

**Humboldt Energy Task Force
Solar Hot Water Program Recommendations**

Prepared by

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Background:

To prepare this report several different types of solar hot water systems were investigated. The likely performance and suitability of these system types for our locale was assessed. A list of solar hot water contractors serving (or willing to serve) our area was compiled, and these contractors were surveyed in order to gather information about their services, including the types of equipment they would be willing to support. In addition, information about other solar hot water programs (such as the Sacramento Municipal Utility District [SMUD] program) was obtained and reviewed. The following is a partial list of information sources that were utilized during this study:

- Residential Contractor Agreement, SMUD Residential Solar Domestic Hot Water Program;
- Solar Weatherization Assistance Program Final Report, Florida Solar Energy Center;
- Solar Rating and Certification Corporation (SRCC) publications;
- California Energy Commission (CEC) Solar Energy and Distributed Generation Grant Program Guidebook;
- Solar Today magazine;
- Home Power magazine.

Solar Hot Water Program Options:

There are a number of actions the Humboldt Energy Task Force could take to promote solar hot water systems in our area. An ambitious program could include bulk purchases of equipment or requests for bids on an aggregated number of systems. These actions would likely serve to lower the installed costs of solar hot water systems, and thereby would provide an incentive for people to install such systems. Alternatively, the Task Force could choose to simply provide information to consumers and to conduct a coordinated public promotional program. Informational materials could include a description of recommended systems for our area, a list of contractors serving our area, general guidelines to follow, CEC rebate information, information on the SRCC rating system, and a list of recommended conservation measures.

In either case, we think the important thing is that the Task Force undertake some coordinated effort to promote solar hot water. The technology is mature and well proven, and it offers economic and environmental benefits to individuals and to the community as a whole. Now is the time to act. Peoples’ awareness of energy issues has been heightened, but their increased interest will not last forever.

Recommended Systems:

The following three solar hot water systems were found to be available in our area. They are all systems that would perform well and are likely to be durable and trouble free. All systems recommended here would serve to preheat cold water from the water main before it is sent to the existing water heater. The existing water heater would then boost the temperature if needed. Note that the cost and payback information presented here does not reflect possible discounts associated with bulk purchasing arrangements. Bulk purchase arrangements could be investigated by contacting vendors and/or manufacturers. Contact information for manufacturers is given in the “Summary of SRCC Certified Solar Collector and Water Heating System Ratings” and contact information for vendors is given in Solar Contractor Survey Results, both of which are contained in the Appendix.

	Option #1	Option #2	Option #3
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System	Six Rivers Solar, Inc.	SunEarth, Inc.	Solahart Industries Pty Ltd
System Type	Indirect forced circulation, drainback	Indirect forced circulation, glycol loop	Indirect thermosyphon
System Specifications	(2) SunEarth SP-40 flat plate collectors, Six Rivers 120-gal. solar storage tank with internal heat exchanger, Taco pump, Goldline differential controller	(1) SunEarth EC-40 flat plate collector, Rheem 80-gal. solar storage tank with wrap around heat exchanger, pump, differential controller	(1) Solahart 302K closed circuit thermosyphon system (includes two flat plate collectors and an 80-gal. storage tank)
SRCC System Model Name/Number	SRS-120-DHW-AC-ELEC (electric back-up), SRS-120-DHW-AC (gas back-up)	TE40C-80-2	302K-AS
Installed Cost	\$4000	\$3600	\$6900
SEF* (electric back-up)	2.0	1.8	1.9
Annual Savings (electric back-up)	\$316	\$277	\$297
Payback Period (electric back-up)	10 yrs	10 yrs	21 yrs
SEF* (gas back-up)	1.2	N/A	N/A
Annual Savings (gas back-up)	\$107	\$74	\$98
Payback Period (gas back-up)	30 yrs	39 yrs	63 yrs
Potential Vendors	Six Rivers Solar Eureka, CA 707-443-5652	Bergquam Energy Systems Sacramento, CA 916-383-9425	Jay Sooter's Spas Eureka, CA 707-444-8001

*Note: SEF is the Solar Energy Factor. This is a performance rating established by the Solar Rating and Certification Corporation (SRCC). This performance rating is explained in the SRCC's "Summary of SRCC Certified Solar Collector and Water Heating System Ratings." An abbreviated version of this document is included in the Appendix to this report.

System Descriptions:

Option #1:

Option #1 is a system packaged by Six Rivers Solar of Eureka, CA. It is a drainback system. These type of systems are highly rated in terms of performance and durability. Six Rivers has been installing and maintaining these type of systems in our area for more than 20 years. This system features SunEarth flat plate collectors and Six Rivers' own locally-manufactured solar storage tank. This is a rather simple system that is expected to require little maintenance. Support service for this system could be provided by Six Rivers Solar.

Below is a schematic of this system.

(graphic not available)

In this system the solar storage tank is filled with tap water when installed. This water is then pumped through the roof-mounted solar collectors and heated. When there is little or no sun available the pump shuts off and the water in the collectors drains back into the solar storage tank. Because there is never any water in the collectors and associated piping at night, there is no danger of freeze damage. When hot water is drawn at the tap, cold water flows through the heat exchange coil in the solar storage tank. This water is thereby preheated before it flows to the existing water heater, where its temperature is boosted if needed.

Six Rivers Solar also offers packages in larger sizes depending on the customer's hot water needs. These include a 3-collector system with a 210 gallon storage tank and a 5-collector system with a 320 gallon storage tank. All three of these systems are SRCC OG-300 Certified, and therefore eligible for the CEC \$750 rebate, when installed with either gas or electric auxiliary back-up water heaters.

Option #2:

Option #2 is a system packaged by Sun Earth Inc. They have been in the solar hot water business since 1978. This system is offered by Bergquam Energy Systems of Sacramento, CA. Bergquam Energy Systems is currently one of three participating contractors in SMUD's Solar Hot Water Program. They come highly recommended by the Solar Hot Water Program Manager at SMUD. This system features a Sun Earth flat plate collector and a Rheem solar storage tank with a wrap-around heat exchanger.

This system is expected to provide reliable, long-term operation. As with any closed loop anti-freeze system it will require a maintenance check-up once every five years to check the anti-freeze quality and level, check controls and valves, etc. Bergquam Energy Systems indicated that they would probably contract with a local solar contractor to provide support service for these systems.

Below is a schematic of this system.

(graphic not available)

This system circulates a non-toxic propylene glycol anti-freeze solution through the collector. This heat transfer fluid picks up heat from the collector and carries it to a wrap-around heat exchanger that surrounds the bottom portion of the solar storage tank. Here the heat is transferred to potable water in the solar storage tank. When hot water is drawn at the tap preheated water from the solar storage tank flows to the existing water heater where its temperature is boosted if needed.

This system is SRCC OG-300 Certified, and therefore eligible for the CEC \$750 rebate, when installed with an electric auxiliary back-up. It is not currently SRCC certified with a gas auxiliary back-up (though a very similar SunEarth system with a PV powered pump is certified for both cases). It is possible that the CEC will provide a rebate for this system with a gas auxiliary back-up.

Option #3:

Option #3 is a system packaged by Solahart Industries. Solahart has been manufacturing and selling solar hot water systems since 1953. They make a high-quality durable product that is very simple. There is no pump and no electronic controller, and fewer components means that there is less that can go wrong. The Solahart system has been promoted as part of the SMUD Solar Hot Water Program. Locally, Jay Sooters Spas has recently been appointed as a Solahart dealer. Jay Sooter has installed a number of solar hot water systems in the past and is currently providing maintenance support for about 100 systems. He has not been installing systems in recent years.

Below is a schematic of this system.

(graphic not available)

Solahart offers systems with 5 and 12 year warranties. These systems require routine maintenance at a 5 and 12 year interval, respectively. At this time the sacrificial anode in the solar storage tank is replaced and the level and quality of the heat transfer fluid is checked.

The Solahart system is an indirect thermosyphon unit. The two flat plate collectors and solar storage tank are integrated into a single package that is mounted on the roof. The solar collectors are filled with a propylene glycol solution (non-toxic, FDA food-grade). This solution flows, due to natural convection, through the collectors where it picks up heat and then through a heat exchanger in the solar storage tank where it transfers heat to the potable water supply. When hot water is drawn at the tap preheated water from the solar storage tank flows to the existing water heater where its temperature is boosted if needed.

This system is SRCC OG-300 Certified, and therefore eligible for the CEC \$750 rebate, when installed with an electric auxiliary back-up. It is currently undergoing SRCC testing and is expected to be certified later this year with a gas auxiliary back-up. Solahart also offers an SRCC certified system that consists of a single collector and a 47-gallon solar storage tank.

One drawback with the Solahart system is that it requires a large volume of water, and therefore a significant amount of weight, to be placed on the roof. The two-collector system with the 80-gallon storage tank weighs just over 1000 lbs. when filled with water. Placing all of this weight on the roof is not a trivial task. Reinforcement bracing is typically required to support the added weight. Fortunately, a compendium of structural calculations is available from Solahart for various rafter types, rafter spacing, and roof coverings. These calculations provide specifications for reinforcement bracing and in most cases are sufficient for securing approval from a building code official. If promotion of this type of system is pursued it would be wise to meet with local building inspectors to get their input about building structural issues and code requirements in our locale.

Another drawback with this system is the higher cost. However, we talked with a SMUD solar contractor who is installing these systems in Sacramento, and he quoted us an installed cost of \$5500 for a Solahart system similar to the one Jay Sooter quoted. Perhaps a better installed price can be obtained locally as well. In addition, Wing Solar and Wood Energy in Red Bluff quoted us an installed cost of \$3500-\$4000 for a very similar indirect thermosyphon system manufactured by SunEarth Inc. The system offered by SunEarth, called the Sunsiphon, is also SRCC certified. Insufficient information on this system was available to SERC engineers at the time this report was prepared to make a recommendation.

How Systems Were Chosen:

The systems we have recommended were chosen based on a number of criteria. One key criterion was that there be one or more reputable, experienced solar contractors who would be willing to install and service these systems in our area. We found this to be a rather limiting criterion. The solar hot water business is not a booming business, and consequently the number of solar hot water contractors who are willing to serve our area is not great.

We feel that it is very important that any product that is promoted have a local support infrastructure capable of servicing this equipment. In addition to this criterion, the systems we have recommended also meet the following criteria:

- Certified by the Solar Rating and Certification Corporation (SRCC),
- Eligible for the CEC \$750 rebate,
- Manufactured by reputable company that has been in the solar hot water industry for numerous years,
- Made of high quality and durable materials,
- Incorporate adequate freeze protection for our climate,
- Exhibit good performance in our climate.

System Types Not Recommended:

The system types recommended in this report include an indirect forced circulation drainback system, an indirect forced circulation closed loop glycol system, and an indirect thermosyphon system. We feel that these system types are likely to perform well and to be durable and trouble free in our locale. We considered a number of other system types, but ruled them out for various reasons, as noted below:

- Some level of dependable freeze protection is required in our climate. Systems relying on recirculation or draindown freeze protection techniques historically have been found to be unreliable.
- Integral collector storage (ICS) systems are typically simple, low-cost systems with adequate performance in some climates. However, they suffer large amounts of nighttime heat loss in cooler climates such as ours.
- Forced circulation systems with solar electric powered pumps require a good match between the power needs of the pump and the power output of the solar electric panel. According to one of the SMUD solar contractors these systems often perform badly because of a poor match between these components.

Contractor Survey:

We conducted a brief contractor survey in our immediate and surrounding area to find out how many contractors were currently installing and servicing solar hot water systems. We identified potential contractors by searching the on-line Yellow Pages for the 707 and 530 area codes. We then called contractors as far south as Ukiah and as far east as Redding and Red Bluff. We also searched Home Power Magazine's list of solar contractors.

We asked these contractors if they would be willing to respond to an RFP for installation work in Humboldt County, what types of systems they were installing, and what their typical installed system costs were. We found that only a handful of contractors are currently installing and/or servicing solar hot water systems in our county, and that only one contractor has installed more than one system in our area in the last year. However, it does appear that there is some renewed interest in this field, and that the time may be ripe for a program that promotes solar hot water. In addition, there are some contractors who currently serve surrounding areas who may be willing to serve our area as well.

A copy of the survey questionnaire, as well as a summary of the results is included in the Appendix to this report.

Customer Guidelines:

The following is a list of questions that can be used to identify households that are likely to benefit most from the installation of a solar hot water system. Households answering yes to these questions are more likely to benefit:

- Do you have an electric water heater?
- Are there at least three or four people in your household? Do you use lots of hot water?
- Do you have sufficient unshaded south facing roof area to install solar collectors (40 to 80 square feet)?
- Will it be easy to route pipes from the water heater to the roof?
- Is there room nearby to your existing water heater to locate a solar storage tank?

System Installation Guidelines:

The following is a list of recommended criteria that each installed solar hot water system should meet:

- All sites should have clear solar access between at least 9 AM and 3 PM solar time throughout the year.
- The collector orientation should be within 30° east of true south and 45° west of true south.
- The collector slope should be in the range of 15° to 55° from the horizontal.
- Installed systems should be SRCC certified and should meet CEC requirements.
- Participants should be encouraged or even required to adopt basic hot water conservation measures (see page 10).

Contractor guidelines:

The following is a list of recommended criteria that contractors in a solar hot water program should meet. Contractors should:

- Possess an active Class B, C-36 or C-46 California State Contractor's License,
- Agree to maintain all applicable licenses, permits, insurance and bonds required by law,
- Provide evidence of at least two years experience installing and maintaining solar hot water systems,
- Agree to maintain the manufacturer's warranty and a three-year installation warranty at no additional charge to the customer,
- Agree to provide on-going system support and service for a minimum of five years.

For further information on possible contractor guidelines, see SMUD's Residential Contractor Participation Agreement for Residential Solar Domestic Hot Water Program which is included in the Appendix to this report.

SRCC Ratings:

The Solar Rating and Certification Corporation (SRCC) was incorporated in 1980 and is a non-profit, independent third-party certification entity. They are the only nationally recognized certification agency for solar water heating equipment. The SRCC certification criteria cover system design, reliability and durability, safety, operation and servicing, installation, operation and maintenance manuals, and system performance.

It is now common for solar hot water programs, such as the program offered by SMUD, to require that systems be SRCC certified. A description of the SRCC's rating system is given in their document entitled "Summary of SRCC Certified Solar Collector and Water Heating System Ratings." An abbreviated version of this document is included in the Appendix to this report. For further information about the SRCC ratings and a complete listing of all SRCC certified systems see the SRCC website at <http://www.solar-rating.org/>.

CEC Rebate:

The California Energy Commission offers a \$750 rebate for eligible solar hot water systems under their Solar energy and Distributed Generation Grant Program. In order to be eligible, the solar water heating system must meet the following criteria:

- Be an SRCC OG-300 certified system,
- Have an SRCC OG-300 minimum SEF of 1.4 for systems using electric back-up heaters and a minimum SEF of 0.8 for systems using gas back-up heaters,
- Be covered by a full 3 year warranty that covers all parts and labor,
- Be installed by a contractor who possesses a Class A, C-46 or C-53 contractor's license (note that a system may be installed by a homeowner without a contractor's license),
- Be installed and operated in accordance with all manufacturer's specifications as well as all applicable laws, codes, regulations, etc.

Note that the CEC is currently reviewing their program guidelines and may make modifications to the solar hot water system eligibility criteria. More information about the CEC solar hot water rebate program can be found on the CEC website at <http://www.consumerenergycenter.org/solaranddg/index.html>.

Conservation Measures and Energy Education:

As part of a solar hot water program consumers should first be educated about the importance of using energy wisely. Before investing in a solar hot water system, it is more cost effective to invest in reducing your hot water use load. Good first steps include:

- Install low-flow showerheads and faucet aerators.
- Insulate your existing water heater.
- Insulate hot water pipes.
- Consider installing heat traps on your existing water heater.
- Lower the thermostat on your water heater to 110°F-130°F.
- Use a booster heater on your dishwasher (to raise the water temperature) combined with a lower water heater setting.
- Replace the washers in any dripping faucets.
- Whenever possible, use the cooler cycles on your clothes washing machine.
- Whenever possible, use cold water, not hot.
- Don't use hot water when small amounts of water are required for tasks such as brushing teeth and washing hands.
- Flush out your existing water heater annually to remove sediment and improve efficiency.
- For electric hot water heaters, use a timer to turn off the electric heating element during times when hot water is not needed.

In addition, consumers should be informed about how to get the most out of their newly installed solar hot water system once it is installed. This includes:

- Shower and wash clothes and dishes late in the day, after the sun has heated your water.
- During warm, sunny weather, turn off the electric heating element completely.

Appendix

1. Summary of SRCC Certified Solar Collector and Water Heating System Ratings, July 2001 (abbreviated)
2. Solar Contractor Survey
3. Solar Contractor Survey Results
4. Residential Contractor Participation Agreement, SMUD Residential Solar Domestic Hot Water Program