Energy tab: Zero

Boulder homebuilder Eric Doub is completing one of Colorado's most comprehensive examples of a "zero energy home." Depicted below, the home is designed to produce more energy than it consumes and eliminate utility bills. Here's how it works:

PHOTOVOLTAIC PANELS, also known as PV, convert sunlight directly to electricity for power needs in the home. Any excess electricity generated is sold back into the power grid under a net metering agreement.

Cost: $54,000 before rebates and tax credits; net cost $25,000.

SOLAR THERMAL PANELS use sunlight to heat water. The water is stored in a 6,000-gallon tank that supplies hot water for home heating and domestic uses.

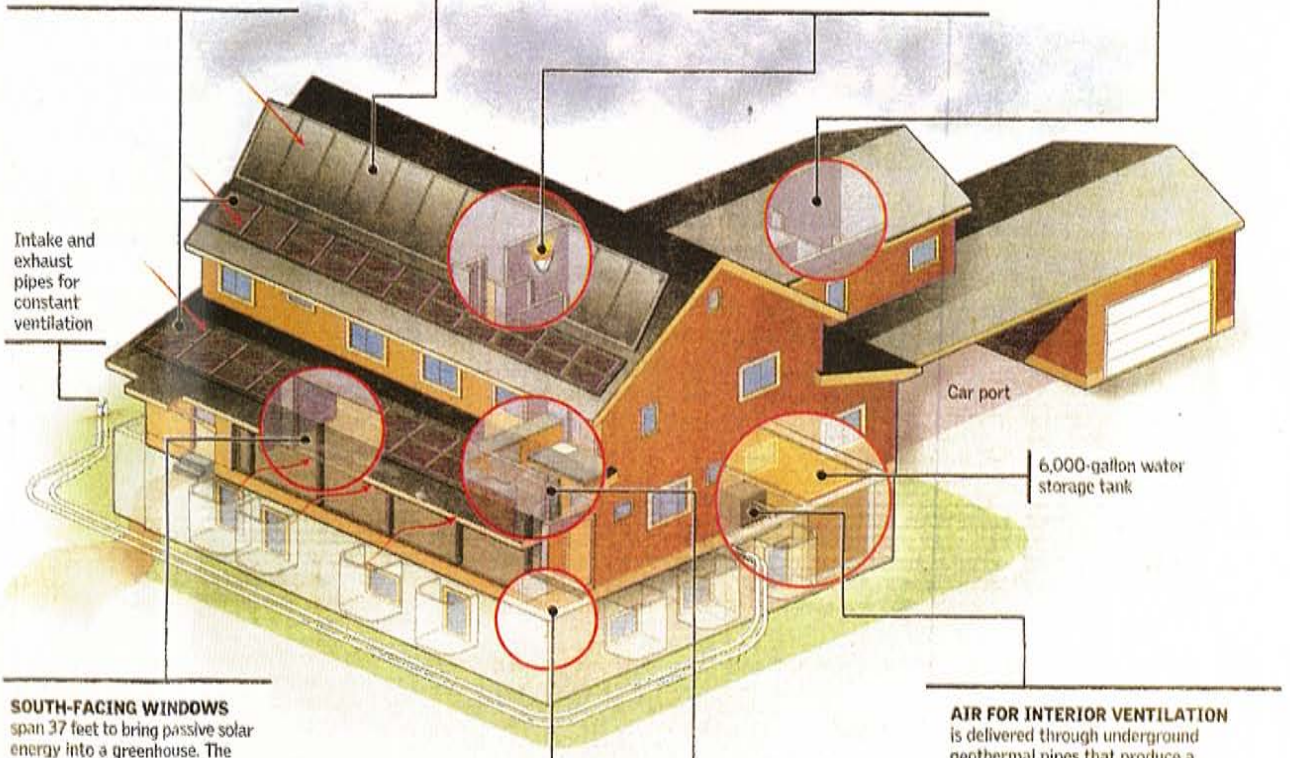
Cost: $31,000.

LOW ELECTRICITY USE is achieved with compact fluorescent light bulbs and occupancy sensors that automatically turn off lights. Each compact fluorescent bulb saves $55-$75 over its life cycle compared to incandescent bulbs.

Cost: Additional $1.25 per bulb.

PAINT, CARPETING and other construction materials emit few toxins, allowing the home to be built tight and keeping ventilation requirements low.

Cost: Increases of 29% to 89% compared to regular materials.



SOUTH-FACING WINDOWS span 37 feet to bring passive solar energy into a greenhouse. The warm air is pumped through ducts for home heating.

Cost: $10,000.

HEAVY-DUTY INSULATION is rated at R-30 for basement walls, R-34 for above-ground walls and R-45 for ceilings. Double drywall in interior walls helps store heat.

Cost: Additional $26,000.

ALL APPLIANCES are Energy Star rated for maximum efficiency.

Cost: No additional cost on most high-end appliances.

AIR FOR INTERIOR VENTILATION is delivered through underground geothermal pipes that produce a constant air temperature of 55 degrees. A heat exchanger recovers heat from stale air to warm incoming fresh air.

Cost: $9,000.

Source: Ecofutures Building, Inc.

Jonathan Moreno | The Denver Post

Futuristic homes rely on the power of the sun and high-tech construction

By Steve Raabe
Denver Post Staff Writer

Eric Doub plans never to pay another utility bill after he moves next month into his new, $1 million Boulder home.

The house will produce at least as much energy as it uses, giving it the rare designation of being a "zero energy" home.

The specter of steeply escalating energy bills is helping push zero energy from a theoretical ideal to an achievable standard in new-home construction.

Zero energy uses a mixture of modern technology, energy-saving materials and the world's oldest energy source, the sun, to keep houses warm and bright, with energy to spare.

Doub, a Boulder general contractor and homebuilder, expects his "Solar Harvest" home to provide an additional benefit on top of zero energy bills. The new home will be an experiment that will help him determine which of its technologies and materials would make sense in homes that Doub will build for customers.

"I'm moving my family into this experiment," he said. "We're the best guinea pigs I can think of."

The Doubs are likely to be comfortable guinea pigs. They'll have a 360-gallon hot tub, more heat

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than they know what to do with in the winter, low-energy cooling in the summer and ample fresh air ventilation throughout the year — all with the expectation that they'll have no energy costs.

At its most efficient, a zero-energy home can be a net energy producer. Solar electric panels give the home the potential to generate more power than it uses and to feed the excess electricity back into the power grid.

The homes are scarce. Among Xcel Energy's 1.5 million customers in Colorado, only about five households have achieved net zero energy status, utility officials estimate.

Not many homeowners have embraced zero energy because it's expensive. Building a new home with the equipment and materials needed for zero energy requires a minimum extra investment of $20,000 to $70,000 above the price of a conventional home, with a payback period of up to 30 years at today's energy prices.

But energy analysts expect the concept to grow in popularity for two key reasons: an expectation that utility costs will remain high and probably go even higher, and a growing consumer ethic of conservation and energy efficiency, even if it costs more.

A handful of homebuilders and homebuyers in Colorado have begun zero-energy projects in the past year.

Nonprofit builder Habitat for Humanity and Golden-based National Renewable Energy Laboratory last month completed work on a zero-energy home in Wheat Ridge. The laboratory plans to monitor the home's energy consumption and production over the next year as part of a research project.

Loveland-based Aspen Homes of Colorado Inc. is in negotiations with its first prospective buyer of a net-zero home — a concept that is ready to take off, said Jammie Sabin, president of the building firm.

"We've made great strides in home energy efficiency, and the next quantum leap is zero energy," Sabin said.

Sabin's prospective buyer, Fort Collins resident Kylan Marsh, said he is happy to pay the estimated $30,000 to $40,000 premium for the super-efficient, 3,000-square-foot home, on top of the cost of at least $300,000 for a comparably-sized home without zero-energy features.

"I'm quite an environmentalist at heart," Marsh said. "I'm personally willing to sacrifice a certain amount of money to be as energy efficient as possible and to have as little an environmental impact as possible."

Marsh, an information technology specialist at Colorado State University, estimates that over the course of a 30-year mortgage, the extra cost will add $175 to $225 to his monthly payment.

With Xcel Energy projecting the typical household heat and electric bill at $240 in December, Marsh's proposed home already would be paying back its extra cost during high-energy winter months, but not in months with lower utility bills.

"The idea is that you can break even right now, or maybe just be slightly behind in recouping the investment based on current utility rates," Sabin said. "But the bigger question is what will happen to utility bills next year, and the years after that. They're probably going to be higher."

Other homebuilders say the costs of a zero-energy home are too high to gain a foothold in the mainstream construction industry.

"The costs of building zero-energy homes currently outweigh the benefits," said Bill Wood, senior vice president of operations for KB Home, one of Colorado's largest builders.

Even Louisville-based homebuilder McStain Neighborhoods, known for its "green" orientation, says the concept can't yet be introduced on a mass scale.

"It's just not economic today," said Eric Wittenberg, chief executive of McStain. "I'm wholeheartedly in favor of moving down the path toward zero energy, but most people are not willing to invest in the higher costs."

Many of the higher costs derive from capturing the power of the sun. This is done in three main ways:

- Passive solar: Orient the home so its longest axis faces south. South-facing windows allow solar heating during the day, which can be enhanced by heat-retaining floors and walls.
- Solar thermal: Roof-mounted thermal panels use sunlight to heat water. The water heats the house and provides hot water for domestic uses.
- Solar electric: Photovoltaic panels mounted on the roof convert sunlight directly to electricity. The produced electricity powers home lighting and appliances. Many utilities, including Xcel Energy, allow homeowners to sell excess solar electricity back to the grid through a process called "net metering."

Photovoltaic panels are the single most important tool — and the single most expensive — in achieving net zero energy expenditures. By tying photovoltaic electric production to a net meter, homeowners can offset the cost of power they purchase from the utility at night or during cloudy periods when the solar panels don't produce enough electricity to serve the home.

Yet the panels are expensive — at least $16,000 to purchase them and install a 2-kilowatt system that would serve an average home. Doub has taken the concept to an extreme level with a $54,000, 6.8-kilowatt system that is expected to generate far more power than the home requires. With rebates and tax credits, his cost dropped to $25,000.

"I want this to be a home power plant," he said. "I want it to really make a statement about the capability of homes like this."

Doub has calculated that the 3,300-square-foot home's photovoltaic array will generate about twice as much power as the home uses. The excess will be sold back to Xcel Energy.

"I expect to get a check from Xcel for several hundred dollars each year," he said.

Other home features that contribute to zero net energy use include airtight construction, high-efficiency appliances, compact fluorescent lighting in place of incandescent bulbs, and extra insulation for walls, ceilings and foundations.

Because zero energy is dependent on building a tight, highly efficient home, the concept is designed for new homes. Older, leakier homes can employ some of the same techniques, but they would have trouble achieving net zero energy bills.

Until Doub's home has a track record of energy use and energy production, he won't know how long it will take for the greater efficiencies to cover the extra costs — although he believes it will be many years.

But like other builders and buyers of zero-energy homes, Doub said the benefits are greater than simple pay-back economics.

He expects to derive satisfaction that can't be measured financially, merely from the fact that he's not depleting natural resources.

"Sometime in the future, when energy bills are $500 or $600 or $700 a month," Doub said, "this place will still be chugging along with no costs and sending excess power back to the grid."

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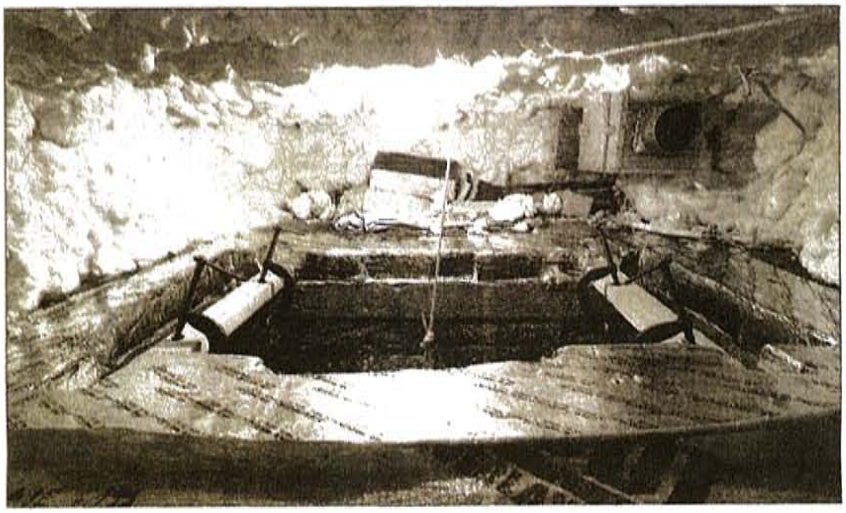
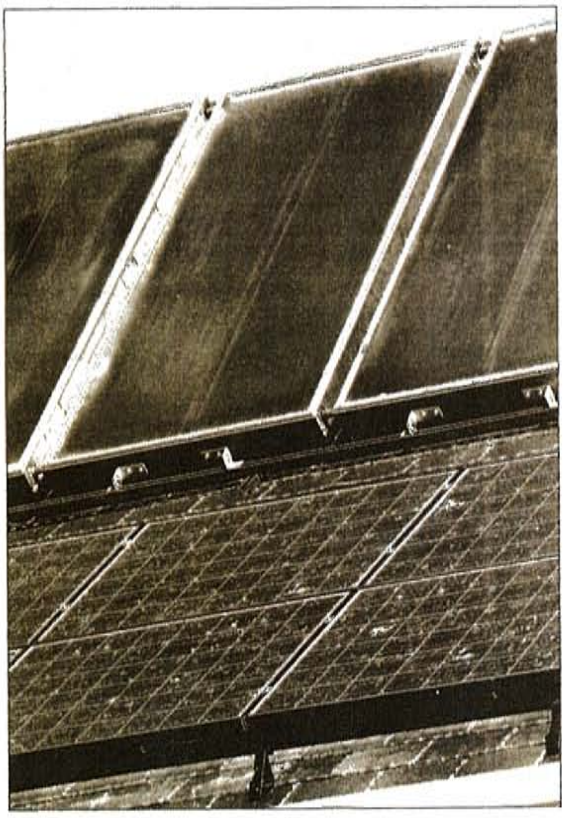


At Doub's house, an insulated 6,000-gallon cistern will hold solar-heated water in the basement. The hot water, piped throughout the house, will provide part of its heat. Experts say the appeal of such zero-energy homes is likely to grow along with utility bills.



Solar hot water, top, and photovoltaic panels share space on the roof of Doub's house. By pitching the roof and facing its long side south, the design maximizes use of active solar energy. Long windows on the south side maximize passive solar.

How long 'til solar pays for itself?

Eric Doub's zero-energy home will be an energy-making machine — and eventually, a money-making machine, once it pays for itself.

Here's the math showing how long it will take Doub to recoup the investment in one key component of his system — the rooftop solar photovoltaic (PV) panels, a crucial zero-energy component.

The net cost of Doub's solar PV panels was $25,000. At peak production, the panels will generate 6.8 kilowatts of electricity — more than twice the amount needed to power the home.

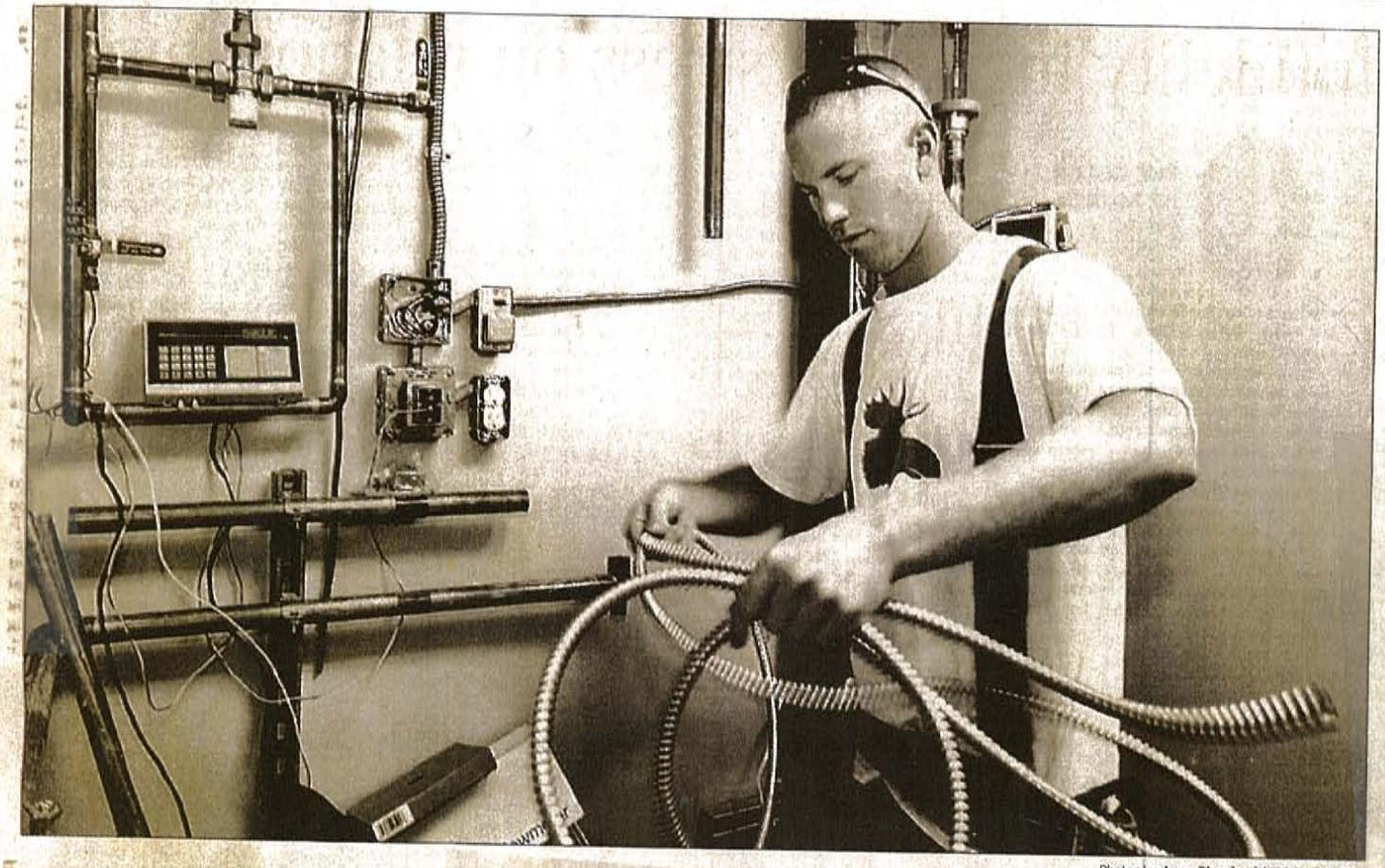
Over the course of a year, the PV system will generate an estimated 14,484 kilowatt-hours, worth $1,444 at current electric rates.

Assuming an annual 9 percent increase in electric rates, by the end of year 11, the system will have produced electricity valued at $25,180, enough to cover its cost.

After the payback period, Doub enjoys the full value of the electricity produced, minus the amount he and his family use in the house. For example, by year 15, the system would be generating power worth $4,792. Household consumption accounts for perhaps $2,400; the remainder goes into Doub's bank account as a rebate from Xcel Energy, which buys the excess power.

A caveat: All of the numbers are estimates and projections. The panels might produce less electricity than predicted; the home may use more energy than anticipated. The projected 9 percent annual increase in electric rates is less than this year's 30 percent, but well above historic averages.

—Steve Raabe



Photos by **Jerry Cleveland** | The Denver Post

Jeremy Mercier, project manager for Eric Doub's zero-energy house in Boulder, coils electrical conduit in the basement. Doub's million-dollar "Solar Harvest" home will harness solar and conservation technologies to give Doub a net utility use of zero.

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