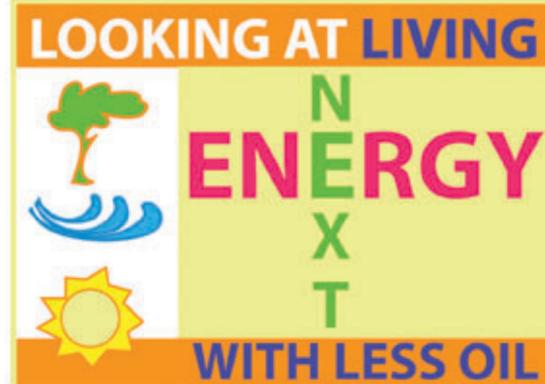


# The "Then" and "Now" of using the sun's energy



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Humans, and all life on Earth, have always been dependent on the energy of the Sun, of course.

Solar energy heats and lights the planet, makes green plants produce oxygen and sugars, and has a direct impact on wind, weather, the hydrological cycle, and the tides.

Is it any surprise that early humans, worldwide, worshipped the Sun?

When we talk about solar energy today, we usually aren't talking about these aspects of 'solar energy', however. We are looking at ways to turn energy from the Sun into space heating, hot water heating, and directly into electricity that can be used for any purpose through the use of solar panels.



Guy Marsden and his Solar Collector

## History of solar energy

The idea of using solar power as an energy source for basic human needs is not new. In the 1890's, many houses, especially in the west, were equipped with solar hot water heaters on the roof. For example, by 1897, 30% of all homes in Pasadena, California had solar hot water heaters, which are called batch, or breadbox heaters.

They consisted of a simple 40 gallon tank, painted black on the outside and lined with glass on the inside, attached to the cold water plumbing of the house.

The water heated up in the tank, then could be drawn down as needed by the household for hot water. They were efficient, low-cost, and did not pollute the environment.

By 1920, tens of thousands of solar hot water heaters had been sold in California, Florida, Arizona, and other naturally sunny places. However, around then, huge deposits of oil and natural gas were being discovered in the western United States, and solar water heating devices began to be replaced by hot water heaters run mostly by natural gas.

Today, solar hot water heaters that are not much different from their early ancestors are making a comeback. There are over a million of them in California alone, heating water for inside homes, businesses, and ... a major use ... swimming pools.

## Three ways of harnessing the Sun's power

For as long as humans have been aware of the power of the Sun, they have taken small steps to arrange living spaces and gardens to fully utilize that power. It is only in the last hundred years that humans abandoned the time-honored practices of orienting a house in a given direction to maximize the use of solar energy.

### Passive Solar Heating and Lighting

To use the Sun's energy most efficiently, homes should be oriented toward the south. Although we think of the Sun rising in the east and setting in the west, for most people in upper latitudes, such as Maine, the Sun rises in the southeast, and sets in the southwest most of the year. In the summer, the Sun rises and sets as far to the north as it ever does. In the winter, the Sun rises as far to the south as it ever does, and doesn't really reach a very high point in the sky, even at noon.

How do you maximize the Sun's energy in such a location? Build a house out of materials that heat up and release solar energy slowly, such as a slate floor, or hardwoods. Put large windows on the south side of the house, and use light wells and skylights where possible. Insulate well.

In short, do everything people did a hundred years ago.

When the great historic houses of Bath were being built, bow windows on the south side and skylit stairwells were "in fashion". That fashion helped to augment the amount of energy – then firewood and candlepower – a household needed during daylight hours.

In general, rooms that were used a great deal during the day – kitchens, breakfast rooms, nurseries and schoolrooms, morning rooms – were located on the south sides of the buildings as well.

Rooms used more in the evenings – parlors, dining rooms, and bedrooms – were put on the north side, since they would have to be lit by candles and lamps anyway.

Houses were well insulated so that heat would not escape in the winter. Because this required some serious ventilation in the summer months, windows were plentiful and opened to let air in.

Fireplaces were a major source of heat loss in older buildings. Flues minimized heat loss when the fireplace was not in use, but fireplaces were just not a very efficient way to heat a room. Too much heat was going up in smoke, literally.

In the early 1700's, cast iron began to be used to manufacture wood stoves for cooking and heating, and began to replace all but the most ornamental fireplaces. Cast iron was an exceptionally good choice for wood stoves, since it was a good conductor of heat and radiated heat energy throughout the room, and it took less wood to heat a house for a longer period. Fireplaces were bricked up, allowing just the woodstove pipe to make use of the flue.

Still, during daylight hours, even in winter, the house was heated more from solar energy on a sunny day than from burning wood.

Today, houses can be designed to capture as much sunlight as possible. Light wells can



Guy and solar charged Lawn Mower

## Today, homeowners can easily find and install solar panels, and even connect them to their own electrical system without a great deal of trouble.

be added so that even dark corridors can be brightened. Windows are more efficient now as well, and can help prevent heat loss, while taking heat in. This use of solar power is called passive solar energy, because it requires no effort, beyond the original design, to utilize the power of the Sun.

### Solar Hot Water

"The first thing we learned from our solar hot water meeting was that everybody's had a bad experience," said Guy Marsden of Woolwich.

Marsden uses a solar hot water system to heat his workshop through radiant objects like his magnetic levitation kit and solar-powered lawn mower.

The solar heating meetings, which are run by John Grill and Fred Horch (formerly of the Green Store in Brunswick, soon to open a new store on Maine Street called F W Horch Sustainable Goods and Supplies), help to flesh out solar hot water heating systems for consumers who aren't engineers by trade.

Since the early days, when "everybody had a bad experience", times have changed. New systems are much more reliable, and are more "plug and play" – that is, the average homeowner can now buy a kit and install the system over a few weekends.

There are a few different methods of collecting the hot water, and more than a few methods of distributing that heat energy once collected.

The method used by Marsden, a closed-loop antifreeze system, is a series of thermal collectors arrayed on the roof of a shed, which was added to his barn-workshop. The shed was added with a pitch perfect for installing the solar collectors. Meanwhile, inside, thick insulation made of a type of polyurethane foam was sprayed on the walls, ceilings, and joints. It took about a month to fully air out.

Because Marsden was using radiant heating from the floor, tubing was laid out and held in place with wire while three inches of concrete was poured on top of it.

"I had a lot of plumbing skills already, so I didn't totally freak out," Marsden said, "but it took many, many trips to the hardware store to get all the correct parts for my system, and I still made critical errors which could have ruined the system." Marsden was never told about the need for large overflow tanks, for instance, as the water expanded due to heat.

In essence, in Marsden's system, heat from the water collecting on the roof in a flat plate collector, travels down into a heat exchanger which heats water entering an eighty-gallon insulated hot water tank. The warm water rises within the tank, while the cooler water sinks. The warm water – which can be 200 degrees – moves past a backup heating system, fired by propane, which will heat the water if it drops below 140 degrees – into the loops in the floor. As the water loses heat to the room and the room warms up, the water returns to the tank, sinks to the bottom, where it is sent back to the heat exchanger to heat up again.

Another system is the evacuated tube system, which is more complex than the simpler collectors that Marsden uses, but the fluid in the tubes boils at a lower temperature than water, so they are more efficient, and a good alternative for colder climates. With evacuated tubes, there is little heat loss from the tubes themselves. Restaurants, and any other

business needing domestic hot water hotter than 200 degrees also uses evacuated tubes for sanitary purposes.

Once the water is hot, it can be used for space heating, as Marsden does, or it can be used for domestic hot water use. Large arrays can be used for both. Neither system generates electricity, and if there is a need for moving the water around actively, a pump generated by electricity must be used. Marsden's pumps are run through the use of photovoltaic (PV) cells, also mounted on the roof.

### Photovoltaics

The third solar energy system in common use is the photovoltaic systems that turn light energy directly into usable electricity.

Marsden has a small PV panel on his shed to run his solar hot water system, but he is hoping, one day, to go solar in his whole house. There are, he says, some common-sense steps people should take when thinking about solar energy as an alternative.

"Maine has a good 'insolation' rate – that is, the amount of usable sunlight Maine receives is pretty good, despite our latitude," said Marsden. "But there are some changes in the way you do things if you want to go solar."

First, he says, forget about heating appliances that use solar energy, except for the smallest ones. Hot water heaters and dryers can't be used efficiently using solar electricity. Get a solar hot water system for hot water, and switch to propane for drying clothes – or better yet, hang them up and let them dry naturally – in the sun, or inside by the wood stove.

Next, look at your "phantom load". Many appliances around your home, especially those that can be switched on by using a remote, are always on, and always using electricity. Marsden used a small handheld device called a "Kill-a-Watt" to demonstrate that small appliances eat up a lot of energy.

What should you do? Use power blocks and switch everything off when you're not in use, advises Marsden. This is a good suggestion for people who don't plan to use solar power to conserve, as well as those who are trying to reduce their solar load.

Finally, switch to more efficient appliances and bulbs. "Buy the most efficient appliances you can afford," Marsden says, "and switch to fluorescent bulbs." Fluorescent bulbs use less than a tenth of the energy that incandescent bulbs use, while giving the same amount of light.

Efficiency Maine, too, supports the use of fluorescent bulbs (www.efficiencymaine.com). For each fluorescent bulb you buy, they are offering a \$2 rebate. This rebate applies even when Mainers buy bulbs during special sales, offered frequently at places such as Shaw's.

Most photovoltaic panels are flat, and are less efficient than arrays that track the Sun across the sky, Marsden says. "Solar tracking arrays have even been reported picking up reflected energy from the Moon as well."

The difficult, pioneering days of solar power are largely behind us. Today, homeowners can easily find and install solar panels, and even connect them to their own electrical system without a great deal of trouble.

Companies that help homeowners install and bring solar systems online include:

- Butler Sun Solutions (www.butlersunsolutions.com)
- Energy Works (www.enworks.net)
- Solar Market (www.solarmarket.com)
- FW Horch (www.fwhorch.com)

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