

ANNUAL ISSUE ON HOUSES TAKING ISSUE

If it's not efficient, it's not beautiful

I've long admired the beauty and craftsmanship of the houses featured in *Fine Homebuilding*. But in many of them there's something missing—a dedicated effort to use energy and water efficiently. Are builders so preoccupied with cabinetry and spiral stairs that they don't keep up with new resource-saving methods that make houses more affordable, comfortable and earth-friendly?

Take windows, for example. In 1983, our owner-built house/indoor farm/research center at Rocky Mountain Institute in Snowmass, Colorado, was fitted with the best then available: argon-filled Heat Mirror glazing (double glazing plus a suspended low-emissivity-coated polyester film) with a center-of-glass insulating value of R-5.3. That's twice as efficient as the triple glazing featured in a 1990 *Fine Homebuilding* article on an "energy-efficient" house. Today the best mass-produced units are R-8.1. The best glazing on the market (from our 1983 supplier—Alpen, Inc. in Boulder, Colorado) now exceeds R-10, four times as efficient as triple glazing. It's two layers of Heat Mirror suspended between two panes of glass, with a low-e coating on one of the lights, krypton gas fill and optimal spacing of the panes. It looks like double glazing, but works about six times as well.

According to Lawrence Berkeley Laboratory, in virtually any U. S. climate an R-7 or better window gains more winter heat than it loses, even facing north. Our R-5.3 units do that even in our mountain climate. No matter which way they face, therefore, super-efficient windows can compensate for other losses through a building's shell. For superinsulated houses, these losses can be so small as to render a furnace unnecessary.

In our 8,700-degree-day climate, where temperatures can drop to -47° F, our 4,000-sq. ft. superinsulated house is more than 99% passive-solar heated. For backup and aesthetics we burn perhaps a half a cord of softwood a year in two small woodstoves. Our neighbors pay upwards of \$1,000 a month to heat conventional houses the same size.

To eliminate the need for a conventional heating system, we needed only R-40 walls, an R-60+ roof, our R-5.3 windows, tight construction, heat-recovery ventilation, good

zone coupling (passive transfer of heat from warm to cold zones) and adequate mass. We didn't need rockbeds, high fan loads, or other throwbacks to the early 1970s. This design also keeps us cool in the summer.

Super-efficient lights and appliances cut our household electric use by about 90% to an average of just over 100 watts, costing about \$5 a month. This in turn avoids the burning at power plants of the equivalent of the building's interior volume in coal every 20 years. The result is less acid rain and reduced global warming.

Likewise, during its lifetime, each of our compact-fluorescent light bulbs adds a ton less of carbon dioxide and 20 lb. less of sulfur oxides to the atmosphere than does an equivalent incandescent bulb. These fluorescents last 13 times as long as incandescents, emit naturally colored light, don't flicker or hum, and save tens of dollars more than they cost. That's not a hard choice.

Adding up all these energy savings makes our house economically equivalent to a barrel-a-day oil well. Saved energy doesn't pollute, run out, get cut off or hurt anyone. The energy savings will more than pay for our entire building in 40-odd years—a small fraction of its expected lifespan.

What was the net extra cost of saving more than 99% of our space- and waterheating energy (both solar heated) and more than 90% of our household electricity? Just \$1.50 per sq. ft., which was paid back in 10 months. At that rate, builders who want a long waiting list might offer to pay their clients' utility bills for the first few years or to pay any excess over, say, \$100 a year.

Oh, yes. That \$1.50 per sq. ft. also includes cutting the house's water consumption by half, mainly via efficient toilets (ours use 0.8 gal. to 1.1 gal. per flush), high-performance showerheads (1.2 gal. to 1.5 gal. per minute), faucet aerators and drip irrigation.

The aesthetic qualities that gifted builders display in *Fine Homebuilding* are the same ones we seek here, but we get them as an integral part of resource efficiency, not separately. Why do people seem to feel good in our house? Maybe it's the 95% natural lighting; the sight, smell, oxygen and ions (and sometimes nutrition—we harvested bananas at Christmas) supplied by the plants in our

900-sq. ft. semitropical attached greenhouse; the high radiant temperature and relatively low air temperature; the ample humidity and good air quality; the lack of mechanical noise and 60-Hz electromagnetic "smog" emanating from electrical devices; the sound of our greenhouse waterfall; and the ubiquitous curved walls that also enhance the building's strength and solar performance. Maybe it's the feeling, too, of not using things up, not stealing from our kids.

Energy and water efficiency don't depend much on a building's size or style, nor on climate. RMI has analyzed, for example, how to build at no extra cost an ordinary house in Las Vegas that consumes 90% less electricity and more than 50% less total energy than conventional houses do. We've also figured out how to shave 77% off the electric bill and more than 60% off the gas bill of a typical house in Little Rock, Arkansas, with a payback of 1 1/2 years (three years for a retrofit).

Actions have consequences. If your clients can't get affordable financing, maybe it's because our society spent \$1 billion on a North Sea oil rig rather than \$10 million on a superwindow coating machine with the same energy output. That's \$990 million and a lot of precious oil lost because builders bought the wrong windows. Or maybe it's because we spent \$1 billion on power plants instead of \$10 million on a machine to make compact fluorescent lamps of equivalent energy value, all because builders bought the wrong light-bulbs. Did you?

American houses in 1989 used about \$40 billion worth of oil and gas and \$75 billion worth of electricity. That doesn't count the costs to the landscapes of Kentucky and Wyoming, to security and prosperity, to native peoples and wild creatures, to oceans and wilderness, to clean air and the earth's climate. How many of those costs have your name on them? How many can you eliminate by using resources more efficiently next time? Your skill and imagination, your dedication to building with elegant frugality, can truly help to save the world—one house at a time.

—Amory Lovins, Director of Research at Rocky Mountain Institute, Snowmass Colo. 81654-9199. RMI offers a free list of publications on energy and water efficiency.