Investing in energy conservation

Are homeowners passing up high yields?

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Energy conservation is examined as an investment option for homeowners. Conservation technologies produce monetary benefits through reduced fuel costs. Calculations suggest that many conservation measures have rates of return significantly higher than alternative investments in stocks, bonds, and real estate, yet the level of conservation activity is inconsistent with these high yields. Several barriers exist which inhibit investments in conservation; it is perceived as risky and the cost of obtaining reliable information is high. Public policies to encourage conservation should focus on reducing the risk of purchasing energy saving devices by improving the accuracy of energy savings estimates.

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Conserving energy may be one of the most profitable actions a homeowner can take. This paper will demonstrate that many common conservation measures have after-tax returns on investment that are often double those of stocks, bonds, money market funds, and real estate. However, the level of energy conservation activity is not consistent with these high yields.

For some, energy conservation means sacrifice – lowering temperatures and driving less – and for others it is a means of reducing high energy bills. While a reduction in energy use and energy cost savings is linked very strongly in many peoples' minds, few have attempted to analyse residential conservation solely as an investment, isolated from the broader public policy issues like national security and the availability of energy resources for future generations. Conservation can be viewed as an investment, something large industry has recognized for years. An investment analysis of residential energy conservation measures will be presented in this article. A method for determining the value of an energy purchase will be described and comparisons with other common investment alternatives will be made.

Examining energy conservation as an investment explains some of the obstacles to more rapid conservation actions and how they might be removed. Recommendations for improving conservation policies and programmes for the domestic sector are also outlined.

Analysing energy conservation as an investment

When decisions are made to purchase bonds, stocks, money market funds, or real estate, several factors are of prime importance. These are:

- the annual return on investment – how much money will be made per dollar invested;
- liquidity – how easily can the investment be converted to cash; and
- risk – how likely will the investment be lost.

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There are trade-offs between these factors. For example, the higher the risk the better return and the more liquid the investment the less the return.

There are some important secondary factors also considered when making investment decisions, and these, in one way or another, affect the primary factors of return on investment, liquidity, and risk. The cost of obtaining investment information is one. Others include length of investment, minimum size of investment, tax effects, and the impact of inflation.

Energy conservation purchases, like conventional investments, can be analysed using these criteria. The results indicate how conservation compares as an investment and how it might fit into a homeowner's investment portfolio.

Payback versus return on investment

The most common method for determining whether a conservation measure is a sound investment is simple payback. The initial cost of the measure is divided by the first year energy cost savings to determine the number of years required for the energy cost savings to repay the investment. The federally mandated Residential Conservation Service requires utility companies to provide residential customers with simple payback analysis for conservation measures. Businesses, despite the availability of techniques and expertise to do more precise analysis, very commonly rely on simple payback as the basic evaluation method for conservation decisions.

Simple payback fails to reveal the true income value of conservation measures. Future energy price increases (or decreases) are not accounted for. Also the life of a conservation measure does not affect its simple payback. For example, one type of weatherstripping may payback in one year but may last for only one year, producing no return. Another material may have the same payback but have a five year useful life. The longer lived measure is a superior investment, but simple payback analysis does not differentiate between the two.

Payback is particularly difficult to compare with other financial analysis techniques. There is no easy correlation between payback and return on investment or net present value. No one talks about payback for money market funds, bonds, or stocks and these are the investments competing for investor dollars.

Return on investment is a preferable method for analysing investments. The length of investment, and changes in prices and savings over time are accounted for. A return on investment analysis requires a computation of annual net cash flows over the life of an investment. Cost and benefit changes are explicitly considered. This expression of financial benefit is understandable and commonly used. Everyone knows how much they make on their savings account. Money market funds, stock dividends, and bond interest are all expressed in terms of return on investment. Comparisons are easily done and the investor can determine which investment is superior.

Returns on conservation measures double competing investments

The return on common energy conservation investments were calculated and compared to other investment opportunities.[1] The results are presented in Table 1 expressed in nominal terms and include the effects of inflation. Both before tax and after tax returns are shown. Real (uninflated) returns would be lower for all investments, but the relative differences between investments would be essentially unchanged.

The before tax returns for conservation measures in many cases exceed 20%. This is substantially higher than the before tax returns for stocks, bonds, money market funds, and real estate investments. When taxes are considered, some energy conservation measures analysed showed returns two to five times larger than those for other investments. For example, investing in a high efficiency furnace will provide an after tax return of 33% while investments in utility bonds would provide an after tax return of only 8% for someone in the 30% marginal tax bracket.

The return on investment calculations for conservation measures assume a home is located in a cold climate (7700 degree days) and total fuel consumption for space heating is about average (120 million Btu per year). Natural gas is assumed to be the primary fuel at a cost of $4.50 per million Btu and increasing 15% per year through 1990 and 10% per year for each year thereafter. Standard engineering calculation procedures consistent with the approved methodologies for the federal Residential Conservation Service and the results of tests were used to determine energy savings.[2] All cost estimates assumed contractor installation. The return on investment is the interest rate that produces a zero net present value from the sum of the discounted annual net cash flows for the life of the investment.

The return for the solar hot water heating system was calculated using hot water consumption for a family of four and assuming an electric hot water heating backup system. The initial electricity price was assumed to be 6¢ per kWh, increasing by 10% per year.

Return on investment for stocks was derived from the performance of 132 long term growth mutual funds.[3] An annualized return was calculated for the previous five years ending December 1980. The analysis included reinvested dividends and for comparison, top performing mutual funds showed a pretax annual return as high as 40%.[4] During the last five years (ending in June 1981), the Standard and Poors index of 500 stocks has shown an annual return of approximately 10%.[5]

Bond returns were based on the five year average (ending September

[1]The return on investment was determined using the following equation and solving for *i*.

$$0 = \sum_{n=1}^{N} NCF_n \left[\frac{1}{(1+i)^n}\right]$$

NCF = net cash flow, i = annual return on investment, n = year, and N = lifetime of investment in years.

[2]Wisconsin Division of State Energy, *Residential Conservation Service State Plan*, Madison, WI, 1981, p 67.

[3]Figures were derived from the Wiesenberg Mutual Fund Index.

[4]Terry Edgerton, 'Investment shopping in a new era', *Money*, October 1981, p 35.

[5]*Ibid.*

Table 1. Return on investment comparison for energy conservation v traditional investments.

	Before tax return on investment (annual percent)	After tax return on investment[a] (annual percent)
Energy conservation		
Set-back thermostat (5° for 8 hours daily)	40	46
Weatherstripping and caulking	31	39
Furnace vent damper (retrofit)	31	35
Condensing cycle furnace (new, compared to pilot light model)	33	33
Wall insulation (R-5 to R-16)[b]	27	30
Attic insulation (R-11 to R-30)[b]	16	18
Window coverings (R-4)[b]	17	19
Superinsulated home (new construction)	16	16
Solar domestic hot water system	11	17
Stocks (average long-term growth mutual funds)	14	12[c]
Bonds (utilities, five year average)	12	8[d]
Money market (money market funds, five year average)	10	7[d]
Real estate (five year average of index of real estate investment trusts)	14	12[c]

[a]Marginal income tax rate of 30%; capital gains tax of 12%; conservation tax credit of 15%; solar tax credit of 40%.

[b]R is a measure of resistance to heat loss. For wall insulation, R-5 to R-16 means adding R-11 (equivalent to 3.5in of fibreglass) to a standard uninsulated stud wall. R-11 to R-30 means adding R-19, or the equivalent of a 6in fibreglass batt, to a partially insulated attic. R-4 refers to adding an insulated window covering with a R-4 rating to a double glazed window.

[c]Returns taxed as income.

[d]66% of returns taxed as capital gains; 33% taxed as income.

1981) for public utility bonds rated Aa by Moody's.[6] Returns for money market funds were derived from a five year average for an index of five money market funds.

It was particularly difficult to determine a return on investment for real estate. Returns vary between regions of the country and between neighbourhoods within a singe city. They also vary between residential and commercial real estate. The figure in Table 1 is based on real estate investment trusts which were used as a proxy for real estate returns. An index of such trusts shows an annual return over the last five years of approximately 14%.[7]

The effects of taxes

All investments are affected by taxes which can significantly alter the value of the investment. Money market funds may pay 15% but, if your combined state and federal tax level is 40%, your after tax yield is 9%. The tax exempt status of all savers certificates make their relatively low nominal yields equivalent to much higher yields on taxable investments. Purchasers of tax free bonds commonly accept yields several percent lower than taxable bonds. The distinction between investment returns which are taxed as income and those which are taxed at capital gains rates and the availability of special tax incentives are also critical factors.

Conservation investments have important tax benefits for homeowners. Conservation measures result in savings on utility bills and savings are tax free. The tax free nature of energy cost savings is an incentive not enjoyed by the business community. Many conservation measures also qualify for a 15% federal income energy conservation tax credit. The after tax returns in Table 1 assume a 30% marginal tax rate. The differential between conservation investments and taxable investments increases as the marginal tax rate rises.

Risk and liquidity comparison

The liquidity of conservation measures is very low. It is almost impossible to remove a conservation measure from your home and sell it to recover your investment. Generally, the home must be sold. There is also a concern that there may not be a market for home efficiency improvements.

In comparison, money market funds are very liquid since there is no monetary penalty for withdrawing funds and withdrawal is often as simple as writing a cheque. Stocks and bonds are moderately liquid because sales require brokers, commissions, and a transaction time of several days. Real estate has a low liquidity rating due to very high transaction costs combined with the time needed to find a buyer and negotiate a sale.

Conventional conservation measures are moderate risk investments. The principles of energy conservation are well known and when applied in suitable situations produce expected energy savings. As discussed later, the moderate rating may not be appropriate. People may perceive conservation as a high risk investment, and in some cases, this may be a valid perception.

Stocks range widely in risk both for dividend earnings and stock prices. Blue chip corporations generally pay stable dividends and have moderate price changes. Others, like the microcomputer and genetic engineering glamour stocks, expose the investor to high dividend and price risks.

[6] Moody's is a firm performing financial analysis. Moody's rates corporate bonds in terms of relative risk to the investor on a sale from Aaa to C with Aaa indicating the lowest risk and highest quality bonds.
[7] Edgerton, *op cit*, Ref 4, p 41.

Money market funds have low risk rating since people are practically assured of being able to redeem their shares and actual returns on money market funds are published daily. Real estate has traditionally been considered a moderate to high risk investment.

Inflation

Increasingly important in recent years is the effect of inflation on an investment. Some investments are sold on the belief that they are hedges against inflation. Inflation can cut both ways. If inflation and interest rates do drop drastically, then purchasing high yielding and long-term fixed investments would be an excellent choice for the future. If, on the other hand, inflation increases, a fixed investment would decrease in value in the future and purchases that produce benefits that rise with inflation become more attractive.

Conservation investments derive a portion of their appeal from the expectation that energy prices will increase in the future and energy savings will become more valuable. In this sense, conservation investments protect the investor from income deterioration due to inflation. Most estimates put the escalation of energy prices a couple of percentage points higher than the rate of inflation.

Investors are neglecting conservation purchases

If the returns on energy conservation purchases are as good as have been calculated, people should be stampeding to hardware and building supply stores. The rush to conservation should have outpaced that for money market funds. This has not been the case.

The record for conservation is fair at best. Between the 1973 oil embargo and 1979, residential energy use per household declined nationally only 11%.[8] To determine whether the historical record is at a desirable level, performance should be compared to an estimate of what is optimal. From society's standpoint, optimal energy conservation levels occur when the cost of conserving an additional Btu is the same as producing one. New oil supplies are selling for over \$8.50 per million Btu to the consumer for home heating fuel oil. The price for deregulated natural gas is over \$9.00 per million Btu. At the same time, many of the conservation measures analysed in Table 1 save energy at a cost of between \$2.85 and \$6.50 per million Btu.[9]

Desired conservation levels are nearly impossible to reach given present conditions. Energy price distortions remain, especially for natural gas. To illustrate the magnitude of the distortion, gas pipelines are purchasing new gas production for over \$9.00 per million Btu while the average cost to the customer is about \$4.50 per million Btu. The end user does not pay the marginal cost of fuel.

As long as price distortions remain, the best that can be expected is conservation up to the long-run cost of fuel to the end user. Cost comparisons need to be made over the appropriate time period which is the life of the conservation measure. Using natural gas as an example, the average annual cost for gas over the next 15 years is about \$9.00 per million Btu.[10] Numerous conservation measures exist that are substantially cheaper. The magnitude of the difference between the per Btu fuel and conservation costs illustrates that we are far from obtaining an optimal level of conservation even if it is defined from the parochial perspective of the individual consumer.

[8]US Department of Energy, *State Energy Data Report*, Washington, DC, September 1981, p 15.

[9]The calculation for computing an annualized cost for conserving energy is:

$$A = \frac{P\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right)}{S}$$

where:
A = annualized cost of conserved energy for a particular conservation measure.
P = present cost of a conservation measure.
S = annual energy savings for a measure in Btu.
i = discount rate (15% was used).
n = useful life of conservation measure in years.

[10]The formula used to determine the annualized cost of escalating fuel costs is:

$$A = P\left[\frac{1-(1+E)^n(1+i)^{-n}}{i-E}\right] \times \left[\frac{i(1+i)^n}{(1+i)^n-1}\right]$$

where:
A = the annualized price of a particular fuel.
P = the current price of a fuel to the end user (\$4.50 per million Btu was used).
E = the nominal escalation rate of a particular fuel (13% was used).
i = the discount rate (15% was used).
n = number of years (15 was used).

Conservation investments have high information costs

Energy policy makers have speculated for years about what prevents people from taking actions that are so much in their own interest. Energy policies and programmes would be much more effective if the specific barriers could be identified and alleviated. Prominent problems like energy price distortions and the financial problems of low income people are known and limited steps have been taken to solve them. However, for many people involved in energy programmes, such issues are beyond their power to change. These barriers must be accepted and efforts concentrated on problems that can be solved without addressing fundamental issues like income redistribution and energy pricing.

The 'conservation as an investment' paradigm can provide some insight into why people are not saving more energy. Factors other than return such as risk, cost of investment information, availability of an investment, liquidity, and tax advantages provide some clues. Three of these factors, the cost of investment information, risk, and liquidity stand out as possible problem areas. For the other factors, conservation either gets a high ranking or is generally no worse than competing investments.

The cost of investment information can vary greatly. Information on bonds, stocks and money market funds is easily found. Bonds, for example, are given simple ratings to guide the investor. There are several reliable sources of information available at public libraries. Professional advice is available from brokerage firms for the price of a commission.

Information on energy conservation is more difficult to acquire. Most conservation measures are dependent upon building condition and an on-site examination is needed to determine whether a conservation measure is appropriate for a particular building. If a conservation measure is needed, then an energy savings estimate must be made. Either an engineering heat loss analysis is performed or energy savings estimated using average energy savings for similar buildings. Reliable energy savings estimates may be hard to find. Conservation cost is another information problem. Obtaining cost estimates by contractors is time consuming. Such information problems force people to either spend a good deal of time researching energy conservation purchases or make decisions with limited information.

A good deal of effort has gone into providing this information. The federal government, state governments, utilities, and the press have all done much to publicise energy information. The problem, however, is that the information is general and does not tell the homeowner what precisely can be expected. It is analogous to telling someone that stocks are a good buy without indicating which particular stock to buy or what its performance is projected to be.

The National Energy Conservation Policy Act is helping to eliminate the lack of site specific information. The law requires public gas and electric utilities, under a programme called the Residential Conservation Service, to offer energy audits to residential ratepayers. The audits require a detailed analysis of the home, using accepted engineering procedures, to determine how much energy each measure could save given the condition of the home and the climate. Cost estimates using local material and labour costs are also provided, together with a simple payback calculation.

While the analysis does not give a return on investment, it does give much of the information needed to calculate one. Some estimate of investment worth is provided with a simple payback calculation. The cost of the information is no more than $15 and involves an hour or two to go over the house with the utility energy auditor and discuss possible conservation measures.

The Residential Conservation Service started only recently and, even when combined with existing energy education programmes, it will be some time before sufficient, reliable information tailored to the particular needs of the individual homeowner is available. This lack of easily obtainable information increases the cost, especially the cost of homeowners' time, to make conservation investments.

Conservation investments are risky

A large part of the reluctance people show towards energy conservation expenditures may be explained by risk. Energy conservation risks include concern about whether predicted energy savings will be realized, the future of energy prices, and the durability and integrity of energy conservation measures. Of these, energy savings and product performance are probably the most important.

People may be willing to pay a high price to find specific information but progress may not be made if it is regarded as unreliable. Sceptism may stem from several causes. People may think that utilities and oil companies benefit from energy shortages and higher prices and thus are suspicious of their conservation information. While the information may in fact be correct, if it is perceived as being unreliable, the conservation measure will become more risky in the eyes of the consumer. Predicted energy savings will be discounted.

There are many documented cases of misleading information being given to consumers. A recent study by the US General Accounting Office titled *Consumer Products Advertised to Save Energy – Let the Buyer Beware* well illustrates the problem.[11] Conservation products are not the first to suffer from fraud and a certain level of misrepresentation will always occur. This, however, enhances the risk of buying conservation products.

Even with the best information and most reliable products, conservation may be risky. Research studies have shown wide variation between energy savings using identical conservation measures on different homes.[12] Homes are complex energy-using structures and there is much the technical experts still do not know about how homes use energy. Undetected infiltration, thermal bridges, poor quality installation, and life styles all affect energy use sufficient for it to be difficult to accurately predict energy savings for any one measure in a particular home.

The engineering calculations generally used to predict the savings for many conservation measures rely on simplistic models of heat loss. Savings estimates may be reasonable when averaged over many homes, but the accuracy deteriorates rapidly when applied to one specific case.

The result of the actual and perceived inaccuracy of conservation information is that investors lack confidence that energy conservation purchases will give predicted results. When several people purchase identical bonds, they know what the interest rate will be for the life of the bond and they know that their interest rate is no different than their neighbours who bought the same bond. With conservation investments, two individuals may make the same conservation purchase, but have very

[11]US General Accounting Office, *Consumer Products Advertised to Save Energy – Let the Buyer Beware*, Washington, DC, 1981.

[12]A good example of the variability of savings for space heating system retrofits can be found in the American Gas Association's study titled *Space Heating System Efficiency Improvement Program.*

different results. The risks of conservation may be such that extraordinarily high yields are necessary to induce people to make conservation purchases.

The market for household efficiency improvements

One explanation for the slow rate of conservation investment is the perception that residential conservation measures will be undervalued when a home is sold. There may be concern that, in essence, a buyer cannot be found for efficiency improvements. This perception is one reason why conservation was given a low liquidity rating.

Recent studies contradict this notion. People are willing to pay more for a house that is energy efficient. It appears that homebuyers will capitalize five years or more worth of energy savings in the purchase price of a home.[13] This is an encouraging sign that indicates that people may not have to hold a conservation investment for its useful life to make projected returns. The earnings potential of conservation investments may be adequately reflected in a higher selling price for the home.

The poor liquidity of conservation becomes less critical if conservation is viewed as part of an investment portfolio. There is a limit to how much conservation one can buy. Several thousand dollars is a reasonable limit for most homes. A diversified investment portfolio should contain a mix of long- and short-term investments. The constraints on the number of conservation opportunities makes it difficult for an investor to over-invest in illiquid assets using conservation purchases alone.

Finally, conservation compares well with other similarly illiquid purchases like real estate. Second homes, home improvements, and trading up to a larger home are commonly justified by the belief that housing is a good investment despite the difficulty of converting it to cash. As shown in Table 1, conservation generally ranks higher than real estate in terms of returns and is no less liquid.

Conclusion and recommendations

Energy conservation, using return on investment analysis, appears to be an excellent investment for residential homeowners. After tax returns are often double those for competing investments. People, however, do not seem to be taking full advantage of the high returns. The high cost of obtaining investment information and the risk of conservation investments appear to be the primary causes of the relative lack of interest. Energy policy makers and programme administrators should concentrate efforts on improving the availability, quality, reliability, and practicality of energy information. Improved information and information delivery will reduce the cost of getting investment data and reduce the risk of buying an energy conservation product.

Energy advice provided to consumers should be specific and practical. People must feel confident that energy conservation recommendations are appropriate to their particular situation. This points to some new directions in energy information. Specific information is probably best provided in an interactive manner where questions can be asked to bring out needed details. Printed materials that have been the predominant method for providing information are severely limited in that they are difficult to tailor to the needs of a particular individual. The Residential

[13]Ruth C. Johnson, *Housing Market Capitalization of Energy-saving Durable Goods Investments*, Oak Ridge National Laboratory, TN, USA, 1981; and Wisconsin's Environmental Decade, *The Effect of Energy Efficiency on the Market Value and Desirability of Residential Real Estate in Wisconsin*, Madison, WI, USA, 1981.

Conservation Service energy auditors hold some promise since they will be making face-to-face contacts.

Energy conservation information programmes, whether from state energy offices, utilities, or oil companies should focus on improving credibility. Information provided should be impeccably researched and reliable in predicting energy savings. Consumer protection agencies should improve efforts to eliminate advertising claims that mislead the consumer.

One promising method of improving the credibility of energy information is to work through public opinion leaders that are already credible within their neighbourhoods and communities.[14] The Cooperative Extension model is appropriate here. Change is encouraged in Cooperative Extension programmes by inducing leaders of a farming community to adopt new technologies. Once the community leaders have shown that the technologies are viable, the mainstream of the farming community follows. The same idea can be applied in energy conservation. The direct experience of someone known and respected has a powerful influence on public opinion and action.

Finally, the ability to accurately link energy savings to conservation measures needs to be improved. Applied research to improve our understanding of how energy is used in homes and why conservation measures perform in certain ways should be conducted. Demonstration projects for conservation measures should be carried out and carefully tested and monitored in actual homes. Research information as well as local energy savings demonstrations can be provided in this manner. Carefully researched and documented results will do much to decrease the risk of making an energy conservation expenditure.

[14]Ugur Yavas and Glen Riecken, 'Stimulating energy conservation: the use of the opinion leadership process', *Energy Policy*, Vol 9, No 3, September 1981, pp 226–231.