Analysis of Investment Projects, ninth ed., Routledge, New York. Bierman et al., also state that it is safer to exclude all debt flows from the cash flow calculation than to include them. This is because including debt flows requires either that the capital structure of the organization (ratio of the market value of the debt to the market value of the equity) be kept constant through time or a different discount rate be used each time period
$5.25 per DC watt, before incentives, is approximately a 10% decrease from the installed costs of such systems in 2011. The National Renewable Energy Laboratory (NREL) gathers data on the installed cost of solar PV systems in the US through its Open PV Project. The data is available at [http://openpv.nrel.gov](http://openpv.nrel.gov). For the period January 1, 2011 through December 31, 2011 the average installed cost of systems between 40 and 60 kilowatts was $5.81 per DC watt, before incentives. This average is based on 119 different installations with a total capacity of 5.9 megawatts.

**8**

Report No. DOE/EIA-0226, Table 5.6.B. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date through October 2011 and 2010

**9**


**10**

Solar Radiation Data Manual for Flat-Plate and Concentrating Collectors, NREL, 1994

**11**

The PVWatts calculator determines the solar radiation incident of the PV array and the PV cell temperature for each hour of the year. The DC energy for each hour is calculated from the PV system DC rating and the incident solar radiation, and then corrected for the PV cell temperature. The AC energy for each hour is calculated by multiplying the DC energy by the overall DC-to-AC derate factor and adjusting for inverter efficiency as a function of load. Hourly values of AC energy are then summed to calculate monthly and annual AC energy production. The calculator is available at [www.nrel.gov/rredc/pvwatts/](http://www.nrel.gov/rredc/pvwatts/)

**12**


**13**

IRC Sec. 168(e)(3)(B)(vi)(I)

**14**

Hawaii Revised Statute Sec. 235-12.5

**15**

Hawaii Revised Statute Sec. 235-71

**16**

Hawaii Revised Statute Sec. 237-13

**17**

Ordnance of Honolulu 8-10.15

**18**

Data on New Jersey SREC pricing is available at [http://www.njcleanenergy.com/renewable-energy/project-activity-reports/srec-pricing/srec-pricing](http://www.njcleanenergy.com/renewable-energy/project-activity-reports/srec-pricing/srec-pricing). Also, see New Jersey Statute Sec. 48:3-51 et seq. and New Jersey Administrative Code Sec. 14:8-1.1 et seq.

**19**

New Jersey Statute Sec. 54:10A-5

**20**

Solar PV systems are exempt from property taxes under New Jersey Statute Sec. 54:4-3.113a et seq. They are exempt from state sales tax under New Jersey Statute Sec. 54:32B-8.33 and New Jersey Administrative Code Sec. 18.24-26.1 et seq.

**21**

Arizona Revised Statute Sec. 43-1085 and Sec. 43-1164

**22**

The rebate amount offered by APS for a particular solar PV system can be estimated using the worksheets available at [www.aps.com/main/green/choice/solar/Business/default.html](http://www.aps.com/main/green/choice/solar/Business/default.html)

**23**

Arizona Revised Statute Sec. 43-1111

**24**

Arizona Revised Statute Sec. 42-5061(N); Sec. 42-5575(A)(14); and Sec. 42-11054(C)(2)

**25**

Minnesota Statute Sec. 290.06

**26**

Solar PV systems are exempt from property taxes in Minnesota under Minnesota Statute Sec. 272.02, and exempt from sales taxes under Minnesota Statute Sec. 297A.67

**27**

In Minnesota solar PV systems with a capacity of less than 40-kilowatts are eligible for net metering. See Minnesota Statute Sec. 216B.164