Summer 2004

SOLAR OREGON

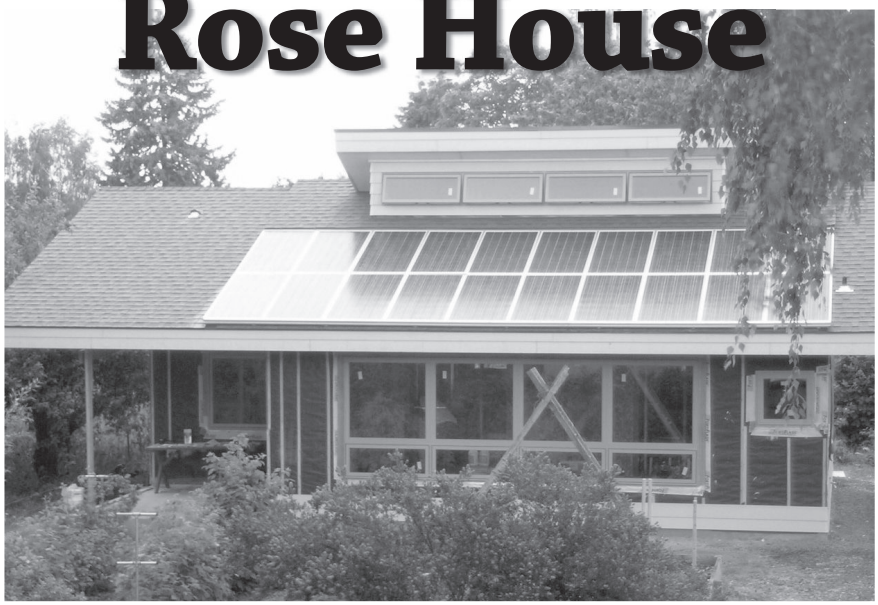
The Solar Energy Association of Oregon

To increase the use of solar energy in Oregon

INSIDE THIS ISSUE

Check the SEAO Web site at www.solaror.org for more!

Rose House



A NET ENERGY PIONEER

Hooray! Imagine: A house that's affordable, attractive—and heats and lights itself—*forever!* A house that actually:

- meets 200% of occupants' energy needs in summer
- delivers a net energy usage bill of $0 for the year (although owners will have to pay the utility's monthly service fee)
- produces no additional greenhouse gases
- saves an estimated $70,000 in energy costs* over 50 years!

It's called a "net energy" or "zero net energy" home. And, thanks to a committed couple and a talented team of architects, builders, energy experts, consultants and supportive organizations, the first house of its kind has been built in Oregon. It's called the Rose House. It's in Northeast Portland, and you may visit it in July and September. Maybe you'll even build one like it.

The Oregon Department of Energy (ODOE) created the concept of the net energy home to help designers, architects and builders make homes that are decentralized power plants. "When we say 'net energy,' we count all of the energy being used by the home, and it tends to be all electricity," explained Charlie Stephens, ODOE Policy Analyst.

It is the first of its kind in Oregon, and one of very few in the U.S., but it's guaranteed to catch on. In fact, Christopher Dymond, ODOE Energy Analyst, who spearheaded ODOE's involvement in the project, said the US Department of Energy expects net energy homes to be the norm by 2020. Imagine that!

Owners Linda Rose and Eldon Haines are ideal pioneers. Now retired, both have been in the forefront of renewable energy development for decades. Eldon, a physicist who consulted for the Jet Propulsion Laboratory, co-founded the company that produced the Copper Cricket passive solar water heater, and served on the board of the Solar Rating and Certification Corporation.

The couple hired a crack team, all truly dedicated to sustainability, to design and build a small, accessible, affordable and comfortable home on their daughter and son-in-law's one-acre lot in Northeast Portland. Linda and Eldon wanted a solar home, but, as the project evolved, they and

continued on page 4

BY MARNIE McPHEE

**Assumes 10,000 kWh/year at eight cents per kilowatthour*

Solar Energy Association of Oregon

Volume 24, Number 2

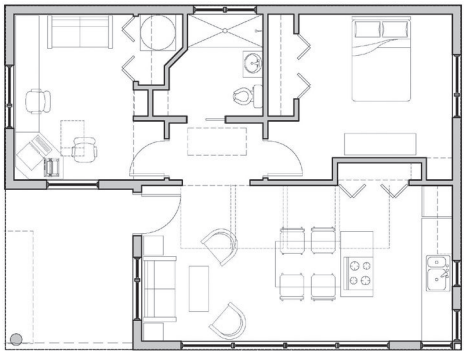
Rose House

CONTINUED FROM PAGE 1

the team decided it should also be "sustainable," which they defined as "operating within the energy contained in the solar energy that falls on the building." They explored a variety of concepts, and selected the following project goals:

* annual positive net energy contribution
* replicable design and construction techniques
* less than 15% more than the cost of conventional construction
* comfort and appeal to mass audiences
* extensive use of reclaimed materials.

To meet their special needs, the team created an 800-square-foot Accessory Dwelling Unit (ADU)—the largest such residence the City of Portland allows on that lot. Such structures also must meet other requirements for non-primary residences.



Rose House floor plan

The compact home includes one bedroom, a study/bedroom, a 12' × 26' great room (kitchen/living/dining), a bath with a walk-in shower for easy accessibility, and an entry/mud room. Storage is located in the pantry, bedroom closets and attic. Eldon and Linda share laundry facilities with their daughter and her family.

In July, Eldon and Linda will welcome tour participants during the American Solar Energy Society's annual conference *(see page 3)*. In September, participants in the Build It Green! Tour *(see page 3)* co-sponsored by SEAO also may tour the home.

Energy Efficiency

The team began with a super-insulated shell. After all, why pay a bundle to put a large and expensive solar electric system on an energy-leaking building?

Dave Heslam, Coho Construction, and SERA Architects collaborated on the integration of several features that are estimated to save 50% more energy than Oregon Energy Code requires:

* an airtight, R-38, 10-inch-thick Structurally Insulated Panel System (SIPS) in the ceiling
* eight-inch-thick, R-25 walls with staggered studs, which are flush alternately with inside and outside walls, and allow walls to be continuously filled with breathable blown-in cellulose insulation (R-25 whole-wall rating) and eliminate the need for a plastic vapor barrier
* sealed plates and SIPS panels to reduce energy losses.

Another benefit of the additional insulation is reduced noise, since the home is near the Portland airport.

Energy-efficient lighting and appliances also exceed current standards, reducing the amount of electricity the home will use.

Space- and Water-heating

The home ingeniously links space- and water-heating in one system. Instead of a furnace, it has an integrated forced-air and radiant-floor system combining passive solar features, a solar-assisted air-to-water heat pump water heater, solar water heater, photovoltaics, and "waste" energy recovery. The system will use less than half the energy of a conventional home, while improving indoor air quality.

Passive solar figures prominently. During the heating season, sunlight streams in the south-facing windows and warms the massive floor in the great room (four inches of well-insulated concrete, covered with Mexican tiles). Dymond predicts passive solar features will contribute 40–60% of the home's annual heating demand.

Fresh air and most of space heat are delivered by a Stirling energy recovery ventilator (ERV). The heat source is a hot water coil downstream of the ERV. Hot water can also be circulated through a tubing circuit in the concrete floor of the bathroom and hall for additional space heating delivery.

The hot water itself is generated by a combination of systems. The primary source is a reconditioned Copper Cricket solar water heater that pre-heats all hot water for space heating and domestic use. Supplemental heating is provided by a Trevor-Martin air-to-water heat pump, which during the space-heating season draws its air from the solar plenum on the roof. Energy is stored in the radiant floors in the bath and hall, a primary 105-gallon tank, and a secondary 50-gallon water heater, which can boost water temperatures when outdoor conditions call for extra space heating.

The solar plenum, an experimental feature, captures heat that collects in the air space beneath the PV panels and makes it available to the heat pump water heater. Not only does the plenum add to the efficiency of the space- and water-heating system, but it improves the PVs' performance (they produce more energy when they are cooler), extends the life of the PVs and the roof, and reduces indoor air temperatures. The plenum is passively vented in summer.

Thanks to these innovations, air-delivery ducts are less than half as large as those found in a normal home, and fit within the stud walls. Air velocity is very low and the system is very quiet.

An electronic controller, commonly used in commercial structures but rarely seen in residences, is coupled with sensors inside and outside the home to optimize air temperature and quality, and humidity.

Cooling

Haines and Rose decided not to use the mechanical HVAC system for air-conditioning. Instead, the super-insulation, natural ventilation via the clerestories and windows, shading by overhangs and large firs, ceiling fans and the nighttime cooling feature of the ERV keep the home comfortable in the summer.

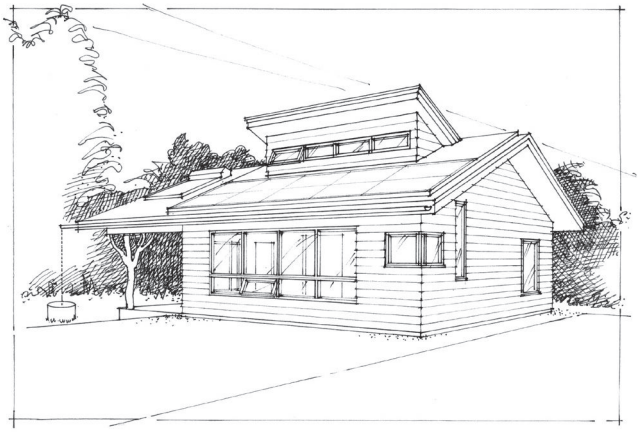
Daylighting/Glazing

Lisa Petterson, SERA Architects' daylighting specialist, maximized the home's access to and use of daylight, to brighten interiors and reduce the need for artificial lighting. Consistent

Rose House

with passive solar design principles, glazing was increased on the home's south façade, minimized on the east and west walls, and virtually eliminted on the north. Clerestory windows in the center of the home contribute (properly shaded) south light to the center of the space, to minimize contrast ratios and even out the illumination.

The team selected fiberglass-framed windows because their coefficient of expansion and contraction is close to that of glass, so they maintain their seals well. Fiberglass frames also are structurally strong, paintable, and less expensive than wood, although they are more expensive than most common vinyl window varieties.



Electricity Production

When the 3.3kW Sharp photovoltaic system produces more electricity than the couple needs, it feeds the extra power back to the utility grid. They sell the surplus power to their utility through a net-metering agreement. The off-the-shelf system also will qualify for an Energy Trust of Oregon rebate.

"This home is a power plant," Stephens said. "It's possible to do that with just about any home, if you're prepared to buy enough photovoltaics to provide the generation. The trick is to make it affordable. We do that by making the loads really small, and using some rather unconventional ways to heat and cool the house. We've designed to stay within the annual sustainable energy budget. When doing that, you just happen to provide a lot more generation than the house itself needs during the day, when the electric grid loads rise and peak. So the contribution to the grid has extra value."

How well will the experiment work? To find out, the Oregon Renewable Energy Center at the Oregon Institute of Technology (OIT) in Klamath Falls has installed a commercial control and data acquisition system with 49 sensors to control six elements in the home and record air, soil and water temperatures, energy consumption, and energy production. OIT will review data and adjust systems as necessary. First-year results will be reported in *Solar Oregon* and on the ODOE, SERA and OIT websites.

Regardless of the data, the home clearly is a breakthrough. "The Rose House goes beyond green building," explained Clark Brockman, project manager for SERA Architects. "It utilizes ideas and methods that lead toward truly sustainable architecture, such as energy generation, zero greenhouse-gas-related energy impacts and low-toxicity materials."

Dymond added, "ODOE wants to encourage the construction of homes that aren't just 15% more efficient than code, but actually produce 40–80% of the power they need. We believe there still will be large power plants, but most 21st-century power plants won't have to have smokestacks. In fact, they can even have screen doors! Eventually, we'll have millions of these smaller power plants all over the world. We see this as the opportunity for Oregon to lay the groundwork for a sustainable new industry." ✪

ROSE HOUSE—COSTS AND INCENTIVES

Estimated gross costs (excluding incentives)
Construction: $117,067; $146 per square foot
Land: $ 0

Incentives
City of Portland Office of Sustainable Development Green Investment Fund: $15,000
Oregon Department of Energy
—PVs: $1,500
—solar water heating, solar space heating, heat pump water heater, energy recovery ventilator and appliances: to be determined
Energy Trust of Oregon (PVs): $12,750

Incremental costs for the innovations
Super-insulated building shell: $8,400
Heating system: $7,000
Fiberglass windows: $4,500
Photovoltaic system: Covered by the Energy Trust of Oregon and ODOE

ROSE HOUSE TEAM

Owners: Linda Rose and Eldon Haines

Architects: John Echlin, Clark Brockman, Jeff Graves and Lisa Petterson, SERA Architects, Inc., Portland, OR

Structural engineer: Tim Terich, Froelich Consulting Engineers, Inc., Portland, OR

Builder: Dave Heslam, Coho Construction, Portland, OR

Technical assistance: Christopher Dymond and Charlie Stephens, Oregon Department of Energy, Salem, OR; Oregon Renewable Energy Center at the Oregon Institute of Technology, Klamath Falls, OR

Solar site analysis: Diggy Breiling, Solar Path Imaging, Hillsboro, OR

HVAC contractor: Norm Yamamura, Building Comfort Systems, Portland, OR

Electric utility: PacifiCorp

SEAO welcomes submissions to *Solar Oregon*, but cannot guarantee they'll be used. For photos, black-and-white or color prints are acceptable; digital photos are preferred. Digital photos must be 300 ppi, JPEG format only, and may be e-mailed. Please send materials to: Editor, *Solar Oregon*, 4303 SE Cora St., Portland, OR 97206, 503-775-8951, fax 503-775-4227 or e-mail marniemcph@aol.com. If you'd like us to return the materials, please enclose a self-addressed, stamped envelope. Submission deadlines are May 10, September 1 and January 10.