

The History of Solar Energy

A Look at Uses of Solar Energy from BC to ITC

Overview

Solar energy has been harnessed as a form of light and heat since early mankind. From rudimentary uses as a source of heat in Roman bath houses and Anasazi dwellings to today's utility-scale power stations; solar energy has been a constant and vital presence in mankind's everyday life. As technology has advanced, the uses of solar have diversified, expanded and become commercialized. Advancements in solar technology sped up exponentially in the last century and the future appears promising.

Early History

Magnifying glasses and mirrors are used to concentrate the sun's rays on a fuel and ignite a fire for light, warmth and cooking. As early as 212 B.C., Greek scientist Archimedes applied the reflective properties of bronze shields to focus sunlight and set fire to Rome's wooden ships, which were besieging Syracuse. Civilizations from Rome to North America begin building homes and bath houses that face the sun in order to capture its heat.

Renaissance and Enlightenment

1500s

Leonardo da Vinci sketched concentrating collectors that would track the sun and focus sunlight onto a central receiver and he began building such a collector in 1515.

1767

Swiss scientist Horace de Saussure is credited with building the world's first solar collector, later used by Sir John Herschel to cook food during his South African expedition in the 1830s.

The 19th Century

1839

French scientist Edmond Becquerel discovers the photovoltaic effect while experimenting with an electrolytic cell made up of two metal electrodes placed in an electricity-conducting solution; the electricity generation increases when exposed to light.

Ancient Use of Passive Solar

This densely populated Anasazi community was built into the cliff side in a compact plans during the Classic Pueblo Period (A.D. 1100-1300). The open front of the dwellings often faced southwest to absorb the most solar energy, while the back of the cliff protected them from cold northern winds. The cliff overhangs let the winter sun in, but shaded villagers from the more intense summer sun.



Figure 1

1891

Baltimore inventor Clarence Kemp patents the first commercial solar water heater.

The 20th Century

1908

William J. Bailey of the Carnegie Steel Company invents a solar thermal collector with copper coils and an insulated box, which is roughly the same collector design used today.

1921

Albert Einstein wins the Nobel Prize for his theories in a 1905 paper, which explained that light would have to be both wave and particle (photon). This is called the photoelectric effect.

1954

Photovoltaic technology is born in the United States when Daryl Chapin, Calvin Fuller and Gerald Pearson develop the silicon photovoltaic (or PV) cell at Bell Labs. Bell Telephone Laboratories then produced a silicon solar cell with 6 percent efficiency.

1956

Architect Frank Bridgers designs the world's first commercial office building featuring solar water heating and passive design. The Bridgers-Paxton building (Figure 2) still stands today and is on the National Register of Historical Buildings.



Figure 2

Solar Technology Reaches the Masses



Figure 3

The photo above is of the original Bell Solar Battery (photovoltaic panel) created in 1954. The next year, Western Electric began to sell commercial licenses for the creation of silicon photovoltaic technologies like the solar powered radio seen below.

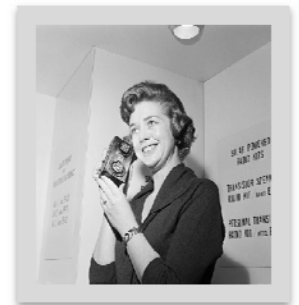


Figure 4

Solar Technology takes to the Road and Skies



Figure 5

In 1981, Paul MacCready built the first solar-powered aircraft, the *Solar Challenger* (above), and flew it across the English Channel. The aircraft had more than 16,000 wing-mounted solar cells and produced 3,000 watts of power. The next year, Australian Hans Tholstrup drove the first solar-powered car, the *Quiet Achiever* (below), almost 2,800 miles between Sydney and Perth in 20 days — 10 days faster than the first gasoline-powered car to do so.



Figure 6

1958

The Vanguard I space satellite, Explorer III, Vanguard II, and Sputnik-3 are launched with PV-powered systems on board. Silicon solar cells become the most widely accepted energy source for space applications and remain so today.

1974

The Solar Energy Industries Association (SEIA) is founded by 5 industry members in Washington, D.C. and Sheldon Butt is elected as its first President.

1976

The NASA Lewis Research Center starts installing the first of 83 photovoltaic power systems on every continent except Australia. They provide power for vaccine refrigeration, room lighting, medical clinic lighting, telecommunications, water pumping, grain milling and classroom television. The project takes place from 1976 to 1985 and then from 1992 to completion in 1995.

1978

NASA's Lewis Research Center installs a 3.5-kilowatt photovoltaic system on the Papago Indian Reservation in southern Arizona—the world's first village PV system. It provides power for water pumping and residential electricity in 15 homes until 1983, when grid power reaches the village. The PV system is then dedicated to pumping water from a community well.

1979

President Carter installs SWH on White House; first investment tax credit that spurs installation of residential SWH systems.

1983

ARCO Solar dedicates a 6-megawatt photovoltaic substation in central California. The 120-acre, unmanned facility supplies Pacific Gas & Electric Company's utility grid with enough power for up to 2,500 homes.

Solar Design Associates completes a home powered by an integrated, stand-alone, 4-kilowatt photovoltaic system in the Hudson River Valley.

1986

The world's largest solar thermal electric facility is commissioned in Kramer Junction, California. Generating 150 MW, the solar field contains rows of mirrors that concentrate the sun's energy onto a system of pipes circulating a heat transfer fluid. The heat transfer fluid is used to produce steam, which powers a conventional turbine to generate electricity.

ARCO Solar releases the G-4000 — the world's first commercial thin-film module.

President Regan removes solar panels from the White House.

1994

NREL develops a solar cell made of gallium indium phosphide and gallium arsenide, the first one of its kind to exceed 30 percent conversion efficiency.

1999

Construction is completed on 4 Times Square in New York (Figure 7), the tallest skyscraper built in the city in the 1990s. It has more energy-efficient features than any other commercial skyscraper and includes building-integrated photovoltaic (BIPV) panels on Floors 37 through 43 on the south- and west-facing facades to produce part of the building's power.



Figure 7

Recent History

2000

The 12-kilowatt solar electric system of a Colorado family is the largest residential installation in the United States to be registered with the U.S. Department of Energy's Million Solar Roofs program. The system provides most of the electricity for the family of eight's 6,000-square-foot home.

2001

Home Depot begins selling residential solar power systems in three stores in San Diego, California. A year later it expands sales to 61 stores nationwide.

2005

The Energy Policy Act is passed, creating an energy and research development program covering various renewable, energy efficient, and climate change technology. The act directs the Federal government to implement an energy conservation program for federal facilities and enacts the 30-percent investment tax credit for installing solar energy systems.

The Energy Policy Act of 2005 (EPAct 05) created a new commercial and residential ITC for fuel cells and solar energy systems that applied from January 1, 2006 through December 31, 2007.

2007

Nevada Solar One comes online with 64 megawatts, first CSP plant built in 17 years.

Solar ITC is extended for another year.

2008

In October, President Bush signs the Emergency Economic Stabilization Act of 2008, a piece of legislation that contains a number of tax incentives designed to encourage both individuals and businesses to make investments in solar energy which includes 8-year extensions of the section 48 business solar investment tax credit (ITC) and the section 25D residential solar ITC.

2009

President Obama signs the American Recovery and Reinvestment Act. Top solar provisions include the creation of a Department of Treasury Grant Program, an improvement to the investment tax credit by eliminating ITC penalties for subsidized energy financing, a new DOE Loan Guarantee Program, creation of tax incentives for manufacturing by offering accelerated depreciation and a 30 percent refundable tax credit for the purchase of manufacturing equipment used to produce solar material and components for all solar technologies.

The House passes a bill including provisions that will significantly brighten solar's future. This included a renewable energy mandate, safeguards to limit global warming pollution damage, new authority to get solar energy to markets, and authority for the federal government to enter 20-year solar contracts.

Solar Hits the Big Stage

In 2007, Nevada's Solar One was completed and came online. The 64 megawatt facility is the largest utility-scale concentrating solar power (CSP) plant since the 1980s in the US.



Figure 8



Figure 9

About the Solar Energy Industries Association

Established in 1974, the Solar Energy Industries Association is the national trade association of the U.S. solar energy industry. As the voice of the industry, SEIA works with its 1,000 member companies to make solar a mainstream and significant energy source by expanding markets, removing market barriers, strengthening the industry and educating the public on the benefits of solar energy.

For a referenced version of this factsheet and more information, please visit www.seia.org.

Works Cited

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Photo Credits

- Figure 1: *Anasazi cliff dwellings demonstrate passive solar design*. Digital image. *Energy Efficiency and Renewable Energy*. US Department of Energy, 11 July 08. 29 July 2009. <http://www1.eere.energy.gov/solar/solar_time_7bc-1200ad.html>.

Figure 2: Bridgers-Paxton Building in Albuquerque, NM. Digital image. *Buildings Technology Program*. US Department of Energy, 2009.

Web. 29 July 2009. <<http://www.artistsdomain.com/dev/eere/web/1956.html>>.

Figure 3: Original Bell Solar Battery. Digital image. *1954: The Solar Cell*. AT&T, 11 June 09. Web. 29 July 2009.

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Figure 4: *Woman Holding Solar Powered Radio*. Digital Image. Kovarik, PHD, Bill. "Photovoltaics." *The Summer Spirit*. Radford University,

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Figure 5: *The Solar Challenger*. Digital Image. Kovarik, PHD, Bill. "Photovoltaics." *The Summer Spirit*. Radford University, 2009. 29 July

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Figure 6: *The Quiet Achiever*. Digital Image. Snooks, Tom. "The Little Car that Could." *The Quiet Achiever- BP Solar Car Crossing of*

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Figure 7: *4 Times Square*. Digital Image. *Energy Efficiency and Renewable Energy*. US Department of Energy, 24 June 09. 29 July 2009. <

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Figure 8: *Aerial View Nevada's Solar One Panel Farm*. "Renewable Energy." NV Energy, 2009. Web. 29 July 2009.

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Figure 9: *Close up Details of the Installation at Nevada's Solar One Panel Farm*. "Renewable Energy." NV Energy, 2009.

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