

# Solar America Cities



U.S. DEPARTMENT OF  
**ENERGY**

Every minute, enough solar radiation hits the earth to power the *entire United States for a year.*





# City Homes Go Solar!

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Credit: C. Bruce Forster

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Credit: Niagara Solar



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Photograph provided courtesy of Acciona

# Solar Energy Plants Power Cities

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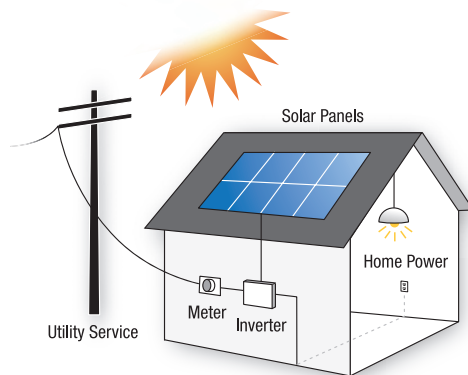


# How Solar Works

## What is a solar electric or photovoltaic system?

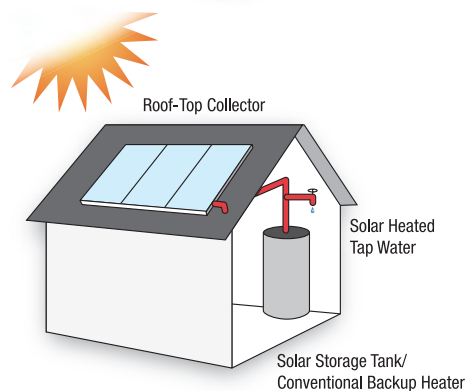
Photovoltaic (PV) systems convert sunlight directly to electricity. Unlike solar thermal systems for heating water, PV does not use the sun's *heat* to make electricity. Instead, electrons freed by the interaction of *sunlight* with semiconductor materials in PV cells are captured in an electric current.

Where utility power connections are available consumers can connect their PV systems to the utility grid to supplement electricity they need during cloudy days and at night. And when the PV system produces more energy than the consumer needs, the excess energy can be fed back into the utility grid to be used by others. Optional batteries can be added to a PV system to provide energy storage or backup power in case of a power interruption or utility outage.



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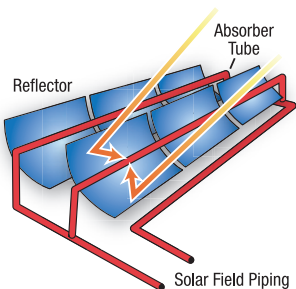
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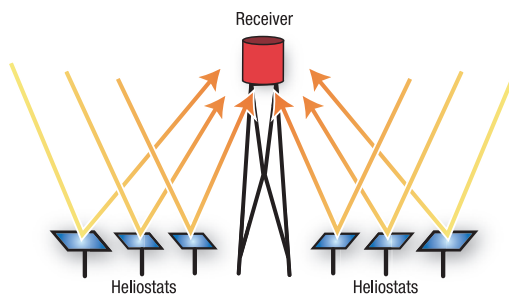
## What is concentrating solar power?

Unlike solar-electric and solar heating systems that are usually installed on buildings, concentrating solar power (CSP) systems are large-scale solar thermal power plants that use mirrors to convert the sun's energy into high-temperature heat. The heat is then used to produce steam which powers a turbine to generate electricity. There are three main types of CSP systems, each of which uses a different type of mirror configuration to attract the sun's heat: parabolic trough, power tower, and dish/engine.

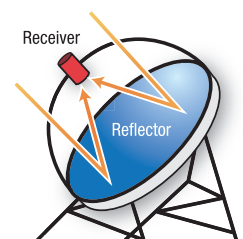
### Parabolic Trough CSP



### Power Tower CSP



### Dish/Engine CSP



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# Affordable \$olar for Homeowners

Solar energy systems have decreased in price over the past 15 years. Generous state and federal incentives can reduce the retail price of a solar system by 40% to 50%. Several cities offer additional financial incentives, making it even more affordable for homeowners to install solar.

▼ **NEW ORLEANS** residents can take advantage of a 50% state tax credit for solar energy systems.



▼ The PV system on this home in **AUSTIN, TEXAS**, was made possible with rebates from Austin Energy. The municipal utility provides one of the highest rebates in the country to help residential customers install solar energy systems—\$4.50 per watt for photovoltaic systems (which covers between 45% and 75% of the total cost), and \$1,500 to \$2,000 for solar hot water systems.



◀ **PORTLAND, OREGON**, residents can take advantage of cash incentives from the Energy Trust of Oregon and tax credits from the state and federal government to cover a significant portion of the total cost of a solar electric system, as shown in the example below:

**2-kilowatt system for Portland General Electric customers**

\$20,000	Total installed cost
-\$4,500	Energy Trust incentive (\$2.25 / watt x 2,000 watts)
\$15,500	Amount paid by customer to contractor
-\$6,000	Oregon tax credit (\$3.00 watt x 2,000 watts, \$6,000 cap)
-\$2,000	Federal tax credit (30% of \$15,500, \$2,000 cap)
<b>\$7,500</b>	<b>Final net cost to customer</b>

## Property Tax Financing of Solar

**BERKELEY, CALIFORNIA** is the first city in the nation to propose a financing program that would allow property owners to pay for solar energy systems and energy efficiency improvements as a voluntary 20-year assessment on their individual property tax bill. The city would cover the up-front costs of the solar installations, and the tax assessment would be transferable between owners. Several cities are examining the possibility of adopting a similar program.

**SAN FRANCISCO'S SOLAR ENERGY INCENTIVE PROGRAM**

provides the following incentives for residential solar installations:

	Total Rebate to Homeowner
Basic incentive	\$3,000
City installer incentive for using a San Francisco-based installer	\$4,000
Environmental justice incentive for installations in designated lower income and racially diverse neighborhoods	\$5,000



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# \$olar Financing for Business & Government

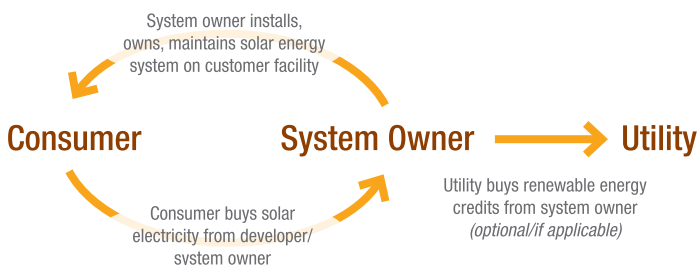
Businesses and local governments are finding creative ways to finance solar energy projects. In addition to financial incentives such as rebates and tax credits, many commercial businesses and government agencies are taking advantage of power purchase agreements to eliminate the high up-front costs of solar installations.



▲ The **CITY OF SAN DIEGO** installed a 1-megawatt solar power system atop three water reservoirs at the city's Alvarado Water Treatment Plant. This system generates about 20 percent of the plant's power, with annual savings estimated at \$40,000. The system was built under a power purchase agreement with SunEdison. Under the agreement, the company installed the photovoltaic system at no cost to the city, avoiding an estimated a \$6.5 million installation cost. SunEdison owns and maintains the solar system, and sells the solar energy to the city's Water Department at rates lower than market price.

## What is a Power Purchase Agreement?

Instead of purchasing a solar energy system, the customer agrees to host the system and purchase the electricity from the system owner/developer at a locked-in rate over a long-term period. The contract to purchase this electricity is called the power purchase agreement or PPA. PPAs are typically used for large installations at commercial or municipal facilities.



► Through its 28-store partnership with SunPower, **MACY'S** has committed to installing a total of 8.9 megawatts of solar power systems on its California stores. For 17 of the 28 stores, Macy's will purchase solar-generated electricity under the SunPower Access™ program, a solar services agreement that allows the retailer to purchase just the electricity generated at its stores—not the solar power systems.



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Credit: Urban Ecology Center

# Solar: Bringing Jobs to a City Near You!

A strong local solar industry not only lays the foundation for a sustainable solar market—it brings job growth and economic development to local communities. Cities recognize these benefits, and are working to develop a solar workforce by establishing training programs for solar installers and attracting solar businesses to the local area.

▲ Workers install photovoltaic panels on **MILWAUKEE, WISCONSIN**'s Urban Ecology Center. The decline of manufacturing jobs in the city has increased unemployment rates and left the city with brownfield sites. The city is striving to revitalize its manufacturing base by promoting a local solar manufacturing industry. In 2006, 17,600 new solar jobs were created in the United States.

## Solar Installer Training

Colleges and universities in several cities are developing training programs for solar installers. This is a just a small sampling:

- **Los Rios Community College District in Sacramento, California**
- **The City University of New York (CUNY)**
- **Houston Community College and the University of Houston**

◀ The **FLORIDA SOLAR ENERGY CENTER** offers a number of photovoltaics training programs and workshops.



Credit: Florida Solar Energy Center

## Attracting Solar Businesses

**TUCSON, ARIZONA**, is the new home of Global Solar Energy, Inc.'s cutting-edge 40-MW thin-film Copper Indium Gallium diSelenide (CIGS) solar factory—the largest CIGS plant in the United States and one of the largest thin-film photovoltaic (PV) factories in the world. ▶

**SACRAMENTO, CALIFORNIA**, is working to attract existing and start-up solar companies to its Clean/Green Technology Incentive Zone. This will help spur growth in the solar market and will help Sacramento become a center of innovation while creating new jobs for its residents.

**PACIFIC GAS & ELECTRIC**, the utility that serves San Francisco and much of northern and central California, has entered into a contract to buy 177 megawatts of power from a solar thermal power plant that will be built by Ausra, a company that develops and deploys utility-scale solar technologies. Ausra projects that the power plant will create over 350 skilled jobs on-site during construction, and an additional 100 permanent jobs in the area.



Credit: Global Solar Energy



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Credit: Russell Harper, Jr.

# Schools Go Solar!

Schools around the country are installing solar energy systems, and using them as teaching tools for their students. Schools are an excellent public location to showcase the benefits of solar energy. Not only do they educate our children, they also teach the entire community about the benefits of solar energy.

▲ Energize Minds for Solar Design!  
The **SACRAMENTO MUNICIPAL UTILITY DISTRICT (SMUD)**, the city's publicly-owned electric utility, provides grants to educators and students for solar projects that help teach about solar technology and practical applications. **WILL ROGERS MIDDLE SCHOOL**, the first recipient of the SMUD grant, broke ground in June 2007 on a new 144-square-foot, solar-powered broadcasting studio. The students will educate classrooms across the country about solar technology and environmental sustainability through podcasts and live radio and television broadcasts.



▲ Students at **O'HENRY MIDDLE SCHOOL** in **AUSTIN, TEXAS** celebrate their new solar installation, made possible through Austin Energy's Solar for Schools Program. O'Henry is one of 14 Austin area solar schools participating in the program. Students can monitor the energy production from the solar installations via a statewide Web site. The Texas Solar for Schools Program hopes to eventually install solar panels at every school in the state.



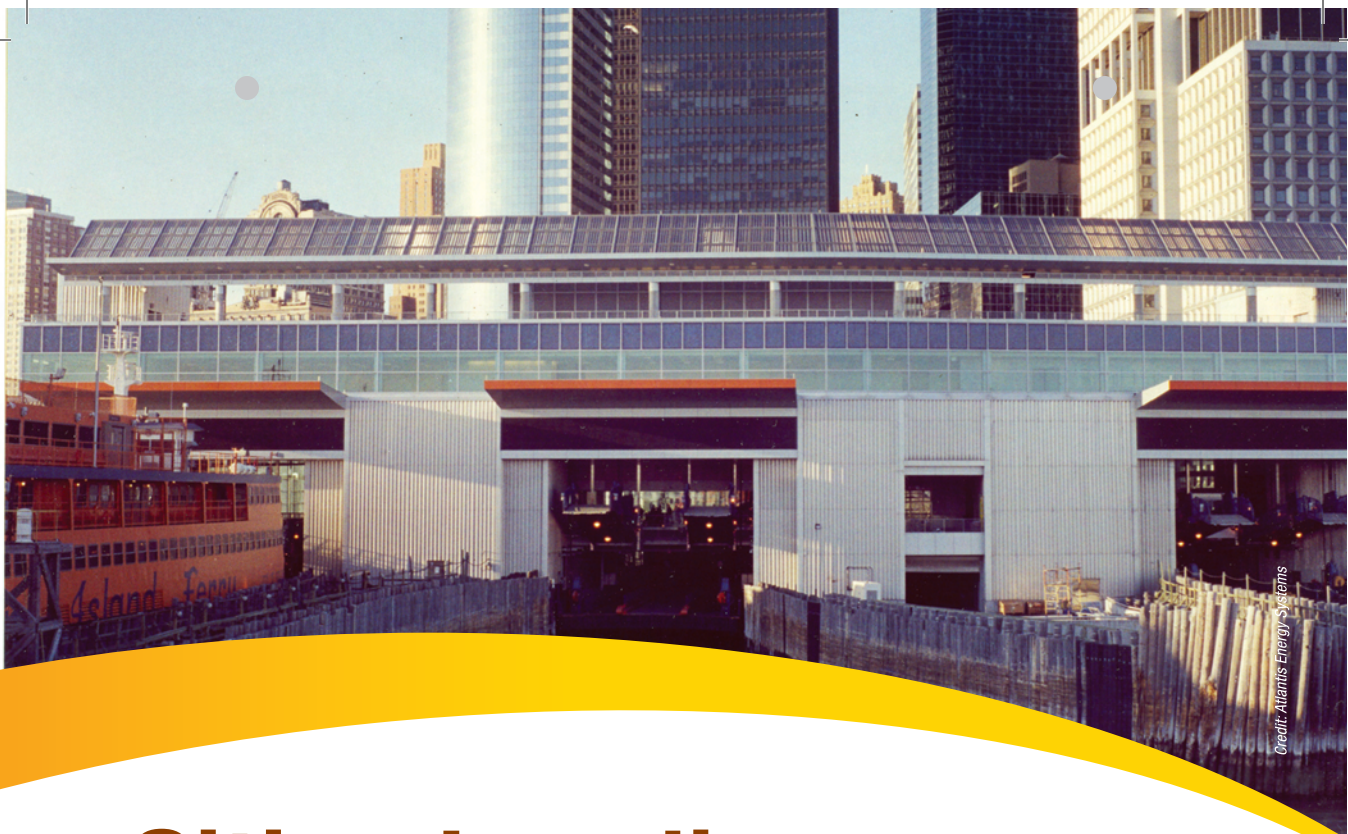
◀ A monitor in the front lobby of the **BRONX HIGH SCHOOL OF SCIENCE** in **NEW YORK CITY** allows students and faculty to monitor the status of the school's rooftop solar array. The solar data collected by the students can be used in analysis activities in the classroom.



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Credit: Atlantis Energy Systems

# Cities Leading by Example

Cities looking to reduce energy costs and combat climate change are setting an example for their communities by installing solar energy systems at city facilities. Public buildings are great locations for educating the public about environmental sustainability. Cities are also looking to solar energy to help prepare for emergencies.

## Solar for Emergency Preparedness

Studies have shown that large-scale deployment of solar photovoltaics (PV) could have prevented the New York City blackouts of 1999 and 2003. When connected to batteries, PV can serve as an uninterrupted power supply to buildings and critical infrastructure, and solar thermal systems can provide heating and hot water if utility service is interrupted. Emergency power and disaster response needs can be met with mobile PV generators, PV-powered back-up systems, and grid-independent emergency phones—all of which can be cost-effectively and reliably integrated into cities' ongoing emergency and homeland security planning efforts.

▲ This 40-kilowatt, building-integrated photovoltaic array at **NEW YORK CITY'S WHITEHALL FERRY TERMINAL** generates electricity and allows sunlight to stream through the canopy panels, providing daylight to interior areas. New York City is one of several Solar America Cities making a *major commitment* to solar energy. In April 2008, Mayor Michael R. Bloomberg announced plans to install 2 megawatts of solar panels on city-owned buildings in all five boroughs.



▲ **THE CITY OF BERKELEY'S SHOREBIRD PARK NATURE CENTER** is the first city-owned straw bale building in the United States. It has a solar hot water radiant system to provide heating year-round in the cool marina climate, and a solar electric system to power the aquarium's computers, lighting and other equipment.



◀ In October 2007, **ANN ARBOR'S FIRE DEPARTMENT HEADQUARTERS** became the first fire station in Michigan to install a solar hot water system. The system provides the Ann Arbor firemen with hot water for showers, clothes washing, and other hot water needs. If there is an interruption to power or heating fuel supplies at the local utility, this solar hot water system will ensure that the firemen are taken care of and better able to serve their community during emergencies. The system is expected to save \$600/year in natural gas costs—savings that could help the city pay for additional first responder resources.



Credit: John Thornton

▲ The **FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)** helps to distribute trailer-mounted, solar emergency power generators to areas that are recovering from disasters.



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# Building-Integrated Solar Technologies

New advances in solar technology and roof-mounted systems have created more stylish systems that blend into their surroundings. Some systems are nearly invisible and can replace traditional building materials such as roof shingles and window awnings.



▲ The first model for demonstrating the integration of photovoltaics (PV) into a federal building is the sky-lighted entryway of the Thoreau Center for Sustainability at **PRESIDIO NATIONAL PARK** in **SAN FRANCISCO, CALIFORNIA**. Laminated to the skylight glass are PV cells that produce electricity while providing shading and day lighting.



▲ The 4 Times Square building in **NEW YORK CITY** has a photovoltaic "skin" on the upper floors, in which thin-film PV panels replace traditional glass cladding material. The system provides enough energy to power the equivalent of five to seven homes.



▲ Solar electric roof shingles can be integrated seamlessly into the roof structure, as shown on this California home.

◀ In this first-of-its-kind application, low-cost, thin-film photovoltaic panels (210 kilowatts) were combined with clear glass in custom glazing units to provide the right balance of shelter, lighting, and electricity generation at **CONY ISLAND'S STILLWELL AVENUE TERMINAL** in **NEW YORK**.



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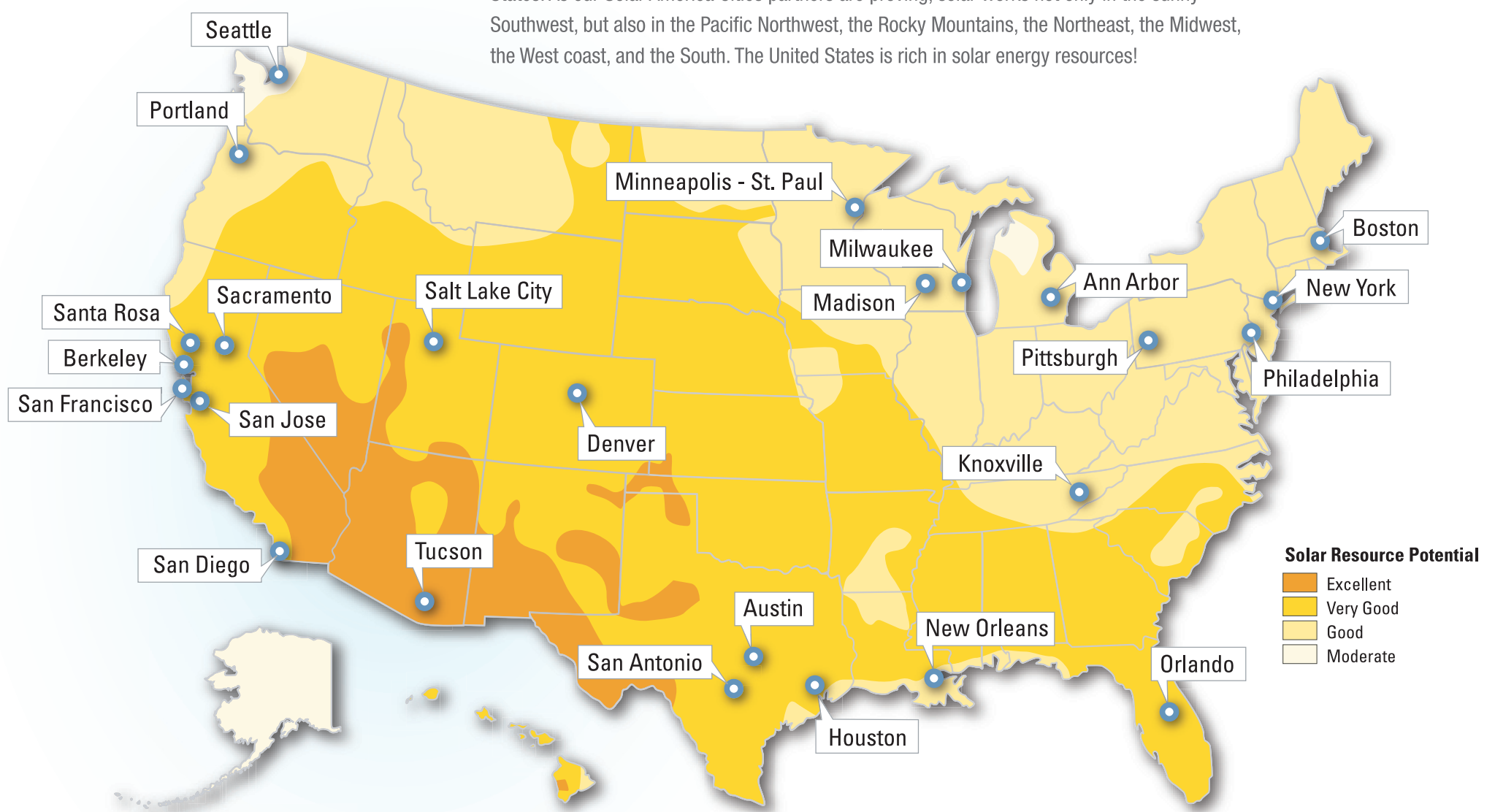


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## The U.S. Department of Energy Teams Up with Cities to Build a Sustainable Solar Market

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Solar energy technologies can provide power and heat just about *anywhere* in the United States. As our Solar America Cities partners are proving, solar works not only in the sunny Southwest, but also in the Pacific Northwest, the Rocky Mountains, the Northeast, the Midwest, the West coast, and the South. The United States is rich in solar energy resources!



### Cities across the United States are turning to solar!



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The U.S. Department of Energy has partnered with 25 cities that have committed to accelerating the adoption of solar energy technologies. These Solar America Cities are helping to lay the foundation for a solar energy market that will serve as a model for cities around the nation. Cities are using a variety of innovative approaches to remove market barriers and increase solar energy use, from creative financing, to education and workforce development, to solar-friendly building codes and policies. Cities are also using solar energy to help prepare for emergencies, and are making solar a part of their energy plans for a clean energy future.





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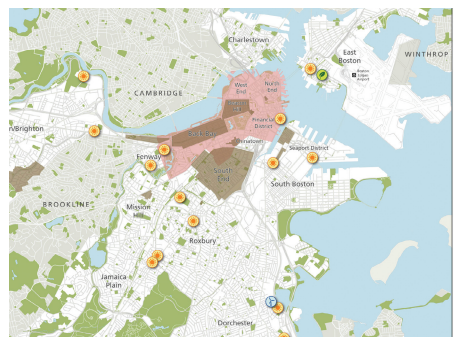
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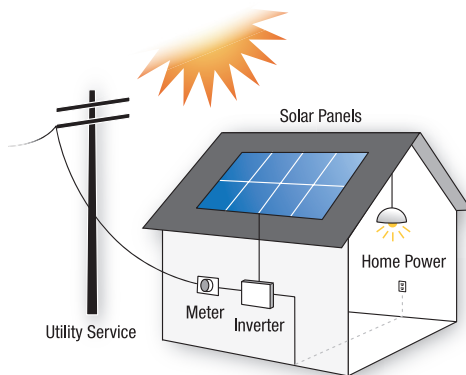


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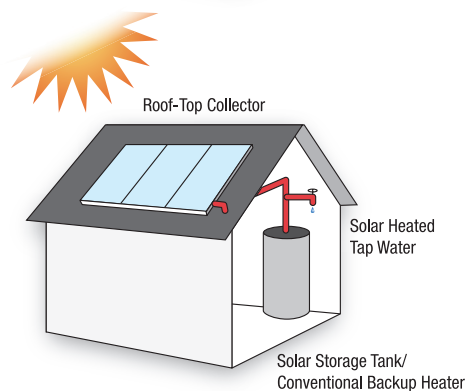
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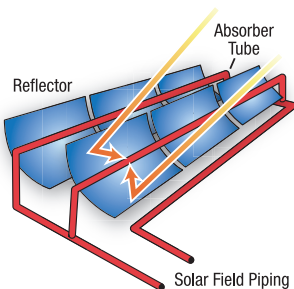
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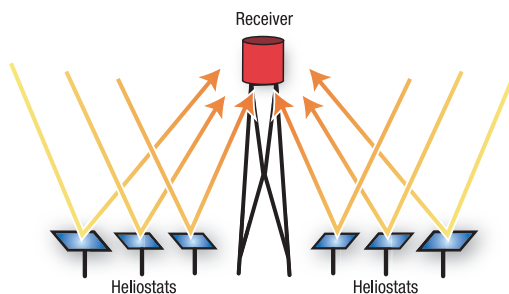
## What is concentrating solar power?

Unlike solar-electric and solar heating systems that are usually installed on buildings, concentrating solar power (CSP) systems are large-scale solar thermal power plants that use mirrors to convert the sun's energy into high-temperature heat. The heat is then used to produce steam which powers a turbine to generate electricity. There are three main types of CSP systems, each of which uses a different type of mirror configuration to attract the sun's heat: parabolic trough, power tower, and dish/engine.

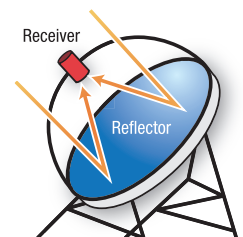
### Parabolic Trough CSP



### Power Tower CSP



### Dish/Engine CSP



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# Affordable \$olar for Homeowners

Solar energy systems have decreased in price over the past 15 years. Generous state and federal incentives can reduce the retail price of a solar system by 40% to 50%. Several cities offer additional financial incentives, making it even more affordable for homeowners to install solar.

▼ **NEW ORLEANS** residents can take advantage of a 50% state tax credit for solar energy systems.



▼ The PV system on this home in **AUSTIN, TEXAS**, was made possible with rebates from Austin Energy. The municipal utility provides one of the highest rebates in the country to help residential customers install solar energy systems—\$4.50 per watt for photovoltaic systems (which covers between 45% and 75% of the total cost), and \$1,500 to \$2,000 for solar hot water systems.



◀ **PORTLAND, OREGON**, residents can take advantage of cash incentives from the Energy Trust of Oregon and tax credits from the state and federal government to cover a significant portion of the total cost of a solar electric system, as shown in the example below:

**2-kilowatt system for Portland General Electric customers**

\$20,000	Total installed cost
-\$4,500	Energy Trust incentive (\$2.25 / watt x 2,000 watts)
\$15,500	Amount paid by customer to contractor
-\$6,000	Oregon tax credit (\$3.00 watt x 2,000 watts, \$6,000 cap)
-\$2,000	Federal tax credit (30% of \$15,500, \$2,000 cap)
<b>\$7,500</b>	<b>Final net cost to customer</b>



## Property Tax Financing of Solar

**BERKELEY, CALIFORNIA** is the first city in the nation to propose a financing program that would allow property owners to pay for solar energy systems and energy efficiency improvements as a voluntary 20-year assessment on their individual property tax bill. The city would cover the up-front costs of the solar installations, and the tax assessment would be transferable between owners. Several cities are examining the possibility of adopting a similar program.

**SAN FRANCISCO'S SOLAR ENERGY INCENTIVE PROGRAM**

provides the following incentives for residential solar installations:

	Total Rebate to Homeowner
Basic incentive	\$3,000
City installer incentive for using a San Francisco-based installer	\$4,000
Environmental justice incentive for installations in designated lower income and racially diverse neighborhoods	\$5,000



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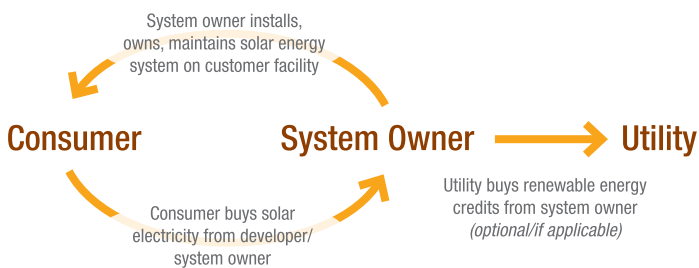


# \$olar Financing for Business & Government

Businesses and local governments are finding creative ways to finance solar energy projects. In addition to financial incentives such as rebates and tax credits, many commercial businesses and government agencies are taking advantage of power purchase agreements to eliminate the high up-front costs of solar installations.

## What is a Power Purchase Agreement?

Instead of purchasing a solar energy system, the customer agrees to host the system and purchase the electricity from the system owner/developer at a locked-in rate over a long-term period. The contract to purchase this electricity is called the power purchase agreement or PPA. PPAs are typically used for large installations at commercial or municipal facilities.



▶ Through its 28-store partnership with SunPower, **MACY'S** has committed to installing a total of 8.9 megawatts of solar power systems on its California stores. For 17 of the 28 stores, Macy's will purchase solar-generated electricity under the SunPower Access™ program, a solar services agreement that allows the retailer to purchase just the electricity generated at its stores—not the solar power systems.



▲ The **CITY OF SAN DIEGO** installed a 1-megawatt solar power system atop three water reservoirs at the city's Alvarado Water Treatment Plant. This system generates about 20 percent of the plant's power, with annual savings estimated at \$40,000. The system was built under a power purchase agreement with SunEdison. Under the agreement, the company installed the photovoltaic system at no cost to the city, avoiding an estimated a \$6.5 million installation cost. SunEdison owns and maintains the solar system, and sells the solar energy to the city's Water Department at rates lower than market price.



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# Solar: Bringing Jobs to a City Near You!

A strong local solar industry not only lays the foundation for a sustainable solar market—it brings job growth and economic development to local communities. Cities recognize these benefits, and are working to develop a solar workforce by establishing training programs for solar installers and attracting solar businesses to the local area.

▲ Workers install photovoltaic panels on **MILWAUKEE, WISCONSIN**'s Urban Ecology Center. The decline of manufacturing jobs in the city has increased unemployment rates and left the city with brownfield sites. The city is striving to revitalize its manufacturing base by promoting a local solar manufacturing industry. In 2006, 17,600 new solar jobs were created in the United States.

## Solar Installer Training

Colleges and universities in several cities are developing training programs for solar installers. This is a just a small sampling:

- **Los Rios Community College District** in Sacramento, California
- **The City University of New York (CUNY)**
- **Houston Community College and the University of Houston**

◀ The **FLORIDA SOLAR ENERGY CENTER** offers a number of photovoltaics training programs and workshops.



## Attracting Solar Businesses

**TUCSON, ARIZONA**, is the new home of Global Solar Energy, Inc.'s cutting-edge 40-MW thin-film Copper Indium Gallium diSelenide (CIGS) solar factory—the largest CIGS plant in the United States and one of the largest thin-film photovoltaic (PV) factories in the world. ▶

**SACRAMENTO, CALIFORNIA**, is working to attract existing and start-up solar companies to its Clean/Green Technology Incentive Zone. This will help spur growth in the solar market and will help Sacramento become a center of innovation while creating new jobs for its residents.

**PACIFIC GAS & ELECTRIC**, the utility that serves San Francisco and much of northern and central California, has entered into a contract to buy 177 megawatts of power from a solar thermal power plant that will be built by Ausra, a company that develops and deploys utility-scale solar technologies. Ausra projects that the power plant will create over 350 skilled jobs on-site during construction, and an additional 100 permanent jobs in the area.



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Credit: Russell Harper, Jr.

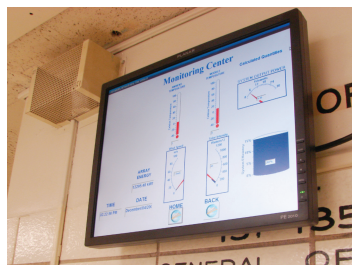
# Schools Go Solar!

Schools around the country are installing solar energy systems, and using them as teaching tools for their students. Schools are an excellent public location to showcase the benefits of solar energy. Not only do they educate our children, they also teach the entire community about the benefits of solar energy.

▲ Energize Minds for Solar Design!  
The **SACRAMENTO MUNICIPAL UTILITY DISTRICT (SMUD)**, the city's publicly-owned electric utility, provides grants to educators and students for solar projects that help teach about solar technology and practical applications. **WILL ROGERS MIDDLE SCHOOL**, the first recipient of the SMUD grant, broke ground in June 2007 on a new 144-square-foot, solar-powered broadcasting studio. The students will educate classrooms across the country about solar technology and environmental sustainability through podcasts and live radio and television broadcasts.



▲ Students at **O'HENRY MIDDLE SCHOOL** in **AUSTIN, TEXAS** celebrate their new solar installation, made possible through Austin Energy's Solar for Schools Program. O'Henry is one of 14 Austin area solar schools participating in the program. Students can monitor the energy production from the solar installations via a statewide Web site. The Texas Solar for Schools Program hopes to eventually install solar panels at every school in the state.



◀ A monitor in the front lobby of the **BRONX HIGH SCHOOL OF SCIENCE** in **NEW YORK CITY** allows students and faculty to monitor the status of the school's rooftop solar array. The solar data collected by the students can be used in analysis activities in the classroom.



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Credit: Atlantis Energy Systems

# Cities Leading by Example

Cities looking to reduce energy costs and combat climate change are setting an example for their communities by installing solar energy systems at city facilities. Public buildings are great locations for educating the public about environmental sustainability. Cities are also looking to solar energy to help prepare for emergencies.

## Solar for Emergency Preparedness

Studies have shown that large-scale deployment of solar photovoltaics (PV) could have prevented the New York City blackouts of 1999 and 2003. When connected to batteries, PV can serve as an uninterrupted power supply to buildings and critical infrastructure, and solar thermal systems can provide heating and hot water if utility service is interrupted. Emergency power and disaster response needs can be met with mobile PV generators, PV-powered back-up systems, and grid-independent emergency phones—all of which can be cost-effectively and reliably integrated into cities' ongoing emergency and homeland security planning efforts.

▲ This 40-kilowatt, building-integrated photovoltaic array at **NEW YORK CITY'S WHITEHALL FERRY TERMINAL** generates electricity and allows sunlight to stream through the canopy panels, providing daylight to interior areas. New York City is one of several Solar America Cities making a *major commitment* to solar energy. In April 2008, Mayor Michael R. Bloomberg announced plans to install 2 megawatts of solar panels on city-owned buildings in all five boroughs.



▲ **THE CITY OF BERKELEY'S SHOREBIRD PARK NATURE CENTER** is the first city-owned straw bale building in the United States. It has a solar hot water radiant system to provide heating year-round in the cool marina climate, and a solar electric system to power the aquarium's computers, lighting and other equipment.



◀ In October 2007, **ANN ARBOR'S FIRE DEPARTMENT HEADQUARTERS** became the first fire station in Michigan to install a solar hot water system. The system provides the Ann Arbor firemen with hot water for showers, clothes washing, and other hot water needs. If there is an interruption to power or heating fuel supplies at the local utility, this solar hot water system will ensure that the firemen are taken care of and better able to serve their community during emergencies. The system is expected to save \$600/year in natural gas costs—savings that could help the city pay for additional first responder resources.



Credit: John Thompson

▲ The **FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)** helps to distribute trailer-mounted, solar emergency power generators to areas that are recovering from disasters.



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# Building-Integrated Solar Technologies

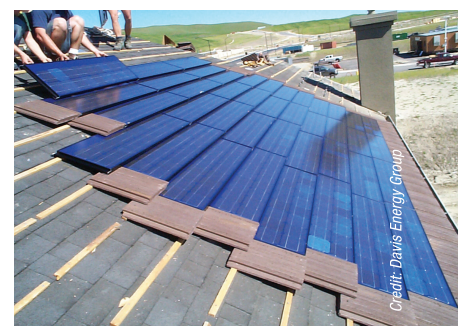
New advances in solar technology and roof-mounted systems have created more stylish systems that blend into their surroundings. Some systems are nearly invisible and can replace traditional building materials such as roof shingles and window awnings.



▲ The first model for demonstrating the integration of photovoltaics (PV) into a federal building is the sky-lighted entryway of the Thoreau Center for Sustainability at **PRESIDIO NATIONAL PARK** in **SAN FRANCISCO, CALIFORNIA**. Laminated to the skylight glass are PV cells that produce electricity while providing shading and day lighting.



▲ The 4 Times Square building in **NEW YORK CITY** has a photovoltaic "skin" on the upper floors, in which thin-film PV panels replace traditional glass cladding material. The system provides enough energy to power the equivalent of five to seven homes.



▲ Solar electric roof shingles can be integrated seamlessly into the roof structure, as shown on this California home.

◀ In this first-of-its-kind application, low-cost, thin-film photovoltaic panels (210 kilowatts) were combined with clear glass in custom glazing units to provide the right balance of shelter, lighting, and electricity generation at **CONEY ISLAND'S STILLWELL AVENUE TERMINAL** in **NEW YORK**.



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