Energy Upgrades: Cash Flow vs. Payback

by Marc Rosenbaum

The question I'm asked most often when doing energy-efficient design is "What's the payback of this energy-efficiency measure?" But since most homes are financed by long-term mortgages, I prefer to steer my clients to the concept of cash flow instead. Cash-flow analysis looks at how much money will be spent per year for energy and on the mortgage. What the homeowner should be looking for is positive cash flow from the energy investments; that is, the value of the energy savings realized should be greater than the added cost to the mortgage payments for implementing the energy upgrades.

A Package of Upgrades

Not long ago, a young couple I know were having a starter home built, a typical story-and-a-half Cape. They were on a tight budget and chose a local builder who had a well-deserved reputation for building affordable homes. However, this builder's homes were also known for using a lot of fuel. I proposed to my friends a package of energy upgrades that would give them positive cash flow (or at least break-even cash flow), and offered to detail and specify the changes at no charge. The specific measures I proposed, listed in order of best return on investment, were:

- *Air sealing the home,* including effective sill sealer, caulking the bottom plates, sealing plumbing and electrical penetrations, sealing around the chimney, and sealing the attic hatch (see Figure 1).
- *Upgrading the single-glazed windows* with storms to double-glazed windows with low-e, argon-filled glass.
- *Insulating the floor above the basement* (this builder uses no insulation in either the floor or on the basement perimeter — not uncommon in New Hampshire, even though it is against code).

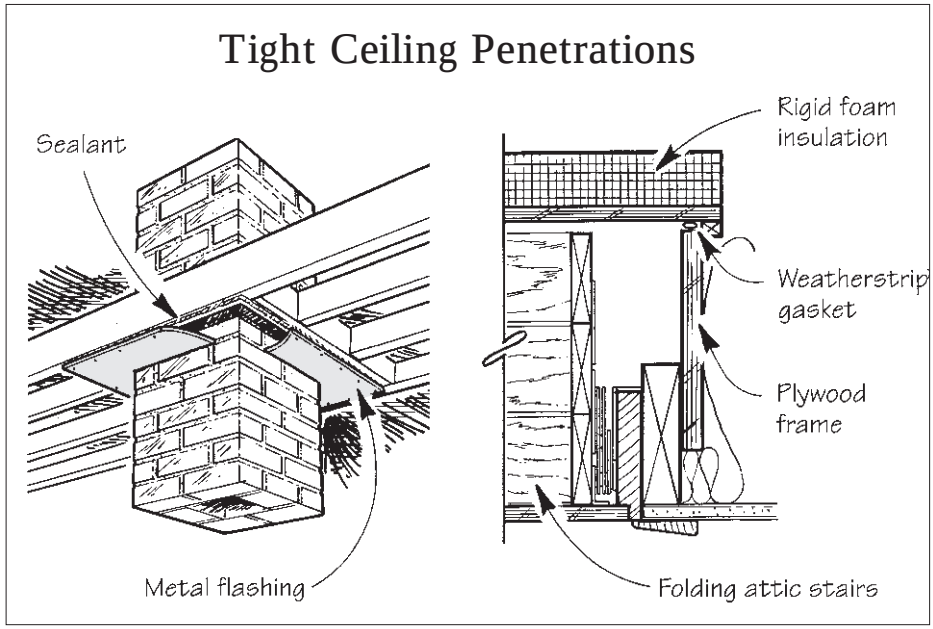
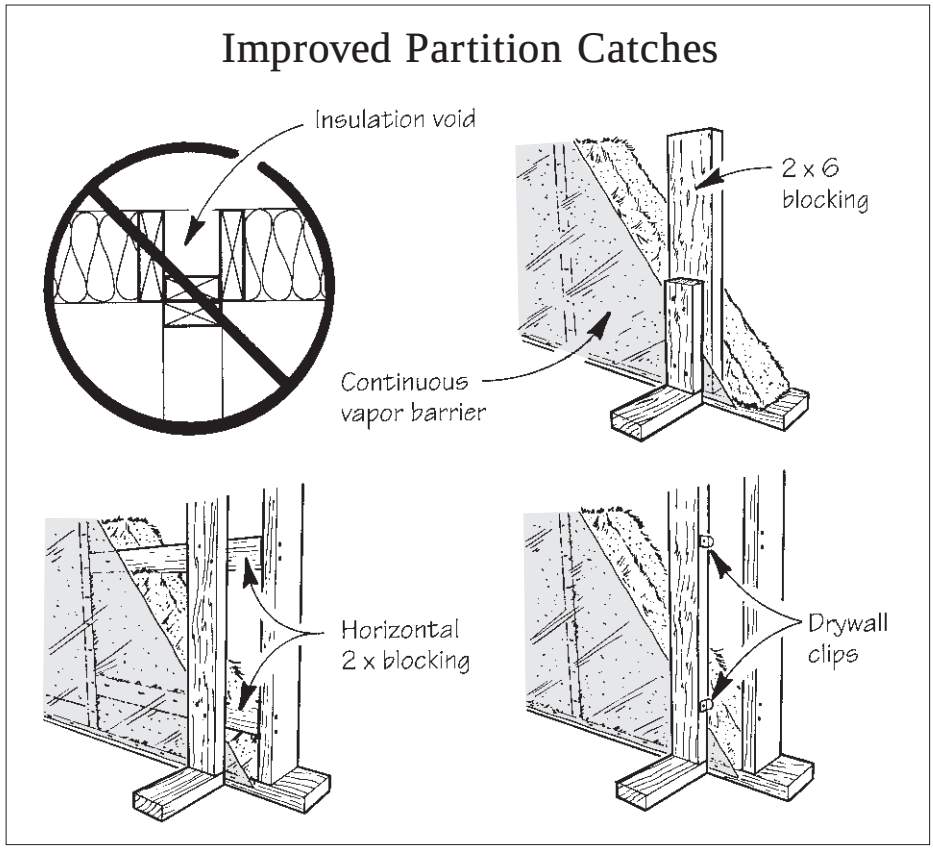


Figure 1. *Sealing around the chimney (left) and the attic hatch (right) are critical for preventing heat loss and keeping moisture-laden air out of the attic.*



- *Changing the wall insulation* to blown-in cellulose, or at least high-density fiberglass batts.
- *Insulating the headers* and eliminat-

ing headers in the gable ends, insulating the corners and interior/exterior partition catches (Figure 2), and insulating the rim joist.

- *Upgrading the typical useless bathroom exhaust fan* to a model capable of providing ventilation and installing a 24-hour timer to control it (see "Simple Whole-House Ventilation," 8/95).

The Advantages of Efficiency

From past experience, I estimated the cost of these measures at between $2,500 and $3,000. My quick calculations showed that the savings would be about 350 gallons of fuel oil annually, which would cost $280 per year at $0.80 per gallon. To add $3,000 to a 25 year mortgage at 8% interest costs $277.80 per year. So the total cost of living in the home would be the same, whether or not the energy investments were made.

Obviously, the interest rate on the mortgage and the cost of the fuel profoundly affect the cash-flow calculation. A higher interest rate makes the cash flow worse; a more costly fuel, such as propane, makes the cash flow better. But the energy investments have some other tangible benefits that may be more difficult to value precisely in dollars.

The mortgage payment stays fixed over the term of the mortgage, but few people believe that the cost of fuel will remain constant. If cash flow is positive in the first year, it is virtually certain to improve every year after that as fuel prices rise. Second, investments in the building envelope are expected to last for the lifetime of the building, without maintenance (how often do you have to get your insulation serviced?) Third, comfort in the upgraded home will be significantly better, due to draft-free construction, better window glass, and insulation improvements.

In addition, the durability of the home will be improved. There will be far less condensation on the window glass, due to the better glass and improved ventilation. Moisture problems in the attic and walls will be eliminated due to the airtight construction, which keeps moisture-laden air from entering building cavities and condensing. Finally, the resale value of the home will be higher if it has a proven track record of lower fuel bills. One more benefit that accrues not only to the homeowners but to all of the planet's inhabitants is the reduced emission of combustion pollutants from the energy-efficient home.

Money in the Bank

Once the building envelope has been upgraded substantially, other opportunities appear. Since heat loss is so drastically reduced, central heating can be eliminated, and comfort, which is what the homeowner really wants, can be provided more cheaply. In my friend's home, the oil-fired forced-hot-water system could have been eliminated, along with one of the chimney flues, and replaced with a sealed-combustion, high-efficiency propane wall heater, such as a Rinnai, or a similar unit running on kerosene, made by Monitor or Toyostove. Several thousand dollars can be saved on the heating system. Now the energy upgrades are paid for up front by the savings in the mechanical system, and the fuel savings are just gravy (even *with* the more costly fuels). The upgraded home costs no more, and likely costs less.

So what happened to my friends? They were sold, but they couldn't get the builder to go along with the improvements — too disruptive to learn something new, I guess. Their house has the usual leaks and drafts and lots of uninsulated portions of the building envelope. The single-glazed windows with storms had the owners pulling their hair out the first year because they were covered with condensation and turning black. For heat, they ended up with an oil-fired forced-hot-water heating system, a woodstove hookup, and a two-flue masonry chimney. But these things only have value insofar as they can provide comfort; a boiler has no intrinsic value. (How many clients have ever told you "I really want a boiler" vs. "I want to be warm"?) So they paid more and got less — less comfort, less durability, less value — and they'll pay more every year to come. ■

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