Financing options and cost analysis
## Agenda

<table>
<thead>
<tr>
<th>1. Financing options &amp; incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Cost analysis</td>
</tr>
<tr>
<td>3. Case studies</td>
</tr>
</tbody>
</table>
Financing options & incentives
There are two avenues you can take for financing a solar system. You can purchase the system and either pay with cash or a loan. There are many loan options for a PV system, and we will go over them shortly.

You can also choose a third party owned system. The contract structures for third party owned systems are lease and power purchase agreement, commonly called a “PPA”. PPAs are available for all types of facilities – residential, commercial, municipal, etc.
Third party owned options

- **Lease**
  - Fixed $ per Month
  - May be pre-paid or monthly

- **Power Purchase Agreement (PPA)**
  - Fixed $ per kWh produced by system
  - Customer buys *all* power produced by system

With both leases and power purchase agreements (PPA), the solar provider is the system owner - not the building owner. Both come with 20-25 year contracts with a option to purchase the system at the end for the “fair market value” of the system.

The difference is how the customer pays the solar provider. With a lease, the customer will pay a fixed amount per month. Whereas a PPA, the customer pays a fixed amount per kWh the system produces.

A solar power purchase agreement (PPA) is a financial agreement where a developer arranges for the design, permitting, financing and installation of a solar energy system on a customer’s property at little to no cost. The developer sells the power generated to the host customer at a fixed rate that is typically lower than the local utility’s retail rate. This lower electricity price serves to offset the customer’s purchase of electricity from the grid while the developer receives the income from these sales of electricity as well as any tax credits and other incentives generated from the system. PPAs typically range from 10 to 25 years and the developer remains responsible for the operation and maintenance of the system for the duration of the agreement. At the end of the PPA contract term, a customer may be able to extend the PPA, have the developer remove the system or choose to buy the solar energy system from the developer.

PPAs provide a means to avoid the upfront capital costs of installing a solar PV system as well as simplifying the process for the host customer. In some states, however, the PPA model faces regulatory and legislative challenges that would regulate developers...
as electric utilities. A solar lease is another form of third-party financing that is very similar to a PPA, but does not involve the sale of electric power. Instead, customers lease the system as they would an automobile. In both cases, the system is owned by a third party while the host customer receives the benefits of solar with little or no up-front costs. These third-party financing models have quickly become the most popular method for customers to realize the benefits of solar energy. Colorado, for example, first entered the market in 2010 and by mid-2011 third-party installations represented over 60% of all residential installations and continued to rise to 75% through the first half of 2012. This upward trend is evident throughout states that have introduced third-party financing models.
http://www.seia.org/research-resources/solar-power-purchase-agreements

With both options, you are buying a service not an asset like if you were purchasing the system. But you can put little or no money down and are usually cash positive in the first year. The systems will generally include operation and maintenance, inverter replacement, insurance and monitoring.

**Both leases and PPAs are available in PA:**
https://understandsolar.com/pennsylvania/
Solar leases and Power-Purchase Agreements (PPAs) are basically ways to get solar power for your home without having to buy the panels yourself. Instead, a company installs solar panels on your home’s roof, and then either leases the system to you (for a set monthly cost) or sells the electricity to you (for a set price per kilowatt-hour).

Collectively known as “third-party ownership,” solar leases and PPAs can be a great way to start generating your own clean energy without spending thousands of dollars up front!

But PPAs are now the preferred way to do 3rd-party solar, because under a PPA you only pay for exactly the electricity produced. That’s good because solar panels deteriorate by tiny amounts over time. By year 20, you’ll probably be getting only 80-85% of the electricity you did at the start. With a PPA, you’ll only be paying for the energy produced, while with a lease, you’d be making the full payment, but getting less electricity.

https://solarpowerrocks.com/solar-lease-map/
## Financing Options

### What are you buying?

<table>
<thead>
<tr>
<th>Purchased</th>
<th>Third Party Owned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buying an asset</td>
<td>Buying a service, usually with a purchase option</td>
</tr>
</tbody>
</table>

Powered by [SunShot](https://www.energie.org)
# Financing Options

## What is included in the purchase?

<table>
<thead>
<tr>
<th>Purchased</th>
<th>Third Party Owned</th>
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</thead>
<tbody>
<tr>
<td>Generally will not include:</td>
<td>Generally includes:</td>
</tr>
<tr>
<td>• Inverter replacement</td>
<td>• Inverter replacement</td>
</tr>
<tr>
<td>• Operations &amp; Maintenance</td>
<td>• Operations &amp; Maintenance</td>
</tr>
<tr>
<td>• Insurance</td>
<td>• Insurance</td>
</tr>
<tr>
<td>May include:</td>
<td>• Monitoring</td>
</tr>
<tr>
<td>• Monitoring</td>
<td></td>
</tr>
</tbody>
</table>

Powered by SunShot
U.S. Department of Energy
Financing Options

What are the tax implications?

<table>
<thead>
<tr>
<th>Purchased</th>
<th>Third Party Owned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need to have the tax liability to make use of the federal investment tax credit (ITC) and the commercial tax depreciation</td>
<td>Solar services provider has the tax liability for the federal investment tax credit (ITC) and the commercial tax depreciation</td>
</tr>
</tbody>
</table>
## Financing Options

### What are the risks?

<table>
<thead>
<tr>
<th>Purchased</th>
<th>Third Party Owned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building owner responsible for operation and maintenance</td>
<td>Longevity of the solar services provider</td>
</tr>
</tbody>
</table>
### Financing Options

**What are the financial benefits?**

<table>
<thead>
<tr>
<th>Purchased</th>
<th>Third Party Owned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on investment in the form of lower electricity bills</td>
<td>Little or no upfront cost, usually cash positive or neutral in the first year</td>
</tr>
</tbody>
</table>
First, we are going to talk about solar loans.

Here is a video that talks about one federally-supported loan program.

http://energy.gov/eere/articles/paying-solar-tips-financing-residential-system

On youtube: https://www.youtube.com/watch?v=h6BDhxzNUiA
Solar PV loans

HomeStyle Energy mortgage:

- Offered by Fannie Mae
- Loan for up to 15% of the as-completed appraised property value
- Must show positive ROI

There are a wide variety of loans for solar PV. The video introduced the HomeStyle Energy mortgage by Fannie Mae. (RESIDENTIAL ONLY)

This program gives homebuyers the ability to add a solar system after the mortgage loan has closed. This is done by allowing up to 15% of the “as-completed” appraised home value to be used to pay for the cost of a solar system with funds escrowed by the lender, and gives the homeowner 180 days after the closing date to have the solar system installed. The mortgage requires homeowners to obtain a home energy report in order to show the value gained through energy savings over time is greater than the installation price tag.

More info: http://blog.rmi.org/blog_2016_06_01_fannie_maes_financing_for_solar
Other solar PV loans include home equity loans, low APR energy efficient and solar loans from local credit unions, and loans provided by the dealer or contractor.

When choosing a solar loan, it is important to understand what the terms are: how long is the pay back period, what is the interest rate, will it require collateral?
First, by offering up to 100% financing on qualifying improvements, PACE can eliminate the need to pay out of pocket for your project.

Second, depending upon the type of improvements installed, repayment may be amortized for a period of up to 20 years, keeping your monthly payments low enough that your utility savings may exceed your payment, creating a net positive cash flow. The interest rate will be tied to the length of the loan and not the property owner.

Third, the interest may be tax deductible.

Finally, because PACE ties the loan to the property and not an individual, the loan may transfer upon sale or refinancing of the property. In other words, you may not need to be concerned about recouping the cost of your improvements if you decide to sell the property before the loan is repaid.

OH: 1. Columbus PACE. Columbus-Franklin area (Commercial)
2. GC-PACE. SW Ohio (Commercial)
3. Lake County PACE. County District (Commercial)
4. NOPEC PACE. NE Ohio. (Commercial)
5. Toledo BetterBuildings NW Ohio. Toledo (Commercial)

CO: CO PACE in Boulder County (Commercial properties)

CT: "C-PACE" statewide coverage. (Commercial properties)

DC: DC PACE, Washington, D.C. (Commercial properties)

FL: 1. Clean Energy Works, several cities and counties (Residential and Commercial)
2. FL PACE Funding Agency. Any municipality in FL. (Residential and Commercial)
3. HERO Program FL. Many cities and Counties. (Residential)
4. Leon County PACE. Leon County. (Commercial)
5. RenewPACE. Any municipality in FL. (Commercial)
6. SELF. St Lucie County (Commercial)

GA: Clean Energy Works. Atlanta (Residential, Commercial)

MN: Minnesota PACE. Many cities and counties (Commercial) Two public entities
operate PACE programs in MN: Saint Paul Port Authority and Rural Minnesota Energy Board. Any city or county can join PACE of MN through a Joint Powers Agreement with the Saint Paul Port Authority (PACE Program), Rural Minnesota Energy Board PACE Program, :
http://programs.dsireusa.org/system/program?fromSir=0&state=MN More info: http://www.cleanenergyresourceteams.org/pace-faq#who

TX: Texas PACE Authority. Multiple cities and counties (Commercial)
Recently passed legislation to open up PACE financing in Illinois

- Communities must opt in before PACE loans are allowed in each jurisdiction
- Single family homes and condos are not allowed

Illinois could get a PACE program for financing energy efficiency and renewable energy in commercial, industrial, and multi-family buildings if the governor signs a bill passed overwhelmingly by the state legislature last month.

Advocates are hopeful that Illinois will become the 20th state with an active PACE program, but nothing is a given in a state with a governor and legislature so at odds that a budget has not been passed for three years.
Solar Renewable Energy Credits (SRECs) are a form of Renewable Energy Certificate in the United States of America. SRECs exist in states that have Renewable Portfolio Standard (RPS) legislation with specific requirements for solar energy. SRECs are available to help payback the system’s initial cost and generate revenue. The value of the SREC is determined by the market supply and demand. Each market (i.e state or utility) will have a different value for SRECs.

SRECs can be purchased by the utility directly or by a third-party aggregators. In order to minimize their costs, utilities will usually only buy from large projects, so small commercial and residential installations will sell their credits to third-party aggregators, who will bundle the credits and sell them to the utility.

For context:
• 1 SREC = 1 Mwh of solar electricity
• A 10 kW facility generates around 12 SRECs annually
Solar Renewable Energy Certificates (SRECs) are a solar incentive that allows homeowners to sell certificates to their utility. A homeowner will earn one SREC for every 1000 kilowatt hours (kWhs) produced by their solar panel system. A SREC can be worth as much as $300 in certain markets.

SRECs exist as a result of a regulation known as the renewable portfolio standard (RPS). Renewable portfolio standards are state laws that require utilities to produce a specific percentage of their electricity from renewable resources. Nearly 30 states and Washington, D.C. have an RPS, and eight states have a renewable portfolio goal. To meet their RPS requirements, electricity providers must obtain renewable energy certificates (RECs), which serve as proof that they have either produced renewable electricity themselves or paid someone who is producing renewable electricity for the right to “count” that electricity themselves. Many renewable portfolio standards also have a solar carve-out, which requires that a minimum percentage of electricity sales in that state come specifically from solar power. In those cases, SRECs are used to account for solar electricity production.

What happens to SRECs if the owner moves? If you sell your solar home while there is an active SREC market in your state, you retain the rights to sell your system’s SRECs even after moving. That means that, even if you sell your home, you could still receive income from the solar panel system you installed for years after. That being said, you also have the option to transfer the rights to the SRECs to the new homebuyer if agreed upon as part of the sale, which is very common. Many
homeowners use this as a negotiating tactic when trying to sell their property for more money. SOURCE: https://www.energysage.com/solar/cost-benefit/srecs-solar-renewable-energy-certificates/

**Solar Renewable Energy Credit programs are available in:**
(SOURCE: http://programs.dsireusa.org/system/program)

**OH:** SREC Program
**DE:** 1. Sustainable Electric Utility (SEU) - SREC Purchase Program
2. Solar Renewable Energy Credits Spot Market Program
3. SREC Procurement Program

**IL:** Solar Renewable Energy Credits
**PA:**
**MA:**

**Washington, DC:** SREC
**NJ:** 1. SREC Registration Program 2. SREC-Based Financing Program (ACE, JCP&L, RECO)
**MD:** SRECs

And in (SOURCE http://www.srectrade.com/srec_markets/introduction#markets):

**NC**
**CA**

**SREC FACTS**
- 1 SREC = 1 Mwh of solar electricity
- A 10 kW facility generates around 12 SRECs annually
- SRECs are sold separately from the electricity
- Value is determined by market supply and demand mechanics
- Facilities must be certified by a state to sell SRECs
Solar Renewable Energy Credits (SRECs)

Pennsylvania SREC Market Prices

Bid Prices for PA - Last Twelve Months (LTM)

$14.50

$7.00

Photo credit: SREC Trade
Here is a video that gives an introduction to the federal investment tax credit (ITC)

(Click on image to play video)

https://www.youtube.com/watch?v=bcLNlv26Ot8
Legislation extending the Solar Investment Tax Credit (ITC) was signed into law on December 18th, 2015. The bill extends the 30% Solar Investment Tax Credits for both residential and commercial projects through the end of 2019, and then drops the credit to 26% in 2020, and 22% in 2021 before dropping permanently to 10% for commercial projects and 0% for residential.

The customer will need the tax appetite or liability to use the full credit. Although, if they cannot use the entire credit in the first tax year, it can be carried over for five years. That is, for example, if your tax credit is $6,000, but you don’t owe $6,000 that year, you can claim portions of that $6K each year for 5 years to acquire the full amount.

Tax credit amount is tied to the date the system is put in service(not the date the system is permitted)

Government and non-profit entities are not eligible for the ITC due to their tax-exempt status.

If you lease or enter into a PPA, the tax credit will be claimed by the solar provider, since they are the owner of the system.

More information: http://programs.dsireusa.org/system/program/detail/1235
(residential)
http://programs.dsireusa.org/system/program/detail/658 (commercial)
Depreciation deductions are available if:
• Taxpayer owns the property
• Solar system is installed for a business, not residential property

The Modified Accelerated Cost Recovery System (MACRS), established in 1986, is a method of depreciation in which a business’ investments in certain tangible property are recovered, for tax purposes, over a specified time period through annual deductions.

Qualifying solar energy equipment is eligible for a cost recovery period of five years. If the ITC was claimed for the system, then the owner must reduce the depreciation basis by one-half the value of the ITC. This means the owner is able to deduct 85% of his or her tax basis.

The market certainty provided by MACRS has been found to be a significant driver of private investment for the solar industry and other energy industries.

For commercial properties, the building owner may be able to take advantage of MACRS, if they purchase the system and have the tax liability. If the system is leased or has a PPA (commercial or residential), the third party owner has the tax appetite to take advantage of the credit and these savings may or may not be passed down to the property owner depending on the contract and payment structure. If the system is purchased for a residential property, the MACRS will not apply.

How to Find Commercial and Residential Loans:
The national online solar resource, EnergySage, has a database for residential and commercial financing companies. You can filter by the state in the drop down box for local financing companies. These states [all of them in our SunShot training] have loans:

AZ
CO
CT
DC
FL
GA
IA
IN
MA
MN
NC
NM
OH

Note that I could not find this portion of the EnergySage website any longer. It appears they now just want you to put in your information and then companies will contact you.
PRESENTERS: The next several slides are state-specific. Please just use the slide that corresponds with the state where you are presenting; delete the others prior to presenting.

DSIRE is the most comprehensive source of information on incentives and policies that support renewables and energy efficiency in the United States.

http://www.dsireusa.org/
Local incentives: Illinois (zip code 60605)

<table>
<thead>
<tr>
<th>Name</th>
<th>State/Territory</th>
<th>Category</th>
<th>Policy/Incentive Type</th>
<th>Created</th>
<th>Last Update</th>
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<tbody>
<tr>
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<td>Financial Incentive</td>
<td>Corporate Tax Credit</td>
<td>03/15/2002</td>
<td>03/01/2018</td>
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<tr>
<td>Energy Efficient Commercial Buildings Tax Deduction</td>
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<td>Financial Incentive</td>
<td>Corporate Tax Deduction</td>
<td>01/10/2006</td>
<td>02/28/2018</td>
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<tr>
<td>Energy Efficient Homeowner Tax Credit for Home Builders</td>
<td>US</td>
<td>Financial Incentive</td>
<td>Corporate Tax Credit</td>
<td>01/10/2006</td>
<td>02/28/2018</td>
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<tr>
<td>Renewable Energy Tax Credit</td>
<td>US</td>
<td>Financial Incentive</td>
<td>Personal Tax Credit</td>
<td>08/10/2005</td>
<td>02/28/2018</td>
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<tr>
<td>Renewable Electricity Production Tax Credit (PTC)</td>
<td>US</td>
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<td>Corporate Tax Credit</td>
<td>03/11/2002</td>
<td>02/28/2018</td>
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<tr>
<td>Residential Energy Efficiency Tax Credit</td>
<td>US</td>
<td>Financial Incentive</td>
<td>Personal Tax Credit</td>
<td>01/10/2006</td>
<td>02/28/2018</td>
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<tr>
<td>U.S. Department of Energy - Indiana University-Purdue University Indianapolis Industrial Assessment Center (IAIC)</td>
<td>IL</td>
<td>Technical Resource</td>
<td>Energy Analysis</td>
<td>08/21/2015</td>
<td>09/11/2017</td>
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<td>U.S. Department of Energy - Industrial Assessment Center (IAIC) Bradley University</td>
<td>IL</td>
<td>Technical Resource</td>
<td>Energy Analysis</td>
<td>06/24/2015</td>
<td>09/10/2017</td>
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<td>U.S. Department of Energy - University of Wisconsin-Milwaukee Industrial Assessment Center (IAIC)</td>
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<td>Technical Resource</td>
<td>Energy Analysis</td>
<td>08/21/2015</td>
<td>05/19/2017</td>
</tr>
</tbody>
</table>

CHANGE for each location.

LOCATION: Ohio

In the DSIRE website, you can filter by state and technology. Here we filtered for Ohio and solar PV. There are currently only 3 active programs in the state for solar PV. Note that this is very low compared to many other states.
The COM financial prospect is complicated. Both EnergySage and PV Watts are incapable of dealing with it. If you want correct financials for COM projects, they will just get you in the ballpark. If you want a lifecycle cost, you need to use SAM. When the real cost is needed, you must use SAM – not EnergySage or PV Watts.
There are many factors that play into a cost analysis for a solar PV system:

• Total system cost
• Available incentives and tax credits: will lower the net cost of the system, and shorten the payback period for purchased systems.
• Financing model (loan, lease, PPA): depending on your financing model, your cash flow will change.
• System design: the tilt, orientation and possible shading will affect the system’s annual production.
• Utility rates: vary across utilities. Businesses with higher utility rates will save more money with a solar system, and will pay off the system faster.
You can use the EnergySage calculator for a cost analysis on residential and commercial properties. You will need to enter the site address, building sector (residential/commercial), and the estimated electricity bill into their 3 step calculator. This is a very simple calculator to get some rough ideas of cost and ROI.

https://www.energysage.com/solar/calculator/
After you enter the site address, building sector (residential/commercial), and the estimated electricity bill, the EnergySage calculator will give you a cost analysis for buying the system with cash, versus a loan, versus a Lease/PPA (if they are available in your area).

In this example, you can see that the cash system has the highest 20 year savings at $31K versus a loan at $21K, and a lease or PPA at $12K. In addition, a cash system has the highest (and only) out of pocket cost. This is reflected in the “Estimated Savings” graph. The cash graph (purple) starts out negative and then end with the greatest amount of savings. Both the loan and lease/PPA graphs start with zero out of pocket, but with a loan you will save more than with a lease or PPA.

It is also important to note that cash and loan systems will add property value to your home, where a lease/PPA will not.

https://www.energysage.com/solar/calculator/
EnergySage Calculator Demonstration

Project Profile: Small Business
Location: Golden, Colorado
Average monthly utility bill: $100

Open EnergySage Calculator and run through simulation:
https://www.energysage.com/solar/calculator/

Use the address of the training facility and their average monthly utility bill, if available. If not, use an estimate for average utility bill.
In addition to the solar calculator, EnergySage has a wealth of information on topics relating to solar PV. This is a great resource to share with your clients that are interested in solar PV. The website covers: why to go solar, solar 101, financing options, and more. They include consumer friendly graphics and videos to keep the consumer engaged.

https://www.energysage.com/solar
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https://www.energysage.com/solar
http://pvwatts.nrel.gov/
Step 1
Enter location
Step 2
Enter system information

DC System Size (kW): 10
Module Type: Standard
Array Type: Fixed (roof mount)
System Losses (%): 14
Tilt (deg): 20
Azimuth (deg): 160
### PV Watts Calculator

**RESULTS**

<table>
<thead>
<tr>
<th>Month</th>
<th>Solar Radiation (kWh/m²/day)</th>
<th>AC Energy (kWh)</th>
<th>Energy Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>2.86</td>
<td>769</td>
<td>85</td>
</tr>
<tr>
<td>February</td>
<td>2.60</td>
<td>683</td>
<td>94</td>
</tr>
<tr>
<td>March</td>
<td>3.10</td>
<td>1,018</td>
<td>144</td>
</tr>
<tr>
<td>April</td>
<td>4.01</td>
<td>1,438</td>
<td>199</td>
</tr>
<tr>
<td>May</td>
<td>5.50</td>
<td>1,872</td>
<td>174</td>
</tr>
<tr>
<td>June</td>
<td>6.80</td>
<td>1,672</td>
<td>174</td>
</tr>
<tr>
<td>July</td>
<td>6.72</td>
<td>1,546</td>
<td>171</td>
</tr>
<tr>
<td>August</td>
<td>5.34</td>
<td>1,460</td>
<td>162</td>
</tr>
<tr>
<td>September</td>
<td>5.61</td>
<td>1,277</td>
<td>147</td>
</tr>
<tr>
<td>October</td>
<td>4.40</td>
<td>1,070</td>
<td>119</td>
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<tr>
<td>November</td>
<td>3.21</td>
<td>785</td>
<td>87</td>
</tr>
<tr>
<td>December</td>
<td>2.78</td>
<td>718</td>
<td>79</td>
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<tr>
<td><strong>Annual</strong></td>
<td><strong>5.03</strong></td>
<td>14,385</td>
<td><strong>$1,591</strong></td>
</tr>
</tbody>
</table>

*System output may range from 13,369 to 14,609 kWh per year in this location. Click HERE for more information.*

**$1,591 Energy Savings**
Project Profile: Public Charter School
Location: Castle Rock, Colorado
Average monthly utility bill: $3,000+
Knowing the cost of electricity is very important. Demand charges on this project were 50% of the cost of electricity, which made PV much harder to justify at this time.
## PV Watts Calculator Demonstration

**Results**

System output may range from 235,282 to 334,905 kWh/yr per year near this location. Click NREL for more information.

**249,448 kWh/Year**

<table>
<thead>
<tr>
<th>Month</th>
<th>Solar Radiation (kWh/m²/day)</th>
<th>AC Energy (kWh)</th>
<th>Energy Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>2.02</td>
<td>12,690</td>
<td>739</td>
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<tr>
<td>February</td>
<td>2.43</td>
<td>14,475</td>
<td>898</td>
</tr>
<tr>
<td>March</td>
<td>4.03</td>
<td>21,837</td>
<td>1,282</td>
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<tr>
<td>April</td>
<td>5.74</td>
<td>25,450</td>
<td>1,405</td>
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<tr>
<td>May</td>
<td>6.29</td>
<td>28,289</td>
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<td>June</td>
<td>7.17</td>
<td>29,786</td>
<td>1,787</td>
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<tr>
<td>July</td>
<td>6.81</td>
<td>27,997</td>
<td>1,683</td>
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<tr>
<td>August</td>
<td>8.10</td>
<td>28,447</td>
<td>1,687</td>
</tr>
<tr>
<td>September</td>
<td>5.20</td>
<td>22,150</td>
<td>1,229</td>
</tr>
<tr>
<td>October</td>
<td>4.14</td>
<td>18,243</td>
<td>1,094</td>
</tr>
<tr>
<td>November</td>
<td>2.92</td>
<td>13,722</td>
<td>783</td>
</tr>
<tr>
<td>December</td>
<td>5.27</td>
<td>10,281</td>
<td>617</td>
</tr>
</tbody>
</table>

**Annual** 4.78 249,448 $ 14,966

Amount of energy and $ savings each year
For a more comprehensive cost analysis, use the System Advisory Model (SAM) created by the National Renewable Energy Laboratory. It was created for project managers and free to download. The tool provides both financial and performance results. This is not an online calculator, but instead is a program that you download and install on your computer.

https://sam.nrel.gov/
First step, select technology type and a financing model.

If you are deciding between two financing models, then you can run two simulations and compare the results.
Then you will enter the location by searching name or coordinates in the search box.

TIP: any box that is grey or blue will not accept inputs.
Then you will select your module model by searching or the name and selecting from the list.
Step 5
Select the inverter

Then on the next page you will select the inverter by searching the name or model number.
Next, you will design the system. You can either specify a desired system size or enter in the number of modules.

You will also need to enter in the ‘design factors’ for the system. These include: orientation/azimuth, tilt, and shading.

Steps 1-5 will generate a production analysis for the system.
Next, to calculate a financial analysis for the system, you will need to enter the system costs, financial parameters, and incentives.
Next, you need to enter the electricity rates and past consumption. You can search for electricity rates by zip code, the load them into the tool. You can find your clients past consumption on their utility bills or many utilities now have online accounts where you can download the data.

After you enter the utility information, select simulate.
The tool will then generate system production and financial analysis graphs and charts. Here is a screenshot of the summary page of the analysis. Here, you will find the most popular charts to present to your clients. There are a wide variety of charts available and you can create your own charts as well.

Now let's take a closer look at a couple of the charts.
Here is a monthly energy production graph. Here we can see what the system is estimated to produce each month of the year. Note, the production will fluctuate month to month, and will have a higher production either in the winter or summer depending on the tilt of the system.
Here we can see the monthly energy load. The dark blue is the production of the system, the grey is the consumption of the building, and the light blue is the NEM credit.

You can see in January and February the client consumed more electricity than the PV system produced, so there is no NEM credit. Then in March, the PV system produced more than what was consumed, resulting in a NEM credit. You can see the NEM credits start to build up until July when electricity consumption spikes and the credit is used.
# Solar Calculator Comparison

<table>
<thead>
<tr>
<th>Type of Analysis</th>
<th>EnergySage</th>
<th>PV Watts</th>
<th>SAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple financial analysis</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>PV production analysis</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Complex financial analysis</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>
## Summary

- Solar PV provides benefits for both the property owner and the community
- Two avenues for solar financing: purchased and third party owned
- Energy Sage Calculator can provide a quick cost analysis – residential or commercial
- PVWatts can provide simple feedback on the size and orientation of the system
- System Advisor Model (SAM) can provide an in-depth cost analysis
Quiz & Discussion
One ownership/financing option that allows the customer to pay a fixed cost for the kWh actually produced by the system is:

a) HomeStyle Energy Mortgage  
b) Third-party lease  
c) Cash purchase  
d) Power purchase agreement
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c) Cash purchase  
d) **Power purchase agreement**
In 2022, the Federal Investment Tax Credit will become permanent for residential/commercial PV projects at what rates?

a) 0% residential and 5% commercial  
b) 0% residential and 10% commercial  
c) 10% residential and 10% commercial  
d) 10% residential and 22% commercial
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a) 0% residential and 5% commercial
b) **0% residential and 10% commercial**
c) 10% residential and 10% commercial
d) 10% residential and 22% commercial
The DSIRE website (www.dsireusa.org) is a great resource for:

a) Finding available financial incentives for renewable energy and efficiency projects
b) Calculating approximate return-on-investment for solar projects
c) Determining the value of solar renewable energy credits (SRECs)
d) Selecting appropriate inverter type for a specific application
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