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Payback Information: It's Effect on Home Buyers Regarding Energy Efficiency

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PAYBACK INFORMATION: ITS EFFECT ON HOMEBUYERS REGARDING ENERGY EFFICIENCY

by

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ABSTRACT

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This study was conducted to find out how payback analysis would affect consumer decision making with regards to home energy efficient upgrade packages.

Three different home plans were obtained from a local builder and seven different energy efficient packages were created. Using Hot2000 the heating and cooling loads were calculated for each building, with each energy efficient package, in each of the four major cardinal directions. The averages were taken and the payback information was calculated. The payback information included the increased cost of the package, the increase in the mortgage payment, the annual savings from heating and cooling bills, the monthly savings, the positive or negative monthly cash flow, the amount of time and interest saved if the monthly savings were added to the mortgage principle, the number of

years required to pay back the original investment, the rate of return and the increased home value.

A survey was taken to see how the subjects would react to viewing the payback information. The subjects were individuals looking to buy a home in the next 12 months somewhere along the Wasatch Front area in Utah. Depending on the size of the home the subjects were looking for, the subjects were shown the different packages with their accompanying cost increase and how that would affect the subjects monthly mortgage payment. The subjects then chose the package they would want for their home, based on their knowledge of construction materials, the additional cost, and how it would affect their mortgage. They were then shown the payback information for the home that was chosen and asked if they would change their mind concerning the previous decision. They were then asked what parts of the payback information they found to be most useful.

This study shows that payback information is indeed useful and would help builders to attract new customers, increase profits, and provide customers with powerful information that will empower them to make better decisions about home energy efficiency.

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CHAPTER 1

Introduction

Importance and Background of the Investigation

Homeownership is the pinnacle of the "American Dream". Over the last 12 years we have seen homeownership grow from 63.7% overall to 69.1% in 2005.[1] Often, homebuyers stretch themselves on their mortgage to buy the most home for their money. When homebuyers are approved for their loan, the loan committee looks at their income, monthly expenditures, and credit score. It is logical that if the home was more energy efficient the owner could apply the savings in heating and cooling costs to the mortgage.

In 2005 at the International Builders' Show an NAHB economist reported that the "five most desired amenities in new homes were walk-in pantries, kitchen islands, extra storage, filtered drinking water, and a built in microwave."[2] Builders often call attention to these upgrades and fail to show the energy qualities of the home. Two visually similar houses can have drastic differences in their energy consumption and, because energy prices are rising, this is a major concern for homebuyers.

The National Association of Home Builders (NAHB), the Department of Energy (DOE), and other organizations have researched many different products to make homes more efficient. Because of their research efforts it is known what products will save energy in homes, but what is not known is whether the cost of making homes more

[1] http://www.census.gov/hhes/www/housing/hvs/historic/histt14.html
[2] Power, Builder Magazine August 2005. 110.

energy efficient outweighs the benefits that could be achieved. The homebuyer needs to have a way to calculate the best energy efficient package for them.

The best option for a homebuyer would be to calculate a payback on the energy savings. A payback is the amount of time that it would take for the annual heating and cooling savings to pay for the additional cost of the more energy efficient products.

The Department of Energy's website (www.doe.gov) offers a sheet to help calculate a payback, however, it is rudimentary and does not allow for a comparison of heat lost or gained. Using this website, it is impossible to compare different options on a home and see how such differences would affect heating and cooling savings. Many large companies are able to run these payback analyses for machinery that are purchased for a factory, a new printer/copier for the office, the building they are looking to purchase or build, or the lighting scheme of the building.[3] For such an important purchase it seems imperative that a homebuyer should also be able to calculate different energy efficient packages and the possible savings of each one in order to make an informed decision.

Sometimes one can hear contractors claim that their windows or insulation products will pay for themselves within a certain number of years. The problem with such a claim is that each home is different. The method of construction, materials, direction the house faces, fuel sources, heating systems, and surrounding landscape can change the energy consumption of a home significantly. Also the combination of different materials will change the effective payback of any one product. Sawhney, et al.

[3] Kulakowski, "Large Organizations' Investments in energy-efficient building retrofits," Energy Analysis Department, (May 1999).

reported, "the use of several well chosen energy-efficient measures may result in synergies that are not realized if individual measures are evaluated separately."[4]

When calculating heating and cooling loads, it is important to take every aspect of the house into consideration. If any aspect changes, for example the roof overhang, the calculation would have to be run again. This becomes nearly impossible for the average homebuyer to accomplish without spending hundreds of dollars or hours of their own time. Builders, however, often do not run these calculations because they do not have the time, knowledge, or money.

What can builders do to increase buyer awareness? The National Association of Home Builders (NAHB) recently suggested that builders include "testimonials or energy bills from past buyers, credible third-party evaluations and results from energy performance tests on your homes."[5] The builder could either use tests to verify the efficiency or use a detailed set of specifications to accomplish this. The NAHB also suggested using a mixture of the "testing approach with the specifications approach to develop specifications for the home and then test a sample of homes to verify performance."[6]

In 2002 the United States consumed approximately 26% of the energy in the world with only 5% of the population.[7] Every year new products are available to help companies, consumers, and homeowners meet their energy needs. Energy efficient light bulbs, power saving computer screens, and low-E windows are just some of the products offered. These energy efficient products often cost more than their non energy efficient

[4] Sawhney et al. "Energy-Efficiency Strategies for Construction of Five Star Plus Homes." *Practice Periodical on Structural Design and Construction*, November 2002, 176.
[5] NAHB making benefits visible to buyers, 1.
[6] Ibid.
[7] Lawrence, "Overcoming Barriers to Efficiency," ASHRAE Journal, (September, 2005), S40.

counterparts. The question is then raised - Is the extra cost worth it, and if so, how can the homeowners know what the best option is for them?

Currently, some builders are building homes to Energy Star standards. Energy Star qualified homes are independently verified to be at least 30% more energy efficient than homes built to the 1993 National Model Energy Code or 15% more efficient than state energy codes, whichever is more rigorous.[8] Questions have been raised about the rationality of consumers and their ability to make decisions regarding energy efficiency. Do consumers understand the savings achievable through Energy Star? Do consumers make the best decisions and weigh the balance between costs and benefits of energy efficient options in their homes?

Turning to the literature only leaves more questions, "For all the attention devoted to the topic, no widely accepted answers to the basic question about consumer rationality and its role in energy-related decisions have emerged in the literature. Moreover, there are few signs that any are soon forthcoming."[9] Many reports about consumer behavior were written in the late 1970's to mid 1980's. Since that time there have been relatively few studies regarding consumer decision-making in regards to energy efficiency. Sanstad and Howarth agree that, "more research is needed on the nature of consumers' decision-making related to energy."[10]

The author argues that homebuyers are not capable of calculating energy savings on their own and that they would benefit by seeing how choosing energy efficient options would affect them and their homes' heating and cooling costs specifically.

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[8] http://www.energystar.gov/index.cfm?c=new_homes.hm_earn_star
[9] Sanstad and Howarth. "Consumer Rationality and Energy Efficiency." Forthcoming in Proceedings of the ACEEE 1994 Summer Study on Energy Efficiency in Buildings, 1994, 4.
[10] Ibid.

Research Questions

- How important is energy efficiency to homebuyers; does it have an effect on the energy efficient packages they chose; and does the payback information change their decision on which energy efficient package they chose?
- How many homes have the homebuyers purchased previously; does that have an effect on the energy efficient packages they chose for their homes; and does the payback information change their previous decision?
- Does the length of time the homebuyers planned on staying in the home effect the energy efficient packages they chose, and does the payback information change their previous decision?
- Would homebuyers change their minds about the energy efficient packages they chose for their home if they had knowledge of the payback information?
- What part of the payback information did future homebuyers find most helpful?

Purpose of the Research

The purpose of this research was to see if giving homebuyers more information about the potential savings of increased energy efficient components could result in more homebuyers choosing those energy efficient components, resulting in more energy efficient homes being built and inspiring homebuilders to offer more energy efficient options on their homes.

Delimitations

This study was limited to the effects of payback knowledge on consumers in the Wasatch Front area of Utah interested in buying a home in the next 12 months; namely the cities from Salt Lake to Payson on the west side of the Wasatch Mountains. It was necessary to limit the study to an area where the heating and cooling degree days varied only slightly from each other. The payback was calculated using three different house plans. These house plans were obtained from a local builder. The plans were the most often purchased house plans the builder used. Although these plans did not encompass all house sizes available, the plans did apply to the majority of homebuyers in the area.

Assumptions

The calculations were made assuming a 5 7/8% fixed loan amortized over a 30 year period and also assumed that utility costs stayed constant for that same period. This was done in order to show the lowest amount of savings possible for the worst case scenario.

In 1998, a study was conducted to find market valuations for home energy efficiency. According to this study,

> "Residential real estate markets assign to energy-efficient homes an incremental value that reflects the discounted value of annual fuel savings. The capitalization rate used by homeowners was expected to be 4%-10%, reflecting the range of after-tax mortgage interest rates during the 1990s and resulting in an incremental home value of $10 to around $25 for every $1 reduction in annual fuel bills."[11]

[11] Nevin and Watson, "Evidence of Rational Market Valuations for Home Energy Efficiency," *The Appraisal Journal* (October 1998): 1.

The amount of $10 per $1 reduction in annual fuel bills was used as the increased home value.

The assumptions made for calculating the heating and cooling loads were as follows: It was assumed that the homes were occupied by a household of four who were home 80% of the time, kept the thermostat at 70 degrees during the summer and 68 degrees during the winter.

Definitions

Additional cost – The increased cost of the option packages. These costs were calculated from the subcontractors who work for the builder. An additional 20% was added to that price as general contractor overhead.

Annual return on investment – The annual savings as a percentage of the additional cost.

Annual savings – The heating and cooling savings calculated by the difference in heating and cooling loads against the baseline.

BaseCalc – A computer program used by Hot2000 to calculate the heat loss factors for a basement. These factors are then input into Hot2000 to calculate the heating and cooling usage. It is available for a free download from: http://www.buildingsgroup.nrcan.gc.ca/software/basecalc_e.html

Heating and cooling loads – The amount of energy needed for heating, British Thermal Units (BTUs), and cooling, Kilowatt Hours (KWHRs).

Hot2000 – A computer program used to calculate the heating and cooling usage by the home. It is available for a free download from: http://www.buildingsgroup.nrcan.gc.ca/software/hot2000_e.html.

Increased home value – As explained above, for every $1 reduction in annual fuel bills the incremental value of the home increased by $10.

Insulated basement walls – Refers to a framed, insulated, and drywalled wall around the perimeter of the basement. No other basement finishes were assumed.

Interest saved – The potential amount of interest saved over the life of the loan if the monthly energy savings were put towards the principle of the mortgage each month.

Invest savings into mortgage – The amount of time saved if the mortgage were paid down by investing the monthly savings into the principle of the mortgage each month.

Monthly cash flow – The amount of cash left over each month if the monthly savings paid down the monthly mortgage increase.

Monthly savings – The annual savings divided into twelve months. To simplify the numbers for the survey subjects the annual savings was divided by twelve.

Mortgage increase – The amount per month that the mortgage will increase if the additional cost is added to the original mortgage.

Options – Different components and building materials used to create the packages.

Package(s) – The packages were created by the author, they include a combination of options.

Payback – The amount of time it would take for the annual savings to pay for the additional cost.

Payback information – Includes the increased cost of the package, the increase in the mortgage payment, the annual savings from heating and cooling bills, the monthly savings, the positive or negative monthly cash flow, the amount of time and interest saved if the monthly savings were added to the mortgage principle, the number of years required to pay back the original investment, the rate of return and the increased home value.

CHAPTER 2

Review of Literature

As the research was gathered it was found that it was important to cover the different views on consumer behavior, the importance of government regulation, consumer attitudes about energy efficiency, and some of the barriers of energy efficiency.

Economic and Behavioral Views

Different views exist regarding consumer rationality and energy efficiency. As noted there are no widely accepted answers to this topic and more research is needed. The key views of consumer rationality are the concepts of economic rationality and behavioral rationality. "Underlying this description is a precise mathematical definition that provides the basis for economic models of consumer behavior…individuals have preferences that they seek to satisfy as fully as possible through purchases of goods and services given the constraints imposed by their incomes and market conditions."[12] Economic rationality holds that consumers have "preferences" and they will make the right economical choices. "Behavioral scientists and market researchers tend to view the problem from a different perspective, focusing on the factors that increase awareness, improve information, and lead to action on the part of the individual."[13]

[12] Sanstad and Howarth, "Consumer Rationality", 4.
[13] du Pont, ""Energy Policy and Consumer Reality: The Role of Energy in the Purchase of Household Appliances in the U.S. and Thailand." (Ph.D. diss., University of Delaware, 1998), 2-2.

Economic theory is based in rational choice theory. Rational choice theory is a way of looking at a number of possible choices and to rationally decide which one would be the best, or to calculate which option would be the optimal choice. Critics of rational choice theory argue, "if rational choice theory were a literal description of consumer behavior, then energy consumers would need to solve extremely complex optimization problems: not just life-cycle costs minimization, but optimal control problems, stochastic dynamic programs, and the like."[14]

Scholars holding to economic theory believe consumers would be able to calculate these problems on their own but many of these programs are expensive. Rational choice scholars disagree with the economic theory scholars, they believe these programs are too complex for the average consumer to use.

> "Non-economists typically find it perplexing that economists ascribe such high levels of expertise to consumers…the assumption that consumers solve complex (or even not-so-complex) optimization problems appears false on its face: the relevant technical skills are held only by specialists in mathematics, economics, and related disciplines; solving even simple problems often requires the use of high-speed computers and sophisticated software. Therefore, the usual economic models of decision making are either clearly false of simply do not make sense." [15]

Economic theorists agree that consumers do not have the technical skills to compute those calculations but state "people may not actually solve complicated problems of utility maximization. They just behave 'as if' they do so that the models

[14] Cowing and McFadden. "Microeconomic Modeling and Policy Analysis: Studies in Residential Energy Demand." Orlando, Florida: Academic Press, 1984, quoted by Sanstad and Howarth, 5.
[15] Sanstad and Howarth. "Consumer Rationality", 5.

provide a good description of observed behavior."[16] Other scholars have used this argument to defend economic theory. "Goett uses a form of this argument to explain the use of life-cycle cost calculations in modeling consumer decisions regarding energy-efficiency. According to Goett, implicit discount rates 'do not simply reflect a conscious, mental calculation of the cost tradeoffs among [sic] alternative technologies. Rather, they summarize an amalgam of market forces that determine consumers' actual choices.'[17]" [18]

The issue with Friedman justification for rational choice models is that it "does not allow for falsification of the rationality hypothesis when empirical results run counter to theoretical predictions…instead Friedman invites analysts to modify their models by adding transaction costs, information asymmetries, and other special features until a fit to the data is obtained."[19] Thus the results are not completely accurate because the data can be manipulated to fit the desired outcome.

Critics of the rational choice theory, however, are not all non-economists. Some economists have argued against this theory.

> "[Simon] rejects the 'as if' approach in favor of an alternative grounded in psychological studies of human behavior, drawing a distinction between "substantive" and "procedural" rationality. Substantive rationality implies that individuals make decisions in the manner prescribed by formal optimization models, or that their choices are fully consistent with the predictions of such models. Procedural rationality, in contrast, implies that people make decisions

[16] Friedman. "The Methodology of Positive Economics," in M. Friedman, Essays in Positive Economics, 1953, quoted by Sanstad and Howarth. "Consumer Rationality", 5.
[17] Goett, "Implicit Discount Rates in Residential Customer Choices, Vol. I: Investments in Conservation Measures. Electric Power Research Institute EM-5587 Project 2547-1, Final Report, February, 1988, quoted in Sanstad and Howarth. "Consumer Rationality", 5.
[18] Sanstad and Howarth. "Consumer Rationality", 5.
[19] Ibid.

> subject to constraints on their attention, resources, and ability to process information."[20]

Bounded Rationality

Bounded rationality is the theory that observers look at a range of choices and look at the limited information available to the consumer and also their ability to handle the intricacy of the situation. Simon notes that the best possible manner to predict rational behavior is bounded rationality. He explains: "real-world decisions are best characterized by the concept of 'bounded rationality.'[21] Since psychological limitations imply that individuals cannot render substantively rational decisions, the best they can do is muddle through with generally imperfect results." [22] However, there is support for this theory, "Empirical studies of consumer decisions regarding energy use generally support the bounded rationality hypothesis."[23]

If consumers are indeed bounded rationally we would need some way to help consumers make more informed decisions. It would seem that incentives such as discounts and rebates are the solution to helping consumers and helping to the lower the energy bills for the consumer. These incentives would help consumers to achieve better or more rational results. Discounts and rebates could take away the sting of the initial high cost of energy efficient items since, "Consumers are viewed by policy makers as

[20] Simon. "Theories of Decision-making in Economics and Behavioral Science." American Economic Review 49:223-283, 1959. and Simon. "Rationality in Psychology and Economics." Journal of Business 59:209-224, 1986, quoted in Sanstad and Howarth. "Consumer Rationality", 5.
[21] Simon quoted in Sanstad and Howarth. "Consumer Rationality", 5.
[22] Sanstad and Howarth. "Consumer Rationality", 5-6.
[23] Ibid, 6.

rational economic actors, and it is assumed that economics will be a primary motivating factor when they make energy-related decisions."[24]

However, in 1986, a researcher named Stern found "a weak correlation between the size of program financial incentives and participation rates."[25] Stern found that "information held by consumers regarding residential energy use 'is not only incomplete, but systematically incorrect. Generally speaking, people tend to overestimate the amounts of energy used by and that may be saved in technologies that are visible and that must be activated each time they are used.'[26]" In two other studies of equipment performance labeling researchers, "found that the provision of technically accurate information on the costs and benefits of energy efficiency does not necessarily improve the quality of decision-making".[27] These studies show that even when consumers are trying to make good choices they "lack expertise in balancing the costs and benefits of energy-related decisions" leading them to make, not necessarily wrong choices, but not optimal choices.[28]

Even to this argument there is some skepticism. One response "is to argue that, while consumers may indeed 'optimize imperfectly' in making energy-related decisions, they do so randomly."[29] Consumers are unable to calculate properly the costs and benefits of energy related decisions which results in a randomness of optimal decisions.

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[24] du Pont, 2-2.
[25] Ibid.
[26] Stern "Blind Spots in Policy Analysis: What Economics Doesn't Say about Energy Use." Journal of Policy Analysis and Management 5:200-227, quoted by Sanstad and Howarth. "Consumer Rationality", 6.
[27] McNeill and Whittier. "Consumer Discount Rates implied by the Purchase of Energy-Efficient Refrigerators." Energy 8, December 1983, and Robinson "The Proof of the Pudding: Making Energy Efficiency Work." Energy Policy 19(7):631-345. quoted in Sanstad and Howarth. "Consumer Rationality", 6.
[28] Sanstad and Howarth. "Consumer Rationality", 6.
[29] Sweeney "Comments on Energy Efficiency: Lessons from the Past, Strategies for the Future," Proceedings of the World Bank, Development Conference, 1994, quoted in Sanstad and Howarth. "Consumer Rationality", 6.

While a consumer may wish to save energy, some of the decisions he or she makes may actually result in over consumption of energy or negligible savings. For example, setting the "air conditioner too 'high' relative to the levels required to assure sustained comfort", results in this over consumption.[30] While the consumer might rationally think that by setting the thermostat at a cooler setting during the summer the air conditioner won't work as hard, they fail to recognize that the air conditioner will have to turn on and off more frequently, thus using more energy than leaving the thermostat at a constant, comfortable temperature. "According to this view, while policies designed to improve consumer decision-making might very well benefit individual consumers, they would not necessarily result in aggregate energy savings."[31]

Recent studies have left uncertainty about the idea of "random misoptimization." "Making rational decisions about energy use and energy efficiency would seem to require consumers to carry out numerical calculations on the costs and benefits of their actions."[32] A study by the U.S. government in 1993 found that 90 million American adults are functionally illiterate and innumerate.[33] Therefore, it would be irrational to assume that consumers would be able to make economically rational decisions by calculating the costs and benefits of energy-related decisions.

Government Intervention

If technology were better some would argue that it would be only natural for consumers to reap the economic benefits. Although this is not the case. "Two studies that

[30] Sanstad and Howarth. "Consumer Rationality", 6.
[31] Ibid.
[32] Ibid, 6-7.
[33] Kirsch, Adult Literacy in America: A First Look at the Results of the National Adult Literacy Survey. Washington, D.C.: Office of Educational Research and Improvement, U.S. Department of Education, 1993.

deal specifically with energy issues were carried out by Howarth and Andersson (1993) and Friedman and Hausker (1988). These studies establish that limitations on consumers' ability to form unbiased and/or efficient estimates of the energy savings achievable through state-of-the-art technologies may impede the adoption of technologies yielding clear economic benefits." [34] Subsequently, even with state-of-the-art technologies consumers might not be able to achieve the economic benefits.

This then leads to a very controversial issue. If consumers can't make these decisions, who should?

"When the field of energy analysis was founded following the 1973 Arab oil embargo, 'energy conservation' and 'energy efficiency' were viewed as virtually synonymous by advocates of interventionist energy policies…using energy was seen as a policy imperative, whether through behavior changes or alternative technology."[35] When the market doesn't follow with energy efficient technologies it is seen as a market failure.

> "If the adoption of cost-effective energy-efficient technologies is impeded in the market, then energy analysts argue that policies to promote energy efficiency are warranted. Although this argument is commonly viewed as an 'engineering' point of view, it is in fact fundamentally based on economic reasoning. Cost-minimization is a necessary condition for economic efficiency, and the life-cycle cost criteria of engineering economics are nothing more that applied project analysis. Thus evidence that least-cost technologies are routinely passed-by by markets points to the existence of market failures"[36]

Somewhere along the line consumers have not understood the savings or need for the efficiency.

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[34] Sanstad and Howarth. "Consumer Rationality", 7.
[35] Ibid, 8.
[36] Sanstad and Howarth 1994. "'Normal' Markets, Market Imperfections, and Energy Efficiency." Energy Policy. Quoted by Sanstad and Howarth, "Consumer Rationality," 8.

> "…individuals frequently do not purchase energy efficiency measures that would benefit them by reducing the cost of obtaining energy services. Research reveals…that consumers use heuristics that result in systematically incorrect energy-related decisions; do not process information in an effective ("objective") manner; or otherwise do not or cannot arrive at "correct" conclusions regarding the potential benefits of efficiency investments."[37]

In short, Stern and Robinson believe "1) consumers do not behave according to the standard model of rational choice; 2) policies to promote energy efficiency are therefore warranted; and 3) these policies should be designed using results from behavioral research on energy decision-making so as to ensure their effectiveness." [38]

The government was seen as the entity that could help regulate and force consumers to be efficient. There is a large dilemma with this style of thinking - the consumer must voluntarily buy an energy efficient product or be forced by the government to do so.

> "…noneconomists often fail to recognize that their arguments are in principle not only consistent with economic reasoning but might in fact find their best expression through economic models. The technique of 'qualitative choice analysis' (Train 1986) for example, provides a very general approach to modeling consumer choice among discrete possibilities such as alternative appliances. It can, in particular, readily incorporate a number of 'noneconomic' factors that behavioral studies suggest play a role in energy-related decisions." [39]

Should the government intervene in regards to energy efficiency? Many have argued against such action.

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[37] Stern quoted by Sanstad and Howarth, "Consumer Rationality" and Robinson quoted by Sanstad and Howarth, "Consumer Rationality"
[38] Sanstad and Howarth. "Consumer Rationality", 8.
[39] Ibid, 9.

> "…departures from substantive rationality are irrelevant to questions of public policy: individuals should be free to make their own decisions, and the government has no business interfering…the argument can be framed with a somewhat different emphasis: consumer behavior may deviate from the dictates of perfect optimization; indeed, people may be flipping coins or consulting their astrologers when making energy-related decisions. But that's their prerogative, and the government should refrain from intervention on the ground that freedom of choice is fundamentally more important that economic efficiency." [40]

A certain style, color, brand, selected feature, or other desire can deter a consumer from buying the most energy efficient product on the market. "The resulting literature on bounded rationality suggests that the question is not whether but rather in what sense people are rational."[41] If a consumer is looking for a certain type of product that is not necessarily energy efficient, the fact that it is not energy efficient will not be a deterrent to buying it if the product is what they desire.

If we agree that consumers are in fact "boundedly rational", "this fact does not necessarily provide a blanket justification for policies aimed at promoting energy efficiency. If consumers are inexpert at dealing with energy choices, this constitutes a potential barrier not only to effective market decisions but also to programs designed to improve on market outcomes."[42]

> "This line of reasoning indicates an important distinction between policies aimed at directing technology, such as equipment performance standards, and those relying on marketing, such as demand-side management. If consumers cannot, on average, make correct calculations regarding energy efficiency, as may be implied by the

[40] Kahn, 1991. "An Economical Rational Approach to Least-Cost Planning," The Electricity Journal. 4(5):11-20, June. Quoted by Sanstad and Howarth, "Consumer Rationality", 9.
[41] Ibid.
[42] Sanstad and Howarth. "Consumer Rationality", 9.

> findings of high implicit discount rates, then efficiency standards may serve to replicate the correct calculations on a centralized, cost-efficient basis. Thus direct regulation may in some cases bypass the problem of bounded rationality altogether by focusing on technologies rather than behavior."[43]

Therefore, policies aimed at bettering technologies are not as disputed as policies intended to force the consumer directly. For example, the Department of Energy in January of 2006 changed the minimum Seasonal Energy Efficiency Rating (SEER) on an air conditioner from ten to thirteen. This change will make running the air conditioner 30% more efficient for the homeowner and consumers that already have an air conditioner will not be forced to by a new one. Rather, it is designed for new construction, retrofits, or additions.

All the research conducted on consumer behavior begs the question, is there research that connects behavior to a cost-benefit analysis?

> "…behavioral research on energy-related decision-making is rarely connected to standard cost-benefit analysis, a step that is essential if this research is to be fruitfully applied in practice. It is interesting to note, for example, that what may be the most comprehensive review of energy efficiency programs from a social and behavioral perspective (Katzev and Johnson, 1987) contains almost no quantitative discussion concerning costs and benefits."[44]

Consumer Attitudes and Priorities

The environmental attitudes of consumers during the 1980's and 1990's have remained favorable. In 1989 the Harris poll conducted a survey which concluded that 97% of the public felt the country should be doing more to curb environmental pollution.

[43] Ibid.
[44] Ibid.

In a 1990 New York Time/CBS poll, three-quarters of the public agreed with the statement that "Protecting the environment is so important that the requirements and standards cannot be too high, and continuing environmental improvements must be made regardless of the cost."[45]

With regard to energy efficiency, surveys have shown support as well. In a 1996 survey by the Sustainable Energy Budget Coalition, 55% of respondents said that energy efficiency should be the government's highest energy research priority. In the same survey three-quarters said they would be willing to pay more for electricity generated from 'cleaner renewable sources.'[46] In the Professional Builder 22nd Annual Consumer Survey, energy efficiency ranked third with 25.9% when the survey subjects were asked what elements in a new house would make them consider moving from their current home.[47] With all of the favorable attitudes it seems strange that there is discrepancy in translating that behavior into action.

To help consumers understand the efficiency of appliances, the U.S. has put energy labels on those appliances. After "years of campaigns and nearly two decades during which energy labels have been prominently displayed on U.S. appliances, energy use is not a high priority during the consumer's decision making process."[48] During 1996, in a survey of 323 consumers in four U.S. cities, "'low operating cost' ranked seventh on a list of factors that would influence a consumer's decision to buy a new appliance."[49] Consumers can, however, be taught the importance of energy efficiency and it can help to sway their decisions. Multiple studies have shown that "simply training

[45] du Pont, 2-4.
[46] Ibid.
[47] Bady and McLeister. "How to build what buyers want." 55.
[48] du Pont, 2-5.
[49] Ibid.

salespeople and providing point-of-purchase information on energy efficiency can increase the priority that consumers place on energy efficiency as a purchase criterion."[50]

In the 23rd Annual Consumer Survey by Professional Builder Magazine only 7% of consumers listed energy efficiency as the primary reason to buy a different home.[51] But a year later another survey showed that 22.9% of people felt their homes were lacking in energy efficiency and were looking for a new more efficient home.[52]

In a study of first-time homebuyers, price and size were the largest factors that drove the purchasing decision. Monthly payment was also listed as impacting the buying decision.[53]

Energy Efficiency Barriers

Energy efficiency doesn't only profit the consumer. "Energy-efficient homes can improve builder profitability and competitiveness, improve home quality and comfort for the homeowner, reduce energy requirements, cut down on air pollution, and enhance the national economy."[54] Often both builders and consumers feel overwhelmed with the plethora of existing and emerging energy-efficient technologies.

As contractors market energy efficiency, the major concern of most homebuyers is whether or not the cost is worth the benefit.

> "The obvious hope for energy efficient practices is that they will pay for themselves over time through reduced operating costs, and provide the same services to residents while requiring less energy. One problem is that developers have to invest a larger amount in the construction process and then pass on the difference to

[50] Ibid.
[51] Bady and Lurz. "What buyers want in a new home", 68.
[52] Bady et al. "What they want in their next home." 86.
[53] Bady. "First-time Buyer", 74.
[54] Sawhney et al. "Energy-Efficiency Strategies for Construction of Five Star Plus Homes." 174.

> homebuyers, which burdens the developer with the task of convincing homebuyers that their more expensive houses are either going to pay them back eventually, assuming that this is even true, or that such a house is simply a better house. The most crucial factor for creating a market for mass construction of energy-efficient housing will be based on the payback period for the investment in energy efficiency."[55]

This puts a heap of responsibility on the contractor to show how energy efficiency will benefit the buyer. Because of the large e cost that is incurred to show such data, most builders have not marketed their energy efficient homes as well as they could.

Because builders build on such tight margins it is difficult to invest a lot of money in something new. Nevertheless builders are not the only ones to blame.

> "Other factors that impede the more widespread use of these technologies include the lack of national leadership for energy efficiency; the focus of marketing programs on price, location, amenities, and appearance; the lack of satisfactory analysis tools that clearly demonstrate the benefits of the advanced technologies; the fragmented and competitive nature of the residential construction industry that complicates access to information; and the lack of regulation and consumer demand for the advanced technologies that permits builders to cut costs by conforming to regulations at the lowest level possible."[56]

The industry as a whole is struggling to find programs that show the benefits of more efficient products, as well as the ability to inform the consumer that the savings that could be attained would be in their best interest.

As builders and homebuyers struggle to find the best options available to them, the major barrier has been, "has been the lack or tools that clearly demonstrate the cost-

[55] Lehigh. "Energy Savings and Cost Effectiveness of Energy Efficient Housing." 3.
[56] Sawhney, 175.

effectiveness of these measures."[57] Often when showing energy efficient options the standard method of calculating the payback is on an individual basis. The problem with such an approach is that, "energy efficient measures considered on an individual basis do not always produce optimal solutions."[58] If products are not looked at as a whole package then results will vary. For example, low-E windows in a poorly built house will not obtain the results that a tight built, energy efficient house would achieve. Thus a package system is the only way to evaluate energy efficient measures.

[57] Ibid.
[58] Ibid.

CHAPTER 3

Methodology and Procedures

Methodology

The importance of using packages instead of individual options was an important part of this study. The basis of the study was to see if homebuyers would choose more efficient options if they could see the possible savings achieved through different options. Three home plans were acquired from a local home builder: The Adams, a starter home with 860 SF of living space on the main floor and 865 SF unfinished in the basement; The Aspen, a midsized home with 1285 SF on the first floor with an additional 1000 SF on the second floor with 1009 SF unfinished in the basement; and the Yukon, a larger home with 2040 SF on the main floor with 2008 SF unfinished in the basement.

To calculate the payback it was important that different options be packaged together to compare with the original plan. Seven packages were created; the price of the upgrade was calculated as well as the affect on the monthly mortgage. The payback information was then calculated using an Excel program created by the author.

The baseline for the three homes obtained from the builder included 2x4 exterior walls framed 16" on center, R-13 insulation in the walls, 1/2" drywall, R-38 in the ceiling, an unfinished basement, and double pane clear windows. The author wanted to focus on stud size, stud spacing, insulation, and windows because many builders in the area build with 2x4 walls, R-13 insulation and clear windows. Changing the stud size, spacing, and

windows is not something that is too dissimilar from what the contractor already uses. It was also intended to show that it would better serve homebuyers and builders to construct homes using one of the packages. It is not the intention of the author to say that the packages are the best alternatives available but rather that a package can be constructed that would be beneficial to the builder and buyer. The seven packages were constructed as shown in Table 3-1.

Table 3-1: List of Packages with Options

	Options												
	Exterior Walls		Stud Spacing		Wall Insulation			Insulated Basement Walls		Windows Double Pane		Ceiling Insulation	
Packages	2x4	2x6	16 oc	24 oc	R-13	R-19	R-22	No	Yes	Clear	LowE	R-38	R-50
Baseline	X		X		X			x		X		X	
Package 1	X		X		X			X			X	X	
Package 2	X		X		X				X		X	X	
Package 3		X	X			X		X		X		X	
Package 4		X		X		X		X			X	X	
Package 5		X		X		X			X	X		X	
Package 6		X		X		X			X		X	X	
Package 7		X		X		X	X		X		X		X

The insulated basement wall is a framed 2x4 wall insulated with R13 with 1/2" drywall around the perimeter of the basement. This option was used mainly to show the effects of insulating the basement wall. There were other possible solutions to insulating the basement such as ridged insulation on the outside of the foundation. Since the builder had not used a ridged insulation as a below grade insulation before, the author used a framed wall around the perimeter of the basement to show the insulating values that could come from an insulated basement.

For this study the information was collected from the plans and inserted into Hot2000[59] and BaseCalc[60], programs used to calculate heating and cooling usage. The BaseCalc program calculated heat loss specifically in the basement. Heat loss factors are then created by the program and used by Hot2000 to calculate the total heating and cooling loads used by the residential building.

The house data was then input into Hot2000 changing the building components for each package. The heating and cooling loads were then calculated for each package. These energy simulation programs were used for the baseline and also each package for the three houses. The author also tested each package as well as the baseline facing the four cardinal orientations (north, south, east, and west). This was necessary since heating and cooling loads differ depending on which direction the house is oriented. A sample is seen on Table 3-2.

[59] NRCan. 2005. Download the HOT2000 computer simulation program at http://www.buildingsgroup.nrcan.gc.ca/software/hot2000_e.html.

[60] NRCan. 2005. Download the BASECALC computer simulation program at http://www.buildingsgroup.nrcan.gc.ca/software/basecalc_e.html

Table 3-2: Heating and Cooling Loads by Cardinal Orientation

		Adams		Aspen		Yukon	
Direction	Package	BTU's	KWRH	BTU's	KWRH	BTU's	KWRH
N	Baseline	114	3258	87	2710	95	3536
N	1	111	3176	85	2649	92	3457
N	2	95	3147	72	2644	65	3418
N	3	105	3195	78	2730	88	3613
N	4	102	3209	77	2667	85	3549
N	5	89	3266	66	2722	61	3582
N	6	86	3181	64	2661	59	3508
N	7	85	3080	64	2649	59	3490
W	Baseline	122	3744	94	2977	102	3664
W	1	119	3640	92	2897	99	3573
W	2	103	3613	79	2893	72	3537
W	3	113	3691	85	2977	95	3716
W	4	110	3676	83	2901	92	3632
W	5	96	3745	72	2972	67	3683
W	6	93	3651	70	2896	64	3594
W	7	92	3543	70	2886	64	3577
S	Baseline	122	2842	96	2418	101	2940
S	1	119	2798	94	2373	98	2886
S	2	102	2770	80	2366	71	2850
S	3	112	2815	87	2416	95	2974
S	4	109	2809	85	2370	91	2930
S	5	95	2828	74	2410	67	2743
S	6	93	2783	72	2364	64	2893
S	7	91	2721	72	2355	64	2878
E	Baseline	122	3744	94	2984	98	3929
E	1	119	3640	92	2907	96	3826
E	2	103	3613	79	2900	69	3789
E	3	113	3701	85	2992	92	4003
E	4	110	3676	83	2915	89	3909
E	5	96	3745	72	2986	65	3971
E	6	93	3651	70	2910	62	3870
E	7	95	3555	70	2900	62	3850

The British Thermal Units (BTUs) are calculated as millions of BTUs and the kilowatt hour (KWHR) usage is the total KWHRs needed to cool. As seen in the chart above, depending on the house and its orientation there is a large difference between the heating and cooling loads.

Each option was then entered into a payback calculation program the author created in Excel. Prices were gathered from subcontractors who worked for the builder

and an additional 20% general contractor's markup was added. An example of the additional cost is seen in Table 3-3.

Table 3-3: Example of Additional Cost

Adams

Direction	Package	Millions of BTU's	KWHR	Additional Cost
N	B	114	3258	
N	1	111	3176	$ 163.40
N	2	95	3147	$ 1,068.80
N	3	105	3195	$ 498.40
N	4	102	3209	$ 420.28
N	5	89	3266	$ 1,315.22
N	6	86	3181	$ 1,325.67
N	7	85	3080	$ 1,850.39

A payback program was created to help estimate the total cost of completing the various packages. The costs included both materials and labor in order to calculate an accurate cost. The payback program implemented the heating and cooling loads from Hot2000 to help calculate the heating and cooling costs. The electrical cost was kept at a constant $0.069 per KWHR plus additional taxes and fees from Utah Power & Light and the cost of gas was $1.10 per therm plus additional taxes and fees from Queststar Gas. The paybacks were then compared against the original plan.

By comparing against the original plan, the author was able to calculate the difference in cost of materials and labor. Hence, the cost of the packages was not the total cost of the package, but rather the difference in the cost of materials and labor between the baseline and each package. Defining this cost difference was necessary to calculate the payback information.

It should be noted that these numbers do not show inflationary utility rates for various reasons. One reason for excluding this was if a loan was taken out to cover the cost of the upgrade then the interest owed on the loan would cancel any savings that would come as a result of higher gas prices. Also, the author wanted to show the maximum number of years for the payback. Under these conditions, the worst case scenario would be shown. If there was an increase in utility prices it would result in a faster payback and the returns would be higher.

Table 3-4: Payback Information

Adams

Package	Additional Cost	Monthly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Package 1	$ 234.84	$ 1.39	$ 2.94	$ 1.55	$ 35.31	2 months	$ 1,557.12	6.65	15.04%	$ 353.08
Package 2	$ 1,205.00	$ 7.13	$ 16.17	$ 9.04	$ 194.02	10 months	$ 8,676.23	6.45	15.52%	$ 1,940.23
Package 3	$ 613.71	$ 3.63	$ 7.72	$ 4.09	$ 92.70	5 months	$ 4,096.67	6.63	15.11%	$ 926.98
Package 4	$ 376.85	$ 2.23	$ 10.18	$ 7.95	$ 122.22	6 months	$ 5,892.14	3.09	32.43%	$ 1,222.18
Package 5	$ 1,378.73	$ 8.16	$ 20.88	$ 12.72	$ 250.62	1 yr. 1 month	$ 11,405.54	5.51	18.18%	$ 2,506.15
Package 6	$ 1,391.27	$ 8.23	$ 23.60	$ 15.37	$ 283.21	1 yr. 2 months	$ 13,077.44	4.91	20.36%	$ 2,832.05
Package 7	$ 1,974.66	$ 11.69	$ 24.59	$ 12.90	$ 295.06	1 yr. 3 months	$ 13,038.71	6.71	14.94%	$ 2,950.58

It is assumed a 5 7/8% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Paybacks were calculated against the Baseline
Calculated with an 80% efficient furnace

After calculating the cost of the upgrade and the savings per year, the author tracked the increased monthly mortgage payment, monthly energy savings, annual energy savings, the positive monthly cash flow, the number of years that would be taken off the mortgage if the savings were used to pay down the principle of the mortgage, the total amount of interest that would be saved if the mortgage were paid down, the number of years to pay back the original investment through energy savings, the return on investment and the increased home value.

The author contacted a large development in West Jordan, Utah, and asked if it were possible to survey subjects as they came to look at model homes. There were 22 model homes in roughly one square block built by nine different builders. There was a steady flow of people that were looking to buy a home in the next year. An example of the survey that was taken can be seen in the appendix A.

While the subjects did see the packages and the payback information, the subjects never saw the home plans because the author didn't want the aesthetics of the home to influence their decision. For example, if a subject disliked a split-level home the author didn't want that information to have an influence on their decision. The actual home plans are posted in appendix C of this report. The data was collected during the beginning of May and 100 households were surveyed.

Survey

For 2 weeks the author roamed the development in West Jordan as future homebuyers viewed the model homes. The potential subjects were met on the sidewalk and asked to participate in a 5-10 min study. To maintain anonymity the questions were verbally asked and the author filled in the answers on the survey. About 60% of the subjects were found at the development. The other subjects were located in the author's neighborhood on the Grandview Hill in Provo, UT.

As the subjects participated in the study questions were answered by the author about building materials and methods. The differences between insulation types, the benefits of building walls with studs 24" on center, and a quick explanation of the difference between low-E and clear windows were the most common explanations. As

comments were made by the survey subjects the author also wrote those on the survey, especially if a comment about the study surfaced more than once.

Statistical Methods

The author used descriptive statistics to estimate the proportion of prospective homebuyers who would change their mind about their previous decision after being informed of the payback information. Proportions were computed and confidence intervals calculated based on these statistics.

The author also looked to see if other demographic information affected the choices made by the subjects and used a chi-squared test for independence to verify the importance of the demographic information. A power analysis estimate was run by the statistics department and it was determined that a sample size of 100 was needed for adequate precision.

The sample size of 100 was required to attain accuracy between 7%-8%. The findings are more descriptive than statistical. Because of the large number of packages, chi-squared tests showed no real statistical inference that could be made.

CHAPTER 4

Findings

Payback Information: What was helpful?

In order to better understand the results of the study the author decided to answer the last question first. By understanding this question it will be easier to see which package was the best. By using a weighted average matrix the author was able to determine what the subjects thought were the most important issues that helped them to make their decisions. Before we look at how the matrix was built let's look at the issues that the subjects found as being most important.

Table 4-1: Payback Information by Importance felt by Subjects

Reasons	
Item	**%**
Increased Home Value	46%
Monthly Cash Flow	45%
Monthly Savings	31%
Interest Saved	31%
Payback in Years	31%
Annual ROI	29%
Additional Cost	22%
Investing Savings	20%
Annual Savings	19%
Mortgage Increase	16%

As we can see from table 4-1, 46% of the respondents felt the increased home value was the most important factor for them, closely followed by monthly cash flow with 45%. Reviewing the rest of the items it is worth noting that only 16% of the subjects found the monthly mortgage increase to be a significant factor in making their decision.

It was important to understand the reasons why the subjects made the decisions they did. First, it helped to understand what issues were important to the subjects and second, it helped to figure out how to weigh each item in the matrix. Because the survey was out of 100 subjects the author took the percentage of subjects that found each reason important, then ranked each of the packages by each option. Each option was then weighted according to the importance issued by the subjects. The matrix is show below.

Table 4-2: Weighted Matrix of Payback Information

	Additional Cost	Montly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value	Total
Baseline	-	-	-	-	-	-	-	-	-	-	
Package 1	0.44	0.32	4.34	5.4	2.66	2.8	4.34	3.72	3.48	6.44	33.94
Package 2	1.76	1.28	2.48	2.7	1.52	1.6	2.48	2.48	2.32	3.68	22.30
Package 3	1.32	0.96	3.72	6.3	2.28	2.4	3.72	4.34	4.06	5.52	34.62
Package 4	0.88	0.64	3.1	4.5	1.9	2	3.1	0.62	0.58	4.6	21.92
Package 5	2.2	1.6	1.86	1.8	1.14	1.2	1.86	1.86	1.74	2.76	18.02
Package 6	2.64	1.92	1.24	0.9	0.76	0.8	0.62	1.24	1.16	1.84	13.12
Package 7	3.08	2.24	0.62	3.6	0.38	0.4	1.24	3.1	2.9	0.92	18.48

Each item was ranked from best to worst (1-7). Each number was then multiplied by the percentage of subjects who felt that reason was important. Because of this insight the author feels it is important to rearrange the packages in the order of the best to the worst package.

Table 4-3: Package Order by Weighted Matrix

Previous Package Order	New Package Order
Baseline	Package 6
Package 1	Package 5
Package 2	Package 7
Package 3	Package 4
Package 4	Package 2
Package 5	Package 3
Package 6	Package 1
Package 7	Baseline

Now that the packages are arranged in order of best to worst, the following matrices will be easier to understand. The top three packages are 6, 5, and 7 the middle two are 4, 2 and the bottom three are 3, 1, and baseline. This will make it easier to draw conclusions about the packages. Package number 6 was by in large the best package available according to the importance of the reasons.

It is also important to mention that all percentages in the matrices that follow are based on the overall total, not a percentage of each package. Because there were 100 subjects each percentage point is relative to one person.

Importance of Energy Efficiency

It was significant to know how important energy efficiency was to homebuyers, how that might affect their decision making, and if there was a relative affect when they saw the payback information.

Table 4-4: Importance of Energy Efficiency

Importance of Energy Efficiency	
Importance	**%**
Extremely	17%
Very	43%
Somewhat	37%
Not very	2%
Not at all	1%

Sixty percent of homebuyers felt that energy efficiency was either 'extremely important' or 'very important.' Most of the subjects who marked 'somewhat important,' commented that while it was not their top priority, they would not sacrifice the aesthetics of their home in exchange for energy efficiency.

Table 4-5: Importance of Energy Efficiency by First Choice

Matrix Comparing Importance of Energy Efficiency by First Choice (organized by best package)

Importance of Energy Efficiency		First Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
Extremely	17%	1%	2%	10%	1%	1%	2%	0%	0%
Very	43%	7%	2%	15%	8%	3%	5%	0%	3%
Somewhat	37%	1%	2%	13%	7%	1%	4%	6%	3%
Not very	2%	1%	0%	0%	1%	0%	0%	0%	0%
Not at all	1%	0%	0%	1%	0%	0%	0%	0%	0%
Total		10%	6%	39%	17%	5%	11%	6%	6%

Out of the 60% of people that marked the importance of energy efficiency as 'extremely' or 'very,' only 63% marked one of the top three energy efficient packages as their first choice. It is also interesting to note that out of the 40% of people who marked the importance of energy efficiency as 'somewhat,' 'not very,' or 'not at all,' 45% of them marked one of the top three energy efficient packages as their first choice.

As seen above some of the subjects who marked 'extremely' or 'very' went straight to package 7 assuming that since it contained the most energy efficient items in every option, it must have been the best in energy savings.

Table 4-6: Importance of Energy Efficiency by Second Choice

Matrix Comparing Importance of Energy Efficiency with Second Choice (organized by best package)

Importance of Energy Efficiency		Second Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
Extremely	17%	5%	4%	5%	1%	0%	2%	0%	0%
Very	43%	21%	2%	12%	4%	3%	1%	0%	0%
Somewhat	37%	13%	1%	8%	5%	3%	3%	4%	0%
Not very	2%	1%	0%	1%	0%	0%	0%	0%	0%
Not at all	1%	1%	0%	0%	0%	0%	0%	0%	0%
Total		41%	7%	26%	10%	6%	6%	4%	0%

Sixty percent of respondents who marked the importance of energy efficiency as 'extremely' or 'very' chose package 6 after seeing the payback information. Only eight people marked package 6 as their first choice, but 26 people marked it after seeing the payback information. Only 10% of all subjects marked option 6 the first time, whereas 41% did the second time.

Previous Home Purchases

One would assume that a person who has previously purchased a home would be more inclined to purchase a more energy efficient home. They are already aware of the utility costs needed for a home- unlike their first-time homebuyer counterparts who have mostly lived in apartments.

Table 4-7: Previous Home Purchase by First Choice

Matrix Comparing Previous Home Purchase by First Choice (organized by best package)									
Previous Home Purchases		1st Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
First-Time Buyer	78%	8%	6%	25%	15%	3%	9%	6%	6%
1 or more	22%	2%	0%	14%	2%	2%	2%	0%	0%
	Total	10%	6%	39%	17%	5%	11%	6%	6%

The data shows that out of the 22% of the subjects who had previously purchased a house, almost 73% of them chose one of the top three choices. Meanwhile, only 50% of first-time homebuyers chose a package in the top three. Almost 27% of first-time homebuyers chose a package in the bottom three while less than 10% of previous homebuyers did.

Table 4-8: Previous Home Purchase with Second Choice

Matrix Comparing Previous Home Purchase with Second Choice (organized by best package)									
Previous Home Purchases		2nd Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
First-Time Buyer	78%	29%	5%	20%	10%	4%	6%	4%	0%
1 or more	22%	12%	2%	6%	0%	2%	0%	0%	0%
	Total	41%	7%	26%	10%	6%	6%	4%	0%

After seeing the payback information, over 90% of previous homebuyers chose a package in the top three and just over 69% of first-time homebuyers did likewise. Also, about 13% of first-time homebuyers chose a package in the bottom three and 0% of previous homebuyers chose a package in the bottom three.

Length of Time in the Home

Because many of the subjects planned on staying in their home for variable amounts of time it was important to see if the length of time they planned on living in the home would have an effect on the package they would choose.

Table 4-9: Length of Time to Stay in the Home by First Choice

Matrix Comparing Length of Time to Stay in the Home by First Choice (organized by best package)

Length of Time to Stay in the Home		First Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
less than 5 years	18%	3%	0%	8%	3%	1%	0%	1%	2%
5 years	43%	4%	1%	14%	9%	3%	5%	4%	3%
5 to 10 years	12%	1%	1%	3%	4%	1%	1%	1%	0%
10 + years	27%	2%	4%	14%	1%	0%	5%	0%	1%
Total		10%	6%	39%	17%	5%	11%	6%	6%

Only 23% of all respondents marked one of the bottom three choices. It did seem that those who were more prone to choose non-optimal choices planned on staying in the home five years or less, but this was also where the majority of respondents were. Of the subjects that marked 'less than 5 years', 61% marked one of the top three packages whereas 74% of subjects that marked '10+ years' did.

Table 4-10: Length of Time to Stay in the Home by Second Choice

Matrix Comparing Length of Time to Stay in the Home by Second Choice (organized by best package)

Length of Time to Stay in the Home		Second Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
less than 5 years	18%	9%	0%	6%	1%	1%	0%	1%	0%
5 years	43%	16%	1%	10%	6%	3%	4%	3%	0%
5 to 10 years	12%	7%	2%	2%	1%	0%	0%	0%	0%
10 + years	27%	9%	4%	8%	2%	2%	2%	0%	0%
Total		41%	7%	26%	10%	6%	6%	4%	0%

Over 83% of the subjects who marked 'less than 5 years' chose a package in the top three after seeing the payback information; nearly 78% of the subjects who marked '10+ years' chose a package in the top three on the second choice. While there was not a large increase in the number of subjects that changed who marked '10+ years', it is worth noting that 22% marked one of the bottom three choices the first time while only 7% marked one of the bottom three after seeing the payback information.

Payback Information

In order to fully understand if there was a change we must first know what options were chosen initially. The matrix that follows shows the first choice packages in the left hand column with the percentage of subjects who chose each package. The packages listed across the matrix are the second choice packages. Underneath each second choice package it shows the percentage of subjects who chose each package on their second choice.

Table 4-11: First Choice by Second Choice

Matrix Comparing First Choice with Second Choice (organized by best package)

1st Choice		2nd Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
Package 6	10%	10%	0%	0%	0%	0%	0%	0%	0%
Package 5	6%	2%	4%	0%	0%	0%	0%	0%	0%
Package 7	39%	14%	2%	21%	1%	1%	0%	0%	0%
Package 4	17%	9%	0%	2%	4%	1%	0%	1%	0%
Package 2	5%	2%	0%	2%	0%	1%	0%	0%	0%
Package 3	11%	1%	1%	0%	2%	2%	5%	0%	0%
Package 1	6%	3%	0%	0%	1%	0%	0%	2%	0%
Baseline	6%	0%	0%	1%	2%	1%	1%	1%	0%
Total		41%	7%	26%	10%	6%	6%	4%	0%

For example 6% of the subjects (or six people) chose the baseline as their first choice. One person chose package 7, two people chose package 4, one person chose

package 2, one person chose package 3, and one person chose package 1. No one who chose the baseline as their first choice chose packages 6, 5, or the baseline as their second choice.

We can see that 55% of respondents chose a package in the top three as their first choice, whereas 74% chose a package in the top three as their second choice. Concerning the bottom three, 23% of respondents chose an option in the bottom three as their first choice, only 10% of the subjects chose a package in the bottom three, and no one chose the baseline as their second choice.

CHAPTER 5

Conclusions and Recommendations

In accordance with the methodology stated in Chapter 3 and the findings in Chapter 4 the conclusions were drawn. The research objectives are again stated here.

- How important is energy efficiency to homebuyers; does it have an effect on the energy efficient packages they chose; and did the payback information change their decision on which energy efficient package to choose?
- How many homes have the homebuyers purchased previously; does that have an effect on the energy efficient packages they chose for their homes; and did the payback information change their previous decision?
- Does the length of time the homebuyers planned on staying in the home effect the energy efficient packages they chose, and did the payback information change their previous decision?
- Would homebuyers change their minds about the energy efficient packages they chose for their home if they had knowledge of the payback information?
- What part of the payback information did future homebuyers find most helpful?

As the tables are viewed again it is important to remember that all the percentages are percentages of the total (100%), and not a percentage of each category.

Importance of Energy Efficiency

Most of the survey subjects felt that energy efficiency was 'extremely' or 'very important', and only three subjects felt it was 'not very' or 'not at all important'. There is an increasing demand for energy efficient homes; however, many of the respondents did not want to compromise the look of the home for the sake of energy efficiency. Did the importance placed on energy efficiency have an effect on the packages they chose? With regard to the first choice, nearly 60% of respondents who marked 'extremely important' chose package 7, as they assumed it was the package that was the most energy efficient. There was a correlation between how the subjects viewed the importance of energy efficiency and, ultimately, the quality of the package that was chosen.

Table 5-1: Importance of Energy Efficiency by First Choice

Matrix Comparing Importance of Energy Efficiency by First Choice (organized by best package)

Importance of Energy Efficiency		First Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
Extremely	17%	1%	2%	10%	1%	1%	2%	0%	0%
Very	43%	7%	2%	15%	8%	3%	5%	0%	3%
Somewhat	37%	1%	2%	13%	7%	1%	4%	6%	3%
Not very	2%	1%	0%	0%	1%	0%	0%	0%	0%
Not at all	1%	0%	0%	1%	0%	0%	0%	0%	0%
Total		10%	6%	39%	17%	5%	11%	6%	6%

After viewing the payback information there was a movement to choose a more energy efficient package.

Table 5-2: Importance of Energy Efficiency by Second Choice

Matrix Comparing Importance of Energy Efficiency by Second Choice (organized by best package)									
Importance of Energy Efficiency		Second Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
Extremely	17%	5%	4%	5%	1%	0%	2%	0%	0%
Very	43%	21%	2%	12%	4%	3%	1%	0%	0%
Somewhat	37%	13%	1%	8%	5%	3%	3%	4%	0%
Not very	2%	1%	0%	1%	0%	0%	0%	0%	0%
Not at all	1%	1%	0%	0%	0%	0%	0%	0%	0%
Total		41%	7%	26%	10%	6%	6%	4%	0%

Upon viewing the payback information, the difference in choice made by those who marked 'extremely' didn't vary much from the packages chosen by those who marked 'very'. Although there was more of a movement from those who marked 'very' and 'somewhat' to choose package 6, which was the best package according to the importance the subjects put on the various parts of the payback information. This study showed that those who view the importance of energy efficiency as 'extremely' are more prone to give up energy savings in order to have a house that contains more insulation.

Previous Home Purchases

While over three-quarters of the subjects were first time homebuyers there were still differences that were apparent when looking at the choices that were made.

Table 5-3: Previous Home Purchase by First Choice

Matrix Comparing Previous Home Purchase by First Choice (organized by best package)									
Previous Home Purchases		1st Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
First-Time Buyer	78%	8%	6%	25%	15%	3%	9%	6%	6%
1 or more	22%	2%	0%	14%	2%	2%	2%	0%	0%
Total		10%	6%	39%	17%	5%	11%	6%	6%

Since the subjects had no knowledge of the savings that could be achieved through the various packages on their first choice, it is interesting to see that most of the subjects who had previously bought a home chose package 7 on their first choice. We can conclude from this data that previous homebuyers are more willing to choose what seemed to be the top choice and are more willing to spend money to make a home more energy efficient. This could be highly related to the fact that previous home owners are very aware of the high costs of heating and cooling a non-efficient home.

Table 5-4: Previous Home Purchase by Second Choice

Matrix Comparing Previous Home Purchase by Second Choice (organized by best package)									
Previous Home Purchases		**2nd Choice**							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
First-Time Buyer	78%	29%	5%	20%	10%	4%	6%	4%	0%
1 or more	22%	12%	2%	6%	0%	2%	0%	0%	0%
Total		41%	7%	26%	10%	6%	6%	4%	0%

The payback information did help both previous homebuyers and first-time homebuyers. On their first choice previous homebuyers chose a package in the top three 72.7% of the time, whereas only 50% of first-time homebuyers did the same. After seeing the payback information, previous homebuyers chose a package in the top three 90.9% of the time, but only 69% of first-time homebuyers did. Both groups equally benefited from viewing the payback information. There was a 20% increase in choosing a package in the top three.

Length of Time in the Home

It was assumed by the author that subjects planning on living in the home for less than the payback period would chose packages that correlated with the amount of time they planned on staying in the home.

Table 5-5: Length of Time to Stay in the Home by First Choice

Matrix Comparing Length of Time to Stay in the Home by First Choice (organized by best package)

Length of Time to Stay in the Home		First Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
less than 5 years	18%	3%	0%	8%	3%	1%	0%	1%	2%
5 years	43%	4%	1%	14%	9%	3%	5%	4%	3%
5 to 10 years	12%	1%	1%	3%	4%	1%	1%	1%	0%
10 + years	27%	2%	4%	14%	1%	0%	5%	0%	1%
Total		10%	6%	39%	17%	5%	11%	6%	6%

This assumption seemed to be true after the results of the first choice, even though they hadn't seen the payback information and didn't know how long the payback would have been. After seeing the payback information it was difficult to see whether the length of time the subjects planned on being in the home had any bearing at all. Nearly every group had a significant amount of people choosing a package in the top three. Of the subjects who marked 'less than 5 years', over 83% chose packages that would seem more logical for a long term benefit.

Table 5-6: Length of Time to Stay in the Home by Second Choice

Matrix Comparing Length of Time to Stay in the Home by Second Choice (organized by best package)

Length of Time to Stay in the Home		Second Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
less than 5 years	18%	9%	0%	6%	1%	1%	0%	1%	0%
5 years	43%	16%	1%	10%	6%	3%	4%	3%	0%
5 to 10 years	12%	7%	2%	2%	1%	0%	0%	0%	0%
10 + years	27%	9%	4%	8%	2%	2%	2%	0%	0%
Total		41%	7%	26%	10%	6%	6%	4%	0%

Many of the subjects planning on living in the home for less than 5 years did state that while the payback on the investment wasn't going to pay back while they were in the home, the increase home value made the investment worth while. We can thus conclude that length of time is not a significant factor in determining what packages the subjects would choose. Although 31% of the subjects felt that payback was an important part of payback information, payback did not have an influence over how long they planned on staying in the home.

Payback Information

Payback information has been a great benefit to all of the subjects. While most subjects did agree there was a lot of information there were only 1-2 subjects that felt overwhelmed by the quantity of the information. Nearly all of the subjects commented that they would like to see some information like this when they buy their home.

Table 5-7: First Choice by Second Choice

Matrix Comparing First Choice by Second Choice (organized by best package)

1st Choice		2nd Choice							
		Package 6	Package 5	Package 7	Package 4	Package 2	Package 3	Package 1	Baseline
Package 6	10%	10%	0%	0%	0%	0%	0%	0%	0%
Package 5	6%	2%	4%	0%	0%	0%	0%	0%	0%
Package 7	39%	14%	2%	21%	1%	1%	0%	0%	0%
Package 4	17%	9%	0%	2%	4%	1%	0%	1%	0%
Package 2	5%	2%	0%	2%	0%	1%	0%	0%	0%
Package 3	11%	1%	1%	0%	2%	2%	5%	0%	0%
Package 1	6%	3%	0%	0%	1%	0%	0%	2%	0%
Baseline	6%	0%	0%	1%	2%	1%	1%	1%	0%
	Total	41%	7%	26%	10%	6%	6%	4%	0%

One of the first things that should be mentioned is that Package 5 was chosen significantly less often than both Packages 6 and 7. The difference between Package 5 and Packages 6 and 7 is that Package 5 doesn't have low-E windows. We can conclude

that low-E windows are viewed by most people as a great energy saving component. Although Package 5 is one of the top three packages it was not chosen as often because of that reason.

In Table 5-7 it is clear to see the movement of the subjects from their first choice to their second choice. While only 10% of the subjects chose Package 6 the first time 41% chose it for their second choice after the payback information was shown to them.

Recommendations

If this study were to be duplicated it is recommended that fewer packages be created. Truer data could be collected without such a quantity of packages. The author's purpose in showing all the packages was to answer any questions that might arise about what would happen if one component were changed. For example Package 5, showed the effect of removing the low-E windows from Package 6 and could have been removed.

A study could be conducted creating Energy Star qualified packages. It would be interesting to see if subjects would be more inclined to buy an Energy Star package if they could see the payback information or if better packages could be constructed.

A study conducted in a similar manner that surveyed builders instead of homebuyers could lead to some insight as to why builders build what they do. It could be possible that many builders are unaware of the savings that could be achieved through simple energy efficient upgrades. By helping to inform home builders this could help to change the product that is offered.

Implications

Offering payback information does help a significant amount of homebuyers to choose the best package for them. For most small builders it might be difficult to find someone that could provide such a service and still make the profits they do. Large builders, on the other hand, would benefit by providing payback information of the energy efficient packages they offer. This would increase the energy efficient options selected and help to set that builder apart as one who cares about their customer and allowing the customer to make the decision that is best for them.

The most important information that a builder could show their customer if they were to build their own payback information would be the following; increased home value, monthly cash flow, monthly savings, interest saved, payback in years, and annual ROI. This information was desired by at least 30% of all survey subjects.

All of the packages that were created for this study were fairly inexpensive. On average the total builder profit only amounted to $400 per package, on packages 6 and 7. If we assume that a builder used payback information to sell energy efficient upgrades on their homes. It would increase sales of those upgrades by 20%. A builder's added gross profit would be about $8,000 for every 100 homes sold. This profit only comes from the 20% builder's margin included in the price of each package. A builder could also increase sales by including the payback information and attracting more potential customers. These customers could be attained not only because the builder provides the payback information but also because the homes the builder sells already have an increased home value. If the builder used increased home value to increase the cost of the home, the builder could increase profits on the same 100 homes, from $8,000 to

$66,800. The builder would then have to weight whether increased profits was more important than attracting more potential customers.

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APPENDICES

Appendix A

Appendix A is an example of the survey used in the study. The surveys were filled out by the author to help to maintain the anonymity of the subjects of the study.

1) How many previous home purchases have you made for yourself?

2) What size home are you looking to purchase:

   a. Main Floor Less than 1000 SF
   b. Main Floor 1000 SF – 2000 SF
   c. Main Floor 2000 SF and above

3) Where would you prefer to locate your new home?_____

4) How long do you plan on living in the home?_____

5) How important is buying an energy efficient home to you?

   a. Extremely important
   b. Very important
   c. Somewhat important
   d. Not Very important
   e. Not important at all

The Clients will now choose an energy efficient package. They were shown the cost as well as the options they were choosing.

Adams — **Options**

	Additional Cost	Mortage Increase	Exterior Walls		Stud Spacing		Wall Insulation			Drywall Thickness	Framed Basement		Windows Double Pane		Ceiling Insulation	
			2x4	2x6	16 oc	24 oc	R-13	R-19	R-22	1/2"	No	Yes	Clear	LowE	R-38	R-50
Baseline	$ -	$ -	X		X		X			X	x		X		X	
Package 1	$ 235.98	$ 1.40	X		X		X			X	X			X	X	
Package 2	$ 1,205.00	$ 7.13	X		X		X			X		X		X	X	
Package 3	$ 613.71	$ 3.63		X	X			X		X	X		X		X	
Package 4	$ 376.85	$ 2.23		X		X		X		X	X			X	X	
Package 5	$ 1,378.73	$ 8.16		X		X		X		X		X	X		X	
Package 6	$ 1,391.27	$ 8.23		X		X		X		X		X		X	X	
Package 7	$ 1,974.66	$ 11.69		X		X			X	X		X		X		X

It is assumed a 8% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Assumed an 80% efficient furnace
Paybacks calculated against packaged option1

6) Which energy efficient package did you choose and what was the major factor in making your decision?

   a. Baseline_____
   b. 1_____
   c. 2_____
   d. 3_____
   e. 4_____
   f. 5_____
   g. 6_____
   h. 7_____

At this point the clients saw the payback information.

Adams

	Additional Cost	Monthly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Package 1	$ 234.84	$ 1.39	$ 2.94	$ 1.55	$ 35.31	2 months	$ 1,557.12	6.65	15.04%	$ 353.08
Package 2	$ 1,205.00	$ 7.13	$ 16.17	$ 9.04	$ 194.02	10 months	$ 8,676.23	6.45	15.52%	$ 1,940.23
Package 3	$ 613.71	$ 3.63	$ 7.72	$ 4.09	$ 92.70	5 months	$ 4,096.67	6.63	15.11%	$ 926.98
Package 4	$ 376.85	$ 2.23	$ 10.18	$ 7.95	$ 122.22	6 months	$ 5,892.14	3.09	32.43%	$ 1,222.18
Package 5	$ 1,378.73	$ 8.16	$ 20.88	$ 12.72	$ 250.62	1 yr. 1 month	$ 11,405.54	5.51	18.18%	$ 2,506.15
Package 6	$ 1,391.27	$ 8.23	$ 23.60	$ 15.37	$ 283.21	1 yr. 2 months	$ 13,077.44	4.91	20.36%	$ 2,832.05
Package 7	$ 1,974.66	$ 11.69	$ 24.59	$ 12.90	$ 295.06	1 yr. 3 months	$ 13,038.71	6.71	14.94%	$ 2,950.58

It is assumed a 5 7/8% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Paybacks were calculated against the Baseline
Calculated with an 80% efficient furnace

7) After seeing the payback information which option did you choose?

   a. Baseline
   b. 1
   c. 2
   d. 3
   e. 4
   f. 5
   g. 6
   h. 7

8) If you changed your selection, what was the major factor in making that change?

   a. Price
   b. Payback (Time)
   c. Return On Investment
   d. Effect on Mortgage
   e. Other:_____

Appendix B

Appendix B is a compilation of the three different home plans; Adams, Aspen, and Yukon. This study used a mortgage interest rate of 5 7/8%. The following charts show the payback information at different interest rates; 5 7/8%, 6%, 7%, and 8%.

Adams

	Additional Cost	Monthly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Option1	$ 234.84	$ 1.39	$ 2.94	$ 1.55	$ 35.31	2 months	$ 1,557.12	6.65	15.04%	$ 353.08
Option2	$ 1,205.00	$ 7.13	$ 16.17	$ 9.04	$ 194.02	10 months	$ 8,676.23	6.45	15.52%	$ 1,940.23
Option3	$ 613.71	$ 3.63	$ 7.72	$ 4.09	$ 92.70	5 months	$ 4,096.67	6.63	15.11%	$ 926.98
Option4	$ 376.85	$ 2.23	$ 10.18	$ 7.95	$ 122.22	6 months	$ 5,892.14	3.09	32.43%	$ 1,222.18
Option5	$ 1,378.73	$ 8.16	$ 20.88	$ 12.72	$ 250.62	1 yr. 1 month	$ 11,405.54	5.51	18.18%	$ 2,506.15
Option6	$ 1,391.27	$ 8.23	$ 23.60	$ 15.37	$ 283.21	1 yr. 2 months	$ 13,077.44	4.91	20.36%	$ 2,832.05
Option7	$ 1,974.66	$ 11.69	$ 24.59	$ 12.90	$ 295.06	1 yr. 3 months	$ 13,038.71	6.71	14.94%	$ 2,950.58

It is assumed a 5 7/8% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Paybacks were calculated against the Baseline
Calculated with an 80% efficient furnace

Adams 6%

	Additional Cost	Monthly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Option1	$ 234.84	$ 1.40	$ 2.94	$ 1.54	$ 35.31	2 months	$ 1,891.31	6.65	15.04%	$ 353.08
Option2	$ 1,205.00	$ 7.22	$ 16.17	$ 8.95	$ 194.02	10 months	$ 8,917.59	6.45	15.52%	$ 1,940.23
Option3	$ 613.71	$ 3.68	$ 7.72	$ 4.04	$ 92.70	8 months	$ 4,460.34	6.63	15.11%	$ 926.98
Option4	$ 376.85	$ 2.26	$ 10.18	$ 7.92	$ 122.22	6 months	$ 6,254.41	3.09	32.43%	$ 1,222.18
Option5	$ 1,378.73	$ 8.26	$ 20.88	$ 12.62	$ 250.62	1 yr. 1 month	$ 11,492.39	5.51	18.18%	$ 2,506.15
Option6	$ 1,391.27	$ 8.34	$ 23.60	$ 15.26	$ 283.21	1 yr. 2 months	$ 13,056.15	4.91	20.36%	$ 2,832.05
Option7	$ 1,974.66	$ 11.84	$ 24.59	$ 12.75	$ 295.06	1 yr. 3 months	$ 12,951.02	6.71	14.94%	$ 2,950.58

It is assumed a 6% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Paybacks were calculated against the Baseline
Calculated with an 80% efficient furnace

Adams 7%

	Additional Cost	Monthly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Option1	$ 234.84	$ 1.56	$ 2.94	$ 1.38	$ 35.31	2 months	$ 2,160.44	6.65	15.04%	$ 353.08
Option2	$ 1,205.00	$ 8.01	$ 16.17	$ 8.16	$ 194.02	11 months	$ 11,994.27	6.45	15.52%	$ 1,940.23
Option3	$ 613.71	$ 4.08	$ 7.72	$ 3.64	$ 92.70	5 months	$ 5,629.16	6.63	15.11%	$ 926.98
Option4	$ 376.85	$ 2.50	$ 10.18	$ 7.68	$ 122.22	7 months	$ 7,970.62	3.09	32.43%	$ 1,222.18
Option5	$ 1,378.73	$ 9.17	$ 20.88	$ 11.71	$ 250.62	1 yr. 2 months	$ 15,018.92	5.51	18.18%	$ 2,506.15
Option6	$ 1,391.27	$ 9.25	$ 23.60	$ 14.35	$ 283.21	1 yr. 4 months	$ 17,064.96	4.91	20.36%	$ 2,832.05
Option7	$ 1,974.66	$ 13.13	$ 24.59	$ 11.46	$ 295.06	1 yr. 4 months	$ 16,997.87	6.71	14.94%	$ 2,950.58

It is assumed a 7% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Paybacks were calculated against the Baseline
Calculated with an 80% efficient furnace

Adams 8%

	Additional Cost	Monthly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Option1	$ 234.84	$ 1.72	$ 2.94	$ 1.22	$ 35.31	2 months	$ 1,312.52	6.65	15.04%	$ 353.08
Option2	$ 1,205.00	$ 8.84	$ 16.17	$ 9.04	$ 194.02	12 months	$ 13,788.40	6.45	15.52%	$ 1,940.23
Option3	$ 613.71	$ 4.50	$ 7.72	$ 4.09	$ 92.70	6 months	$ 5,919.58	6.63	15.11%	$ 926.98
Option4	$ 376.85	$ 2.77	$ 10.18	$ 7.95	$ 122.22	8 months	$ 8,941.54	3.09	32.43%	$ 1,222.18
Option5	$ 1,378.73	$ 10.12	$ 20.88	$ 12.72	$ 250.62	1 yr. 3 months	$ 18,227.44	5.51	18.18%	$ 2,506.15
Option6	$ 1,391.27	$ 10.21	$ 23.60	$ 15.37	$ 283.21	1 yr. 5 months	$ 20,864.76	4.91	20.36%	$ 2,832.05
Option7	$ 1,974.66	$ 14.49	$ 24.59	$ 12.90	$ 295.06	1 yr. 6 months	$ 20,867.44	6.71	14.94%	$ 2,950.58

It is assumed a 8% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Paybacks were calculated against the Baseline
Calculated with an 80% efficient furnace

Aspen

	Additional Cost	Monthly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Package 1	$ 168.72	$ 1.00	$ 2.03	$ 1.03	$ 24.31	1 month	$ 1,068.19	6.96	14.41%	$ 243.10
Package 2	$ 1,328.28	$ 7.86	$ 12.70	$ 4.84	$ 152.43	8 months	$ 6,383.16	8.72	11.48%	$ 1,524.30
Package 3	$ 380.59	$ 2.26	$ 7.19	$ 4.93	$ 86.23	4 months	$ 4,036.53	4.42	22.66%	$ 862.25
Package 4	$ 331.93	$ 1.97	$ 9.01	$ 7.04	$ 108.11	5 months	$ 5,220.06	3.08	32.57%	$ 1,081.10
Package 5	$ 1,483.51	$ 8.78	$ 17.46	$ 8.68	$ 209.57	11 months	$ 9,164.07	7.08	14.13%	$ 2,095.68
Package 6	$ 1,491.49	$ 8.83	$ 19.48	$ 10.65	$ 233.80	1 year	$ 10,412.73	6.38	15.68%	$ 2,337.98
Package 7	$ 2,072.04	$ 12.26	$ 19.55	$ 7.29	$ 234.58	1 year	$ 9,795.98	8.84	11.32%	$ 2,345.83

It is assumed a 5 7/8% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Assumed an 80% efficient furnace
Paybacks calculated against packaged option1

Aspen 6%

	Additional Cost	Monthly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Package 1	$ 168.72	$ 1.01	$ 2.03	$ 1.02	$ 24.31	1 month	$ 1,111.61	6.96	14.41%	$ 243.10
Package 2	$ 1,328.28	$ 7.96	$ 12.70	$ 4.74	$ 152.43	8 months	$ 6,416.69	8.72	11.48%	$ 1,524.30
Package 3	$ 380.59	$ 2.28	$ 7.19	$ 4.91	$ 86.23	4 months	$ 4,126.36	4.42	22.66%	$ 862.25
Package 4	$ 331.93	$ 1.99	$ 9.01	$ 7.02	$ 108.11	5 months	$ 5,313.83	3.08	32.57%	$ 1,081.10
Package 5	$ 1,483.51	$ 8.89	$ 17.46	$ 8.57	$ 209.57	11 months	$ 9,090.64	7.08	14.13%	$ 2,095.68
Package 6	$ 1,491.49	$ 8.94	$ 19.48	$ 10.54	$ 233.80	1 year	$ 10,273.50	6.38	15.68%	$ 2,337.98
Package 7	$ 2,072.04	$ 12.42	$ 19.55	$ 7.13	$ 234.58	1 year	$ 9,642.98	8.84	11.32%	$ 2,345.83

It is assumed a 6% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Assumed an 80% efficient furnace
Paybacks calculated against packaged option1

Aspen 7%

	Additional Cost	Monthly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Package 1	$ 168.72	$ 1.12	$ 2.03	$ 0.91	$ 24.31	1 month	$ 1,506.75	6.96	14.41%	$ 243.10
Package 2	$ 1,328.28	$ 8.83	$ 12.70	$ 3.87	$ 152.43	8 months	$ 8,708.51	8.72	11.48%	$ 1,524.30
Package 3	$ 380.59	$ 2.53	$ 7.19	$ 4.66	$ 86.23	5 months	$ 5,546.63	4.42	22.66%	$ 862.25
Package 4	$ 331.93	$ 2.20	$ 9.01	$ 6.81	$ 108.11	6 months	$ 7,106.52	3.08	32.57%	$ 1,081.10
Package 5	$ 1,483.51	$ 9.87	$ 17.46	$ 7.59	$ 209.57	1 year	$ 12,261.24	7.08	14.13%	$ 2,095.68
Package 6	$ 1,491.49	$ 9.92	$ 19.48	$ 9.56	$ 233.80	1 year 1 month	$ 13,814.35	6.38	15.68%	$ 2,337.98
Package 7	$ 2,072.04	$ 13.78	$ 19.55	$ 5.77	$ 234.58	1 year 1 month	$ 13,058.58	8.84	11.32%	$ 2,345.83

It is assumed a 7% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Assumed an 80% efficient furnace
Paybacks calculated against packaged option1

Aspen 8%

	Additional Cost	Monthly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Package 1	$ 168.72	$ 1.24	$ 2.03	$ 0.79	$ 24.31	1 month	$ 2,010.43	6.96	14.41%	$ 243.10
Package 2	$ 1,328.28	$ 9.75	$ 12.70	$ 2.95	$ 152.43	9 months	$ 11,622.34	8.72	11.48%	$ 1,524.30
Package 3	$ 380.59	$ 2.79	$ 7.19	$ 4.40	$ 86.23	5 months	$ 7,329.58	4.42	22.66%	$ 862.25
Package 4	$ 331.93	$ 2.44	$ 9.01	$ 6.57	$ 108.11	7 months	$ 9,370.35	3.08	32.57%	$ 1,081.10
Package 5	$ 1,483.51	$ 10.89	$ 17.46	$ 6.57	$ 209.57	1 year 1 month	$ 16,243.94	7.08	14.13%	$ 2,095.68
Package 6	$ 1,491.49	$ 10.95	$ 19.48	$ 8.53	$ 233.80	1 year 2 month	$ 18,256.96	6.38	15.68%	$ 2,337.98
Package 7	$ 2,072.04	$ 15.21	$ 19.55	$ 4.34	$ 234.58	1 year 2 month	$ 17,386.87	8.84	11.32%	$ 2,345.83

It is assumed a 8% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Assumed an 80% efficient furnace
Paybacks calculated against packaged option1

Yukon

	Additional Cost	Montly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Package 1	$ 331.74	$ 1.96	$ 2.73	$ 2.73	$ 32.77	1 month	$ 1,322.16	10.25	9.88%	$ 327.65
Package 2	$ 1,928.01	$ 11.41	$ 24.65	$ 13.24	$ 295.77	1 year 3 months	$ 13,126.14	6.52	15.35%	$ 2,957.73
Package 3	$ 595.20	$ 3.53	$ 4.84	$ 1.31	$ 58.09	3 months	$ 2,335.48	10.31	9.76%	$ 580.93
Package 4	$ 541.03	$ 3.20	$ 7.91	$ 4.71	$ 94.89	5 months	$ 4,296.68	5.71	17.54%	$ 948.90
Package 5	$ 2,119.06	$ 12.54	$ 27.13	$ 14.59	$ 325.52	1 yr. 4 months	$ 14,449.92	6.44	15.36%	$ 3,255.15
Package 6	$ 2,137.30	$ 12.65	$ 29.84	$ 17.19	$ 358.03	1 yr. 6 months	$ 16,113.07	5.97	16.75%	$ 3,580.30
Package 7	$ 2,859.46	$ 16.92	$ 29.95	$ 13.03	$ 359.37	1 yr. 6months	$ 15,364.51	8.41	11.93%	$ 3,593.73

It is assumed a 5 7/8% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Assumed an 80% efficient furnace
Paybacks calculated against packaged option1

Yukon 6%

	Additional Cost	Montly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Package 1	$ 331.74	$ 1.99	$ 2.73	$ 0.74	$ 32.77	1 month	$ 1,372.11	10.25	9.88%	$ 327.65
Package 2	$ 1,928.01	$ 11.56	$ 24.65	$ 13.09	$ 295.77	1 year 3 months	$ 12,767.04	6.52	15.35%	$ 2,957.73
Package 3	$ 595.20	$ 3.56	$ 4.84	$ 1.28	$ 58.09	3 months	$ 2,399.58	10.31	9.76%	$ 580.93
Package 4	$ 541.03	$ 3.24	$ 7.91	$ 4.67	$ 94.89	5 months	$ 4,387.60	5.71	17.54%	$ 948.90
Package 5	$ 2,119.06	$ 12.70	$ 27.13	$ 14.43	$ 325.52	1 yr. 5 months	$ 13,955.67	6.44	15.36%	$ 3,255.15
Package 6	$ 2,137.30	$ 12.81	$ 29.84	$ 17.03	$ 358.03	1 yr. 6 months	$ 15,457.69	5.97	16.75%	$ 3,580.30
Package 7	$ 2,859.46	$ 17.14	$ 29.95	$ 12.81	$ 359.37	1 yr. 6months	$ 14,868.40	8.41	11.93%	$ 3,593.73

It is assumed a 6% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Assumed an 80% efficient furnace
Paybacks calculated against packaged option1

Yukon 7%

	Additional Cost	Montly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Package 1	$ 331.74	$ 2.20	$ 2.73	$ 0.53	$ 32.77	1 month	$ 1,872.45	10.25	9.88%	$ 327.65
Package 2	$ 1,928.01	$ 12.82	$ 24.65	$ 11.83	$ 295.77	1 year 4 months	$ 17,137.02	6.52	15.35%	$ 2,957.73
Package 3	$ 595.20	$ 3.96	$ 4.84	$ 0.88	$ 58.09	3 months	$ 3,290.98	10.31	9.76%	$ 580.93
Package 4	$ 541.03	$ 3.60	$ 7.91	$ 4.31	$ 94.89	5 months	$ 5,919.09	5.71	17.54%	$ 948.90
Package 5	$ 2,119.06	$ 14.09	$ 27.13	$ 13.04	$ 325.52	1 yr. 6 months	$ 18,717.62	6.44	15.36%	$ 3,255.15
Package 6	$ 2,137.30	$ 14.22	$ 29.84	$ 15.62	$ 358.03	1 yr. 8 months	$ 20,690.07	5.97	16.75%	$ 3,580.30
Package 7	$ 2,859.46	$ 19.02	$ 29.95	$ 10.93	$ 359.37	1 yr. 8 months	$ 19,764.91	8.41	11.93%	$ 3,593.73

It is assumed a 7% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Assumed an 80% efficient furnace
Paybacks calculated against packaged option1

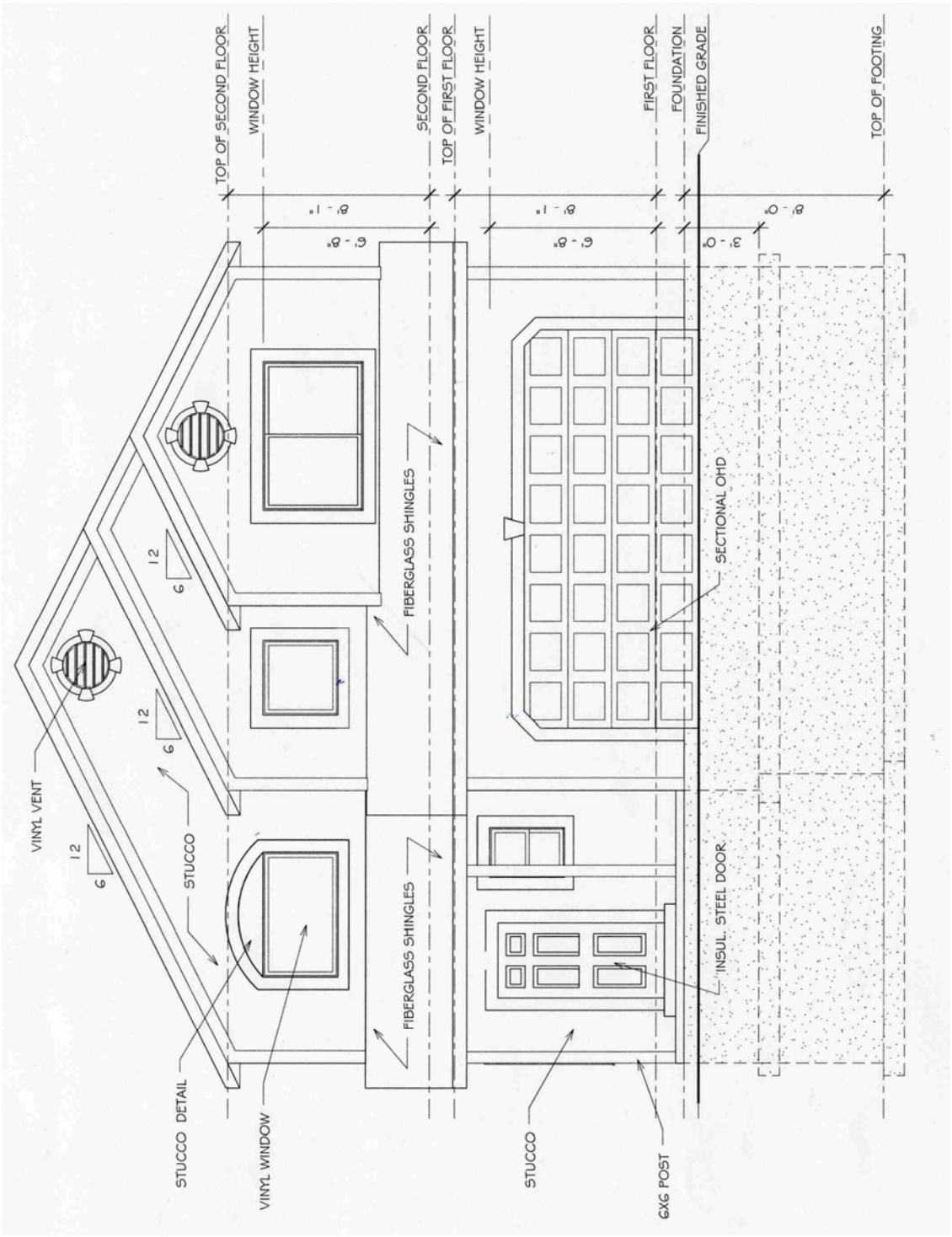
Yukon 8%

	Additional Cost	Montly Mortgage Increase	Monthly Savings	Monthly Cash Flow	Annual Savings	Invest Savings into Mortgage	Total Interest Saved	Payback in Years	Return On Investment	Increased Home Value
Baseline	$ -	$ -	$ -	$ -	$ -	-	$ -	-	0%	$ -
Package 1	$ 331.74	$ 2.44	$ 2.73	$ 0.29	$ 32.77	2 month	$ 2,478.93	10.25	9.88%	$ 327.65
Package 2	$ 1,928.01	$ 14.15	$ 24.65	$ 10.50	$ 295.77	1 year 6 months	$ 22,552.40	6.52	15.35%	$ 2,957.73
Package 3	$ 595.20	$ 4.37	$ 4.84	$ 0.47	$ 58.09	3 months	$ 4,375.78	10.31	9.76%	$ 580.93
Package 4	$ 541.03	$ 3.97	$ 7.91	$ 3.94	$ 94.89	6 months	$ 7,794.81	5.71	17.54%	$ 948.90
Package 5	$ 2,119.06	$ 15.55	$ 27.13	$ 11.58	$ 325.52	1 yr. 8 months	$ 24,610.49	6.44	15.36%	$ 3,255.15
Package 6	$ 2,137.30	$ 15.68	$ 29.84	$ 14.16	$ 358.03	1 yr. 10 months	$ 27,127.93	5.97	16.75%	$ 3,580.30
Package 7	$ 2,859.46	$ 20.98	$ 29.95	$ 8.97	$ 359.37	1 yr. 10 months	$ 26,054.14	8.41	11.93%	$ 3,593.73

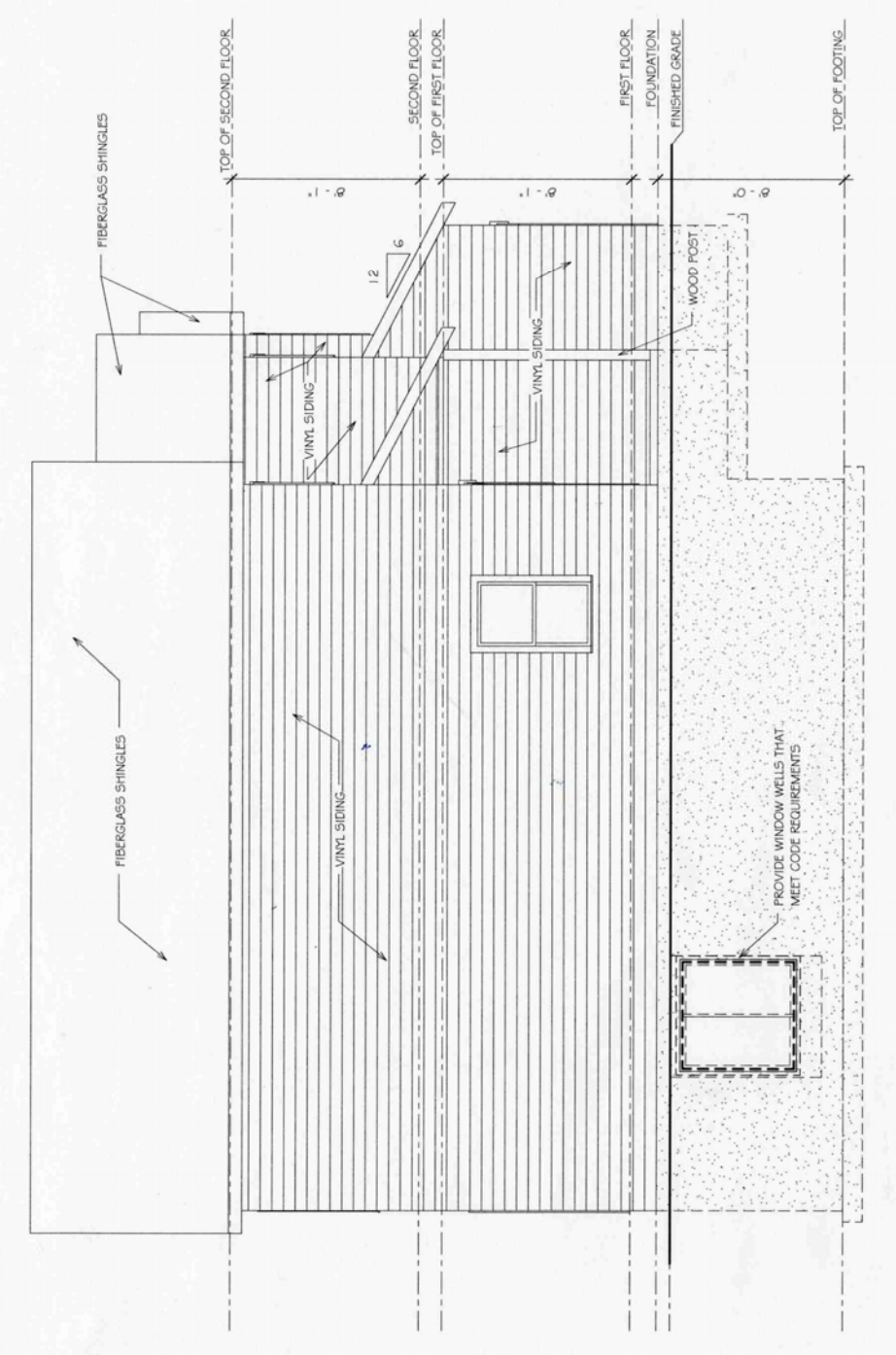
It is assumed a 8% fixed loan amortized over a 30 year period.
It is assumed that the utility costs stay constant for 30 years.
Assumed an 80% efficient furnace
Paybacks calculated against packaged option1

Appendix C

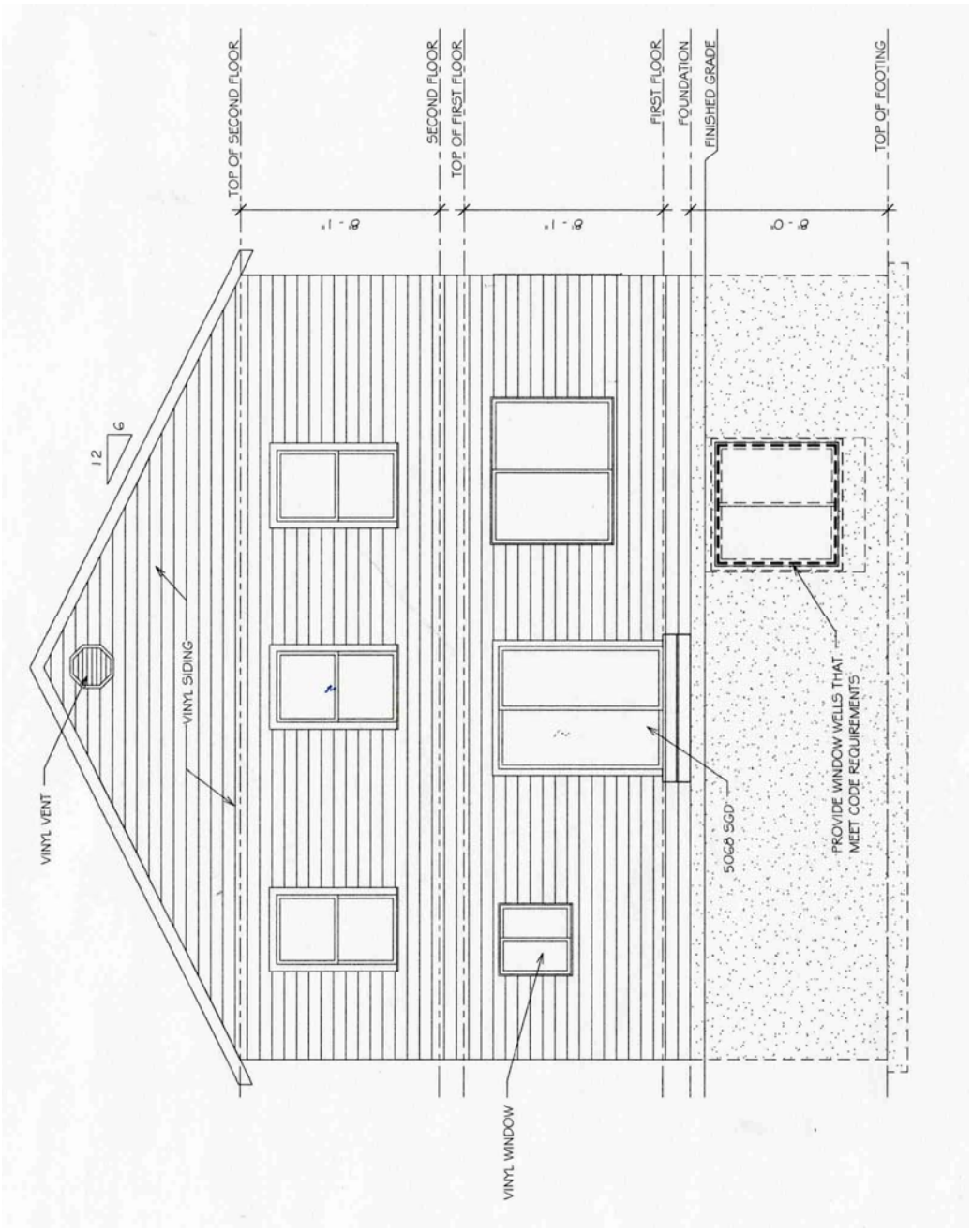
Appendix C contains the elevations and floor plans of the buildings used in the study.



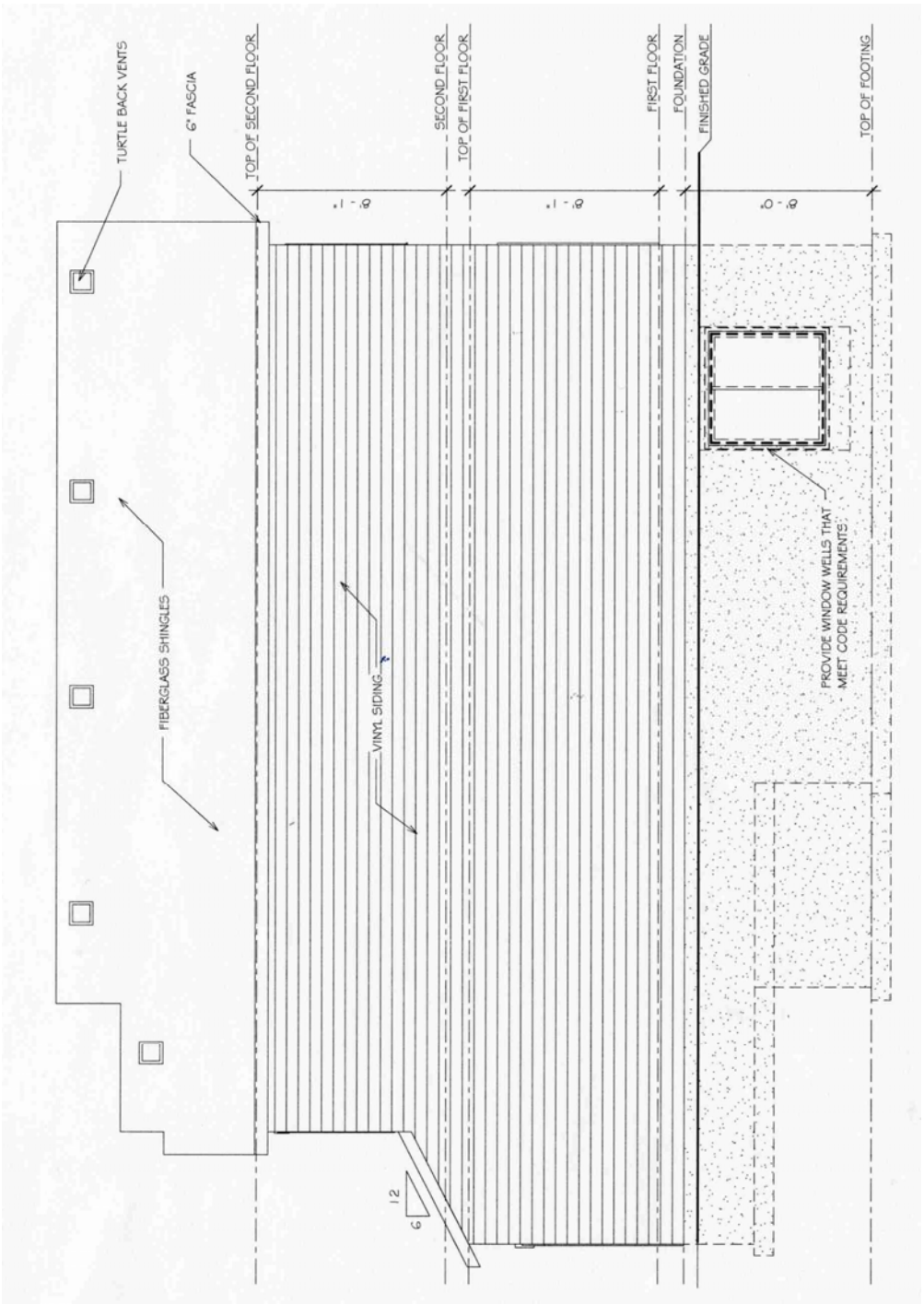
Adams Front Elevation



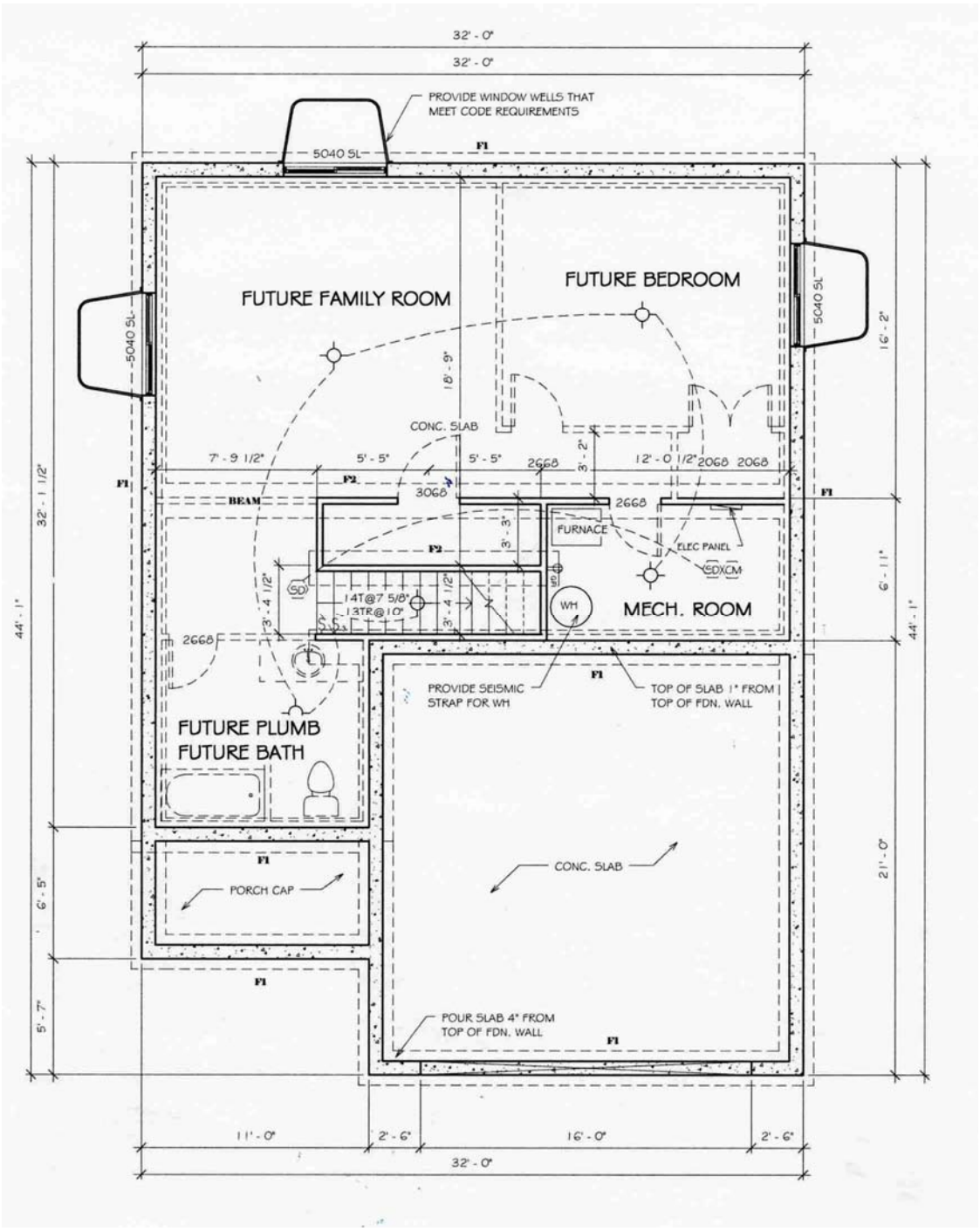
Adams Left Elevation



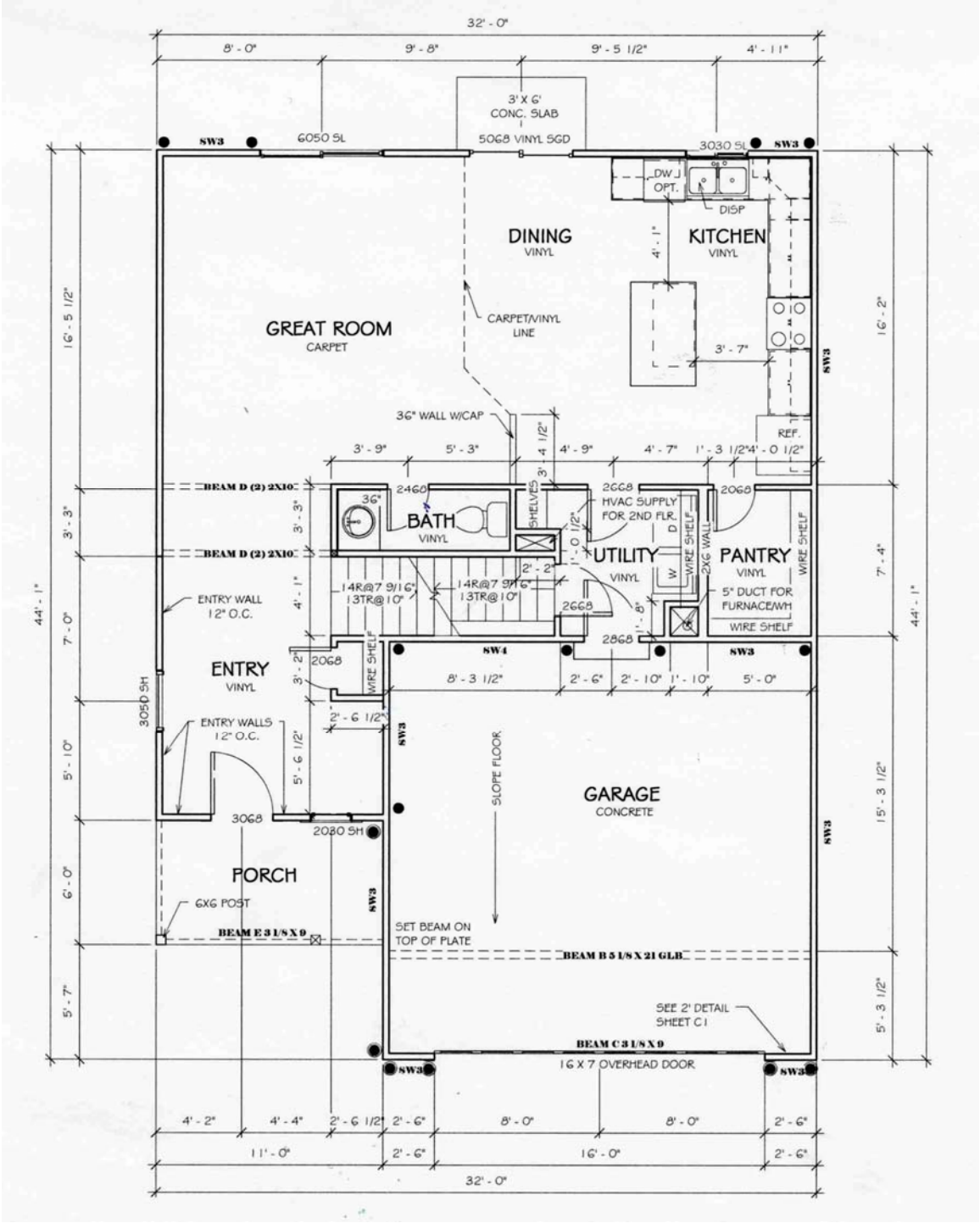
Adams Rear Elevation



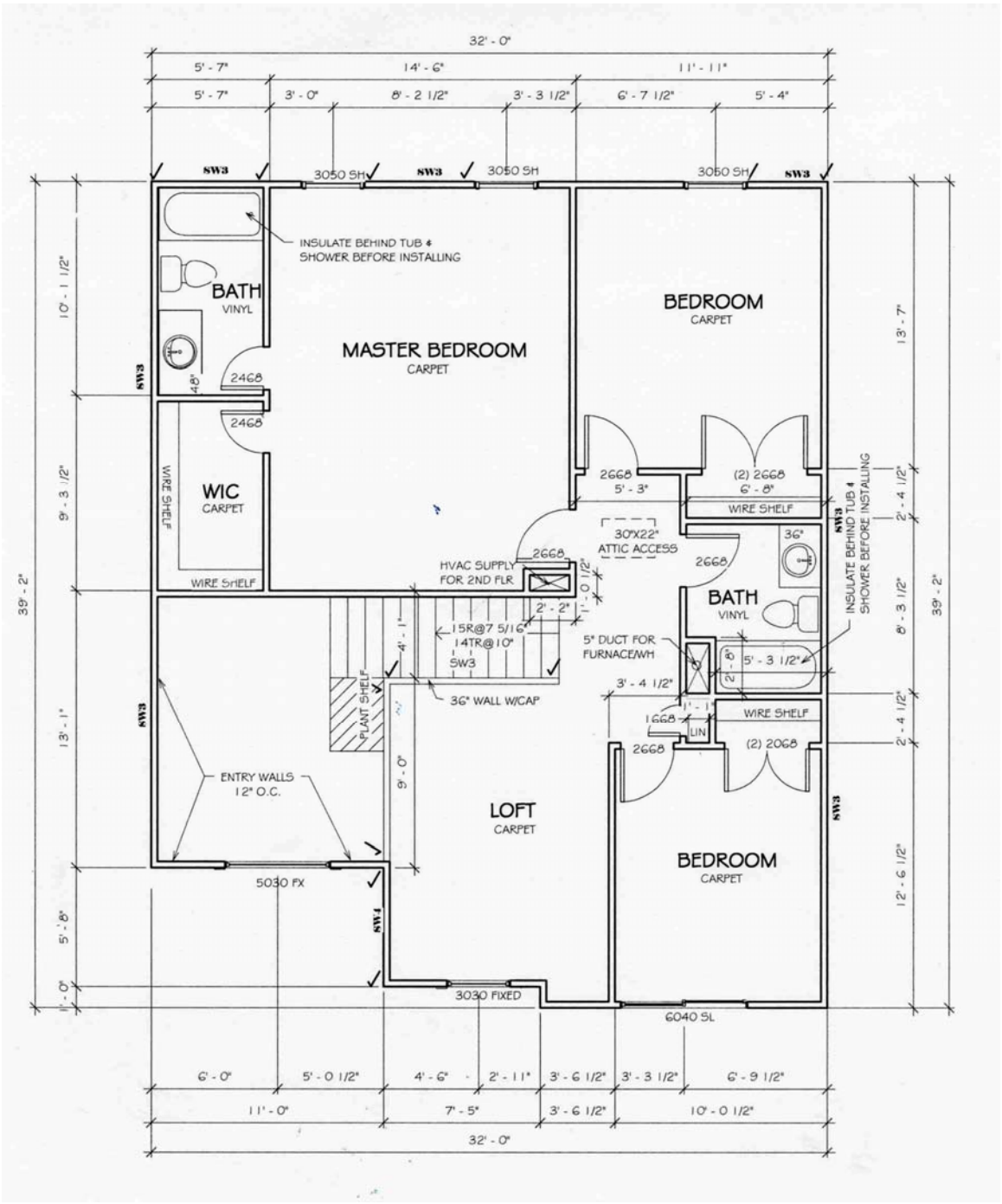
Adams Right Elevation



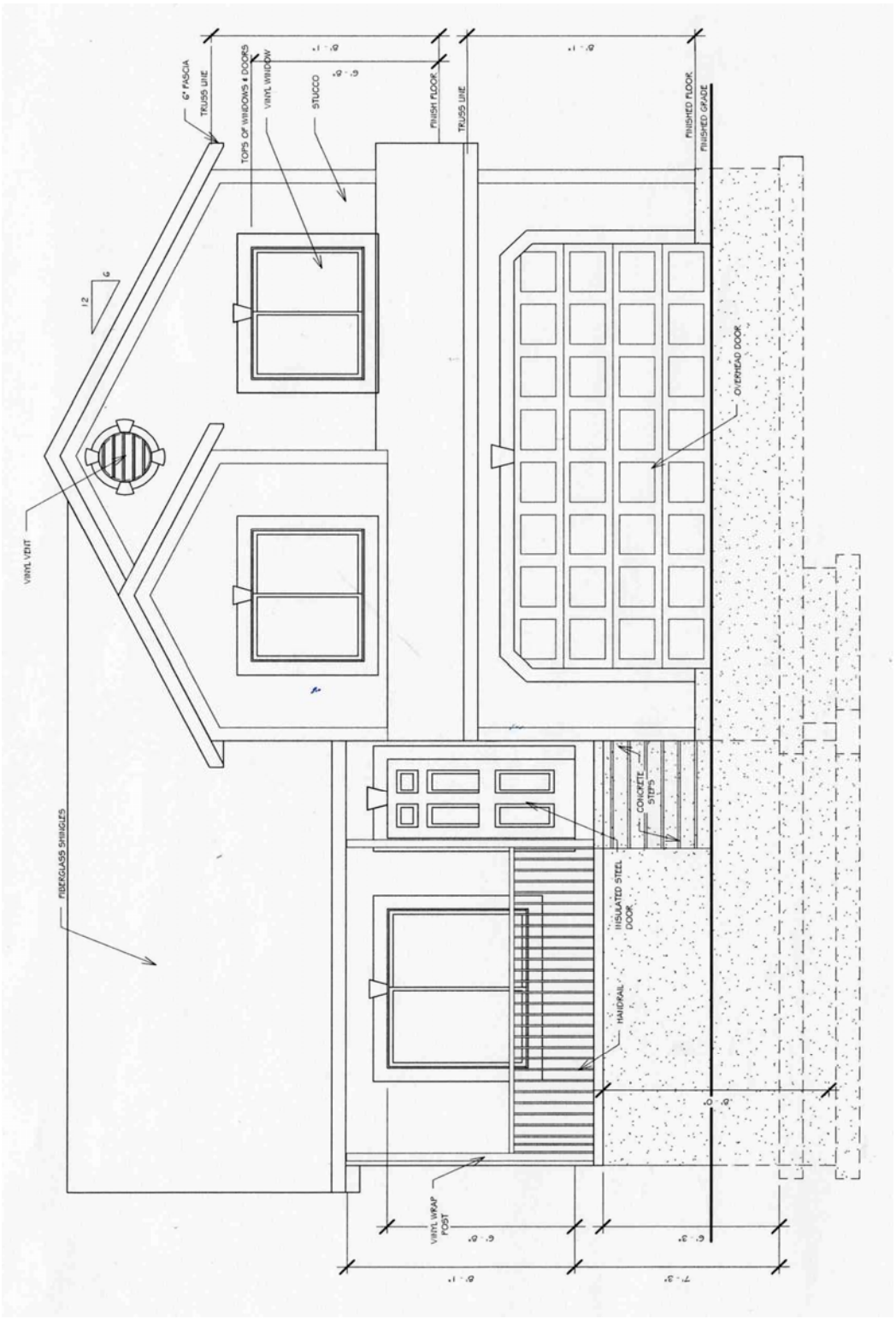
Adams Basement Floor Plan



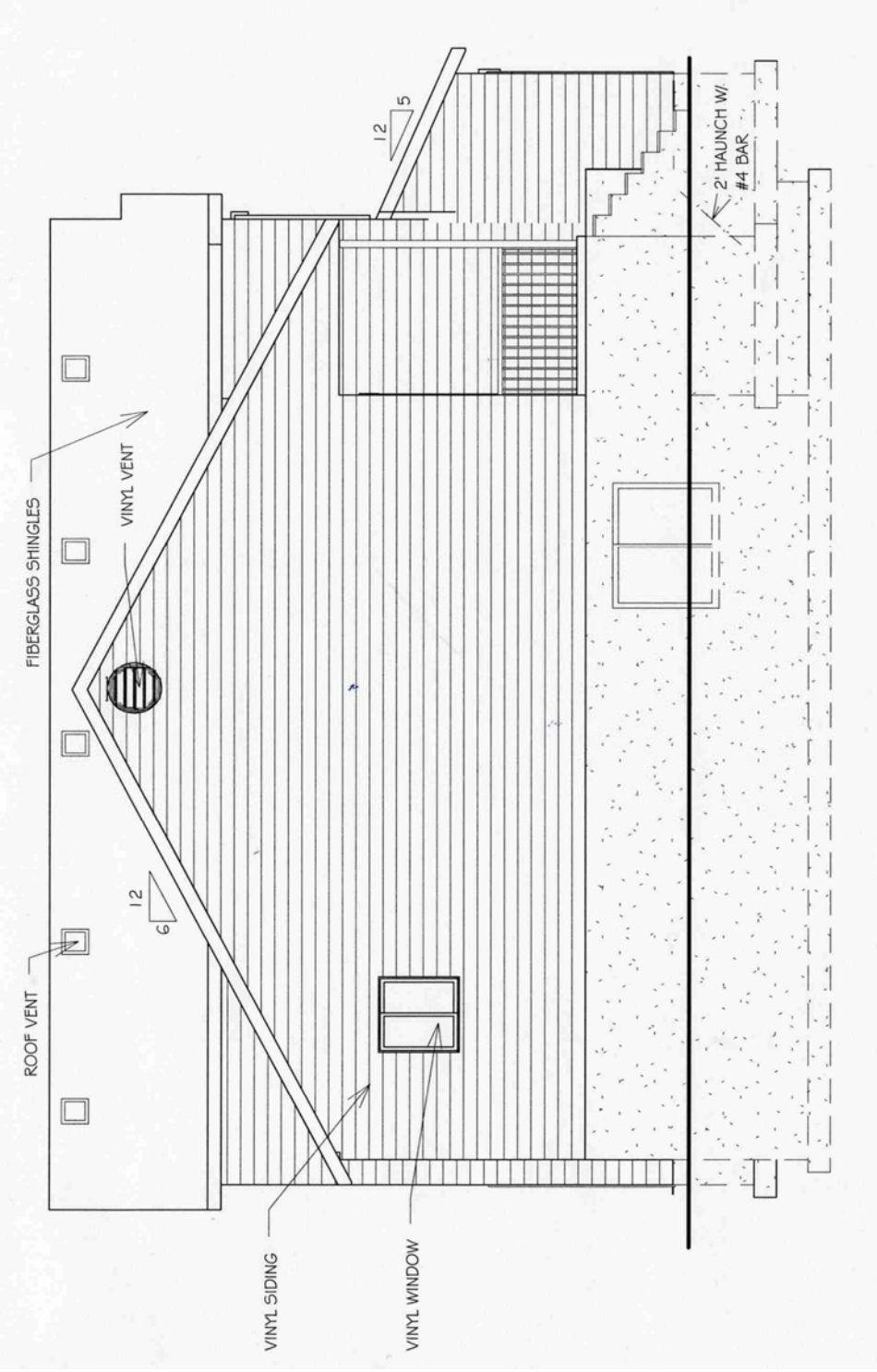
Adams Main Floor Plan



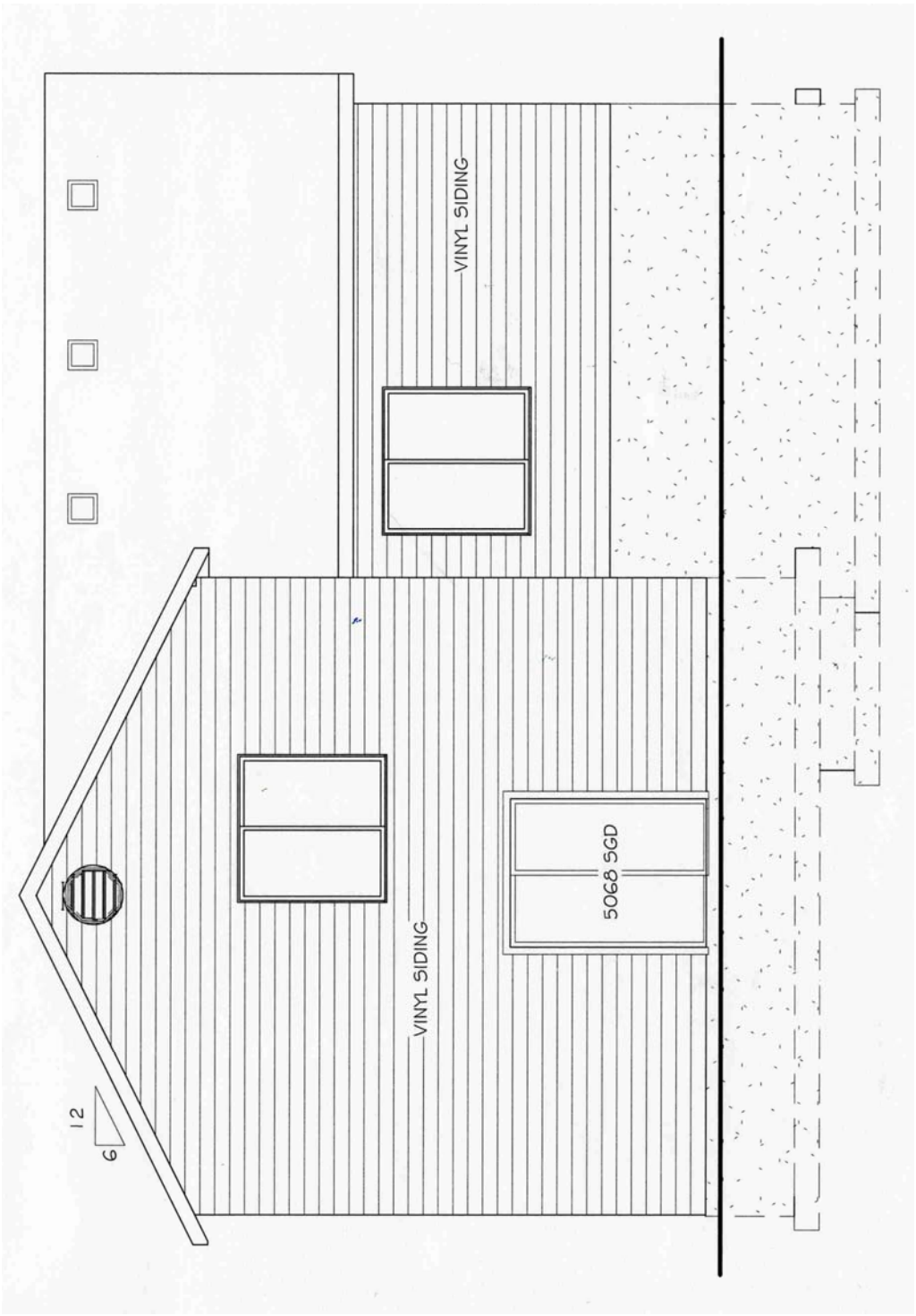
Adams 2nd Floor Plan



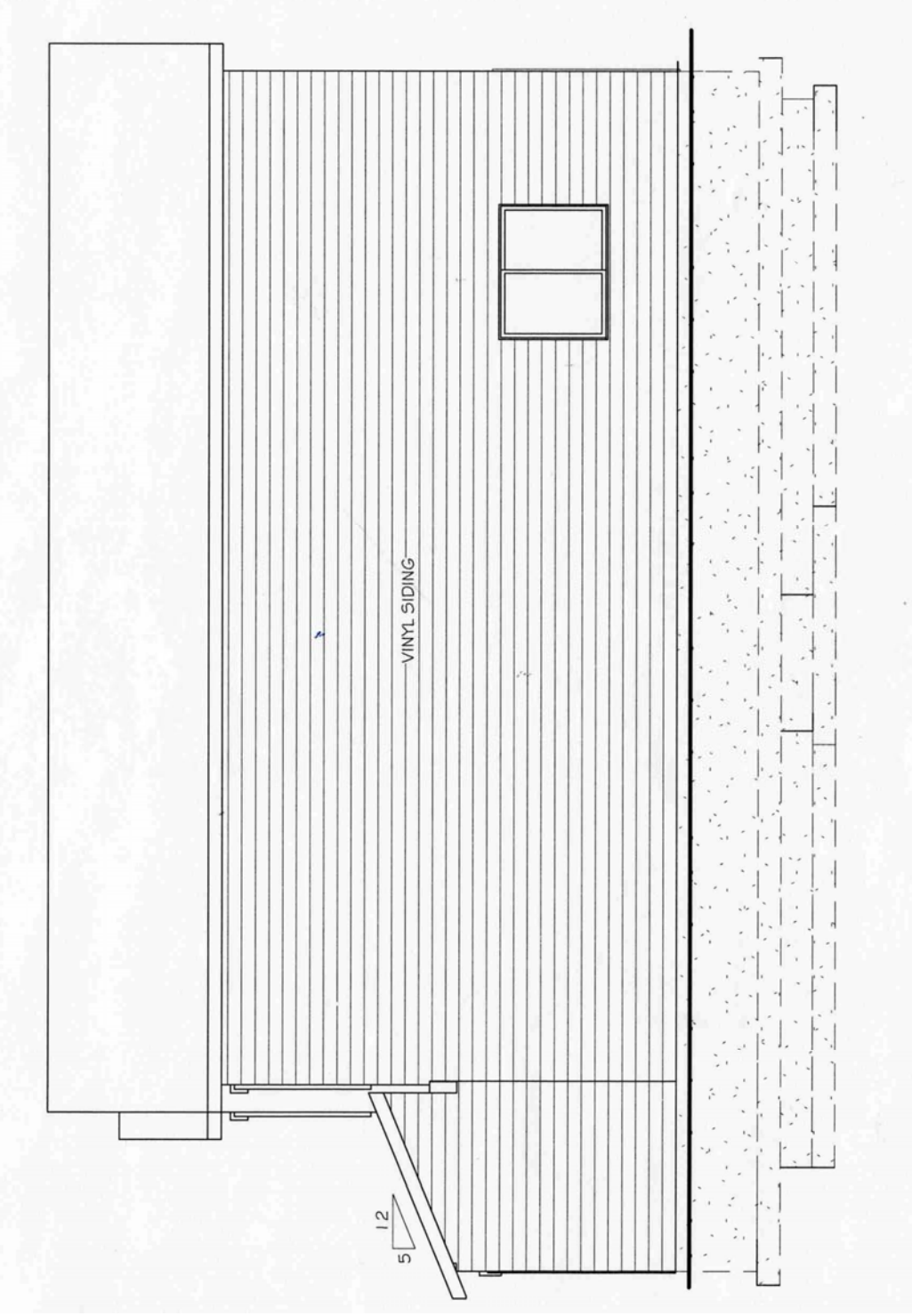
Aspen Front Elevation



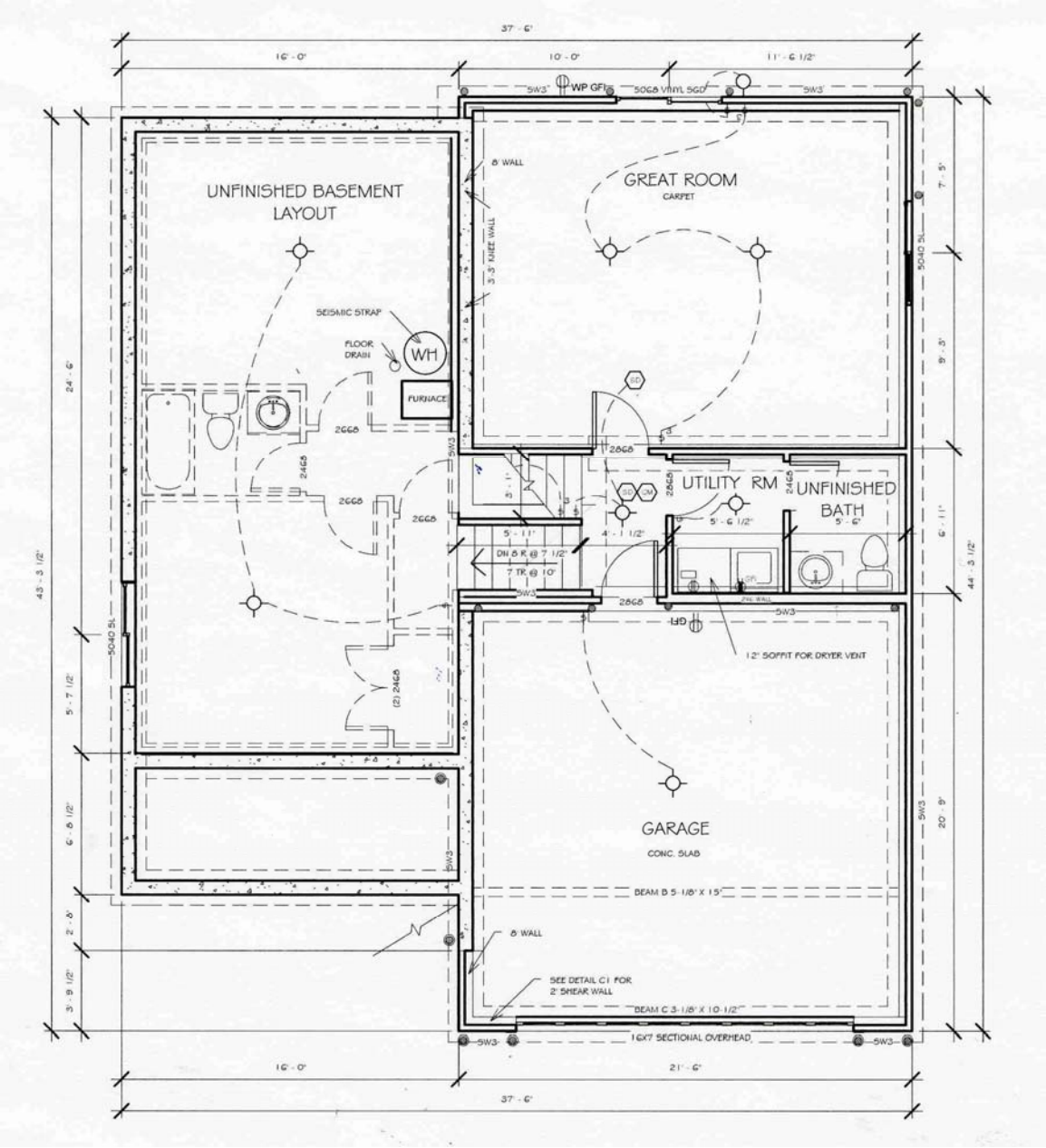
Aspen Left Elevation



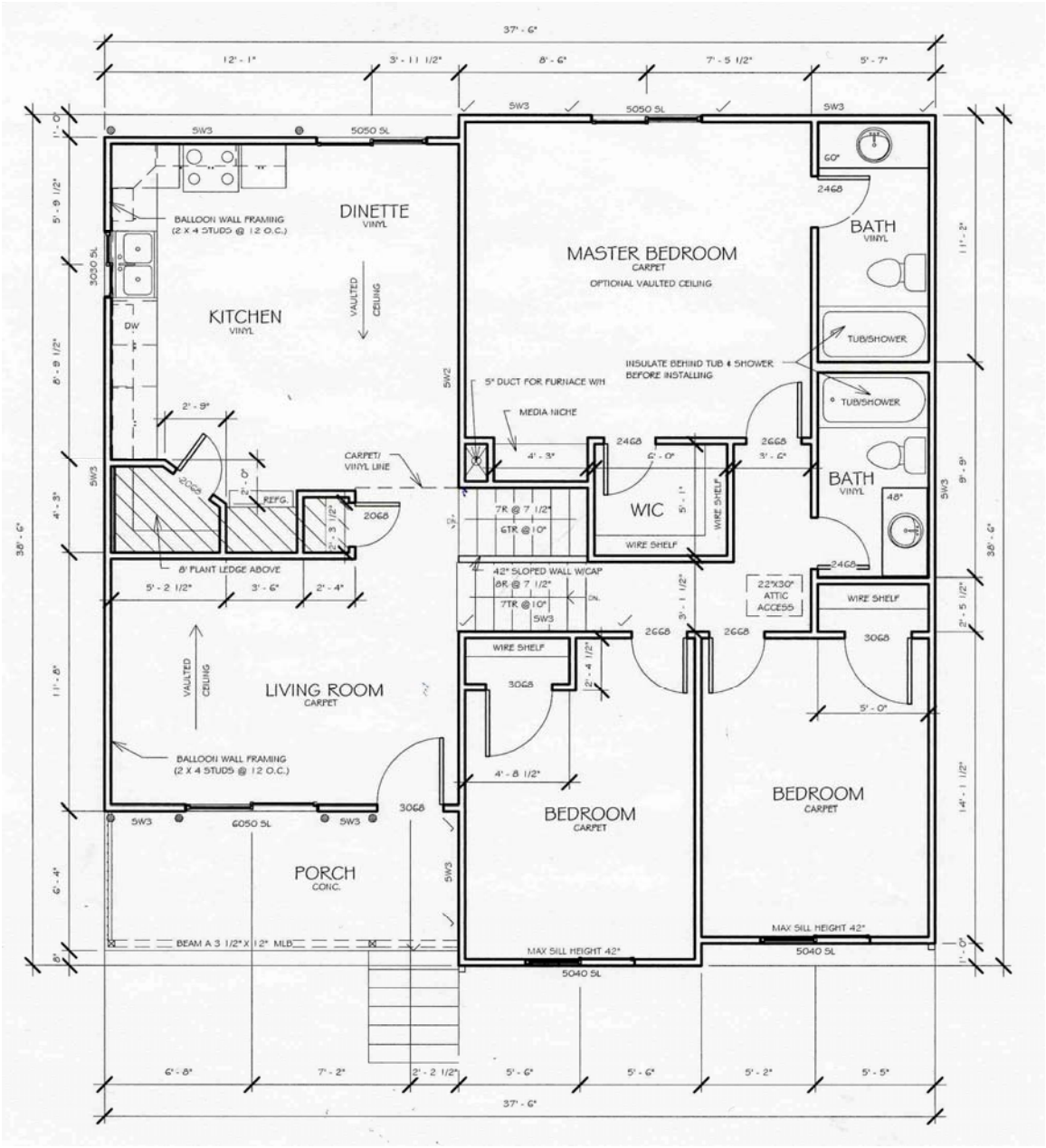
Aspen Rear Elevation



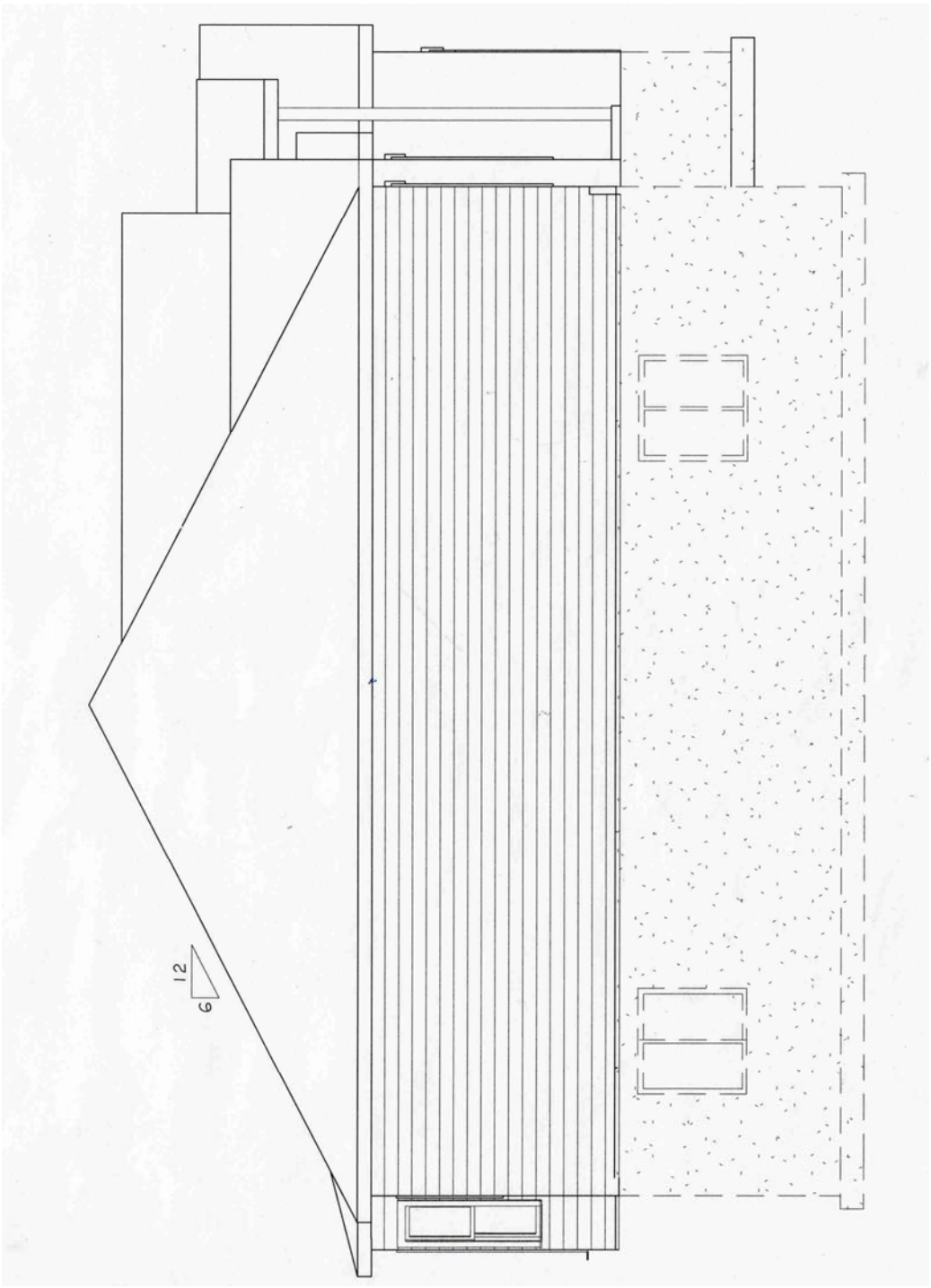
Aspen Right Elevation



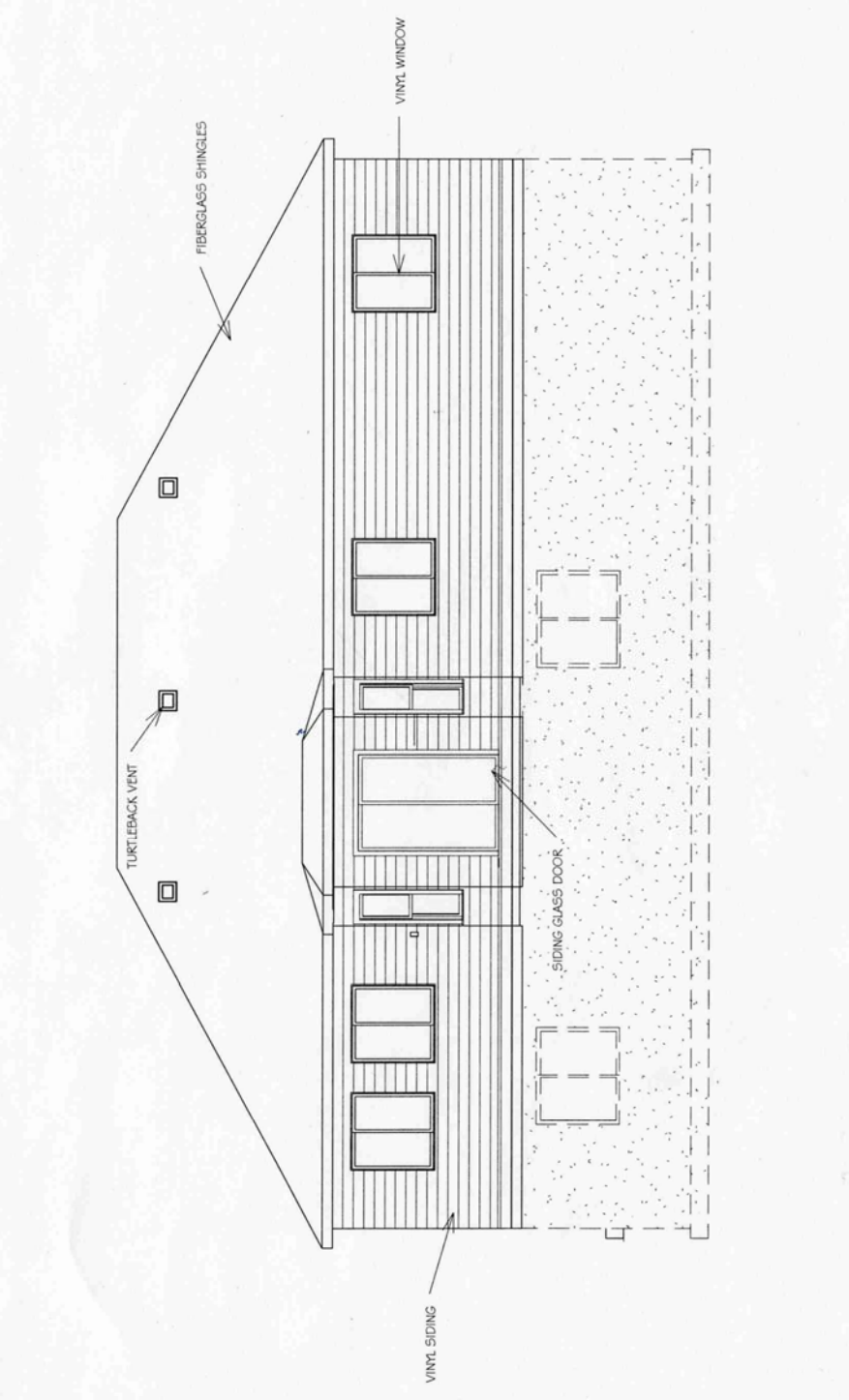
Aspen Basement Floor Plan



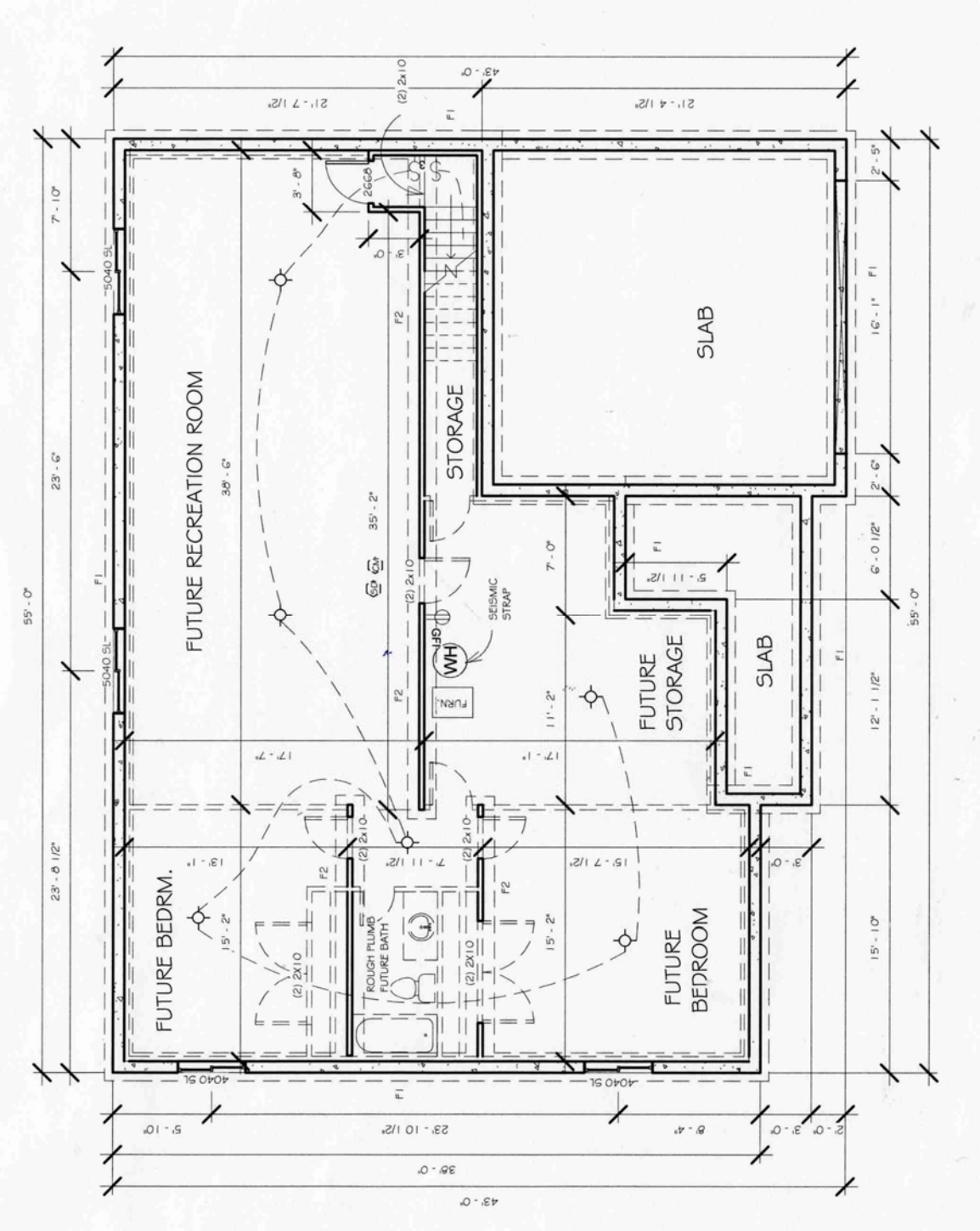
Aspen Main Floor Plan



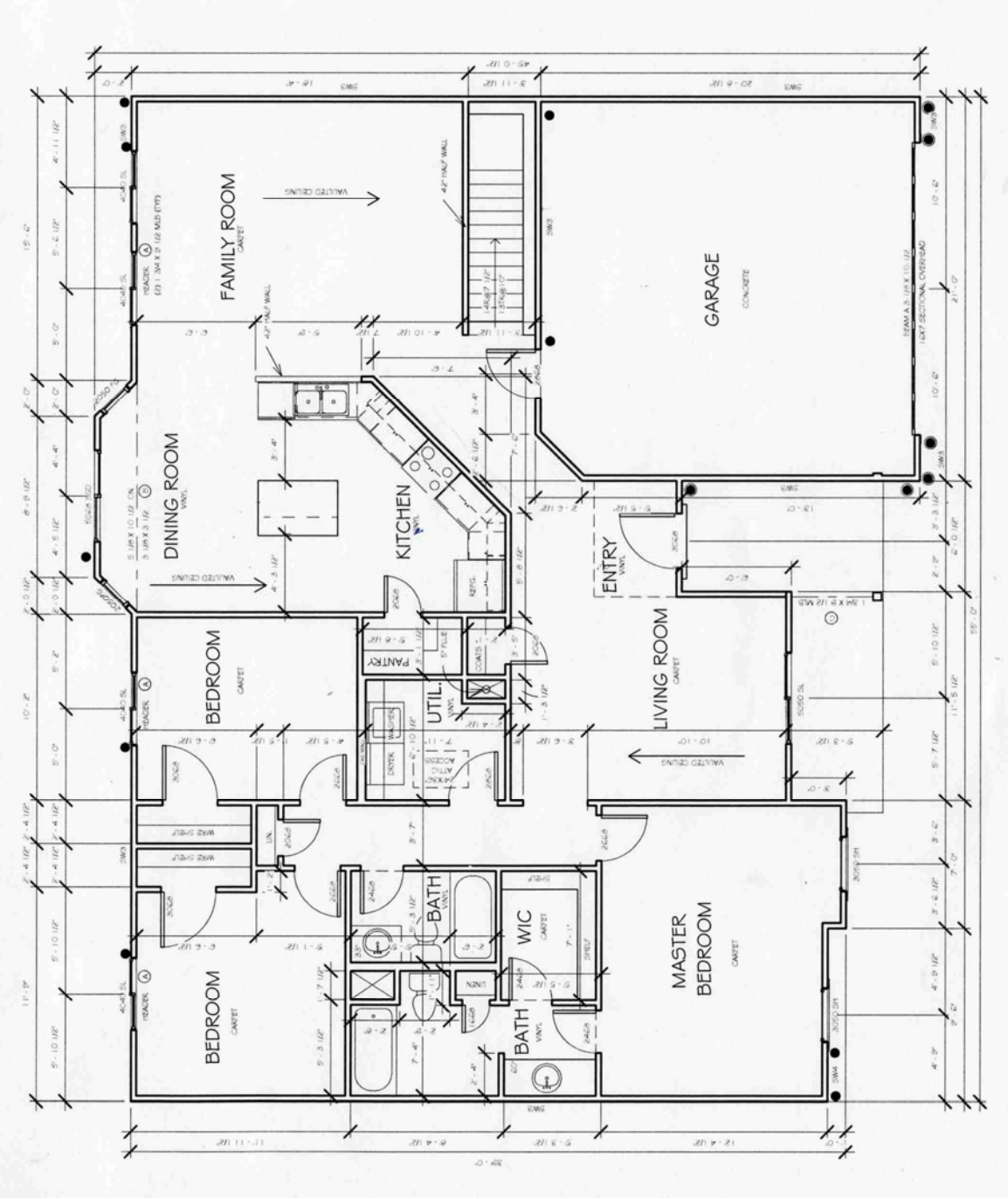
Yukon Left Elevation



Yukon Rear Elevation



Yukon Basement Floor Plan



Yukon Main Floor Plan

Appendix D

Appendix D is a compilation of the data from the study. Information was gathered from the survey in Appendix A.

	Previous Home Purchases	Home Size			How long will you live in the home				Importance of buying energy efficient					First choice								Second Choice								Reasons									
		less than 1000	1000-2000	2000+	less than 5 years	5 years	5-10 years	10 plus	Extremely	Very	Somewhat	Not Very	Not at All	B	1	2	3	4	5	6	7	B	1	2	3	4	5	6	7	Additional Cost	Mortgage Increase	Monthly Savings	Cash Flow	Annual Savings	Invest Savings	Interest Saved	Payback in years	Annual ROI	Increased Value
1	4		X					X	X												X							X					X					
2	1		X					X		X										X								X								X	X	X
3	0	X				X			X									X										X							X			X
4	0		X		X				X												X					X											X	
5	1			X		X				X											X							X		X									X
6	0		X			X			X								X								X													
7	0	X			X								X								X							X				X					X	
8	0		X			X				X											X							X							X			X
9	1			X		X					X										X							X								X	X	
10	0			X				X			X								X								X			X						X		
11	0			X			X				X				X													X			X	X						
12	0			X	X						X									X								X			X					X		X
13	0			X				X	X										X								X			X			X					X
14	0			X	X						X			X									X						X	X								
15	0			X		X					X							X					X															X
16	0		X					X		X								X									X		X							X		X
17	0		X			X				X				X												X			X							X		
18	0		X			X					X										X							X				X						X
19	0	X				X				X							X											X		X					X	X		
20	0		X		X					X								X										X							X	X		
21	0		X			X					X										X								X					X				
22	0		X			X				X								X										X				X					X	X
23	0		X				X				X							X										X							X	X		
24	0		X			X				X										X								X		X	X							
25	0		X				X			X						X												X			X	X						X
26	3		X			X			X												X						X								X				
27	0		X		X					X										X								X								X		X
28	0		X			X					X						X								X									X				
29	0		X			X				X									X									X						X				
30	0	X						X			X								X									X				X	X	X				
31	1			X				X			X						X							X								X					X	X
32	1			X			X			X							X									X					X	X						
33	0			X				X		X				X												X											X	X
34	0	X						X			X						X								X													
35	0			X			X			X											X							X		X							X	
36	1		X			X			X												X							X			X	X		X				
37	2			X	X					X								X										X				X			X			
38	0			X	X				X												X							X				X			X			
39	0		X			X				X								X										X						X	X			
40	1			X			X				X							X										X							X	X		
41	0		X		X						X										X							X	X	X	X	X	X	X	X	X		X
42	0		X			X					X							X								X			X	X	X	X	X	X	X	X	X	X
43	0	X				X				X						X					X							X			X	X	X			X		
44	0		X		X					X											X							X				X						X
45	0	X				X			X									X								X			X							X		
46	0		X					X		X								X							X					X					X			
47	0		X			X					X				X											X									X	X		
48	0		X			X				X										X								X								X	X	
49	0	X			X						X			X							X							X							X				
50	0	X					X			X									X								X				X	X						X

Survey Data

	Previous Home Purchases	Home Size			How long will you live in the home				Importance of buying energy efficient					First choice								Second Choice								Reasons									
		less than 1000	1000-2000	2000+	less than 5 years	5 years	5-10 years	10 plus	Extremely	Very	Somewhat	Not Very	Not at All	B	1	2	3	4	5	6	7	B	1	2	3	4	5	6	7	Additional Cost	Mortgage Increase	Monthly Savings	Cash Flow	Annual Savings	Invest Savings	Interest Saved	Payback in years	Annual ROI	Increased Value
51	0		X				X				X							X									X			X	X	X	X	X	X	X	X	X
52	0			X			X			X											X								X						X		X	X
53	0	X				X					X			X											X								X	X				
54	0		X					X		X											X								X				X		X	X	X	X
55	1			X	X					X						X													X								X	X
56	0		X			X					X										X								X				X				X	X
57	0		X					X		X										X								X			X	X		X		X		X
58	0		X					X		X											X								X			X	X					
59	0		X			X					X							X								X											X	
60	0		X				X			X										X								X			X	X	X					X
61	0		X					X		X								X							X										X	X		
62	1		X			X			X							X												X							X		X	
63	0			X				X		X											X								X				X						
64	0		X			X				X								X						X												X			
65	1		X			X				X											X								X					X			X		
66	0	X				X				X				X										X									X	X					
67	0		X		X						X										X								X	X	X	X	X	X	X	X	X	X	X
68	0		X					X	X										X								X								X			X
69	0		X			X					X										X								X									
70	0		X			X						X								X								X				X	X					X
71	0		X			X					X				X									X						X			X					X
72	0		X		X						X				X												X					X	X	X		X		
73	0		X			X				X										X								X				X	X					
74	0		X		X							X						X										X					X					X
75	1		X			X					X										X								X	X	X	X	X	X	X	X	X	X	X
76	0	X				X					X				X						X								X			X	X					X
77	1		X					X	X												X								X				X				X		
78	0		X					X		X											X								X			X	X				X	X	
79	3		X			X			X												X								X	X	X	X	X	X	X	X	X	X	X
80	0			X				X		X							X									X									X			X
81	0		X			X					X					X								X							X	X						
82	0		X				X				X							X								X				X	X	X	X	X	X	X	X	X	X
83	1			X	X						X										X							X					X				X		X
84	0		X			X					X							X								X				X					X		X	X	
85	0		X			X				X								X									X							X	X			X
86	2			X	X				X											X							X				X	X		X				
87	0		X					X			X										X							X			X	X	X						
88	1			X				X			X										X							X		X		X	X				X		X
89	2			X			X		X												X							X											
90	1			X	X						X										X			X												X	X	X
91	0		X			X				X								X								X						X					X	X
92	0		X					X		X											X								X					X			X		X
93	1			X				X	X												X								X		X	X	X			X			
94	0		X			X					X				X									X															
95	0			X		X				X											X								X		X	X	X			X			
96	0		X					X			X										X								X			X	X		X				X
97	0		X			X				X											X								X	X		X	X					X	
98	0		X					X		X											X								X		X	X	X						X
99	0		X					X	X												X						X			X									X
100	0			X				X		X											X							X		X								X	X

Survey Data Continued