SUPERINSULATED HOUSES:
THE IMPORTANCE OF RESALE VALUE

Dick Holt
U.S. Department of Energy

ABSTRACT

This paper analyzes how the mobility of the U.S. population, together with uncertainty in the resale value of an investment in high thermal efficiency of a house, may conspire to make those investments economically unattractive to a significant fraction of the new home market.

Lack of good information among buyers and builders may explain the low market penetration of highly effective conservation measures in housing. But it may also be explained by completely rational economic decisions, based on the uncertainty of recovering the investment upon resale.

The median time between moves among U.S. households is about seven years. Homebuyers who move in 2 or 3 years may be quite sensitive to recovering their extra investment in conservation features through resale value -- perhaps even more so than recovery through fuel savings. These homebuyers may prefer to pay high fuel bills for several years, rather than to risk being saddled with an investment whose resale value is low or uncertain.

Although investments in thermal efficiency may improve the cash flow of the home owner, uncertain resale value of such investments may jeopardize his or her net worth.

Data on resale values are presented, along with numerical examples of total cost of ownership for investments in increased thermal efficiency in new single family dwellings.

The short-run economic view of the potential homebuyer is contrasted with the longer-term economic view of a government agency or a utility company.
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SUMMARY

Extensive analyses, backed up by accurate field measurements, have shown persuasively that superinsulated homes may provide a "least-cost" solution to indoor thermal comfort (Shick, 1976; Shurcliff, 1980; Rosenfeld et al 1980; Dallaire, 1980). Additional mortgage costs for insulation, glazing, and ventilation control may be more than offset by reduced fuel bills. Further, the investment receives favorable tax treatment through the deductibility of mortgage interest, and superinsulation techniques are easily adaptable to a wide range of climates and architectural styles. Why then is superinsulation not making more rapid inroads in the market for new houses?

A common answer to this question is that home buyers do not have good information about the economics of space heating costs (Stern, 1984). This answer may be the basis for proposed actions such as consumer information programs, demonstration houses, or house labeling. It is also possible that home buyers fear indoor air pollution, a problem that has received considerable press attention.

However, it is also possible to explain low market penetration of superinsulation techniques without appeal to ignorance or fear. It is possible to explain low market penetration by assuming that consumer reluctance to buy superinsulated houses is based on sound economic reasoning, and that they are acting rationally in their own best self interest.

How can this be? I think that the explanation rests in two connected adverse factors. First, U.S. households are mobile. According to the Census Bureau, (U.S. Census Bureau 1980), the median time between moves for homeownering households in the U.S. is about seven years. Second, home buyers may have little or no confidence that they can recoup their additional superinsulation investment upon resale.
ANALYSIS

Consider the home buyer who may anticipate living in a newly purchased superinsulated home for two or three years. An extra investment of say $5,000-$10,000 will probably not have been fully repaid through fuel savings by then. Neither will much equity have been gained, since a large fraction of the mortgage payments goes to interest in the early years of a loan. The homeowner must rely almost totally on increased resale value to recoup his or her investment.

In theory, the homebuyer might expect that the investment in thermal improvement might be recovered upon resale. A regression analysis of resale data from 1317 single family houses sold in Knoxville, Tennessee in 1978 estimated that, under certain qualifying assumptions, "an investment in an energy-saving durable good resulting in a one-dollar reduction in the annual fuel bill of the house will, ceteris paribus, increase the market value of the house by $20.73 in 1978 dollars" (Johnson and Kaserman, 1983). However, the economic model used to derive this estimate assumed that the individual discount rate applied to the energy savings over the period of occupancy is equal to the social discount rate -- an assumption that may not hold true for that fraction of homebuyers who move in only a few years. The model also concedes that small values of the period of home occupancy and large values of expected lifetime of the durable good induce a "distorting effect ... that may well predominate".

However, in practice, data about the resale value of thermal efficiency improvements are meager, and there is wide regional variation. The newsletter of the Society of Real Estate Appraisers reported (in 1979) that the fraction of the original cost of added insulation recovered upon resale ranged from 15% to 25% in St. Louis, 20%-30% in New York City, 25%-35% in Houston, and 50%-100% in Seattle. A Remodeling Industry Trade Association (with a vested interest in estimating on the high side) characterizes added insulation as a "good investment if you plan on staying 4 or 5 years. Short term recovery estimated to be 50%". These data cannot be too reliable, since the resale values of thermal efficiency measures were not controlled for inflation in housing prices or for the value of other important house features -- location, kitchen design, lot size, schools, fireplaces, etc.

So, home buyers who anticipate remaining in a house only a few years may adopt what is a perfectly rational least-cost strategy for them -- pay the higher fuel bills for those few years, and avoid the risk of being stuck with an investment that may not be adequately recovered at
Home buyers who do plan to remain for more than two or three years may still be uncertain about when they might want to move or have to move. They also may avoid the investment, just to keep their options open.

It is thus probable that only buyers who are reasonably certain that they will live in the house long enough to recover their investment primarily through fuel savings are likely to purchase thermally efficient homes. Although such homes are economically efficient for the economy as a whole, they may not be economically efficient for the individual home buyer.

It also follows that buyers who are not economically motivated to buy thermally efficient homes will, in turn, not generate significant demand among builders, who are already just as happy to keep first costs low.

NUMERICAL EXAMPLES

For numerical examples we draw upon data from a newly constructed superinsulated house in Vermont, analyzed extensively by Brookhaven National Laboratory (BNL) (Hagan and Jones, 1983). BNL evaluated several incremental levels of investment and the resulting reductions in space heating requirements, shown below in Table I:

Table I. Investments in Thermal Efficiency

<table>
<thead>
<tr>
<th>House</th>
<th>incremental cost</th>
<th>annual heating requirement (million BTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;conventional&quot;</td>
<td>0</td>
<td>77.0</td>
</tr>
<tr>
<td>5.5&quot; walls</td>
<td>$2100</td>
<td>40.7</td>
</tr>
<tr>
<td>12.5&quot; walls</td>
<td>$7290</td>
<td>11.7</td>
</tr>
</tbody>
</table>

We further assume a 14% mortgage rate, a 25% combined federal and state marginal income tax rate, and a national average electricity price of 7.25 cents per KWH (DOE, 1983).

By several criteria, an increased investment in improved thermal efficiency should be attractive to homebuyers. For example, the $2100 investment above:
 improves the homebuyer's cash flow by reducing annual payments (principal, 0.75 x interest, plus electricity) by about $480 (more when interest deductibility is taken into account);

o provides a substantial hedge against future fuel or electricity price increases;

o has a simple payback of less than 5 years, less than the median time between moves among U.S. homeowners;

o might increase the resale value of the house substantially -- by almost $16,000 according to the estimates of Johnson and Kaserman;

o receives favorable tax treatment through the deductibility of mortgage interest (even more favorable than the conservation tax credit).

And yet, home buyers may continue to avoid such investments if they fear that it will jeopardize their net worth through failure to recapture their initial investment at time of resale.

The top half of Figure 1 shows the long run cumulative total out-of-pocket cost of space heat incurred by the homeowner in the absence of resale recovery of the initial investment. Over a 50 year span the $2100 investment (labeled "SI-1") results in almost $30,000 less out-of-pocket cost compared to the conventional (zero incremental investment) house. The $7290 investment (labeled "SI-2") results in almost $37,000 lower total cost. In the long run, the larger investment costs less because, once the loan is repaid, fuel bills are substantially lower. Over a 50 year time span, the $7290 investment reduces space heating energy requirements from 3.8 x 10^9 BTU to 0.58 x 10^9 BTU.

In Figure 1, the vertical height of the "wedge" between respective cost lines represents the dollar value that must be recovered upon resale for the energy efficient homeowner to break even. At some future date, the total cost lines of the energy efficient house and conventional house cross. At that time, the owner of the energy efficient house begins to turn a profit, even without any resale recovery of the initial investment. If resale value is positive then, it represents a very favorable return on investment to the homeowner.

The lower half of Figure 1 contrasts the long-term view with the short-term view. At the top half of the figure, the 50 year time horizon shows enormous savings in money and energy for investment in super-insulation features. But most buyers will tend to look microscopically at the short-term consequences of that investment. The magnified lower
half of the figure shows that, without substantial resale recovery, the short-term view will heavily favor conventional construction.

Other assumptions on fuel price, efficiency improvement costs, interest rates, etc. would, of course, produce numerically different illustrations, but the logic remains unchanged. If one were to use a present value calculation, the lines of Figure 1, would bend downward progressively in later years, however the structure of the long-term/short term argument would remain unchanged.

For retrofit of an existing home, I hypothesize that the effect of uncertain resale value is more severe -- financing terms are likely to be more expensive, over a shorter loan period, and the construction work itself is intrinsically more expensive for a given level of improvement in the thermal integrity of the house.

CONCLUSION

An investment in superinsulation may be economically efficient ("least cost") as seen from the longer time horizon of the nation or of the utility company. But it may not be economically efficient, in the sense of least total cost during occupancy, as seen from the shorter time horizon of the individual home buyer. From the longer range national point of view, a number of advantages accompany increased investment in thermally efficient buildings -- advantages which are in part public goods:

- private savings are increased, thus tending to reduce interest rates;
- national energy consumption is reduced, thus lessening oil import dependence;
- environmental quality is improved in proportion to fuel consumption displaced;
- pressure to construct new electric generating capacity is eased, and seasonal peaking problems are moderated.

Of these advantages, many individual home buyers may "see" only the first -- increased private savings -- and that only if the resale recovery of the initial investment is high in the early years. And thus, no single buyer in the sequence of buyers is likely to be willing to risk a capital loss in an investment that may primarily benefit subsequent owners. It is a challenge to those interested in the long range national welfare to devise public policies that will facilitate such private investment in thermally (and economically) efficient buildings.
Figure 1. Cumulative total cost of space heating in the absence of resale recovery.
References

Dallaire, Gene; "Zero Energy House: Bold, Low-Cost Breakthrough that May Revolutionize Housing" Civil Engineering/ASCE May 1980


U.S. Census Bureau, Private Communication; See Also "Annual Housing Survey Part D: Housing Characteristics of Recent Movers"
