Solar Energy Industries Association®

SAVING MONEY & ENERGY:

How Solar Heating & Cooling is Paying Big Dividends for U.S. Businesses

505 9TH STREET NW | SUITE 800 | WASHINGTON DC 20004 | 202.862.0556 | WWW.SEIA.ORG

Solar Energy Industries Association

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This report was prepared by: Katherine Stainken and Holt Mountcastle.

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Executive Summary

Many businesses and commercial building owners have already taken steps to reduce their electricity bills by making energy efficiency improvements and installing renewable energy systems. But that is only the beginning. Across the country, business owners and commercial building owners are now catching on to the hidden treasure that is solar heating and cooling (SHC).

SHC systems are based on a simple process everyone is familiar with: Things left in the sun tend to heat up. With SHC technology, this thermal energy can be efficiently captured by solar collectors and transferred to heating or cooling applications, easily integrating into most buildings.

Given that heating and cooling are huge energy drains—representing 35 percent of commercial buildings' energy usage—the potential benefits of SHC technology, both in terms of dollars saved and carbon emissions reduced, are enormous.

SHC systems are unique in that they generate thermal energy on site and displace the price-volatile fossil fuels traditionally used for heating and cooling. Including SHC systems in new building financing can often lead to businesses and commercial building owners achieving immediate positive cash flow, as the fuel cost savings can exceed the monthly payment for a financed SHC system. For SHC, the cost of the fuel is free, and it always will be. While at the moment point-of-use costs for natural gas are slightly lower than solar heat in most regions ($0.06/kWh$_{th}$ for SHC compared to $0.04/kWh$_{th}$ for natural gas), when externalized costs and future volatility are considered, SHC can be the least-cost option.

Not only is installing a SHC system a smart financial decision, it is also a smart investment in the future as a way to reduce carbon emissions. SHC systems emit zero pollutants per megawatt-hour equivalent of thermal energy generated, while burning natural gas to generate an equivalent amount of heat energy results in 400 pounds of carbon emissions. With the expected operational life of SHC systems extending up to 30 years, even a small solar heating system has the ability to significantly reduce a building's carbon footprint and lessen dependence on fossil fuels.

The following report highlights the broad scope of applications for solar heating and cooling systems. Hotels, grocery stores, commercial pools, dairies, breweries, and multi-family housing units are just some of the applications that can benefit from the installation of solar heating technologies. Given that solar energy is available throughout the country, these systems can be designed for every state in the nation.

Take a look through the many project examples that follow to see how SHC is making a difference for these businesses and commercial building owners.

SHC Basics

Solar heating and cooling technologies collect the thermal energy from the sun and use this heat to provide hot water, space heating and cooling, and pool heating for residential, commercial and industrial applications. These technologies displace the need to use electricity or natural gas.

Collectors

Different types of solar collectors are used based on the application. Simple unglazed collectors are typically used to heat pool water or preheat large volumes of industrial process water in warm climates. Flat plate, concentrating, and evacuated tube collectors use transparent cover plates or glazing, metal or polymer absorbers, and insulation to efficiently produce heat at higher temperatures, usually up to 200°F. Some concentrating collectors can deliver heat in excess of 400°F for steam generation in industrial and manufacturing processes. Solar air heating collectors can also be used to preheat incoming "make-up" air from 30° to 100°F above ambient temperature, thereby reducing the amount of energy required by backup conventional heating systems. Solar-driven cooling can be accomplished using thermally activated systems driven by solar energy from the appropriate solar collectors.

System Size, Output and Lifespan

SHC systems are typically sized to meet only the amount of thermal energy required in the building. The energy output from a SHC system is typically measured in British Thermal Units, or BTUs. BTUs can be converted into kilowatt hours (kWh) or megawatt hours (MWh), which are generally the energy units most familiar to consumers. Approximately 3,413 BTUs are equivalent to one kilowatt hour. For example, an SHC system generating 500 million BTUs/year is effectively generating 146.5 MWh. A system generating 3 billion BTUs in a year is generating 879 MWh. To put this into perspective, the average family of four uses about 15 million BTUs in a year for heating water, so a SHC system generating 3 billion BTUs is conserving a substantial amount of energy!

Once a SHC system is installed, the only cost is minimal periodic maintenance over its expected 25- to 30-year lifespan.

Application: Prison

Project Name: Duffield Regional Jail

Location: Duffield, Virginia

Technology: Solar water heating

Overview: In 2013, the Duffield Regional Jail completed the installation of a solar water heating system on the roof. To date, this is the largest solar water heating system installed in the state of Virginia. Since expensive propane had previously been used to heat the water for the prison, the county looked to solar water heating to save on heating fuel costs. Funding for the project was provided by the VA Department of Mines, Minerals, and Energy and the U.S. Department of Energy. The project received praise from many different individuals, including Virginia State Senator Phillip Puckett: "The project was on-time and under budget, and if we continue to do things like this, this is about the future. It will save money as we go down the road. In 10 or 11 years this project will be paid for and yet those solar panels will still be saving dividends."

Project Highlights

Companies involved: SOLARHOT, Sigora Solar

System size: 72 solar collectors

Total cost before incentives: $465,749

Estimated annual savings: $37,500

Estimated savings over the life of the system: $1.5 million

Estimated life of the system (years): 40

Heat energy generated on an annual basis (BTUs): 649.7 million

Application: Aquatic Center

Project Name: NOMAD Aquatics & Fitness Center

Location: Huntersville, North Carolina

Technology: Solar pool heating

Overview: Located just outside Charlotte, NC in the town of Huntersville, the 30,000 sf family-owned and operated NOMAD Aquatic Facility opened its doors in 1991. Inside, a 25x27.3 yard pool serves as the main competition area, with a smaller instructional "warm pool" of 20x15 yards around the corner. For the owner, Steve Billings, heating the two indoor pools was a necessary evil. Though competition rules state pools must be maintained at 79˚F, being indoors means neither pool receives any warmth from natural sunlight. For years, running their natural gas heater was viewed as an unavoidable operating cost for NOMAD—just another expense on the balance sheet. But as energy prices skyrocketed, heating the pools with fossil fuel became increasingly expensive. "At their worst, our bills ran upwards of $12,000 every month," recalls Steve. He knew there had to be a way to keep the water at the proper temperature without breaking the bank. After attending a presentation on solar pool heating, Steve started to see solar pool heating as a good potential investment in his facility. The 35 percent state tax credit offered in NC on new commercial solar pool heater installations reduced the payback period even further. "I would say I had some misconceptions as far as cost went, up till that point. As I learned more about the technology, the investment seemed more and more like a no-brainer." The system at NOMAD is fitted with an ISTEC® flow-meter, which measures the amount of BTUs the solar system provides when operating; the system at NOMAD has a daily production capacity of approximately 13 million BTUs (or 3,800 Kwh). "It's really about as simple as it gets," says Steve. "You just wouldn't believe how well it works."

Project Highlights

Companies involved: Aquatherm, Solar Services

System size: 269 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 165

Total cost before incentives: $200,000

Total cost after Incentives: $130,000

Estimated annual savings: $96,000

Estimated savings over the life of the system: $1.5 million

Estimated life of the system (years): 15

Estimated return on investment (years): 1

Heat energy generated on an annual basis (BTUs): 3.12 billion

Application: Multi-residential Housing

Project Name: Waikiki Shore Apartments

Location: Honolulu, Hawaii

Technology: Solar water heating

Overview: In 2010, Waikiki Shore Apartments decided to address the high water heating costs for the building by installing a solar water heating system, a proven, cost-effective technology for commercial applications. Expecting that the system would reduce and stabilize the water heating costs, the condo association said it was still surprised at the amount of savings the system produced. In fact, gas consumption was reduced so dramatically that the utility dispatched technicians to determine if the meters were malfunctioning. The Waikiki Shore Apartments are still saving an estimated 50 percent on the gas bill since the installation of the solar water heating system, and have reduced dependence on fossil fuels and CO_2 emissions. Current Capital and Consulting financed the system through a true lease in which the lessor, Bank of Hawaii, is the legal and tax owner of the system. The project was able to utilize federal and state tax credits and capitalize on the depreciation of equipment, allowing the bank to pass these savings to the condo association in the form of monthly lease payments that were less than a conventional loan.

Project Highlights

Companies involved: Green Energy Solutions, The Chong Group, Inter-Island Solar Supply

System size: 60 solar collectors

Estimated carbon emissions displaced over the life of the system (metric tons CO_2): 230

Total cost before incentives: $505,000

Total cost after incentives: $176,750

Estimated annual savings: $35,000

Estimated annual savings over the life of the system: $875,000

Estimated life of the system (years): 25

Estimated return on investment (years): 5

Heat energy generated on an annual basis (BTUs): 895 million

Application: Hotel

Project Name: Royal Hawaiian Hotel

Location: Honolulu, Hawaii

Technology: Solar water heating

Overview: The Royal Hawaiian Hotel recently installed 40 solar collectors atop its 17-story building. The system is used to heat water in the pool and in guest rooms. This solar installation is part of a larger effort on the part of Royal Hawaiian to increase efficiency.

Project Highlights

Companies involved: Ritter Group USA, GSI Pacific

System size: 40 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 40

Total cost before Incentives: $300,000

Total cost after incentives: $105,000

Estimated annual savings: $26,000

Estimated savings over the life of the system: $650,000

Estimated return on investment (years): 4

Estimated life of the system (years): 25

Heat energy generated on an annual basis (BTUs): 6.6 million

Application: Food Processing Facility

Project Name: Stapleton-Spence Fruit Packing Company

Location: Gridley, California

Technology: Solar water heating, unglazed collectors

Overview: Between the orchard and the grocery shelf, prunes and other dried fruit are transformed by applying steam heat to rehydrate the dried fruit. Stapleton-Spence, a leading packer of prune concentrates, purees, juices, nuts, and other dried fruits, uses this process at their packing plant in Northern California. Processing and packing over 8,000 tons of dried plums in a year, the company was using roughly 650,000 therms of natural gas annually to preheat the water used in the process. In order to save on heating costs, Stapleton-Spence turned towards an innovative, cost-effective, and lightweight commercial solar pre-heat system developed by the oldest and largest solar thermal manufacturer in the U.S., FAFCO, Inc. The company installed 500 unglazed polymer solar collectors on the roof of the packing plant which transfer heated water to a 13,000 gallon solar storage tank. The storage tank preheats the cold well water before the water enters the boilers. As the largest industrial solar pre-heating system in the state of California, the system can generate a peak output of 3 million watts of heat in a single day, while the customer saves approximately 1 therm of natural gas for every 75 gallons of water consumed. The energy savings and hot water usage have been monitored since August of 2012, showing close correlation to performance estimates, thus allowing future project performance to be projected with confidence.

Project Highlights

Companies involved: BCM Construction, FAFCO Inc

System size: 500 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 150

Total cost before incentives: $800,000

Total cost after incentives: $60,000

Estimated annual savings: $15,000

Estimated savings over the life of the system: $300,000

Estimated return on investment (years): 4

Estimated life of the system (years): 20

Heat energy generated on an annual basis (BTUs): 28,384

Application: Multi-residential Housing

Project Name: 4600 Connecticut Avenue Condo

Location: Washington, DC

Technology: Solar water heating

Overview: The goal of this project was to provide guaranteed savings to customers through green energy, at no cost to them. Nextility provides solar energy to the 4600 Connecticut Avenue Condominium through a price-indexed power purchase agreement. The project location is a 267-unit high-rise multifamily building at 4600 Connecticut Avenue NW in Washington, DC and the system was placed in service on January 20, 2012. Skyline provided the financing, project development services and ongoing operations, maintenance and monitoring of a roof-mounted solar hot water system for offsetting the building's use of natural gas for residential hot water. The system consists of roof-mounted solar thermal collectors for residential water heating with an integrated monitoring system. The monitoring system consists of temperature sensors, flow meters, BTU meters and a networked central data monitor (the Skybox, a product developed by Nextility) that sends solar energy consumption and system performance data to Skyline for monitoring, maintenance and billing.

Project Highlights

Companies involved: Nextility, Solar Energy Services

System size: 64 solar collectors

Estimated carbon emissions over the life of the project (pounds): 2.18 million

Total cost before incentives: $288,000

Estimated annual savings: $2,226

Estimated savings over the life of the system: $240,935

Estimated life of the system (years): 30

Heat energy generated on an annual basis (BTUs): 182 MWh

Quotes: "Many building owners shy away from green technology because they believe the expense isn't worth the savings. But at 4600 we've shown that both savings and reduced consumption can be achieved even with little to no cost at all." - Harry Richter, 4600 Manager

Application: Brewery

Project Name: Brown's Brewing Co.

Location: Hoosick Falls, New York

Technology: Solar water heating

Overview: When the owners of Brown's Brewing Co. purchased an old abandoned paper mill to restore and transform into their new production facility, they found that the location of the mill had no access to natural gas to heat water used in the brewing process. The owners investigated installing a solar water heating system not only for the cost savings—and accessibility—but also for the significant impact a solar water heating system would have on reducing their carbon footprint. The brewery now has 20 Schuco solar collectors mounted on a rubber roof via ballasted raised aluminum racking. These collectors heat the water within two 512-gallon storage vessels, to go into the tankless propane water heater. As the brewery uses on average about 3,000 gallons of water/day, the solar water heating system not only preheats the wash-down water, but also helps heat the radiant heating loop for the facility.

Project Highlights

Companies involved: The Radiant Store

System size: 20 solar collectors

Estimated annual carbon emissions displaced: 11.2 metric tons CO_2

Total cost before incentives: $58,000

Total cost after incentives: $8,000

Estimated annual savings: $4,817

Estimated annual savings over the life of the system: $229,925

Estimated life of the system (years): 25

Estimated return on investment (years): 1.5

Heat energy generated on an annual basis (BTUs): 141 million

Project Name: Battenkill Valley Creamery

Location: Salem, New York

Technology: Solar water heating

Overview: This system consists of two 10 collector arrays, one for preheating water at the production and bottling facility of Battenkill Valley Creamery, and one on the dairy farm pre-heating wash-down water. Dairies are one of the most ideal solar water heating applications, because they have consistent and large hot water demands twice a day during wash downs, 365 days a year. Dairies are almost always located in rural locations with no access to natural gas, so the prior reliance on oil or propane greatly increases the ROI. The Battenkill Valley Creamery only bottles twice a week with limited use in between, so that system has oversized storage to accommodate more hot water production between uses.

Project Highlights

Companies involved: The Radiant Store

System size: 20 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 15.87

Total cost before incentives: $56,000

Total cost after incentives: $6,000

Estimated annual savings: $4,700

Estimated savings over the life of the system: $224,440

Estimated life of the system (years): 25

Estimated return on investment years): 1.5

Heat energy generated on an annual basis (BTUs): 136 million

Project Name: Viewpoint Primary School

Location: Calabasas, California

Technology: Solar pool heating

Overview: This solar pool heating system was installed under the California Solar Initiative Thermal Rebate Program. The program offers rebates to businesses and schools with swimming pools that are heated by natural gas to install solar pool heating systems. According to EPA estimates, the combined heating load of all commercial pools in California produces annual CO_2 emissions equivalent to 436,310 passenger vehicles driven a total of nearly 5 million miles. Viewpoint Primary School was able to install this solar pool heating system for very little upfront cost and has been enjoying the energy savings while also incorporating sustainable practices.

Project Highlights

Companies involved: Aquatherm Industries, Inc. & Catersolar

System size: 72 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 44.7

Total cost before incentives: $60,000

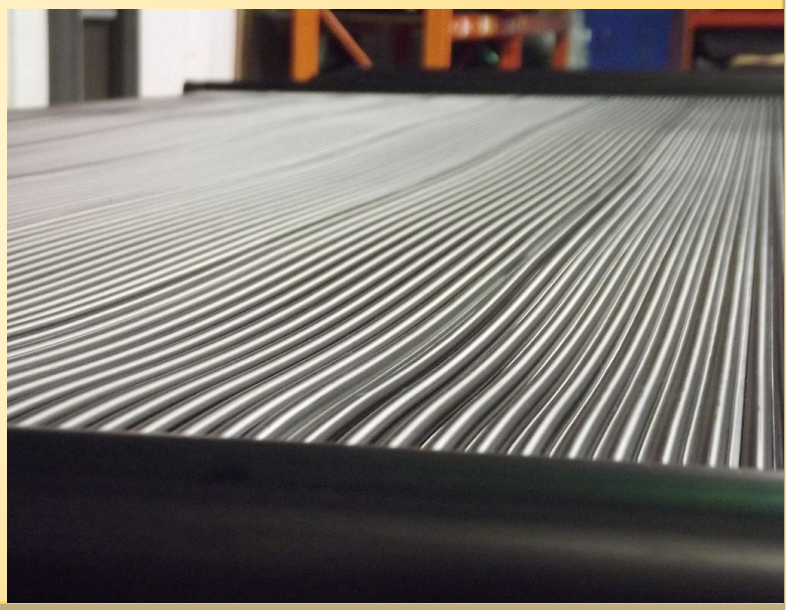
Total cost after incentives: $59,000

Estimated annual savings: $11,855

Estimated savings over the life of the system: $177,825

Estimated life of the system (years): 15

Heat energy generated on an annual basis (BTUs): 842 million



Quotes: "It's tangible, in that you can see how many BTUs of energy the system is generating. That's energy that would have come from natural gas before. It's also an incredible piece of infrastructure to be able to add to the school. It makes a statement. Wherever an institution can make its mark, as far as sustainability goes, I'm all for it." - Mike Adams, Director of Physical Plant at Viewpoint

"Once solar is installed, a facility can cut up to 100 percent of its pool heating costs, paying for itself in just a few short years. By reducing upfront costs through a rebate or other incentive, it becomes much more economically feasible for a facility to add a solar pool heating system." - Molly Friar, Aquatherm

Project Name: Skidmore College

Location: Saratoga Springs, New York

Technology: Solar water heating

Overview: Skidmore College's Strategic Plan, to be executed over the next ten years (2015-2025), prioritizes sustainability. Specifically, the plan focuses on a reduction of greenhouse gas emissions through various green energy improvements. The college already installed a geothermal and large-scale PV system, but housing more than 1,500 students on campus, domestic hot water usage was responsible for a large portion of the college's carbon emissions. The 46-collector system is spread across four dormitories and the Van Lennep Riding Center. Each dormitory has 10 Viessmann 200˚F collectors mounted horizontally at a 45° angle, ballasted on a rubber roof and paired with two 264-gallon storage tanks for pre-heated water that feed into the building's auxiliary DHW system. The riding center has the remaining six collectors mounted flush on a metal roof, paired with 132 gallons of pre-heat storage. This large-scale installation is especially impressive since the entire system has live production monitoring accessible via the web. Through the Sunnovations Ohm system, the tank temperatures, production tracking, and system status updates all can be viewed live.

Project Highlights

Companies involved: The Radiant Store, Sunnovations, Viessmann

System size: 46 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 17.95

Total cost before incentives: $149,280

Total cost after incentives: $30,000

Estimated annual savings: $3,200

Estimated annual savings over the life of the system: $152,700

Estimated life of the system (years): 25

Estimated return on investment years): 9

Heat energy generated on an annual basis (BTUs): 314 million

Application: Brewery

Project Name: Milwaukee Brewing Co.

Location: Milwaukee, Wisconsin

Technology: Solar water heating

Overview: In the spring of 2013, Milwaukee Brewing Co. became Milwaukee's first brewery to utilize solar water heating to supplement their heavy hot water demands and reduce the high cost of energy in the beer brewing process. The system saves an estimated 27 percent of the brewery's water heating costs. "Milwaukee Brewing decided to free itself from the expense and environmental impact of natural gas by turning to solar water heating," says Adam Gusse of H&H Solar Energy Services. The system is controlled with a Caleffi multi-functional temperature differential controller, which includes built-in heat metering and data logging that measures how much heat is produced by the system, allowing the company to track its fuel savings. Producing 1,200 to 1,500 gallons of hot water per day, the system immediately started making a difference in the brewery's natural gas consumption. The system is comprised of 28 Caleffi collectors installed on the roof for a total capacity of 1,120,000 kBTU/day, a 175-gallon solar drain back tank, and two specially made, 550-gallon solar storage tanks that rest on the brewery floor.

Brewery owner Jim McCabe adds, "We hope our installation encourages others to make the investment. This project will help boost the brewery's competitiveness." The project was funded in part with grants from Wisconsin's Focus on Energy program as well as the ME2 Milwaukee Energy Efficiency program and the city of Milwaukee's solar program, Milwaukee Shines. "Here's a good example of a perfect application for solar hot water. Breweries use a lot of water—and so it made sense for them to invest in this," says program manager Amy Heart.

Project Highlights

Companies involved: Caleffi, H&H Solar

System size: 28 solar collectors

Estimated annual carbon emissions displaced: 12 metric tons CO_2

Total cost before incentives: $155,000

Total cost after incentives: $45,000

Estimated annual savings: $2,000

Estimated annual savings over the life of the project: $70,000

Estimated return on investment (years): 13

Estimated life of the project (years): 30

Application: Brewery

Project Name: Barrington Brewery & Restaurant

Location: Great Barrington, Massachusetts

Technology: Solar water heating

Overview: The Barrington Brewery & Restaurant was the first brewery on the East Coast to install a solar water heating system. The system was initially installed with 15 collectors, but the owner eventually doubled the system size to produce even more solar-heated water for the restaurant and brewing process. A 1,500 gallon atmospheric tank stores the heated water. As the hot water is used, cold water is pumped through the solar collectors and back into the storage tank. The large volume of water ensures that the tank temperatures stay consistently low, allowing the collectors to operate at their most efficient heat transfer rate. The ratio of gallons of storage to number of solar collectors is 50:1, which is typical for commercial solar water heating systems. The brewery will generally brew 1,100 barrels (34,100 gallons) of beer per year, averaging three 220-gallon batches per week. On average, 620 gallons of water go into each batch.

Project Highlights

Companies involved: Precision Decisions LLC, Solarwave Energy, Stiebel Eltron

System size: 30 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 6.96

Total cost before incentives: $85,000

Total cost after incentives: $35,000

Estimated annual savings: $2,100

Estimated savings over the life of the system: $63,000

Estimated life of the system (years): 30

Application: Multi-residential Housing

Project Name: Nonotuck Street Apartments

Location: Holyoke, Massachusetts

Technology: Solar water heating

Overview: The Nonotuck Street apartment building includes 10 apartments and two first-floor office spaces. As the project was built next to an old cemetery, the savings the building received from reduced land costs were invested into overall energy efficiency improvement costs. A solar water heating system was installed as one of the green measures to keep the building hot water bills low. High-efficiency gas condensing boilers serve as a back up to the solar water heating system, which also provides radiant heat to the floors of the apartments. A large atmospheric tank (1,500 gallons) serves as the storage for the solar-heated water. As the heated water is used, cold water is preheated through the solar tank and piped into a Stiebel Eltron storage tank. If the water is at the desired temperature needed, the gas boiler will not turn on. This setup ensures that the residents always have hot water, even when the sun isn't shining. The ratio of gallons of solar storage to number of collectors is 93:1, which is much higher than in typical solar water heating systems. The large ratio ensures that the tank temperature stays consistently low, allowing the collectors to operate at their most efficient heat transfer rate.

Project Highlights

Companies involved: Stiebel Properties and D. A. Gratz

System size: 16 solar collectors

Estimated carbon emissions displaced over the life of the system (metric tons CO_2): 6.35

Total cost before incentives: $42,000

Total cost after incentives: $18,700

Estimated annual savings: $2,000

Estimated savings over the life of the system: $60,000

Estimated life of the system (years): 30+

Estimated return on investment (years): 9.5

Heat energy generated on an annual basis (BTUs): 102 million

Project Name: Buggy Bath Car Wash

Location: Bozeman, Montana

Technology: solar water heating

Overview: The owner of Buggy Bath Car Wash decided to install a solar water heating system at the car wash not just to save money, but also to attract customers. In fact, the owner boasts the message "We Use Solar Heated Water" on a sign outside the car wash. The solar water heating system is a simple drainback design that uses a 250-gallon, non-pressurized storage tank for the solar heated water. The system functions year round; in fact, in the cold Montana winter months, the water is heated from a chilly 39˚F to nearly 100˚F for use. The solar water heating system saves hundreds of dollars each month, keeping prices low at the car wash and allowing the business to remain competitive.

Project Highlights

Companies involved: Liquid Solar Systems, SunEarth

System size: 8 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 6.8

Total cost before incentives: $17,000

Total cost after incentives: $11,900

Estimated annual savings: $1,400

Estimated savings over the life of the system: $35,000

Estimated life of the system (years): 25

Estimated return on investment (years): 8.5

Heat energy generated on an annual basis (BTUs): 96.2 million

Quotes: "The busiest days are also the sunniest days. People wash their cars when it's sunny out, not when it's raining. So, a car wash is a pretty ideal place for solar systems." - Todd Hoitsma, Liquid Solar Systems

Project Name: Los Alamos County Eco Station

Location: Los Alamos, New Mexico

Technology: solar water heating and space heating using glazed, flat-plate collectors. Radiant space cooling via night sky radiant cooling using unglazed, flat-plate collectors.

Overview: This unique solar water and space heating system at the Los Alamos County Eco Station uses a solar "combi-system", providing multiple functions. The solar system supplies radiant heat to the building floors and also produces hot water, while a high-efficiency boiler serves as a back-up source. However, using the solar heating system at night for radiant cooling is an innovative twist. The system cools the floors—and therefore the building space—at night by using night sky radiant cooling (NSRC), which uses the solar collectors to shed excess heat to the outside air at night. The installer of the system, SolarLogic, was awarded the "Most Innovative System" and "Best Radiant Cooling System" awards by the Radiant Professional Alliance in 2012 in recognition of the solar heating and cooling system.

Project Highlights

Companies involved: SolarLogic, LLC; Eldorado Solar; Los Alamos County; Cedar Mountain Solar

System size: 10 glazed solar collectors, 12 unglazed solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 12.1

Estimated annual savings: $630

Estimated savings over the life of the system: $30,000

Estimated life of the system (years): 25

Heat energy generated on an annual basis (BTUs): 31.2 million for heating, 8.4 million for cooling

Application: Charitable Organization

Project Name: Salvation Army Southern Nevada

Location: Las Vegas, Nevada

Technology: Solar water heating

Overview: The solar water heating system at the Las Vegas Salvation Army provides guaranteed hot water for nearly 600 homeless residents each night. The savings from the solar water heating system allow the facility to invest funds elsewhere on the 45,000 sf campus. Southwest Gas provided financing for half of the project, while the Consumer Electronics Association donated the rest.

Project Highlights

Companies involved: Green Chips, Consumer Electronics Association, Las Vegas Convention and Visitors Authority, Southwest Gas Corporation

System size: 6 solar collectors

Total cost before incentives: $25,570

Total cost after incentives: $12,695

Estimated annual savings: $741

Estimated savings over the life of the system: $7,400

Estimated life of the system (years): 10

Heat energy generated on an annual basis (BTUs): 84.1

Project Name: Fort Drum

Location: Jefferson County, New York

Technology: Solar air heating

Overview: One of the largest and most extensive solar air heating projects in the world is located at the United States Military base at Fort Drum in upstate New York. The project shows the tremendous potential for solar air heating when it is deployed on a large scale in terms of energy and CO_2 savings. In 2005, the Army Corp of Engineers commissioned a multimillion-dollar retrofit program to upgrade 27 of the vehicle maintenance buildings at Fort Drum. Conserval Engineering and Conserval Systems worked closely with the military base over the two-year duration of the design and installation of the SolarWall® systems. SolarWall® technology had previously been used at eight other U.S. military bases, which is one reason why the U.S. Corp of Engineers identified solar air heating as a cost-effective solution for the base. Typical military buildings, such as vehicle maintenance garages, hangars and warehouses are ideal for solar air heating as they have a high ventilation load, which represents an enormous energy expenditure given the tremendous volume of air that must continuously be heated. These buildings also have large wall surfaces available, making them easy to integrate a solar air heating system into the exterior façade. For the Fort Drum project, the SolarWall panels were mounted 6 to 10 inches from the exterior wall to create an air cavity. The heated boundary layer is then drawn off the panels and through the panel perforations into an air cavity behind. From there, it is either directed into the HVAC units or into the building through a fan and ducting system. The $3 million that was allocated to the turnkey solar air heating project will allow the base to generate a minimum of 4 MW of thermal energy. It will displace 2,000 tons of CO_2 annually by reducing 44,000 million BTU/h (46,000 GJ) of natural gas each year. From a cost and energy production perspective, these values illustrate the financial attractiveness of the solar air heating system. The project at Fort Drum also created ten man-years' worth of work, which highlights the local job creation benefits of solar.

Project Highlights

Companies involved: Conserval Systems, Inc. (SolarWall)

System size: 110,000 sf of solar collectors (50 systems on 27 buildings)

Estimated annual carbon emissions displaced (metric tons CO_2): 2,000+

Heat energy generated on an annual basis: 4 MW of thermal energy equivalent

Project Name: Mother Clara Hale Bus Depot (New York Transit)

Location: New York City, New York

Technology: Solar air heating

Overview: With a new solar air heating system on the building walls, the Mother Clara Hale Bus Depot is the largest solar-heated building in New York City. The system is an excellent showcase for how solar air heating can seamlessly be integrated into an architectural façade to produce on-site energy using the building envelope. Installing a solar air heating system helped the state-of-the-art building achieve a LEED® certified rating by dramatically reducing greenhouse gas emissions from fossil fuel heat sources. The SolarWall system is a building integrated solar air heating system that was designed in a green color to augment the building envelope. The system on the bus depot is more than 25,400 sf, part of which will be operational right away and part of which will be ready for use in the future. The solar system will heat the ventilation air for the building, significantly reducing the use of conventional energy and corresponding greenhouse gas emissions. With a solar conversion efficiency over 70 percent, the system is sized to produce 1.5 MW of thermal energy. The system will also generate substantial cost savings over the 30+ year lifetime of the system.

Project Highlights

Companies involved: Conserval Systems, Inc. (SolarWall)

System size: 25,400 sf

Estimated annual carbon emissions displaced (metric tons CO_2): 500+

Total cost before incentives: $275,000

Estimated Life Time of the system (years): 30

Heat energy generated on an annual basis (BTUs): 1.5 MW

Application: Laundromat

Project Name: World's Largest Laundromat

Location: Berwyn, Illinois

Technology: Solar water heating

Overview: The 36-panel solar water heating system, installed in 2006, is one of the largest commercial solar arrays in Illinois. The reduction in annual CO_2 emissions is equivalent to planting 56 acres of trees each year.

Project Highlights

Companies involved: Alternate Energy Technologies, Solar Service Inc.

System size: 36 solar collectors

Estimated life of the system (years): 25

Heat energy generated on an annual basis (BTUs): 1.44 million

Quotes: "The gas crisis of the winter of 2001 created an energy cost crunch that made me look for an alternative. Solar was by far the best way to go. Despite gas prices going up, my solar hot water system will enable me to maintain lower prices for my customers." — Tom Benson, World's Largest Laundromat owner.

Project Name: IKEA Orlando

Location: Orlando, Florida

Technology: Solar water heating

Overview: In October 2007, Ikea began building its 309,000 sf Orlando store, which included a restaurant and catering. Ikea Orlando was designed to be green from the ground up and to earn LEED Certification. To reduce their energy bills in the restaurant, they installed a solar water heating system on their building. This earned them valuable LEED points and reduced their natural gas consumption. Seven years later, solar water heating technology is still used to help heat the water used for cooking food and cleaning dishes. This highly efficient technology offset Ikea's normal natural gas usage, saving them a great deal in energy costs. In total, the system offsets the consumption of natural gas therms by 20,160 per year and produces 4,000 gallons of hot water per day. The panels were manufactured by Alternate Energy Technologies in Jacksonville, Florida, and were installed by The LeverEdge.

Project Highlights

Companies involved: Alternate Energy Technologies, The Leveredge

System size: 60 solar collectors

Estimated annual natural gas displaced (therms): 20,160

Estimated life of the system (years): 25

Heat energy generated on an annual basis (BTUs): 2.4 million

Project Name: Proximity Hotel

Location: Greensboro, North Carolina

Technology: Solar water heating

Overview: The Proximity Hotel in Greensboro, North Carolina is the first LEED Platinum hotel in the United States. Advanced Energy Technologies and FLS Energy helped the hotel achieve this distinction by installing 100 solar collectors on the hotel in 2007. The system generates the equivalent hot water demand of 100 average households in the U.S. Solar water heating is just one of the 70 sustainable practices used at this super energy-efficient hotel.

Project Highlights

Companies involved: Alternate Energy Technologies, FLS Energy

System size: 100 solar collectors

Estimated life of the system (years): 25

Heat energy generated on an annual basis (BTUs): 4.0 million

Application: Food Processing Facility

Project Name: Adams Farm Slaughterhouse

Location: Athol, Massachusetts

Technology: Solar water heating

Overview: Designed and installed in November 2013 by Paradigm Partners, the solar water heating system at the Adams Farm Slaughterhouse consists of 70 solar flat plate collectors. The project was the fifth system to be built under the MA Clean Energy Center's Commercial Solar Thermal Financing program, which allows commercial and non-profit building owners to reduce their water heating bills by installing solar water heating at little or no upfront cost. Offsetting propane, this system will save the Adams Farm about 4,600 gallons of propane a year, eliminating about 96,000 pounds of greenhouse gas emissions each year.

Project Highlights

Companies involved: Paradigm Partners

System size: 70 solar collectors

Annual Energy Savings: 4,600 gallons of propane

Estimated Annual Carbon Emissions displaced (pounds CO_2): 96,000

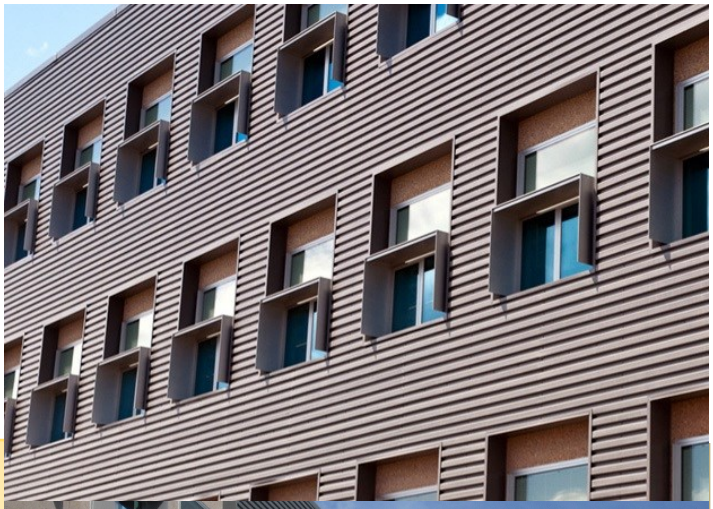
Application: Government Facility

Project Name: NREL Research Support Facility

Location: Golden, Colorado

Technology: Solar air heating

Overview: The National Renewable Energy Laboratory (NREL) is the preeminent national laboratory of the U.S. Department of Energy. When its Office of Energy Efficiency and Renewable Energy was tasked with building its next sustainable green building, a new Research Support Facility (RSF), it was decided the 222,000 sf office building would be a showcase for energy efficiency and renewable energy technologies. NREL's RSF is the largest Net Zero building in the US with more than 800 staff. The RSF was designed to use 50 percent less energy than a standard office building, incorporating green innovations such as daylighting, natural ventilation, building-integrated PV and a SolarWall® solar air heating system, all of which contribute to the building's LEED Platinum Plus rating from the USGBC. Incorporating the SolarWall® technology into the new building was a natural fit because NREL was involved with the development of the SolarWall® technology, and had referred to it as "the most reliable, best-performing, and lowest-cost solar heating system for commercial and industrial buildings." Two SolarWall® systems were incorporated into the south façade of the building. The charcoal-colored solar collectors span over 8,640 sf and pre-heat the fresh ventilation air, reducing heating costs and greenhouse gas emissions. The SolarWall® systems at the RSF are projected to deliver more than 238 MWh (856 GJ) of thermal energy each year and reduce emissions by more than 53 tons of CO_2 annually. The new NREL facility was the winner of a prestigious 2013 ASHRAE Technology Award for its use of innovative technology.



Project Highlights

Companies involved: Conserval Systems, Inc. (SolarWall)

System size: 8,640 sf of solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 53+

Heat energy generated on an annual basis: 238 MWh (856 GJ) of thermal energy

Project Name: University of California, San Diego, North Campus Housing

Location: San Diego, California

Technology: Solar water heating

Overview: The UC San Diego North Campus Housing student apartments house 807 students in a LEED-certified gold-rated building. Contributing to the Gold rating is the solar water heating system that was installed on the roof—one of the biggest solar water heating systems to date installed on an American university. A total of 6,378 sf of collectors installed on seven buildings provide almost all of students' hot water needs. Some of the collectors are mounted on canopies to provide shading to the building. External financing was used to fund the project though University of California-issued bonds that will be repaid through student housing fees. UC San Diego also received a large rebate from the CSI thermal program.

Project Highlights

Companies involved: Viessmann Manufacturing, Aztec Solar, Son Energy Solar Systems

System size: 232 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 162

Estimated life of the system (years): 25

Heat energy generated on an annual basis (BTUs): 1.62 billion

Application: Grocery Store

Project Name: Whole Foods Kailua

Location: Kailua, Hawaii

Technology: Solar cooling

Overview: The Whole Foods Market located in Kailua, Hawaii opened its doors in April 2012. As part of the company's ongoing effort towards sustainability, Whole Foods had commissioned Lumen Solar LLC and J&J Mechanical to design a groundbreaking solar cooling system for the new 25,000 sf market– the first of its kind to be featured in a supermarket in the U.S. The system provides hot water, air conditioning and refrigeration by utilizing Seca Thermal Liquid Desiccant Air Conditioning (LDAC) technology combined with an Apricus solar water heating array. The system works by dehumidifying the outside ventilation air entering the store and uses the LDAC system to greatly reduce energy consumption from the air conditioning and refrigeration systems. The Apricus solar array then provides heat to regenerate the constantly circulating liquid desiccant back through the air conditioning device. The system produces an average daily output of 3.4 million BTUs and is expected to reduce Whole Foods Kailua's air conditioning and refrigeration costs by about 40 percent, paying for itself in approximately one year.

Project Highlights

Companies involved: Apricus, Lumen Solar, J&J Mechanical Systems

System size: 80 solar collectors

Average daily output: 3.4 million BTUs

Annual energy savings: 45,000 kWh

Payback period: 1 year

Quotes: "Both as a good corporate citizen and a member of the Hawaii community, one of Whole Foods Market's core values is to reduce our environmental footprint whenever and wherever possible. It is our hope that this [LDAC system] will help light the way for others in the industry to take a look at how we can incorporate new technology into being more environmentally conscious companies." - Tim Talkington, Whole Foods Market Kailua Store Team Leader

Project Name: University of Arizona Student Recreation Center

Location: Tucson, Arizona

Technology: Combined solar HVAC and solar pool heating with central plant district cooling and heating

Overview: The University of Arizona Student Recreation Center has certainly gone solar. The solar project includes six separate rooftop sites: four solar PV and two solar water heating. In total, the solar capacity is about 1.72 MW_{ac}. The solar water heating collectors use evacuated tube technology, which generates over 50 percent more energy than PV, based on the area of the collector. This efficiency has helped the University achieve its solar goals while optimizing available space. The 346 solar heating collectors provide hot water to the absorption chiller, which produces chilled water for use in multiple buildings, including classrooms, laboratories, a hospital and dorms. Any excess heat is used to heat the Olympic-sized outdoor pool at the Recreation Center. The absorption chiller is manufactured by Broad and is rated at 140 tons. The project, completed in April 2011, has received a significant amount of national attention, including a cover story in the October 2011 issue of *PM Engineer Magazine.* The solar heating and cooling system, along with the insulated water tanks that store the solar heated water, help the campus save electricity and natural gas, and cut down on utility bills by a significant portion by offsetting peak electricity rates and demand charges.

Project Highlights

Companies involved: SunChiller

System size: 346 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 1,520 (SHC and PV)

Estimated life of the system (years): 20+

Total solar capacity: 1.72 MW_{ac} (SHC and PV)

Application: Aquatic Center

Project Name: St. Mary's Pool and Recreation

Location: Bronx, New York

Technology: Solar pool heating

Overview: Managed by the Department of Citywide Administrative Services (DCAS), the first phase of a project to reduce carbon emissions at St. Mary's Recreation Center in St. Mary's Park involved green retrofits to the building, such as switching to energy-efficient lights and pool motors. With these efficiency measures in place, the DCAS then turned to addressing the building's hot water needs. An evacuated tube drain-back solar water heating system was installed to supply the indoor pool and domestic hot water needs, while a condensing summer boiler allows Center staff to shut down the building's main boiler, while maintaining the system as a back up for extended cloudy periods. The city is expected to save $39,000 a year in avoided natural gas costs, cutting the Center's carbon footprint by 141 tons of CO_2 a year, the equivalent of taking 27 cars off the roads. The renovations at the center are part of the PlaNYC initiative making public buildings more sustainable. St. Mary's was the first recreation center in the city to undergo the energy enhancements.

Project Highlights

Companies involved: Ely Beach Solar

System size: 25 solar collectors

Estimated annual carbon emissions displaced (metric tons CO_2): 141

Estimated annual savings: $39,000

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