

Passive & Active
Solar Systems

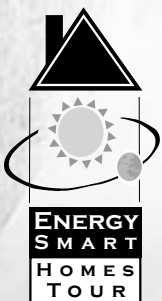
Geothermal Heat
Pumps

Advanced Home
Weatherization

Clean Air for
Truckee

Water-Efficient
Landscaping

Green Building



energy-smart homes tour

October 18, 2003 • Truckee

This photo shows the main
hallway of a rammed earth home
on the tour in 2001 and 2002.

Tour Schedule

- 8:00 - 8:30 **Registration**
- 8:45 - 9:30 **Tahoe Berry Garden (page 3)**
Water Efficient Landscaping
- 9:45 - 10:30 **Stoumen Home (page 3)**
Green Home; Passive Solar
- 10:45 - 11:45 **Rick Solinsky Home (page 4)**
Solar PV; Wind; GSHP
- 11:45- 12:30 **Lunch by Dragonfly**
- 12:45 - 1:30 **New Middle School (page 5)**
Green Building; GSHP
- 1:45 - 2:30 **Laws Home (page 6)**
Passive Solar; Trombe Wall
- 2:45 - 3:30 **Flys Home (page 6)**
Advanced Weatherization; GSHP
- 3:45 - 4:00 **Teen Activity Center; KidZone;
Sierra High School (page 7)**
Solar PV; GSHP; Advanced
Weatherization

Have a Great Weekend!

IS YOUR HOUSE TOXIC?
the SIERRA GREEN BUILDING ASSOCIATION
PROUDLY PRESENTS the MOVIE PREMIERE of
BLUE VINYL
SATURDAY, OCTOBER 18, 2003
6:30 p.m.
Truckee Donner Public Utility District
11570 Donner Pass Road, Truckee

Free admission
(Optional \$5 donation)

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Patrick Hayes,
Film Technical Consultant
will be present for Q&A

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"Sorty and hilarious"
Divis Mitchell, New York Times
"That are muckraking film
with a sense of humor."
Kenneth Turan, Los Angeles Times

Welcome!

Ahhh..... The summer heat is subsiding, the leaves on the trees are starting to change color and the days and nights are gradually becoming cooler. Already, the prices of traditional energy sources like propane, heating oil, natural gas and gasoline are on the rise and could be at record prices this winter. Once again, the Truckee Energy-Smart Home Tour is a timely event.

As the seasoned tour-goer knows, we focus on energy conservation, green building, and a variety of renewable technologies available to us here in Truckee. During this year's tour you will have the opportunity to visit a number of energy-smart homes and businesses. These buildings demonstrate ways of utilizing efficient, renewable and sustainable technologies and building materials.

The organizers of the tour would like to thank the following homeowners and businesses for allowing us to view their homes/projects:

- * Don & Margot Gibson @ Tahoe Berry
- * John & O'Malley Stoumen
- * Karen Fly
- * Rob & Sigi Law
- * Tahoe Truckee Unified School District
- * Recreation District's Activity Center & the KidZone

Many of the solutions to managing our heating and/or cooling comfort and cost issues can easily be cured by careful planning and often can be alleviated with fairly simple, do-it-yourself-today remedies.

Our town is blessed with many people who have the knowledge about efficient and renewable technologies and are willing to share with others — all we need to do is ask. We now have a local group, Sierra Green Building Association (SiGBA), dedicated to educating people about sustainable, green building design. Visit their website, www.sigba.org for information about the organization and their local events. I would highly recommend you at least take a look at what these resourceful and dedicated people are up to and to possibly join their organization.

I'd like to add a little side-note here. I would appreciate if everyone kept an eye out for homes for us to show in upcoming tours. It is getting difficult to find new and interesting homes that we feel meet the energy-smart criteria. It is truly amazing that in a location such as Truckee, where we have the great fortune of experiencing over 300 days a year of clear, unobstructed sunlight, that there are not more Energy Smart homes to choose from for this tour. Please feel free to contact me if you know of any homes which you'd like to be included in a future tour.

So many people offered the inspiration in creating this year's Truckee Energy-Smart Home Tour. A special thanks goes to the Town of Truckee for their support in promoting efficient, clean technologies that help improve Truckee's air quality. Likewise, Scott Terrell and the Truckee Donner PUD have done much in this community to help homeowners and businesses control their energy costs. They have been truly invaluable in supporting and helping coordinate this project. It is refreshing to know that we live in a community where the city government and local utility district are willing to extend their hand for such a worthwhile endeavor.

This year's dedicated group of people worked hard to plan this event that is better than we have done in the past. I hope you enjoy this event as much as we enjoy bringing these people together today to share their knowledge. Next year this event will be hopefully even more expansive and we look forward to your involvement.

— Rick Solinsky, Tour Organizer

Proceeds from this event go to KidZone and to SiGBA



Tahoe Berry

Water Efficient Landscaping;

Truckee Donner Public Utility District sponsored a demonstration project at Tahoe Berry: a low-water use garden to demonstrate easy, effective ways to reduce landscape water use while still creating and maintaining a beautiful garden. The Tahoe Berry Garden contains a variety of low-water-use plant species in combination with a water-efficient drip irrigation watering system. The Tahoe Berry building has several other energy and water efficient features as well — take a look at them in the TDPUD brochure, which is available on the Tour.

“According to [TDPUD] data, Truckee water use in the fall, winter and spring is pretty much static with District residents using two to three million gallons per day last year. However on many days in summer 2002, District residents used nearly nine million gallons of water per day, primarily for landscape irrigation.”

- Peter Holzmeister, TDPUD General Manager

A Quick list of high mountain plants with low-water needs

Trees: Incense Cedar, Ponderosa Pine, Jeffrey Pine, Lodgepole Pine; Russian Olive; Locust

Shrubs: Serviceberry; Juniper; Snowberry; Chokecherry; Mountain Roses; Western Spirea; Russian Olive; Broom, Pink Winter Currant, Lemon Willow, Oregon Grape, Potentilla

Ground Covers: Kinnickinnick; Bearberry Cotoneaster; Creeping Phlox ‘Candy Strip’; Creeping Junipers, Thyme, Creeping Mahonia; Japanese Honeysuckle

Perennials: (most require low-to moderate rather than regular watering) Yarrow; Goldenrod; Blanket Flower, Flax, Lambs Ears, English Lavender; Rockcress; Russian Sage, Sedum, Satice, Bluebeard

Grasses Switch Grass

(Source: Cindy Monroe, Rock Garden)

More information on Landscaping in this Guide

- See Eric Larusson’s article, “High Efficiency Landscaping,” page 13
- See Scott Terrell’s article, “Being Water-wise in the Yard,” page 19

Stoumen Home

Green Home; Passive Solar

Project: Stoumen Cabin at Summit Creek
Owner: Jon, O’Malley, Jacob and Sadie Stoumen
Size: 3,000 sq. foot house plus garage, studio and greenhouse/breezeway
Designer: Jon Stoumen, Architect
Date of Construction: 2001-2004
Builder: Jon Stoumen

Site Characteristics of Focus During Construction:

Site offered two building envelopes with a 10’ public utility easement east-west between them. Summit Creek, which feeds Donner Lake on the west shore, lies at the north of the site, and a small creek is to the west. The solar window on Dec. 21 is from 9 a.m. to 1:45 p.m. All other days the sunshine is available longer. The views are 360 degrees with Donner Peak to the southwest. The two building envelopes are of irregular shape.

The creek bank needed erosion protection and we designed and installed rip rap with granite boulders from the area after an extensive agency approval process. The second year was spent grading the site and preparing the pads. We raised the area under the structures to achieve a gentle downslope for the driveway and front yard.

These drain toward the street and create a higher elevation in case of a 500 year flood. The site had some weak soils, as well as old stumps and organic debris which was encountered during foundation excavation. To mitigate this we over excavated to 9’ and firm ground, then pumped in 5’ of slurry mix to provide a base for our footings. We built a rock wall to terrace the grounds to the north of the house adjacent to the creek. We designed the garage on one of the building envelopes and the house on the other. The breezeway/greenhouse will tie the two buildings together. The round floor plan was the result of many iterations and design alternates. It was chosen for many reasons, including efficiency and strength. The wall system we utilized is Durisol, which are blocks made of recycled wood, cement and rock wool insulation. The hollow cells in the blocks are fitted with rebar and poured with concrete. The roof was designed to manage the snow and protect the major entries and glazed areas, while being efficient to build. The orientation provides a surface to mount a photovoltaic system and hot water heating panels. The exterior finish is lime



stucco plaster. The entire assembly and landscape design is planned to create a fire safe environment.

Construction Type:

Stay-in-place masonry wall forms grouted with concrete, covered with lime stucco plaster; wood timber roof system. Roofing is standing seam metal on the garage and artificial slate on the house. Passive solar system. Direct gain southern glazing with high thermal mass efficient insulated low infiltration wall and slab floor systems. Interior granite boulders and stone work; slab, steel and concrete lined walls provide thermal storage. Curtains and low heat glass on east, west and north elevation retain heat at night. Orientation, roof overhangs, and trellis vines provide shade in summer and fall for extensive southern glass areas. Stone piers are thermally broken between windows in the bay shaped sun space.

Active Solar System: 2.5 kw PV system for electrical power and solar hot water panels for domestic hot water heating.

Main Heating System: Solar with BPA phase 2 certified wood stove backup.

Auxiliary Heating System: Hydronic radiant floor heating with +/- 90% efficient natural gas boiler.

Conservation Features: Recycled wood wall system

with fly ash concrete grout, lime stucco plaster interior and exterior, sustainably grown exposed wood beams, engineered wood in concealed areas, recycled old growth redwood plates, fascia, window jambs, etc. Recycled fir paneling, water based sealers and finishes, use of local granite materials, roof shingles made from recycled automobile window gaskets, clad wood windows from sustainably grown and certified forests, use of durable fire resistive construction systems for low cost of ownership and maintenance. Natural daylighting, natural ventilation and healthy materials and finishes.

Performance Data: Off the charts!

Subjective Evaluation/Design Consideration: Chalet inspired design on south facade to keep snow managed safely and from piling up in front. Integration of building with site features, views and sunshine. The design seeks to capture, utilize and celebrate its solar and view resources. It offers space to grow plants and flowers and provide fountains in the two story winter garden and greenhouse breezeway. The design integrates the various levels vertically for daylighting, heating, cooling and ventilation distribution through natural means. The aesthetic will be Alpine, incorporating elements of indigenous old Tahoe architecture and Swiss mountain design. This home will be a high performance solar and environmentally responsive home for our family of four and extended family of many.



Solinsky Home

Solar PV; Wind; Ground Source Heat Pump

Project: **Two Story Single Family Home**
 Owner: **Rick & Lauri Solinsky**
 Size: **2,750 square feet**
 Designer: **Jill McGovern**
 Date of Construction: **1999**
 Builder: **Eric Ethimu, Alpine Construction, (530) 587-0777**

Site characteristics or focus during construction or remodel: We purchased this property with 270-degree views. When we designed our home, we wanted to have a floorplan which benefitted from our very sunny –very exposed location.

In planning the positioning of the home, these were the factors we wished to work with:

1. Make the home as energy efficient as possible
2. Situate the home such that from the picture window where the lazyboy chairs are – we could see the Palisades at Squaw Valley, while at the same time aligning the position of the windows to block the main view of the sewer plant.
3. Use active and passive solar whenever possible.
4. Use the existing group of trees to the west of the house as a way to increase the shading of the home during the hottest months of the summertime.

The glacial moraine on which the house is located is one of the windiest parts of Truckee. During winter, storms blow in from the southwest and literally pummel us with 85 mph winds.

During the wintertime, this location gets unobstructed sun from 7am until 5pm and in the summertime the solar panels get sun from 6am to 6pm. The house is situated such that after about 3pm in summertime, it is in the shade of the trees directly to the west of the us — offering a welcome shading effect to both the front and back porches during the hottest part of the day.

We positioned the home to take advantage of the summertime down slope winds to cool the home in the summertime while conversely in the wintertime we often endure sustained gale force winds.

In the wintertime, the majority of our energy production is from our solar panels- while occasionally the wind supplements our output as storms blow in. Summer is the time of year when we experience the greatest energy output of both our solar panels and wind turbine during the late mornings and early to late afternoons.

Construction Type: The house is wood frame construction with stucco walls and log accents. Stucco was an

attractive feature due to its complimentary look coupled with logs and fire resistance of the material- which is a valid concern while living on property that is surrounded by thousands of acres of sage-brush.

Passive Solar System: The home was posi-

tioned to take advantage of the full day exposure to the winter sun. In the summertime, the sun is high enough and the edge of the roofline is such, that the sun's rays barely enter the house. Yet, during the wintertime, when the sun is lower in the sky, it shines on the northern wall in the great room. Our main mistake when we built the home was to assume the gypcrete in the floor would be enough mass to store and retain our passive gains. However, eliminating our carpets in the great room could possibly help.

Solar Domestic Hot Water: For over 4 years we have been using a 2-panel solar hot water system which was designed to act as a pre-heating unit for our propane-fired domestic hot water tank. The solar system is a closed-loop set up — where the glycol-based water in the panels is circulated from hot water side of the panels to a heat exchanger and back to the panels.

Solar Hydronic Hydroponic Greenhouse: I thought it would be kind of neat to grow my own lettuces and tomatoes in the wintertime in order to have minutes-old fresh wintertime salads. I just so happened to have a couple of extra 4x10 foot solar panels to use for this project. First I built a 9x16 greenhouse, with an insulated foundation and hydronic pex lines embedded in the concrete floors.

The solar hot water system includes a similar system design as my solar domestic hot water. The panel to the heat exchanger is an identical design. The floor loop system is a little different than with the solar domestic hot water. During a sunny day in the late fall, winter and early spring, the thermostat in the greenhouse turns on and allows the solar heated water to circulate into the floor all day long. Since the greenhouse has the potential to lose heat rather quickly, I added some more mass to the heating system by building a water wall on the north side of the greenhouse- the water wall is basically a 2x6 stud wall which has a netted face which holds six 55 gallon bags of water on the wall. There is a hydronic pex line which loops behind the bags to add a little extra heating to them during the day.

The plumbing design of this system starts from the solar hot water tank. The solar heating circuit goes from the bottom of the tank, through the heat exchanger and back into the tank. The floor heating circuit, runs from the mid point of the tank, through an instantaneous hot water heater, and out to the floor and then back to the tank. During the sunny day, when the floor pump turns on, the cold water in the tank will pass through the instantaneous hot water heater and since the temp will be colder than acceptable, the burners of the instant hot water heater will turn on and flash heat the water, which then circulates into the floor. As the water circulating through

the heat exchanger heats up, the burners on the instant hot water heater will turn off and then only the solar heated water will heat the floors. After the sun goes down, all the pumps turn off. There will be a carry over time when the mass will keep the greenhouse warm. During the evenings when the temp of the greenhouse falls below 60 degrees Fahrenheit, the thermostat in the greenhouse will turn on only the floor pump, which circulates the water through the instant hot water heater to the floor. At that point, the instant hot water heater flash heats the water and provides the hydronic night-time heating on demand.

Active Solar System: In an effort to make an environmental conscious statement, we chose to supplement the power we purchase from TDPUD with our own "Solinsky Utility District" power. We currently have 1800 watts of solar panels (1200w of which is on a tracker and 600w is on a fixed mount) and a 2500 watt wind turbine on the property. The power is directed through two 4000 watt Trace inverters and stored in a 24 volt battery bank with 1750 amp hours of storage. The system is set up to be manually switched to back up power during times of TDPUD power loss. We currently produce around 9 kilowatt hours per day, which is back-fed into the PUD's power lines in accordance with California's net metering law.

Main Heating System: The home has a 5-ton ground source heat system coupled with a hydronic in floor heating system. I can't say enough about how happy we are with this system- the house is a welcome refuge during even the coldest days in the wintertime- there is not a single cold spot in the place.

Auxiliary Heating System: Since the ground source heating is electrically driven (and it draws a lot more power than my inverters can produce), we needed to have a back-up heating system in case of PUD power outage. We chose to use a propane gas fireplace (Extrordinaire) – this fireplace is rated as a furnace and quickly takes the edge off during the spring and fall and will operate without power.

Conservation Features: Dual Pane Low-E windows, some energy efficient appliances (freezer in garage), compact fluorescent bulbs, a house design which allows a single light on in order to illuminate most of the whole house, cellulose insulation in the walls.

Subjective Evaluation/ design considerations:

When we were first designing the house, I specifically stated to our designer I wanted to design a solar home. Her reply was " I know how to design a solar home" — well, apparently to her, a solar home means a home having plenty of south facing glass. What she neglected to add to the design was any MASS! Mass is an extremely important feature to a solar design- mass provides a heating "carry-over" time- so when the sun leaves the mass, and the house cools down, the mass then re-radiates the heat into the home. Our home lacks that feature and thus during the cold winter nights, the ground source heat pump runs all night long.

When we insulated the home, we chose to pay a little extra to get cellulose insulation instead of fiberglass insulation. From what I could read about it, the cellulose insulation works better in our extreme climate than the fiberglass does. We had one minor problem when the insulation people showed up; they only filled the walls with Cellulose, but neglected to do the ceilings and instead used fiberglass on the ceilings. At the time, the contractor said that there was no way to make the cellulose stick to

See Solinsky, Continued next page



Middle School

Green Building; Ground Source Heat Pump

Project: **Alder Creek Middle School**
 Owner: **Tahoe Truckee Unified School District**

Size: **87,000 square feet**
 Designer: **Lionakis Beaumont Design Group**

Date of Construction: **2002-2004**

Builder: **Phase 1 Site work — Granite Construction, Phase 2 Building — Clark & Sullivan**

Site characteristics or focus during construction or remodel: This site was selected, because it was one of the few sites in Truckee that could meet the California Department of Education's requirements for location and size, is near the majority of the student population, and affordable.

During pre design meetings, the desire to have a lot of daylight, natural ventilation, reducing maintenance costs and simplifying snow removal were high priorities.

The building is set on an east-west axis to allow better control of the sunlight entering the building. We have provided maximum affordable day lighting to improve the learning environment within the building and reduce light energy costs.

The two-story construction reduces the amount of area disturbed for construction of the facility. It also reduces the roof area, which is a high maintenance item for the district as well as source of heat gain into the building. We have designed a white "cool" roof to further reduce heat gain.

The primary student and staff entry and the outdoors PE area are south facing, which takes advantage of the sun for melting snow and ice.

To reduce the visual impact of the facility on the scenic corridor, the cafeteria is bermed into the earth. The berm serves as a thermal buffer on the north and west side.

Construction Type: Two story concrete block with a steel frame. The concrete block provides a good long-

term low maintenance exterior, and due to its mass, it provides a time lag for heat and cold to impact the interior. The interior walls are either exposed block, high impact sheet rock, or plastic laminate covered sheet rock. All of these materials were used to minimize damage from vandalism and reduce typical wear and tear on the building.

Passive Solar System: N/A

Active Solar System: N/A

Main Heating System: The facility has a 300-ton ground source heat pump system. There are 48 water source heat pumps through out the campus. Each classroom has its own heat pump to allow for limited individual control of the space. Because we cannot have glycol in the system, there is a backup boiler that will inject hot water into the system if the loop temperature approaches freezing.

Auxiliary Heating System: N/A

Conservation Features:

- Low e glazing will reduce thermal heat gain on the south facing windows and the reduce transfer of cold to the interior from the north facing windows.
- Horizontal window blinds integrated between the panes of glass will act as light shelves to bounce sunlight deeper into the classrooms.
- The first rows of lights near the windows have sensors to keep them off provided there is adequate daylight. There is a delay on the sensors to keep passing clouds from activating the lights.
- All lighting has T 8 second-generation lamps and energy efficient ballasts. Motion sensors control each room; the entire campus is tied into the districts energy management system. A sky light above the classroom stair well and two openings in the second floor will provide day lighting into the classroom hallways. Curtain walls on the north and south will provide day lighting into the common areas. The lighting system is designed 36% below what is required by title 24.
- The water source heat pumps are ultra high efficiency model.
- Low flow fixtures in classrooms; rest rooms and kitchen will reduce domestic water consumption. •

Planting of native materials on a drip system and a synthetic turf soccer field will reduce water consumption.

- Operable windows in each classroom will reduce the need for cooling.
- The contractor is required to recycle 50% by weight of the construction waste.
- The carpeting, linoleum, ceiling tiles, toilet partitions, walk off mats, and tackable wallboard are made from recycled products.
- Additional valves have been added to the ground source heating system, which may allow us to preheat domestic water in the future.

Subjective Evaluation/ design considerations: At this time we are happy with what has been designed. We expect to find items we wish we had done differently once we start using the facility.

Solinsky, continued from page 4

the ceiling (which upon later reflection, I found out that it was just that he preferred not to do so). The problem with this is lack of the cellulose barrier on the ceiling, is that since there is no sheetrock between the fiberglass and the wood deck ceiling, the hot air in the room easily flows out the joist bays to exit out the roof.

Also, in an attempt to "save money," I went out and purchased the "cans" for the living room ceiling. Unfortunately, I was unaware "insulated cans" were available so I purchased the un-insulated cans and had them installed. I then had a "swiss cheese" ceiling which allowed even more heated air to exit to the roof. I later added insulated reflectors to the cans, which seemed to help dramatically the heat loss through the light cans.

Since we have a lot of south facing glass, in the nighttime -in the winter, we could feel some cold drafts from the windows. We went out and purchased "duette" type of window coverings, which dramatically helped keep the great room warm during the evenings.

Our wintertime monthly utility bill is around \$150/month for both gas and electricity.



Law Home

Passive Solar; Trombe Wall

Project: **Three Story Single Family Home**
 Owner: **Rob & Sigi Law**
 Size: **3,000 square feet**
 Designer: **Mike Manuel**
 Date of Construction: **1991**
 Builder: **Mike Manuel**

Site characteristics or focus during construction or remodel: The house sits on a relatively flat, oversized lot. This location was chosen by Mike because of the level lot and full southern exposure. The house has full sun all year from early morning until evening.

Construction Type: Wood Frame construction with huge windows that allow the sun to passively heat the home.

Passive Solar System: The home was positioned to take full advantage of the southern exposure, huge windows allow plenty of sun and then the rock trombe wall stores and re-radiates the heat at night.

Main Heating System: The heating system is done using woodstove heat circulated through a hydronic heating distribution system. Two wood burning stoves keep us warm all winter, hardly ever do we need to use the heater.



Fly Home

Advanced Weatherization; GSHP

Project: **Karen Fly Residence**
 Owner: **Karen Fly**
 Size: **1625 square feet**
 Designer: **Unknown**
 Date of Construction: **1960s - 70s**
 Builder: **Unknown**

Site characteristics or focus during construction or remodel: Home was selected by TDPUD for a pilot energy project due to energy inefficient construction techniques resulting in substantial building envelope air leakage and great potential to make more energy-efficient.

Construction Type: One story, been remodeled/add-on, raised floor, living room has vaulted ceiling. Remodel resulted in some building energy-efficiency problems.

Passive Solar System: The home has an east-west axis and plenty of south-facing glass. The home is passively- solar heated, but was not designed specifically to be passively solar heated as there is no thermal mass for solar heat storage.

Active Solar System: None

Main Heating System: There are two ground source heat pump units, 3.5 and 2 ton systems.

Auxiliary Heating System: The home contains a gas fireplace, primarily for aesthetic purposes.

Conservation Features: The Fly home has gone through two rounds of conservation efforts. A lot of work has been done to seal the leaky building envelope and the two central air distribution systems. The house was also retrofitted with double-pane glass from single-pane. Other work performed included improving the central air distribution system's airflow, sealing the crawlspace vents and floor penetrations and repairing insulation defects. Airflow improvements resulted in 20% additional air flow. The conservation work resulted in reducing duct air leakage on one distribution system by 41% and 50% on the other. Building envelope air leakage sealing efforts resulted in a 28% improvement.

Subjective Evaluation/ design considerations: The Fly home had a substantially higher heat loss and heating system sizing requirement than could have ever been imagined for a 1,625 sq. ft. home. Originally a 3.5 ton ground source heat pump was installed in the home to cover 100% of its heating requirements. Then a 2 ton GSHP system was added since 3.5 tons was not enough to comfortably heat the home. Due to all the advanced weatherization work that has been performed on the home it is now an energy-efficient home and can easily be heated with one or both ground source heat pump units. This is a prime example of how you can use a super-efficient heating system in a building, but still have high energy bills because the building itself is not energy-efficient. The morale of the story is do not expect to have low energy bills if you use high efficiency heating equipment placed in a low-efficiency building.



Teen Activity Center

Solar PV; GSHP; Advanced Weatherization

Project: **Teen Activity Center**
 Owner: **Truckee Parks & Recreation**
 Size: **2,800 square feet**
 Designer: **Ron Gaunt**
 Date of Construction: **Mid-1900's; Renovated 1998**
 Builder: **Unknown**

Site characteristics or focus during construction or remodel: Utilizing a recycled building, the Parks and Recreation Department wanted to provide as much green technology as possible in the construction of the building.

Construction Type: Raised Floor, 2x6 frame construction

Passive Solar System: Plenty of south facing glass

Active Solar System: 2kw solar photovoltaic system

Main Heating System: Geothermal Heat pump

Conservation Features: Building has incorporated blown-in wet cellulose wall insulation and advanced home weatherization features

Subjective Evaluation/ design considerations:

Conservation features coupled with the geothermal heat pump and active solar system on the roof results in a comfortable, highly energy-efficient structure, with low energy bills.



KidZone

Ground Source Heat Pump; Hydronic

Project: **KidZone Center**
 Owner: **Partnership**
 Size: **3,600 square feet**
 Designer: **Sprung**
 Date of Construction: **2002**
 Builder: **Dave Vain Wright**

Passive Solar System: Good Sunny Location

Features: The KidZone building is a state-of-the-art "tension structure," a series of trusses interlocked with a weather-tight Teflon coated vinyl fabric. The design is cost effective and fun, featuring a skylight and cathedral-style windows that will look out to Donner Peak. Engineered to stand up against the worst Truckee winter, the building sits on a concrete slab that will be warmed with a hydronic system that heats the floor to make it even more comfortable for our budding crawlers. KidZone is a warm, well-lit space where infants, toddlers, and children can escape the winter snows for a great day of fun and stimulating play. The KidZone also features an air-to-air heat exchanger which allows for fresh air ventilation while keeping the heat in the building from going out with the outgoing air.

Sierra High School

Solar Photovoltaics

Features: Solar Photovoltaics — With meters on the walls inside the school, the solar system at the Sierra High School is set up to educate kids and adults on the possibilities of the abundant Truckee solar energy resource.



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**East West Partners encourages people to:
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Sunflowers, granite & over 280 days of sunshine, → use it !

By Jon Stoumen
Architect

Several volunteer sunflowers have been growing at our home site near Donner Lake this summer. Right now they are drooping under the heavy burden of ripening seeds. But just a few weeks ago they could be seen facing the sun full on. This phenomenon can be seen driving the back roads around Davis, as well as in Italy, France and Spain — whole fields of sunflowers point the way south. Some flowers that thrive on sunshine, such as poppys track and open their petals in the bright daytime hours and close up at night. If we were describing a solar building this might be how we explain its operation. These flowers are good metaphors for solar architecture.

So orientation, tracking, openness, and withdrawing are features of solar design; we can look to nature for some other important characteristics as well.

I stopped just above Rainbow Lodge last spring to eat a sandwich and to enjoy the rushing cataract in this stretch of the Yuba River. Snow was on the ground but the huge granite boulders along the river were clear and the sun was strong. I picked a spot out of the spray and sat watching the falling water. I was amazed that the huge boulder I sat upon was warm to the touch. The heat of the rock illustrates the principle of thermal mass. The thermal mass concept was used in Anasazi homes in New Mexico dating back 1000 years. Granite, like adobe is an excellent heat storage medium.

Lying in the sun, the rock retained the sun's energy. As I sat there amidst the winter's leftover snow in the high Sierra, listening to the roar of the river, I felt the warmth stored for my comfort by this granite boulder.

The Truckee/ Tahoe region provides a dependable climate for the utilization of solar energy. With more than 280 days of sunshine (and lots of clear days between snowstorms) one is afforded the opportunity to temper the cold winter temperatures with the sun's warmth. By using this energy source with careful planning and proper design, the hot summer days will not overheat homes and other buildings. The use of this abundant source of energy should and can be enthusiastically harnessed in this lovely mountainous region of California.

What does it take to use the sun's power and what are the some of the other factors to be considered as one explores environmentally conscious building in the Truckee/Tahoe basin?

Look to the south to see what your solar window is from the building location under consideration. The ideal site would have sunshine from 9:00 a.m. — 3:00 p.m. throughout the year. Hopefully the view is to a garden, mountains, water etc. In some cases the entry can work from the south but ideally it would be from the north, east or west. A solar home would place high solar gain glass on the south and fewer openings on the other sides of the building. Since the sun is high in the summer and low in the winter, there should be overhangs to manage the snow and the sun.

It is preferable to have the snow fall to the sides leaving the south side of the house free to collect energy. The roof eaves should be designed to provide shade in summer and can often be helped along with trellised vines shading



Sunflowers



Smothers Living Room



Anasazi Cliff Dwellings



Windmill, Stoumen Ranch

See **Use it!**, continued next page

the south glazing. The window layout should allow solar gain from the south and the glass's energy-efficient design will help keep the heat inside throughout the rest of the day and at night.

The building envelope needs to be heavily insulated in order to retain the direct gain heat.

Buildings in this region can greatly benefit from thermal mass consisting of stone, concrete or other mass materials. The age-old idea is based on the fact that sunshine which passes through a glass wall (the greenhouse effect) is absorbed by the mass of walls, floors or other exposed masonry elements. (See photo: *Smother's Living Room*) These ideas were used extensively by the Native Americans in their cliff dwellings and kivas. (See photo: *Anasazi cliff dwellings*)

The facades of a solar building are asymmetrical since their functions are different. Some sides collect energy and others help retain it. Roof insulation is highly important as heat rises, lots of precious stored solar energy can be lost skyward. As mentioned before the roof can manage snow and shed it to safe and non-solar

interrupting areas. The roof can also provide a place to install solar hot water panels as well as photo-voltaic panels to produce electricity.

Some sites may afford potential for wind driven electrical generators or hydro electric power. (See photo: *Windmill, Stoumen Ranch*)

To summarize so far: the orientation of the building on the site is essential if we wish to harvest solar energy. Look at the solar window and position the day time use areas (living, dining family, kitchen and solarium) to the sun and the south. Make the envelope like a thermos.

Include massive thermal elements in walls, floors and freestanding masonry to

absorb abundant solar heat entering thru the southern (correctly specified) glazing. Reduce openings to north.

In summer and fall, design for shading with overhangs and landscape elements. Provide areas which vertically align to enable natural ventilation keeping the air fresh and preventing summer/ fall overheating. Look to produce solar-powered electricity and hot water.

To further the environmental consciousness of the building one might incorporate low energy and low impact materials and components. Renewable type cellulose and rock wool insulation along with recycled materials greatly contribute to the buildings overall impact on the planet. Our solar buildings are designed to reduce infiltration from wind and cold temperatures and this requires

tightly sealed envelopes.

But in order to provide safe and healthy interior environments we need to provide fresh air and allow the building to slowly breathe. This places more importance on the nature of the materials and finishes used in the building. Healthy, non-toxic and natural materials will help insure the quality of the interior spaces.

We have other environmental concerns: abundant heavy snow, high winds, wild fires, earthquakes, extreme temperature swings, freezing, thawing, and avalanches. All of these factors can be accommodated in the design and site planning of our structures. The snow can be managed by shape, materials and structural design. Look to site context and design to assess the possibility for avalanche. See the use of trees above the town of Andermatt in the Swiss Alps to see how the villagers protected the trees and the trees protected the town.

Simple uncluttered plans reduce waste and allow for the efficient use of materials (like Buckminster Fuller advocated). The roof design and shape can provide additional help to the structure resisting snow loading and contributing aerodynamically to the design thus mitigating huge loads posed by high winds. (See photo: *Roof Design, Stoumen Cabin*)

Soils engineering and geologic investigation can reduce damage from earthquakes, which are certainly integral to the Sierra. Extreme temperature swings are tempered by super insulating and enclosing dense thermal massing within the building envelope. Finishes and building components need to have the capacity to expand and contract with the changes in temperature. All of the above should be built into a fire resistant, durable, low maintenance shell.

This way we are creating buildings that contribute to the capital wealth of the planet. Build to last, but build efficient structures. High performance structures provide an economical total cost of ownership.

Enjoy and be humbled by the wonderful opportunity that building in the Sierra affords. Take advantage of the blessing of an average of 280 plus days of sunshine. Build yourself a solar building and reduce reliance on precious non renewable sources of energy.

Look around at the flowers, see which way they open up. Feel some granite after it has been in the sun for a while and imagine what coupling these two phenomena can do for your home in the mountains of the Sierra.



Swiss Alps



Roof Design, Stoumen Cabin

Been There Done That

*"Experience is the worst teacher;
it gives the test before presenting the lesson."*

Vernon Law

The homeowners listed below have generously offered to share invaluable knowledge they have gathered when *building it green*. If you've got a project in mind, give them a call.

Penny & Bob Fink

587.8242

Their rammed earth home was on Energy-Smart Home Tour 2001 & 2002; see photo front cover

ExperienceWindows, Green roof, Pise/rammed earth; Concrete floors/acid staining; Electronic control systems; Ground source geothermal/hydronics; Accessibility; Plaster/colored plaster/water-proof plaster in showers; Icynene insulation; instant hot water heating

Hardy Herger

587.7166

His home was on the Solar Home Tour 2001

Solar PV, Solar Hot Water, Solar Hydronics, Ground Source Heat Pump, An expert in extreme plumbing situations (you gotta see his basement to really appreciate that comment!)

Neal & Sue Mock

582.8809

His deck-mounted Solar PV system was on the Energy Smart Home Tour in 2002

Solar Photovoltaic

Rick Solinsky

587.1920

His home is on this year's Energy Smart Home Tour, see page 4

Solar Photovoltaic (connected to the grid), Passive Solar, Solar Greenhouse, Solar Water Heater, Wind Turbine, Ground Source Heat Pump, Advanced Weatherization,

Ben Solomon

[www.solarquest.com/nevada/hometour/
ht1999/solomon.htm](http://www.solarquest.com/nevada/hometour/ht1999/solomon.htm)

Solar Photovoltaic

Chris Worchester

582.4503

His off-grid home was on the Solar Home Tour 2001

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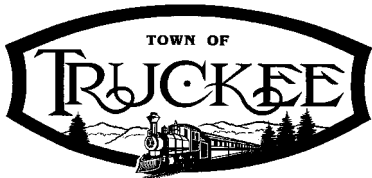
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High Efficiency Landscaping

By Eric Larusson
Villager Nursery

A home landscape is obviously aesthetically pleasing, colorful and fragrant. It may provide a screen from light, noise, neighbors and wind. Your landscape also cleans and cools the air, produces oxygen and may even provide insulation.

Landscaping can make a significant difference in your heating and cooling bills. With creative use of trees, shrubs and vines and groundcovers, you can modify the climate around a home to reduce heat gains in summer and heat losses in winter.

Trees not only provide shade from the sun but they also cool the air through evaporation from their leaves (transpiration). The more foliage your garden contains in trees, shrubs and groundcovers, the greater the cooling effect.

When planting trees for summer shade, keep in mind the angle of the winter sun so as to not block solar gain in the cold months. Deciduous trees provide summer shade while allowing the winter sun through the branches. It is best to keep even these to the west or east in order to avoid blocking any of the southern winter sun.

There are few deciduous trees that are large enough and suitable as shade trees in our climate. 'Dolgo' Crabapple, *Malus 'Dolgo'*, is the largest of our crabapple trees, reaching an eventual height of near 30 feet. 'Canada Red' chokecherry, *Prunus virginiana 'Canada Red'*, is a large and fast growing bushy tree with spring flowers and fall colors that grows to around 30 ft. Quaking Aspen, *Populus tremuloides*, is a spreading, fast growing, 40 to 80 ft. tree with quaking foliage.

Where space is limited, vines may be used to shade and cool southern and western walls. *Clematis alpina*, *C. viticella*, *C.*

tangutica and 'Blaze' climbing roses can work when trained onto trellises. These vines are deciduous, shading the walls in summer but dropping leaves to allow warming in winter. Espalier apple trees are also an effective deciduous shade for a wall.

Limbing dead branches and thinning some live branches in existing mature pines can have a dramatic affect by increasing light and warmth in winter.

Approximately 50 percent of the heat striking lawns is dissipated by transpiration and lawns provide additional cooling well into the night. Turf also traps carbon dioxide, ozone and particulate matter (including PM10) from the roads.

Windbreaks function by reducing air movement around the home and thereby slowing heat loss from the walls of the buildings. Since prevailing winds in Truckee are from the south and southwest, plant protective windbreaks to the south and southwest of the home.

The most effective area of a windbreak is at a distance from four to six times the height of the trees, depending on wind speeds. A 20 ft. tall windbreak of Black Hills Spruce would provide the greatest wind reduction 80 to 120 feet to the north or northeast. A single row of trees helps quite a bit but several rows are much more effective.

A screen should be fast growing, strong under snow loads and able to maintain dense lower branches. While deciduous plants will provide the fastest growth, the screening may only be effective half of the year. Evergreens will provide year-round screening from lights, noise and wind.

Native Jeffrey and Lodgepole pines will thrive and can grow 1-2 ft. each year but they quickly discard their lower branches, become very open and make a poor windbreak. Juniper is incred-



ibly dense but extremely slow growing. Contrary to some misconceptions, spruce are, by far, the fastest growing evergreens for this climate. Norway spruce, *Picea abies*, is the fastest spruce, often growing more than 3 ft. each year with proper soil conditions, reasonable fertility and ample moisture. Spruces are planted as windbreaks and shelterbelts around the world because of their rapid growth, strong branches and dense habit. Blue Spruce (Colorado Spruce), *Picea pungens*, holds its lower branches well into maturity and grows only slightly slower than the Norway spruce. The "blue" needles may be deep green to bright blue and there are many cultivated varieties with slower growth rates, or shorter mature heights. Black Hills Spruce *Picea galuca densata*, is a little slower growing again, but as the varietal name suggests, it is dense. Black hills spruce seldom grows over 20 ft. tall.

In order to create a more rapid summer screen, these deciduous species might also be used: Scouler's Willow and Red-twig Dogwood. Scouler's Willow is a dense upright oval shrub to 20 ft. or more. Scouler's willow may grow 6 to 8 ft. or more in a season. Red-twig dogwood is another very rapid grower with proper soil preparation, fertilization and moisture. Red-twig dogwood has rich red-maroon fall colors and bright red winter stems which accent against Blue Spruce beautifully.

With an eventual spread of the spruce of 10 to 15 ft. they should be spaced at 5 to 8 ft. for maximum density depending upon budget. It would be better in the long term to spend your resources on more moderately sized (5 to 7 ft.) trees than on fewer larger trees, within reason.

The Truckee Cemetery was planted with a combination of spruce and deciduous plants at 7 ft. spacing in the fall of 2002.

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How much electricity does **THAT** consume?

Every household uses power differently but here's a rough guideline for where the juice is going, per year:



Refrigerator: About 1,000 kilowatt hours

Lighting: About 400 to 2,000 kilowatt hours in lights, lamps, etc.

TV/VCR setup: As much as 1,000 kilowatt hours. A typical TV uses about 250 kilowatt hours, but many homes have duplicate sets, VCRs and cable boxes

Home Office: About 1,000 kilowatt hours. Desktop computer monitor, speakers, modem and printer all need juice. A laptop uses just 10% of the power of a desktop

Dishwasher: About 400 to 500 kilowatt hours. Preheating water, using dryer etc. are among some of the variables

Washing Machine: About 200 kilowatt hours — not counting the hot water

Clothes Dryer: 500 to 800 kilowatt hours. Motor and heating element. Variables include how damp clothes are when they go in; if the spin cycle on the washer does a good job, clothes will dry faster

Microwave: About 50 kilowatt hours. Uses much less power than an electric oven/stove

Electric Stove: About 600 to 800 kilowatt hours

Electric water heater: Up to 3,000 kilowatt hours...it's a big draw.

Swimming Pool pump: About 4,000 kilowatt hours to circulate and filter water

Hot Tub: About 2,000 to 5,000 kilowatt hours

Aquarium: About 1,000 kilowatt hours for a mid-size unit, with heater and lights

Water bed heater: 600 to 1,000 kilowatt hours

Heater/Air-conditioner: From 1,000 to 5,000 kilowatt hours. An adjustment up or down of a few degrees has a big impact.

Air cleaner: About 800 kilowatt hours

Source: Alan Meier, Lawrence Berkeley National Laboratory

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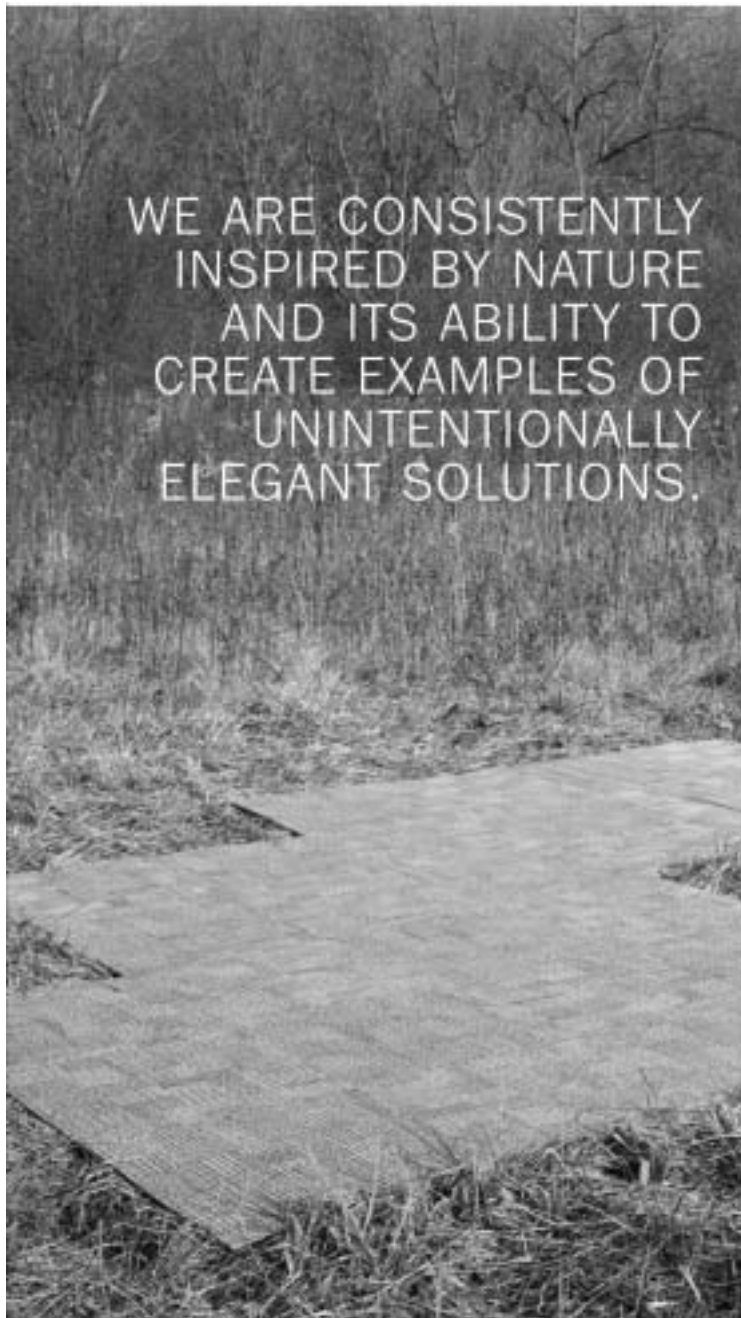
What Tahoe Mountain Resorts

Environmental Fund is a non-profit 501(c)(3) organization dedicated to protecting and enhancing the natural environment in Truckee-North Lake Tahoe. The Fund supports programs and initiatives regarding environmental education, restoration of natural areas, and resource conservation, such as alternative transportation solutions.

Who The Fund was founded by East West Partners-Tahoe, located in Truckee, and dedicated to developing sustainable recreational communities in the North Lake Tahoe region.

Process Tahoe Mountain Resorts Environmental Fund offers a well-defined process through which Truckee-North Lake Tahoe groups and individuals are invited to provide input and to bring worthy initiatives to the attention of the Fund's board of directors.

Contact Aaron Revere, Director of Environmental Initiatives for East West Partners-Tahoe, oversees the daily operation of the Fund, working closely with a board of directors. Contact Aaron at 530-587-2222 or at arevere@ewpartners.com



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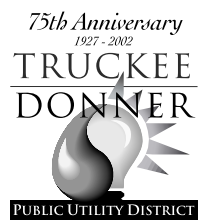
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Being Water-wise in the Yard

By Scott Terrell

In May the Truckee Donner Public Utility District (TDPUD) launched a Landscape Water Conservation Program in an effort to curb water use during peak summer months. The goal of this program is to inform home and business owners about easy, effective ways to reduce landscape water use while still creating and maintaining beautiful yards.

According to our research, water use during fall, winter and spring is static with residents using an average of three million gallons of water per day. However, this number jumped dramatically last summer to 9 million gallons, most of which was primarily used for landscape irrigation. The increase in summer water use is starting to burden our system, which is why this voluntary Landscape Water Conservation Program is so critical.

Being aware of the many different aspects of a water-wise yard is the first step in landscape water conservation. According to area nurseries, there are three primary steps in planning such a yard: plant selection, planting techniques and irrigation.

Plant Selection

There are many plants and landscaping combinations that are both appealing and easy on our water supply. Native plants are always the first to come to mind, however, not all native plants are drought tolerant. In fact, native plants require just as much water for the first few years as any other plant.

There are many drought-tolerant plants to

choose from as well. Drought tolerant means that once the plant is fully established (after two or three seasons), it can handle periods of drought better than other non-drought tolerant plants. It is always a good idea to consult with local nurseries about the selection of drought tolerant plants for your low-water use yard.

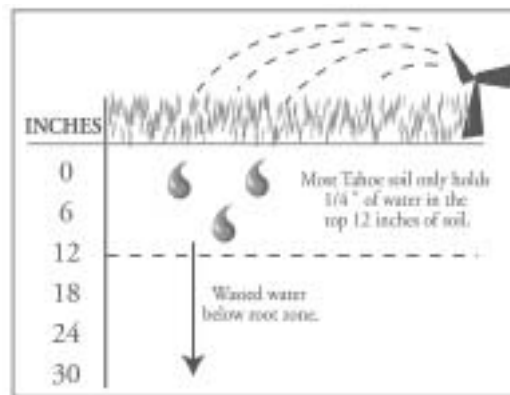
Planting Techniques

When plants are not correctly planted they become stressed, need more water and will eventually die. Remember when planting it is important to dig the hole twice as wide as the pot the plant is in and to amend the soil with compost or topsoil first. It is also a good idea to fertilize the plant while backfilling the hole. The soil level around the plant should be the same as it was in the pot because if the plant is planted too high it will dry out quickly and need more water. Finally, cover the exposed soil with mulch material to limit competition from weeds and evaporation during the heat of the day.

Irrigation

The third component of water conservation is using the proper irrigation system. There are many types of irrigation systems for different types of landscapes. An automated (timer driven) drip system is best for flower beds or watering shrubs and trees. Drip watering is considered by many to be the ideal. With its low volume over long periods, there is little water loss to evaporation and the moisture goes deep.

An automated pop-up sprinkler can also



Lawn Watering Guide: Place empty cans or coffee mugs at various places on your lawn. Measure in minutes how long it takes your sprinklers to apply 1/4 inch of water. Then operate your sprinklers for this amount of time. Studies show that watering more than 1/4 inches of water at one time wastes water and washes fertilizer below the root zone. In May, June and September, water three times per week. In July and August, water four times per week (apply 1/2 inch per water if these months are especially hot.) In April and October, water just twice per week.

(Graphic courtesy of Pettit Gilwee Public Relations)

be designed to conserve water by using pop-up heads that can be fine tuned for the area to be watered. It is best to water multiple times but for short periods of time during each watering.

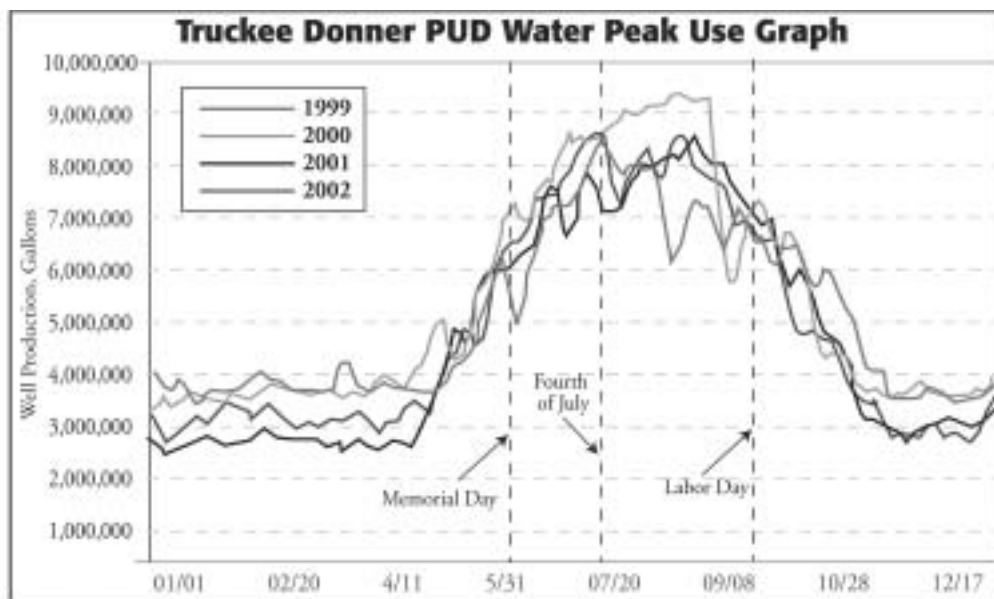
When landscaping a yard it is important to pick a lawn that works best for the area's climate. Remember to only water lawns 1/4 to 1/2 inch at a time. Studies show that watering more than this wastes water and washes water and fertilizer below the root zone. Raising the lawn mower blade to at least three inches also helps conserve water. A lawn cut higher encourages the grass roots to grow deeper, shades the root system, and holds soil moisture better than a closely-clipped lawn.

What's Being Done?

Since the program's inception, the TDPUD has sponsored the planting of a Landscape Water Conservation Display Garden at Tahoe Berry (across from the Truckee Factory Outlets) and supported our local nurseries in offering workshops to residents presenting steps that can be taken to have a healthy and beautiful water conservative yard. We have also created and mailed a Landscape Water Conservation Newsletter to customers with useful information about best-watering practices for a low-water usage yard.

In the future, we will be working with area nurseries to offer more hands-on workshops as well as continue our advertising campaign highlighting landscape water conservation tips that folks can implement immediately. For more information, please contact the Truckee Donner Public Utility District, (530) 582-3931 or visit www.tdpud.org.

Scott Terrell is TDPUD Director of Planning. Terrell boasts more than 10 years experience in the field of water conservation.



Over the last few years, the District has seen a significant increase in the amount of water used by both local residents and visitors. Interestingly, early and late summer months water use is increasing at a higher rate than the peak summer months. In fact, the trend is a greater increase in water consumption as early as April and May and as late as September and October.

(Graphic courtesy of Pettit Gilwee Public Relations)

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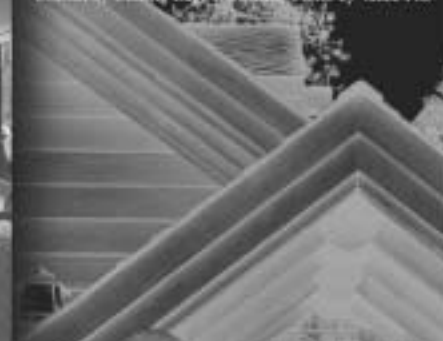
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Sierra Green Building Association

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SiGBA promotes green design and sustainable development. We represent a broad cross-section of professionals and others who understand that the decisions we make when building homes and buildings in our communities can have a profound effect on the environment for generations to come. Professionals include those from engineering, architecture, construction, facility operations, and utilities, as well as homeowners, consultants, and business owners.

Our mission is "to promote effective environmental design in our communities."
SiGBA will achieve this goal by:

- Advocating resource efficiency in all phases of the design, construction and operation of homes and businesses
- Providing educational resources and support in the areas of site development, energy, building materials, air, water and waste
- Coordinating networking opportunities and community events

www.SiGBA.org

Our Vision is to lead the Tahoe, Truckee and surrounding Sierra communities into a new sustainable era. Through Green Building, we can design and construct our build environment to function symbiotically with nature.

Jonathan Stoumen, Architect

web site: www.stoumen.com
email: jon@stoumen.com

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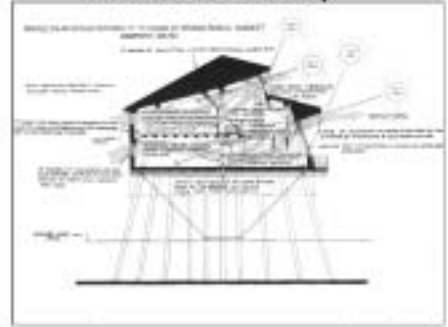
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"The Green Resource Center is the central hub for information on green building in the San Francisco Bay Area. We are building a network that links consumers with all components of the emerging green building industry and channels market demand into action.

What is Green Building?

"A green building is sited, designed, constructed, and operated both to enhance the well being of its occupants and to minimize negative impacts on the community and the natural environment. "Buildings have a big impact on the environment: according to Worldwatch Paper 124, 1995, they consume 40% of the world's energy and materials, 25% of the wood harvested, and 17% of the water we use. Our buildings also have a big impact on us: most of us spend more than 80% of our time indoors, and the poor quality of our indoor environment is often far more polluted than outdoors due to various building materials and bad lighting design."

www.usgbc.org

(The U.S. Green Building Council)

"The Council is the nation's foremost coalition of leaders from across the building industry working to promote buildings that are environmentally responsible, profitable and healthy places to live and work."

www.sbicouncil.org

"SBIC is a nonprofit organization whose mission is to advance the design, affordability, energy performance, and environmental soundness of residential, institutional, and commercial buildings nationwide."

"As the foremost national resource for sustainable design and product information, SBIC offers professional training, consumer education, and energy analysis tools. SBIC provides accurate, easy-to-use guidelines, software, and general information about energy conservation measures, energy efficient equipment and appliances, daylighting, and sustainable architecture. The Council is also active in presenting workshops and seminars geared toward improving building energy performance in cities and towns throughout the nation.

"SBIC represents a unique partnership of Federal policymakers, national laboratory staff, and professionals within the building industry. From the outset, SBIC has pursued a strong partnership with the U.S. Department of Energy's Office of Building Technology and the National Renewable Energy Laboratory. Together, we've developed building design tools, software, and educational guidelines. SBIC also conducts workshops throughout the country on our Designing Low-Energy Buildings with Energy-10 software and design guidelines package, and also offer specialized assistance in the form of consulting services to design teams throughout the public and private sectors on a project-by-project basis. SBIC resources help its members create aesthetically pleasing, cost-effective, sustainable buildings, cultivate a strong base of knowledge and skills, and gain distinct competitive advantages in their respective markets."

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As Seen on
"This Old House"
(HG TV)

Are you in Hot Water?

Solar Water Heating in the Sierra

By Andrew Ryan
Paradigm Earth

How do you heat water? Gas or Electricity — what makes the most sense? Here is an argument for neither but instead using the sun to warm water, aka Solar Thermal.

Solar thermal systems (aka Solar water heaters) use the sun to heat water. Systems in our area typically consist of a collector, mounted on a roof or elsewhere pointed to the south to capture the sun's rays; a storage tank similar to a conventional hot water heater to hold the heated water; and a heat exchanger to keep the system's anti-freeze and potable water separate. Closed-Loop Active Systems are the most prevalent type of system found in the Lake Tahoe Area due to their freeze protection characteristics.

The Lake Tahoe Area has an 84 percent probability of having a clear sunny day. That means we receive roughly 307 days of sunshine per year. With that in mind the following provides an economic breakdown of Solar Thermal Domestic Hot Water (DHW).

Sizing

The rule of thumb sizing is 20 sq. ft. of collector area for the first two members of a family and 12 to 14 sq. ft. for each additional member of the family. Each square foot of collector needs 1.5 to 2 gallons of storage.

Let's consider a family of four:

Collector Area = $20 + 20 + 2 \times (12-14) = 64$ to 68 sq. ft.

Storage Gallons = Collector Area \times (1.5-2) = 96-136 gal

Economics

In order to compare solar to conventional DHW, we must quantify how much each system costs initially and then how much it costs to operate.

Conventional DHW is about \$350 to \$450 for a gas water heater; and \$125 to \$350 for an electric hot water heater. According to the National Renewable Energy Lab (NREL), 25 to 30 percent of your monthly utility bill goes to hot water. With that in mind let's assume our family of four has monthly utility bills of \$175 (If you're following the amount you spend at home, use your monthly average).
 $\$175.00/\text{month} \times 25\% = \43.75 or $\$44/\text{month}$; or $\$528/\text{year}$

Solar DHW in this area is roughly \$3000 to \$4000 installed. If the family of four installs a solar thermal system that accounts for 75 percent of their hot water, they will no longer spend their money each month on heating that water, leaving only 25 percent of their water to be heated by electricity. They will save \$33 a month. See calculations:

$\$44/\text{month} \times 25\% = \$11/\text{month}$; thus a SAVINGS of $\$33/\text{month}$

If we take the initial cost of \$3500 and divide it by yearly savings ($12 \div \$33/\text{month}$) \$396/year the simple payback of the system is approximately 9 years. The life span of most solar DHW systems is



15 to 25 years. After the first 9 years and for the rest of the life of the system, 75 percent of your hot water use will be free.

New Construction

If you are building a new home or refinancing and you include a solar DHW system in the mortgage the economics become more attractive. The cost of the above system would be about \$20/month. With federal and state tax deductions, the monthly payment should be reduced to between \$5 to \$10/month. If you save more than \$15/month (it was \$33/month in the example above) then the system becomes profitable immediately.

Other Factors

Keep in mind that maintenance runs about \$25 to \$35 per year. Here's the million-dollar question: Will the price of natural gas and electricity stay the same or increase? Will the impending natural gas shortage have an impact? Is the population increasing?

The trends seem obvious; don't let it get you down. The sun will come up tomorrow like it has for the last 4.5 billion years and the price will always stay the same- FREE!

Benefits

Environmentally, solar DHW systems do not pollute. When a solar water heating system replaces a gas or electric hot water heater, the energy displaced over 20 years represents more than 50 tons of avoided carbon monoxide emissions. Carbon dioxide traps heat in the upper atmosphere contributing to the Greenhouse Effect.

Financially, you have seen the dollar savings associated with systems above, but don't forget the value added to your home on the resale market. The California Appraiser's Association is scheduled to release standards, streamlining the inclusion of renewable energy systems into the value of a house.

Socially, you are doing your part to reduce this country's dependence on Foreign Oil. Most thermal systems are made in the USA.

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www.stoumen.com
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