#6362

Utility Bills: The Power of that Monthly Reminder

Most Americans take utility meter-readers and their monthly (or bimonthly) bills for granted. However, virtually all of Europe has a completely different billing system. There the utilities read the kilowatt-hour meter only once a year and send estimated bills at various intervals. This situation greatly limits the amount of information that consumers can obtain from utility bills and virtually eliminates the possibility of constructive feedback.

A recent project supported by the Norwegian Ministry of Energy sought to measure the energy savings from more frequent actual-use bills. Researchers randomly selected about 1,200 residential customers from the Oslo area and divided them into a control group and an experimental group. Most of the homes—both houses and apartments—were electrically heated, although about one-tenth of the homes used a mixture of electricity and fuel oil. The experimental groups received a bill for actual use every other month, while the control group received an estimated quarterly bill as in the past.

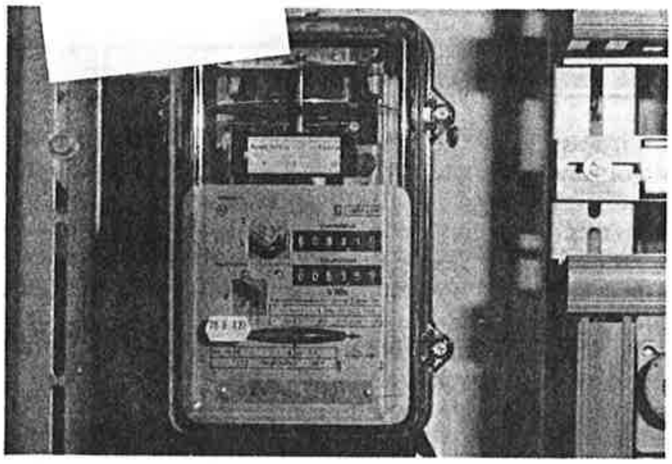
After one year, the groups receiving bills with actual use had cut their electricity use 8% compared to the control group. Households heating with a combination of electricity and other fuels saved much more—almost 25% compared to the other group, suggesting that non-heating end-uses have greater elasticity of savings potential. Households receiving actual-use bills did not appear to return to their original behavior in the second year. Indeed, they saved even more; the gap between the traditional bills and the actual-use bills increased to over 10%.

The Norwegians also wanted to explore the value of different kinds of information. In the second year, the experimental group was split into three. All groups continued to receive the actual use bills, but one group received a graph comparing current consumption with last year, and the third group received energy-saving tips in addition to the graph. Curiously, the graph and energy-saving tips did not appear to cause greater energy savings.

Given the large sample sizes and the rigorous statistical controls, researchers Richard Ling and Hal Wilhite are confident that these are real savings. For extra measure, they are following the groups for a third year to check for any further changes. If these savings persist, then more frequent electricity bills—showing actual use—may become just as commonplace in Scandinavia (and perhaps Europe as a whole) as they are in the United States.

—Alan Meier

Trends in Energy is a bulletin of residential energy conservation issues. It covers items ranging from the latest policy issues to the newest energy technologies. If you have items that would be of interest, please send them to: Trends Dept., **Home Energy**, 2124 Kittredge St., No. 95, Berkeley, CA 94704.



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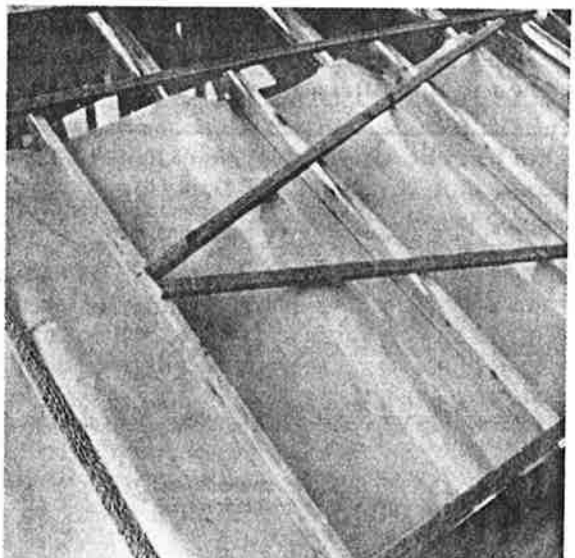
Monthly kilowatt hour meter reading may lead Norwegians to increased energy savings. In one survey, increased frequency of energy billing had a direct bearing on consumer energy use.

Radiant Barrier Update

When *Home Energy* last covered radiant barriers (May/June '89 and Nov/Dec '89), the level of confusion and outright misstatements associated with radiant barriers were at an all-time high. Some of the misinformation came from manufacturers who extrapolated limited test information to validate erroneous claims. The research by that



FSEC

This radiant barrier installation method—weaving the barrier into the beams, then applying roof-decking on top—is effective, but can only be used for new construction.

TRENDS

point was too scanty to support any claims to speak of. Major funding by the radiant barrier industry for an independent study evaporated shortly afterward.

To this day, much less is known about the effectiveness of radiant barriers—the thin sheets or coatings of reflective materials that virtually stop transfer of infrared energy—than about any other type of insulation. But since 1989, the U.S. Department of Energy has sponsored more research into some of the nagging questions about dust accumulation and moisture, and has finally released the long-awaited "Radiant Barrier Fact Sheet" to help consumers and contractors understand the knowledge accumulated to date. Still, no simple ratings (such as R-values for conventional insulation) have yet been developed to aid the public in decision-making about radiant barriers.

Until recently, part of the problem with studying dust and moisture has been that most radiant barrier testing has been field testing. Now, controlled environments such as the Large Scale Climate Simulator at Oak Ridge National Laboratory (see "Convective Loss in Loose-Fill Attic Insulation," *HE*, May/June '92, p. 27–30) are available and are being effectively used to analyze the complex nature of building systems and thermal envelopes.

When the radiant barrier is placed on the attic floor, dust does become a problem. As dust builds up, insulating value is reduced by as much as half, over a period of one to ten years. For reflective barriers attached to rafters—shiny side down—dust appears to be little problem. These findings are integrated into the Fact Sheet in the form of tables distinguishing attic floor and rafter installations.

In cold climates, vapor can become a significant problem when radiant barriers are placed over conventional insulation, on an attic floor. In this case, the foil must be perforated to allow for ventilation. When a radiant barrier is attached to the rafters, it may increase the roofing temperatures by 2°F to 10°F; and it is not presently known if the lifetime of the roof is affected.

Table 1. Present Value Savings of Radiant Barriers (¢/ft²) used with different levels of conventional attic floor insulation.

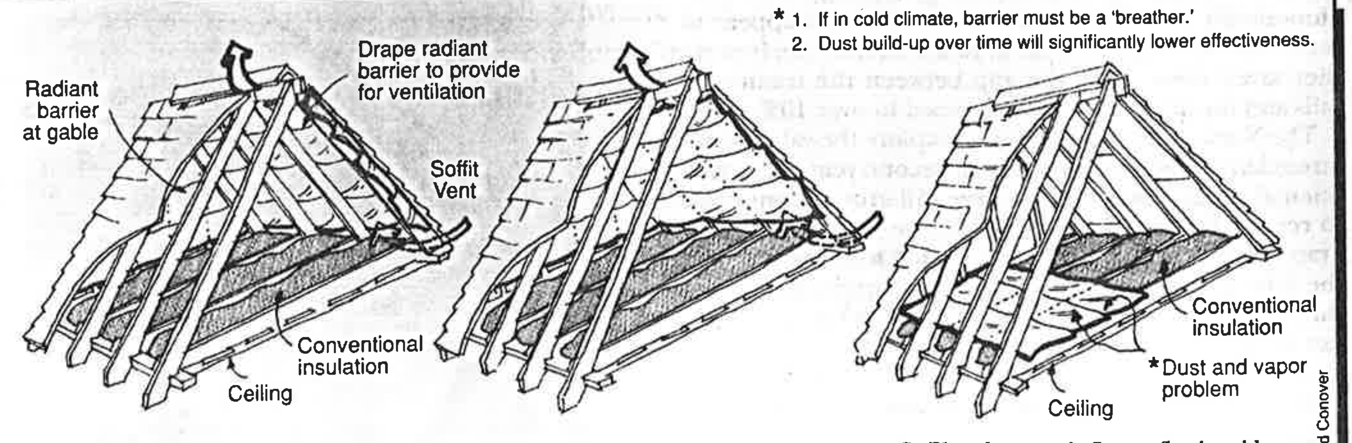
	*Radiant Barrier Attached to Rafter Bottoms**			
	R-11	R-19	R-30	R-38
Bismark, N.D.	18–20	9–10	5–6	4–5
Miami, Fla.	28–36	15–20	9–13	7–10
Topeka, Kan.	22–26	11–13	7–9	5–7
	*Dusty Radiant Barrier on Attic Floor**			
	R-11	R-19	R-30	R-38
Bismark, N.D.	5–14	2–6	1–4	1–3
Miami, Fla.	6–23	3–12	2–7	1–6
Topeka, Kan.	5–17	2–9	2–5	1–4

* The first number represents potential savings for radiant barrier attic installation without central air-conditioning ducts in attic. The second number is for attics with central air-conditioning ducts in attic.

With rafter installations, radiant barriers must also be installed at the gables.

Through computer modeling and confirmation by field checks, researchers devised formulas for predicting possible energy savings for many locations in the country. Cost-effectiveness calculations, called "present value savings," using these formulas were put into tables in the Radiant Barrier Fact Sheet. They take into account many variables, including local weather, energy costs, efficiencies of equipment, building configuration, and factors that affect differences in future and present values, such as inflation, fuel price increases, etc.

To exemplify how the tables work, three cities have been selected from the Fact Sheet (See Table 1). In order to use the tables, one must know the cost of installing the radiant barrier. If the figure given for present value savings for the whole ceiling is greater than the cost of the attic radiant barrier, then the radiant barrier will be cost-effective. The calculations are based on a 25-year life of material, normal inflation, and 7% depreciation. (Both installations



A. Draped over rafters reflective side down—facing attic space.

B. Attached to bottom of rafters reflective side down—facing attic space.

C. Placed over attic floor reflecting side up—facing attic space.

Radiant Barrier in Attics, Possible Installations. The radiant barrier system must include a highly reflective surface facing an air space and some conventional (conduction-reducing) insulation. Note: The American Society for Testing and Materials (ASTM) standard recommends against horizontal radiant barrier installation over insulation.

assume that the radiant barrier has an emissivity of 0.5 or less when clean.)

According to the Reflective Insulation Manufacturers Assoc., the range of costs for contractor-installed radiant barriers in 1991 was 12–45¢/ft² (range is for new versus existing construction, rafter versus attic floor installations and local variations). If one assumes the cost to install radiant barrier is 20¢/ft², the only installations that would be cost-effective are:

	Rafter installation	**Attic floor installation**
Bismark, N.D. *Only one possibility.*	R-11 insulation with central air conditioning	
Miami, Fla. *Three possibilities.*	R-11 insulation	R-19 insulation with central air conditioning
	R-11 insulation with central air conditioning	
Topeka, Kans. *Only one possibility.*	R-11 insulation	

These three examples, in three distinct climate locations, clearly show that radiant barriers are not especially cost-effective. In fact, in the three cities selected, only five of the 48 possible insulating systems were cost-effective. Obviously, very careful evaluation is required before deciding whether or not to install a radiant barrier. For contractors and retrofitters, though, the evaluation is made easier by the Fact Sheet.

Reference

"Radiant Barrier Fact Sheet," Department of Energy, June 1991, in cooperation with the Electric Power Research Institute, the National Assoc. of Home Builders' National Research Center, and the Reflective Insulation Manufacturers Assoc. (For more tables, formulas, and work sheets write: DOE, Office of Scientific and Technical Information, P. O. Box 62 Oak Ridge, TN 37830.)

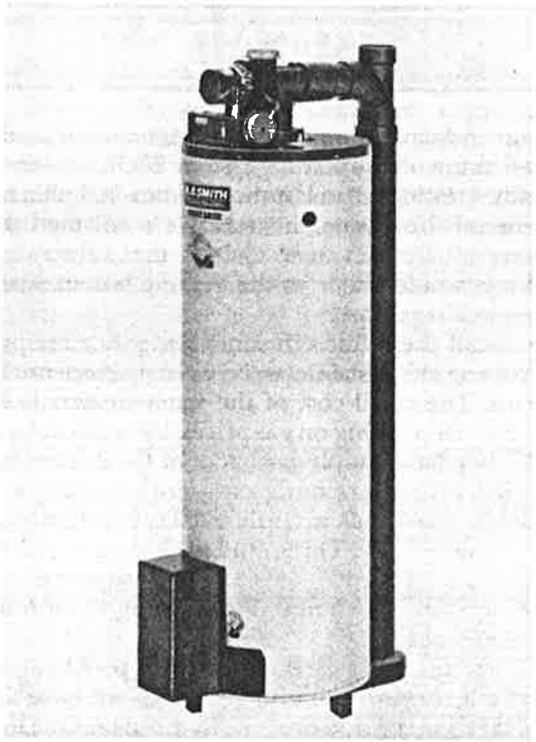
—David W. Conover

David W. Conover is an architect concerned with affordable housing and energy conservation.

Flue Gas Condensation in Some Water Heaters

If you are looking for efficient gas-fired water heaters, you will probably run across ones like Bradford-White's Optimizer, Mor-Flo/American's Nautilus, State's Super-Saver 85+, Rheem's Performer, Rheem's Tri-Power, or Water Heater Innovations's Marathon. On paper, like in *Consumer Guide to Home Energy Savings,* they look great. The energy factors (EFs) range from the low 0.60s up to 0.74. This is 15–37% better than the minimum energy factor of 0.54 allowed by the federal efficiency standards for 40 gallon gas-fired water heaters.

The problem is these mid-efficiency water heaters are too efficient for most existing venting systems. The recovery efficiencies for these heaters are all listed at 80–85%. The recovery efficiency measures how efficiently water heaters heat water while the burner is operating. It does not include standby losses. When too much heat is extracted, the water vapor in the combustion products will start to condense, setting the stage for corrosion and freezing



A. O. Smith

The Sealed Shot water heater avoids many of the condensation problems other heaters in its class suffer with standard venting.

problems. Also, the cooler gases may not be buoyant enough to assure the flow of the flue gases up the vent. This can set the stage for backdrafting and carbon monoxide poisoning of residents.

The same efficiency limits based on flue losses adopted for central furnaces are likely to be used as criteria for proper venting systems for water heaters, says Darrell Paul, projects manager of thermal systems at Battelle Memorial Institute in Columbus, Ohio. These venting guidelines are already being used by some installers of mid-efficiency gas furnaces. And the National Flue Gas Code Committee of the American National Standards Institute (ANSI) has recommended that these guidelines be adopted into codes and standards. Flue loss efficiency is a measure of the amount of energy entering the water heater compared to that leaving the flue. For water heaters it is usually about 3 percentage points higher than the recovery efficiency.

Under new venting guidelines, gas appliances are divided into four categories depending on flue loss efficiency and static pressure of the vent. According to the National Fuel Gas Code specifications, Category I appliances have negative vent static pressures and flue loss efficiencies of less than 83% (recovery efficiency about 80%). This means they can rely on the buoyancy of the flue gases for successful venting. If the appliance has a draft diverter and the flue loss efficiency is greater than 80.5% (recovery efficiency 78% for water heaters), masonry chimneys may need to be relined. All other categories of gas appliances must use venting systems specified by manufacturers to avoid problems with condensation or pressure (see Figure 1).

Category II appliances are ones with negative vent static pressure and flue loss efficiencies above 83%. Mid-efficiency water heaters all fall into this category. Paul