

**Cost / Benefit Analysis: Updating the Michigan  
Uniform Energy Code (MUEC) for  
New Residential Building Construction in Michigan**

Patrick Hudson  
Michigan Bureau of Energy Systems

November 2009

## Summary

This report presents a cost/benefit analysis related to the adoption of the revised Michigan Uniform Energy Code (revised MUEC) for new residential home construction in Michigan. A public hearing to discuss the revised MUEC is expected to be held in Spring/Summer 2010.

In completing this cost/benefit analysis, the Michigan Bureau of Energy Systems has referenced Michigan Compiled Laws, Section 125.1502a, otherwise referred to as the “Stille-DeRossett-Hale Single State Construction Code Act”. More specifically, definitions from Section 2a (n) served as the guideline for this analysis.

- The perspective of a typical first-time home buyer
- Fuel price increases that do not exceed the assumed general rate of inflation
- The buyer of the home qualifying to purchase the home before the addition of the energy efficient standards would still qualify to purchase the same home after the additional cost of the energy-saving construction features
- Benefits and costs over a 7-year time period
- Costs of principal, interest, taxes, insurance, and utilities will not be greater after the inclusion of the proposed cost of the additional energy-saving construction features required by the proposed energy efficiency rules as opposed to the provisions of the existing energy efficiency rules

This report includes energy analysis information relevant to two types of homes in three different Michigan climate zones. The sample homes include: 1) a smaller sized ranch-style home representing a house likely to appeal to a first-time homebuyer, and 2) a standard sized two-story home likely to appeal to a variety of different homebuyers. Three different analyses were conducted for each sample home.

Analysis 1: Benefits and costs from increasing the energy efficiency of a home built to the current MUEC standards (MUEC 2003) compared to the revised standards (equivalent to 2009 IECC) in Zone 1 (southern lower peninsula).

Analysis 2: Benefits and costs from increasing the energy efficiency of a home built to the current MUEC standards (MUEC 2003) compared to the revised standards (equivalent to 2009 IECC) in Zone 2 (northern lower peninsula and portions of the upper peninsula). Analysis 2 reflects an inside foundation wall treatment for insulation.

Analysis 3: Benefits and costs from increasing the energy efficiency of a home built to the current MUEC standards (MUEC 2003) compared to the revised standards (equivalent to 2009 IECC) in Zone 3 (portions of the upper peninsula).

Home Energy Rating System (HERS) improvement analysis reports were used for this cost benefit document. HERS is a standardized system for rating the energy-efficiency of residential buildings. HERS is currently governed by two national industry standards: 1) the Mortgage Industry HERS Accreditation Procedures, and 2) the Residential Energy Services Network (RESNET) Training and Certifying Standards.

The HERS improvement analysis reports used in this cost benefit document were completed by a home energy rater certified by Energy Efficient Homes Midwest, a RESNET accredited home energy rating program. A total of four "Improvement Analysis Reports" were provided by the home energy rater [A) ranch-style home in Zone 1, B) two-story home in Zone 1, C) ranch-style home in Zone 2, D) two-story home in Zone 2. Improvement analysis reports were not provided for Zone 3 because the 2003 MUEC Zone 3 prescriptive requirements and proposed revised MUEC prescriptive requirements were essentially the same.

The home energy rater used REM/Rate Residential Energy Analysis and Rating Software for the reports. REM/Rate software allows raters to enter data that reflects all costs associated with energy efficiency-related construction improvements used in the home to achieve levels of energy performance that meet the current MUEC standards and the standards of the revised MUEC. In the analysis, the rater factored in current utility costs relevant to the locations of the sample houses.

By referencing two sample homes in all three of Michigan's climate zones as identified in the revised MUEC, this report represents homes that are constructed in a range of climate conditions that exist throughout Michigan.

The Michigan Bureau of Energy Systems took the "Improvement Analysis Reports" submitted by the home energy rater and completed the cost/benefit analysis by applying the criteria defined in the Stille-DeRossett-Hale Single State Construction Code Act. The "Improvement Analysis Reports" completed by the home energy rater and the worksheets completed by the Bureau of Energy Systems staff are included in this report as attachments.

**RESULTS:** The complete analysis of the two sample homes modeled in three climate zones indicate that for Zone 1, the average net benefit to a homeowner with a home built to meet the requirements of the revised MUEC is **\$461.50** within the first seven years. *(Zone 1 represents 88% of Michigan's population - 2008 U.S. Census Bureau estimates, <http://quickfacts.census.gov/qfd/states/26000.html>). For Zone 2, the net loss is **-\$4.50**. There is no net benefit or net loss in Zone 3 because the code requirements are the same. The table on page four of this document indicates the net benefit for each of the homes analyzed. *(The net benefit is determined by reducing energy costs by an amount that exceeds the construction-related cost increases.)**

Construction costs and energy savings will vary depending on many factors including location, energy prices, house size and characteristics, material costs, labor costs and the energy efficiency measures used to comply with the revised MUEC. This report referenced housing examples that effectively included the above-mentioned variables.

**CONCLUSION:** This cost / benefit analysis indicates that homes built to the revised energy code standards equivalent to 2009 IECC will provide financial savings to Michigan homeowners exceeding the construction related cost increases over a 7-year time period.

**Residential Energy Code Analysis  
Benefits & Costs During the First 7 Years**

House	<b>*Costs:</b> <i>(all costs proportionate to energy efficiency improvements)</i> down payment, mortgage, property taxes, home insurance, & private mortgage insurance	<b>**Savings:</b> energy savings, tax savings proportionate to the costs of energy efficient improvements, tax savings resulting from interest paid on energy efficient improvements	<b>Net Benefits:</b> during the first 7 years
<b>Zone 1</b>			
First Time, 1,100 sq. ft. - Lansing	79	536	457
Standard, 2,240 sq. ft. - Lansing	79	545	466
<b>Zone 2</b>			
First Time, 1,100 sq. ft. - Traverse City	168	164	-4
Standard, 2,240 sq. ft. - Traverse City	174	169	-5
<b>Zone 3</b>			
First Time, 1,100 sq. ft. - Houghton	0	0	0
Standard, 2,240 sq. ft. - Houghton	0	0	0

\* For Zone 1, the costs reflect increased fuel costs

\*\* For Zone 1, the savings are a result of reduced insulation costs, reduced home insurance costs, and reduced property taxes

## Attachments

### Cost / Benefit Analysis: Updating the Michigan Uniform Energy Code (MUEC) for New Residential Building Construction in Michigan November 2009

A	Assumptions and resources used in the analysis
B	Base information, assumptions and resources from Home Energy Rater
C-1	HERS Improvement Analysis Reports and Energy Office worksheets for a one-story 1,100 sq. ft. home in Zone 1 (Michigan's southern lower peninsula)
C-2	HERS Improvement Analysis Reports and Energy Office worksheets for a two-story 2,240 sq. ft. home in Zone 1 (Michigan's southern lower peninsula)
D-1	HERS Improvement Analysis Reports and Energy Office worksheets for a one-story 1,100 sq. ft. home in Zone 2 (Michigan's northern lower peninsula and portions of the upper peninsula)
D-2	HERS Improvement Analysis Reports and Energy Office worksheets for a two-story 2,240 sq. ft. home in Zone 2 (Michigan's northern lower peninsula and portions of the upper peninsula)
E	Building Component Table from the current 2003 MUEC
F	Building Component Table from the revised MUEC (table excerpt from 2009 IECC)

## Attachment A – Assumptions and Resources Used in the Analysis

### 1. Perspective of a typical first-time homebuyer.

The perspective of a first-time homebuyer was taken into account by having half the analyses done on a smaller sized house using assumptions reasonable for a first-time homebuyer, i.e. 10% down payment and 15% tax rate for federal income tax. The criteria in #4 below applies to the first time homebuyer as well (credit score eligibility for buyers and the ability to finance an energy efficient home compared to financing a home with minimal energy efficient features.)

Important information regarding first-time home buyers purchasing newly constructed homes: According to the U.S. Census Bureau American Housing Survey, first-time home buyers purchasing newly constructed homes represent 3.8% of homes purchased, with the remaining 96.2% representing purchases of existing homes. It is important to note that the qualification criteria for first-time home buyers as described in criteria #4 below (credit score eligibility) is applicable to approximately 3.8% of first-time home buyers.

According to MGIC, home buyers are currently required to have a credit score of 700 to be eligible for private mortgage insurance (PMI). PMI is mandatory for home buyers purchasing a home with a down payment less than 20%. Because of the required credit score of 700 to be eligible for PMI, it is likely that less than 3.8% of homes purchased in the future will be from first-time home buyers.

#### *Sources:*

◇ *First-time home buyer down payment - consultation with representatives from Independent Bank, Flagstar Bank, Tommie Raines Realty and the Michigan State Housing Development Authority*

◇ *First-time home buyer tax category – IRS tables.*

◇ *First-time home buyers purchasing newly constructed homes – U.S. Census Bureau American Housing Survey, <http://www.census.gov/prod/2008pubs/h150-07.pdf> pg. 158.*

◇ *Minimum credit score for Private Mortgage Insurance (PMI) for buyer with less than 20% down payment, MGIC [http://www.mgic.com/pdfs/71-42734uwsummary\\_oct09.pdf#standard\\_guidelines](http://www.mgic.com/pdfs/71-42734uwsummary_oct09.pdf#standard_guidelines)*

### 2. Benefits & costs over a seven-year time period.

The cost/benefit analysis worksheets indicate that the costs included down payment amount proportionate to the cost of improvements, mortgage costs representing the costs of improvements, increased property taxes proportionate to the costs of improvements, increased home insurance costs proportionate to the

## Attachment A – Assumptions and Resources Used in the Analysis

costs of improvement, and increased mortgage insurance costs proportionate to the costs of improvement.

The cost/benefit analysis worksheets indicate that the **benefits** included yearly energy savings, tax savings as a result of improvement dollars spent, and tax savings as a result of interest paid on the energy improvement investment.

In the case of Zone 1, the **costs** represent increased fuel costs, and the **benefits** represent reduced insulation costs, reduced home insurance costs, and reduced property taxes.

### Sources:

- ◇ Definition of benefits & costs over a seven-year time period - Michigan Compiled Laws, Section 125.1502a, otherwise referred to as the “Stille-DeRossett-Hale Single State Construction Code Act”
- ◇ Typical down payment for home purchaser - consultation with representatives from Independent Bank, Flagstar Bank, Tommie Raines Realty, Michigan State Housing Development Authority & Federal Housing Finance Board
- ◇ Cost of energy efficient improvements – Bureau of Construction Codes data as referenced by R.S. Means. R.S. Means includes builder mark-up with their cost figures.
- ◇ Mortgage interest rate – Independent Bank, Michigan State University Federal Credit Union, Wall Street Journal
- ◇ Mortgage costs – on-line mortgage calculator  
[http://mortgages.interest.com/content/calculators/mortgage\\_calculator.asp](http://mortgages.interest.com/content/calculators/mortgage_calculator.asp)
- ◇ Property taxes – Michigan Department of Treasury  
<https://treas-secure.state.mi.us/ptestimator/PTEstimator.asp>
- ◇ Home Insurance costs - A Michigan insurance agency was consulted to provide sample insurance rate figures. An average annual rate increase of \$3.30 per \$1,000 value was utilized for this analysis.
- ◇ Private Mortgage Insurance – Flagstar Bank, Mortgage Division and MGIC Mortgage Insurance Company: Rates vary according to the borrower’s credit score. Minimum credit score of 700.  
[http://www.mgic.com/pdfs/71-42734uwsummary\\_oct09.pdf#tier\\_one](http://www.mgic.com/pdfs/71-42734uwsummary_oct09.pdf#tier_one).  
The formula is:  $.62 \times \text{loan amount} / 12 = \text{PMI monthly rate}$ .  
[http://www.mgic.com/pdfs/71-6704\\_national\\_oct09.pdf](http://www.mgic.com/pdfs/71-6704_national_oct09.pdf)
- ◇ Energy Savings – Utility rates and utility service maps provided by the Michigan Public Service Commission:
  - Zones 1 & 2 gas rates, an average of Consumers Energy and Michigan Consolidated.
  - Zone 3 gas rate, average of Michigan Consolidated and Semco.
  - Zone 1 electric rate, average of Consumers Energy and Detroit Edison.
  - Zone 2 electric rate, Consumers Energy.
  - Zone 3 electric rate, average of cooperative utilities.

(Note: In areas where natural gas is not available and propane is used as an alternative heating fuel, a substantial increase to the savings to

## Attachment A – Assumptions and Resources Used in the Analysis

*investment ratio would be recognized. In this cost benefit analysis, however, propane fuel costs and the corresponding energy savings were not considered.)*

◇ Tax savings based on interest paid - Michigan Department of Treasury  
<https://treas-secure.state.mi.us/ptestimator/PTEstimator.asp>, IRS tables, on-line mortgage calculator  
[http://mortgages.interest.com/content/calculators/mortgage\\_calculator.asp](http://mortgages.interest.com/content/calculators/mortgage_calculator.asp)

### 3. Fuel price increases that do not exceed the assumed general rate of inflation.

The Board of Governors of the Federal Reserve System provides economic projections, including core inflation figures. According to their figures, core inflation was projected to be 2% in the next four years. In keeping with the specific legislative language “fuel price increases that do not exceed the assumed general rate of inflation”, we utilized this 2% core inflation projection figure for this cost/benefit analysis. The Federal Reserve Bank of Dallas provides an explanation for the Personal Consumption Expenditure (PCE) inflation rate that the Board of Governors of the Federal Reserve System reference.

*Source:*

◇ *The Board of Governors of the Federal Reserve System, Minutes of the Federal Open Market Committee*  
<http://www.federalreserve.gov/monetarypolicy/fomcminutes20090624ep.htm>  
◇ *The Federal Reserve Bank of Dallas* <http://dallasfed.org/data/pce/index.html>

### 4. The buyer of the home qualifying to purchase the home before the addition of the energy efficient standards would still qualify to purchase the same home after the additional cost of the energy-saving construction features.

Because most mortgages span over a period of time, typically 30 years, the costs of the energy efficiency improvements can also be addressed over a period of time. Consultation with mortgage lending professionals led to a reasonable assumption that the increased cost of energy efficient improvements would result in only a minimal increase in the monthly mortgage payments. This minimal increase in the monthly payment would typically not disqualify the purchaser from purchasing the home. The home buyer’s credit score determines if the home buyer qualifies for a mortgage. Mortgage lending professionals confirmed that an increase purchase price of \$2,500 translates to an approximate monthly mortgage payment of \$16.00. If the home buyer’s credit score indicated he/she qualified for the mortgage at a purchase price that *did not* include the energy efficient features, that credit score would typically qualify the home buyer to purchase the home that *did* include the energy efficient features. Additionally, the minimal increase in monthly payments would be more than off-set with the decrease in utility bills.

## Attachment A – Assumptions and Resources Used in the Analysis

### *Sources:*

◇ *Consultation with representatives from Independent Bank, Flagstar Bank, Tommie Raines Realty and the Michigan State Housing Development Authority*

### 5. Costs of principal, interest, taxes, insurance, and utilities.

- A. **Principal & Interest:** Mortgage lenders were consulted to provide the average mortgage interest rate of **5.25%**. For the first-time home examples, an average down payment figure of **10%** was used. Various loan programs offer a range of 0% to 3% down payment for low-income homebuyers; however, the 10% rate would be more typical for first-time home buyers. For the standard sized home example, an average down payment of **22.9%** was used. Data from the Federal Housing Finance Board determined this figure. A mortgage calculator was utilized to compute principal and interest costs for a typical 30-year mortgage.
- B. **Taxes: Property taxes paid** were considered proportionate to the costs of energy-saving construction features. Property tax millage rates were obtained from the Michigan Department of Treasury Property Tax Estimator. The reference city tax rate for Zone 1 was Lansing. The reference city tax rate for Zone 2 was Traverse City. The reference city tax rate for Zone 3 was Houghton. **Tax savings** on federal income taxes were also considered (tax deductions associated with the costs of energy-saving construction features, i.e. property taxes and mortgage interest payments). IRS tax tables were used to determine a tax rate of **15%** for a first-time homebuyer and a tax rate of **25%** for a more typical homebuyer.
- C. **Insurance:** A Michigan insurance agency was consulted to provide sample insurance rate figures. An average annual rate increase of **\$3.30 per \$1,000** value was utilized for this analysis.
- D. **Utilities:** Current utility rates were obtained from the Michigan Public Service Commission. Zones 1 & 2 gas rates, an average of Consumers Energy and Michigan Consolidated. Zone 3 gas rate, average of Michigan Consolidated and Semco. Zone 1 electric rate, average of Consumers Energy and Detroit Edison. Zone 2 electric rate, Consumers Energy. Zone 3 electric rate, average of cooperative utilities. These rates represent more than the majority of the residents in Michigan with the remaining residents subject to higher rates. Assumption #3 in this Attachment describes fuel price increases that do not exceed the assumed general rate of inflation.

### *Sources:*

*See sources listed for #2 "Benefits and Costs Over A Seven-Year Time Period"*

Attachment B – Base information, Assumptions, and Resources  
from Home Energy Rater



Home Energy Analysis Team  
Michigan H.E.A.T. LLC.  
7543 Fred W. Moore Hwy.  
Casco, MI 48064  
Phone/Fax (810) 329-0863  
[www.michiganheat.com](http://www.michiganheat.com)



November 16, 2009

Todd Cordill, NCARB  
Assistant Chief  
Plan Review Division  
Department of Labor and Economic Growth  
Bureau of Construction Codes and Fire Safety

RE: Current and Proposed Code Cost Benefit Analysis Report

Dear Todd,

Different building components and various construction practices were used to develop a cost benefit analysis to identify different requirements for existing and proposed building code changes. An 1100 sq. ft. Ranch, and a 2240 sq. ft. 2 Story home were used for the comparison report. REM/Rate, energy analysis software, was used in the development of an Improvement Analysis Report. The report provides a before and after snapshot of the subject buildings which provide a comparison of the buildings operating costs.

The details of the cost benefit analysis are as follows:

Lansing, MI was the location and weather site used for Zone 1

- Average cost for electricity was determined from fees charged by Consumers Energy Company and DTE Energy. The average cost determined for electricity in Zone 1 is .1249 kwh
- Average cost for natural gas was determined from fees charged by Consumers and Michigan Consolidated Gas Company. The average cost determined for natural gas in Zone 1 is .9737 ccf

Traverse City, MI was the location and weather site used for Zone 2.

- The cost for electricity was from fees charged by Consumers Energy Company. The average cost determined for electricity in Zone 2 is .1238 kwh
- Average cost for natural gas was determined from fees charged by Consumers Energy Company and Michigan Consolidated Gas Company. The average cost used for natural gas in Zone 2 is .9737 ccf

Houghton, MI was the location and weather site used for Zone 3.

- Average cost for electricity was determined from fees charged by all cooperatives in the Upper Peninsula. The average cost determined for electricity in Zone 3 is .1286 kwh
- Average cost for natural gas was determined from fees charged by SEMCO and Michigan Consolidated Gas Company. The average cost used for natural gas for in Zone 3 is .8923 ccf

## Attachment B – Base information, Assumptions, and Resources from Home Energy Rater

**Note:** In areas where Natural Gas is not available and Propane is used as an alternative to fossil fuel, a substantial increase to the Savings to Investment Ratio (SIR) would be recognized.

### Ceiling Insulation

#### Zone 1:

- The standards decrease from R-49 to R-38 for ceiling insulation. This change would see an additional utility cost savings per year of - 1100 sq. ft. = \$-11 and
- 2240 sq. ft. = \$-12. Please refer to Improvement Analysis Building File Name: Ranch Zone 1 and 2 Story Zone 1

#### Zone 2 & Zone 3:

- There is not any change in the R-value of the ceiling insulation required, it will remain at R-49

### Foundation walls (FW)

#### Zone 1:

- There will not be any changes for the exterior foundation walls, both codes require using R-10.
- Interior walls using cavity insulation will be required to increase the efficiency from R-11 to R-13. Most materials commonly used will meet the R-13 code requirement, however, it is my understanding that the fiberglass industry has phased out the R-11 batts and has replaced it with a R-13 product. This change would not cause a price increase for the standards required.

#### Zone 2:

- Foundation walls that were insulated with R-10 will be required to increase the efficiency to R-15. This change would see an additional utility cost savings per year of - 1100 sq. ft. = \$27 / 2240 sq. ft. = \$27. Please refer to Improvement Analysis Report Building File Name: Ranch Zone 2 -A and 2 Story Zone 2 - A
- Interior walls using cavity insulation will be required to increase the efficiency from R-11 to R-19. This change would see an additional utility cost savings per year of - 1100 sq. ft. = \$20 / 2240 sq. ft. = \$20. Please refer to Improvement Analysis Report Building File Name: Ranch Zone 2 - B and 2 Story Zone 2 - B

#### Zone 3:

- There will not be any changes required for exterior or interior foundation wall applications. It will remain at R-15 for continuous exterior walls and R-15 for the cavity interior walls.

## Attachment B – Base information, Assumptions, and Resources from Home Energy Rater

### Above Grade Walls (AGW)

#### Zone 1 & Zone 2:

- The standards decrease from R-21 to R-20 in above grade walls. Most materials commonly used will meet the R-20 or R-21 code requirement, however, it is my understanding that the fiberglass industry has phased out the R-19 batts and has replaced it with a R-20 or R-21 product. This change would not cause a price increase for the standards required.

#### Zone 3:

- There will not be any changes required for above grade walls, it will remain at R-21.

**Note:** This value required for above grade walls can be achieved by using a combination of continuous insulation and or cavity insulation.

### Window U-values

- There would not be any changes for the U-value of the window; this is consistent for all 3 zones. It will remain at a U-value of .35

**Note:** In the proposed code, the builder has a trade off option for ceiling insulation. This can be achieved by using energy heel trusses. This option allows the builder to reduce the ceiling insulation in Zone 1 to R-30, and Zones 2 & 3 to R-38. The use of this trade off option would be a decision by the builder. A cost benefit analysis for this change was not considered for the report.

### Mechanical Duct Leakage

The proposed code recommends that all ductwork be installed in the conditioned area of the building. Any air handler and ductwork that is installed in an unconditioned area would require a duct leakage test to determine total duct leakage or duct leakage to the outside. Either of the 2 options would be a decision by the builder. A cost benefit analysis for this improvement was not considered for the report.

### Building Envelope Air Leakage Control

There are two options to demonstrate compliance for all 3 Zones.

- Whole house pressure test at post or mid construction
- Thermal envelope check list to be completed by a building official

Because of the additional cost required to obtain a whole house pressure test, more likely than not, the builder will depend on the code official to meet compliance for this requirement. A cost benefit analysis for this improvement was not considered for the report.

**Attachment B – Base information, Assumptions, and Resources  
from Home Energy Rater**

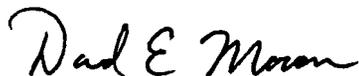
There will be a significant change regarding lighting for the proposed code. A minimum of 50% of the lamps, in permanently installed lighting fixtures, shall be high-efficacy. This limit is based on a count of lamps, not fixtures. Using Compact Fluorescent Lamps (CFL's) will fulfill the proposed requirement. This change, more likely than not, will be the responsibility of the homeowner to provide the lamps to the builder, as it is currently practiced. The increased cost of CFL's compared to incandescent bulbs is not very significant, and the energy saving would be reasonably significant. It is expected that a federal mandate will be implemented between the years 2012 to 2014, restricting the use of incandescent lamps. Because of these two conditions, a cost benefit analysis for the 50% lamp high-efficacy requirement was not considered for the report.

There will also be a noteworthy change with the proposed code regarding zone numbers. New zone numbers will be identified from a national map, unlike what is currently used. Michigan will still have 3 zones, which are very similar to the boundaries that are currently used. Zone 1 will be replaced with Zone 5, Zone 2 will be replaced with Zone 6, and Zone 3 will be replaced with Zones 6 & 7. The national map splits the Upper Peninsula (UP) with Zones 6 & 7. Zone 7 will include the east and west side of the UP, and Zone 6 will be the middle section of the UP. With this change in the UP, some of the energy efficient building components currently used will be less stringent than what is currently practiced. On the national map, county lines will be used to identify zone boundaries.

**Misc. notes:** With the proposed code, there is a lack of significant building component changes along with the inability to use a furnace AFUE as a trade off to meet code. This doesn't allow as many options for a builder to use the performance path for compliance. With that said, third party intervention may be less likely than it is today. This in turn may reduce the amount of work that HERS Raters, and other Energy efficient Professionals, will receive. Also, it will be the responsibility of the code official to be the enforcement officer for energy efficient construction. This will require the code official to become more educated regarding building science principals and practices.

Please call me direct for any questions 810.334.3871.

Sincerely,



David E. Moran - HERS Rater, LEED AP  
Managing Member  
Home Energy Analysis Team  
Direct: 810.334.3871

# Cost/Benefit Analysis Worksheet Nov. 09'

"C-1"

Location	Zone 1
House Type	Ranch, First Time
Analysis Type	Prescriptive

## SAVINGS

<i>Decreased property taxes proportionate to insulation savings:</i>					
Insulation Savings	X	Taxable Value	X	Milleage Rate X 7 Years	
451		0.5		0.04712 X 7	\$ 74.38

<i>Decreased home insurance costs proportionate to insulation savings:</i>					
Insulation Savings	X	Insurance Rate	X	7 Years	
451		0.0033		7	\$ 10.42

**TOTAL SAVINGS** (Includes \$451 in insulation savings) \$ 535.80

## COSTS

<i>Energy Costs</i>	
<i>Annual fuel price increase calculated at 2%</i>	
Year 1	\$ (12.00)
Year 2	\$ (11.76)
Year 3	\$ (11.52)
Year 4	\$ (11.29)
Year 5	\$ (11.07)
Year 6	\$ (10.85)
Year 7	\$ (10.63)

**TOTAL ENERGY COSTS** \$ (79.12)

**NET BENEFITS FOR FIRST SEVEN YEARS** \$ 456.67

## IMPROVEMENT ANALYSIS REPORT

Date: November 19, 2009

Rating No.:

Building Name: RANCH - ZONE 1

Rating Org.: HOME ENERGY ANALYSIS TEAM

Owner's Name: HOMEOWNER

Phone No.: 810.329.0863

Property:

Rater's Name: DAVID E. MORAN

Address: LANSING, MI 48901

Rater's No.: 1014

Builder's Name:

Weather Site: Lansing, MI

Rating Type: Efficiency Options

File Name: RANCH - ZONE 1 - 2009.big

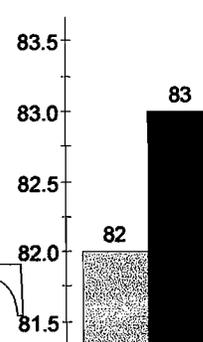
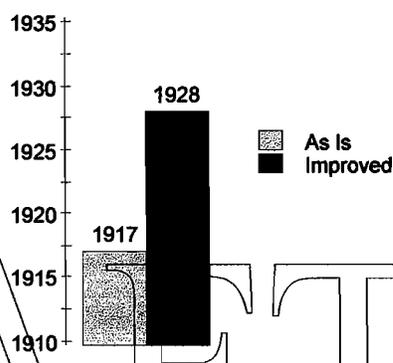
Rating Date: 11/12/09

**Energy Costs (\$/yr)**

**Total Costs (\$/yr)**

**HERS Index**

End-Use	As Is	With All Improvements	Savings
Heating	654	665	-11
Cooling	60	60	-0
Hot Water	187	187	0
Lights and Appliances	910	910	0
Photovoltaics	-0	-0	0
Service Charge	108	108	0
<b>TOTAL</b>	<b>1919</b>	<b>1930</b>	<b>-12</b>

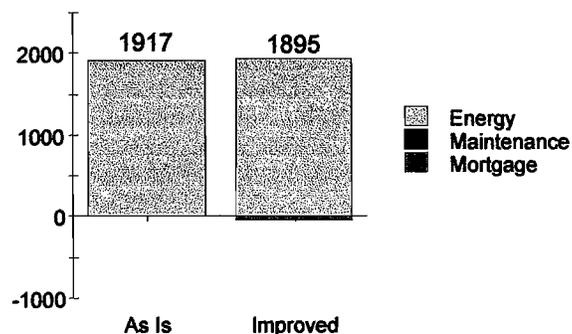


DRAFT

**Information For Lenders and Appraisers**

Installed Cost of Improvements (\$)	-451
Cost Weighted Life of Measure (Years)	30
Mortgage Term (Years)	30
Discount/Mortgage Rate (%)	6.000
Present Value Factor	13.8
Expected Annual Energy Savings (\$)	-12
Expected Annual Maintenance Costs (\$)	0
Expected Annual Savings (\$)	-12
Increased Annual Mortgage Costs (\$)	-33
Present Value of Savings (\$)	-159
Expected Annual Cash Flow (\$)	21

**Cost Comparison (\$/yr)**



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## IMPROVEMENT ANALYSIS REPORT

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RANCH - ZONE 1

Page 2

### Recommended Improvements

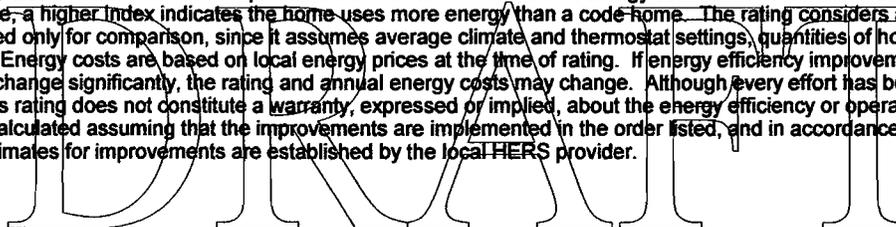
Component	Life	Cost	Yr Savings	SIR	PV	SP	Index
<b>1. Ceiling 1: FLAT</b>	30	-451	-12	0.0	292	99999.90	83
Existing: R-49 ATTIC GRADE #3							
Proposed: R-38 ATTIC GRADE #3							
Measure: REDUCE INSUL R-VALUE 1100 SQ. FT.							

### Criteria

Ranking Criteria: SIR	Maximum \$ Limit: No Limit
Cutoff: 0	Measures: Interactive

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The home's energy efficiency is rated using the HERS Index as defined in the RESNET "Mortgage Industry National Home Energy Rating Systems Accreditation Standards," 2006. An Index of 100 represents a home that meets current energy codes. A lower Index indicates the home uses less energy than a code home, a higher Index indicates the home uses more energy than a code home. The rating considers all energy use in the home. The rating should be used only for comparison, since it assumes average climate and thermostat settings, quantities of hot water, and internal loads for a typical household. Energy costs are based on local energy prices at the time of rating. If energy efficiency improvements are made to the home, or energy prices change significantly, the rating and annual energy costs may change. Although every effort has been made to provide accurate information, this rating does not constitute a warranty, expressed or implied, about the energy efficiency or operating costs of the house. Estimated savings are calculated assuming that the improvements are implemented in the order listed, and in accordance with all local codes and standards. The cost estimates for improvements are established by the local HERS provider.



**General House Specifications  
Ranch Zone 1**

<b>SQ FT of HOME</b>	1100	<b>Number of BEDROOMS</b>	3	<b>Construction Style</b>	RANCH
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**Improvement Specifications**

DESIGN ELEMENT/sq ft	DESCRIPTION 2003 MUEC	DESCRIPTION Revised MUEC (equivalent of 2009 IECC)	NOTES	MATERIALS COST OF IMPROVMENT	SOURCE OF INFORMATION	LABOR COST OF IMPROVEMENT
<i>WINDOWS</i>	U =.35	U =.35	No change			
<i>ABOVE GRADE WALL INSULATION</i>	R-21 Grade III *	R-21 Grade III *	No Change or R-13 with R- 5 exterior sheathing			
<i>BASEMENT INSULATION INTERIOR WALL</i>	R-11 Interior Grade III *	R-13 Interior Grade III *	Minor change **			
<i>ATTIC INSULATION</i>	R-49 Grade III *	R-38 Grade III *	Reduction in requirement from R-49 to R-38	-451.00	R.S. Means	Included

\*A grading system is used to evaluate the installation of the material, grade I being the best.

\*\* Please refer to the summary report for an explanation regarding the small increase to the R-value of the insulation.

Cost/Benefit Analysis Worksheet Nov. 09'

"C-2"

Location	Zone 1
House Type	Two-Story, Standard
Analysis Type	Prescriptive

**SAVINGS**

<i>Decreased property taxes proportionate to insulation savings:</i>							
Insulation Savings	X	Taxable Value	X	Milleage Rate	X	7 Years	
459		0.5		0.04712		7	\$ 75.70

<i>Decreased home insurance costs proportionate to insulation savings:</i>					
Insulation Savings	X	Insurance Rate	X	7 Years	
459		0.0033		7	\$ 10.60

**TOTAL SAVINGS** (Includes \$459 in insulation savings) \$ 545.30

**COSTS**

<i>Energy Costs</i>	
<i>Annual fuel price increase calculated at 2%</i>	
Year 1	\$ (12.00)
Year 2	\$ (11.76)
Year 3	\$ (11.52)
Year 4	\$ (11.29)
Year 5	\$ (11.07)
Year 6	\$ (10.85)
Year 7	\$ (10.63)

(79.12)

**TOTAL ENERGY COSTS** \$ (79.12)

**NET BENEFITS FOR FIRST SEVEN YEARS** \$ 466.18

## IMPROVEMENT ANALYSIS REPORT

Date: November 19, 2009

Rating No.:

Building Name: 2 STORY - ZONE 1

Rating Org.: HOME ENERGY ANALYSIS TEAM

Owner's Name: HOMEOWNER

Phone No.: 810.329.0863

Property:

Rater's Name: DAVID E. MORAN

Address: LANSING, MI 48901

Rater's No.: 1014

Builder's Name:

Weather Site: Lansing, MI

Rating Type: Efficiency Options

File Name: 2 STORY - ZONE 1 -2009.blg

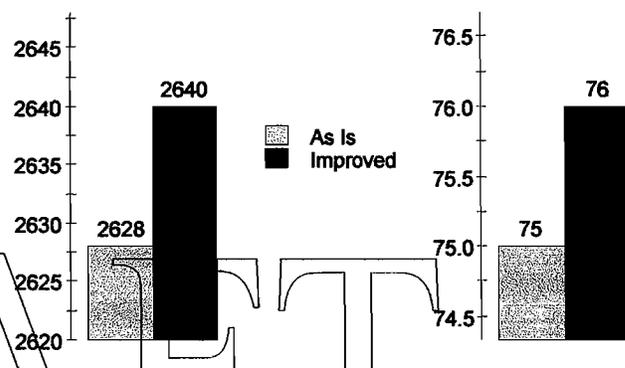
Rating Date: 11/12/09

### Energy Costs (\$/yr)

### Total Costs (\$/yr)

### HERS Index

End-Use	As Is	With All Improvements	Savings
Heating	947	958	-12
Cooling	102	102	-0
Hot Water	215	215	0
Lights and Appliances	1259	1259	0
Photovoltaics	-0	-0	0
Service Charge	108	108	0
<b>TOTAL</b>	<b>2630</b>	<b>2642</b>	<b>-12</b>

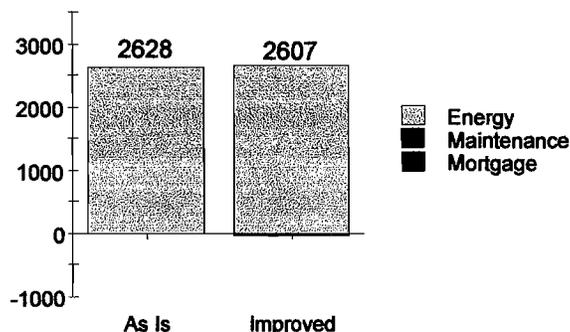


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**Information For Lenders and Appraisers**

Installed Cost of Improvements (\$)	-459
Cost Weighted Life of Measure (Years)	30
Mortgage Term (Years)	30
Discount/Mortgage Rate (%)	6.000
Present Value Factor	13.8
Expected Annual Energy Savings (\$)	-12
Expected Annual Maintenance Costs (\$)	0
Expected Annual Savings (\$)	-12
Increased Annual Mortgage Costs (\$)	-33
Present Value of Savings (\$)	-161
Expected Annual Cash Flow (\$)	22

### Cost Comparison (\$/yr)



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IMPROVEMENT ANALYSIS REPORT

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**Recommended Improvements**

Component	Life	Cost	Yr Savings	SIR	PV	SP	Index
<b>1. Ceiling 1: FLAT</b>	30	-459	-12	0.0	298	99999.90	76
Existing: R-49 ATTIC GRADE #3							
Proposed: R-38 ATTIC GRADE #3							
Measure: REDUCE INSUL R-VALUE 1120 SQ. FT.							

**Criteria**

Ranking Criteria: SIR	Maximum \$ Limit: No Limit
Cutoff: 0	Measures: Interactive

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The home's energy efficiency is rated using the HERS Index as defined in the RESNET "Mortgage Industry National Home Energy Rating Systems Accreditation Standards," 2006. An Index of 100 represents a home that meets current energy codes. A lower Index indicates the home uses less energy than a code home, a higher Index indicates the home uses more energy than a code home. The rating considers all energy use in the home. The rating should be used only for comparison, since it assumes average climate and thermostat settings, quantities of hot water, and internal loads for a typical household. Energy costs are based on local energy prices at the time of rating. If energy efficiency improvements are made to the home, or energy prices change significantly, the rating and annual energy costs may change. Although every effort has been made to provide accurate information, this rating does not constitute a warranty, expressed or implied, about the energy efficiency or operating costs of the house. Estimated savings are calculated assuming that the improvements are implemented in the order listed, and in accordance with all local codes and standards. The cost estimates for improvements are established by the local HERS provider.



**General House Specifications  
2 Story Zone 1**

<b>SQ FT of HOME</b>	2240	<b>Number of BEDROOMS</b>	3	<b>Construction Style</b>	2 Story
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**Improvement Specifications**

DESIGN ELEMENT/sq ft	DESCRIPTION 2003 MUEC	DESCRIPTION Revised MUEC (equivalent of 2009 IECC)	NOTES	MATERIALS COST OF IMPROVMENT	SOURCE OF INFORMATION	LABOR COST OF IMPROVEMENT
<i>WINDOWS</i>	U =.35	U =.35	No change			
<i>ABOVE GRADE WALL INSULATION</i>	R-21 Grade III *	R-21 Grade III *	No Change or R-13 with R- 5 exterior sheathing			
<i>BASEMENT INSULATION INTERIOR WALL</i>	R-11 Interior Grade III *	R-13 Interior Grade III *	Minor change **			
<i>ATTIC INSULATION</i>	R-49 Grade III *	R-38 Grade III *	Reduction in requirement from R-49 to R-38	-459.00	R.S. Means	Included

\*A grading system is used to evaluate the installation of the material, grade I being the best.

\*\* Please refer to the summary report for an explanation regarding the small increase to the R-value of the insulation.

# Cost/Benefit Analysis Worksheet Nov. 09'

"D-1"

Location	Zone 2
House Type	Ranch, First-Time
Analysis Type	Prescriptive

## COSTS

<i>Down payment amount proportionate to cost of improvements:</i>				
Cost of Improvements	X	Downpayment %		
237	X	0.1		\$ 23.70

<i>Mortgage costs representing cost of improvements (as provided by a mortgage calculator):</i>				
Mortgage Paid in 7 Years @ 5.25%				
99.12				\$ 99.12

<i>Increased property taxes proportionate to cost of improvements:</i>							
Cost of Improvements	X	Taxable Value	X	Milleage Rate	X	7 Years	
237		0.5		0.03599		7	\$ 29.85

<i>Increased home insurance costs proportionate to cost of improvements:</i>					
Cost of Improvements	X	Insurance Rate	X	7 Years	
237		0.0033		7	\$ 5.47

<i>Increased mortgage insurance costs proportionate to cost of improvements:</i>							
Cost of Improvements	X	Insurance Rate	/	12 Months	X	84 Months	
237		0.0062		12		84	\$ 10.29

**TOTAL COSTS** \$ 168.43

## SAVINGS

<i>Energy Savings</i>	
<i>Annual fuel price increase calculated at 2%</i>	
Year 1	\$ 20.00
Year 2	\$ 20.40
Year 3	\$ 20.81
Year 4	\$ 21.22
Year 5	\$ 21.65
Year 6	\$ 22.08
Year 7	\$ 22.52

<i>Tax Savings</i>									
<i>Tax savings as a result of improvement dollars spent:</i>									
Cost of Improvements	X	Taxable Value	X	Milleage Rate	X	FED Tax Category	X	7 Years	= Savings
237	X	0.5	X	0.03599	X	0.15	X	7	= \$ 4.48

<i>Tax savings as a result of interest paid on energy improvements (as provided by a mortgage calculator):</i>				
Interest Paid In 7 Years	X	FED Tax Category		= Savings
74.17	X	0.15		= \$ 11.13

**TOTAL ENERGY AND TAX SAVINGS** \$ 164.29

**NET BENEFITS FOR FIRST SEVEN YEARS** \$ (4.14)

## IMPROVEMENT ANALYSIS REPORT

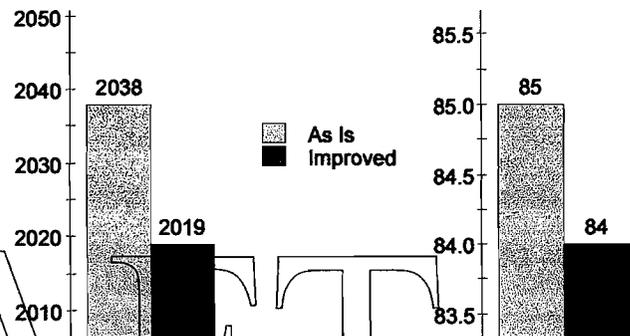
Date:	November 19, 2009	Rating No.:	
Building Name:	RANCH - ZONE 2 - B	Rating Org.:	HOME ENERGY ANALYSIS TEAM
Owner's Name:	HOMEOWNER	Phone No.:	810.329.0863
Property:		Rater's Name:	DAVID E. MORAN
Address:	TRAVERSE CITY, MI 49684	Rater's No.:	1014
Builder's Name:			
Weather Site:	Traverse City, MI	Rating Type:	Efficiency Options
File Name:	RANCH - ZONE 2 - B - 2009.blg	Rating Date:	

**Energy Costs (\$/yr)**

**Total Costs (\$/yr)**

**HERS Index**

End-Use	As Is	With All Improvements	Savings
Heating	804	783	21
Cooling	34	35	-1
Hot Water	194	194	0
Lights and Appliances	902	902	0
Photovoltaics	-0	-0	0
Service Charge	108	108	0
<b>TOTAL</b>	<b>2041</b>	<b>2021</b>	<b>20</b>

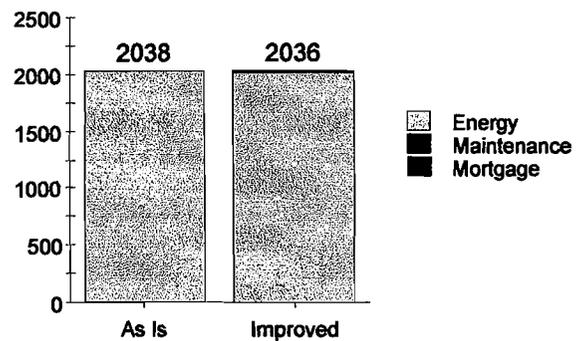


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**Information For Lenders and Appraisers**

Installed Cost of Improvements (\$)	237
Cost Weighted Life of Measure (Years)	30
Mortgage Term (Years)	30
Discount/Mortgage Rate (%)	6.000
Present Value Factor	13.8
Expected Annual Energy Savings (\$)	20
Expected Annual Maintenance Costs (\$)	0
Expected Annual Savings (\$)	20
Increased Annual Mortgage Costs (\$)	17
Present Value of Savings (\$)	271
Expected Annual Cash Flow (\$)	2

**Cost Comparison (\$/yr)**



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## IMPROVEMENT ANALYSIS REPORT

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RANCH - ZONE 2 - B

Page 2

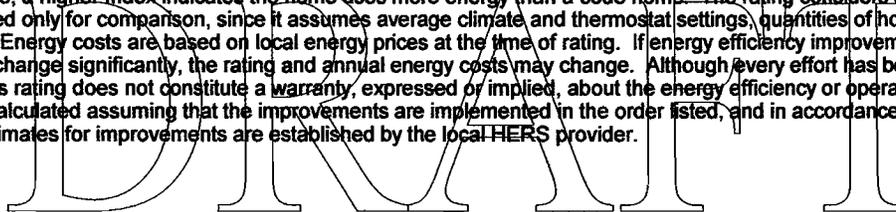
### Recommended Improvements

Component	Life	Cost	Yr Savings	SIR	PV	SP	Index
<b>1. Fnd Wall 1: FW 1</b>	30	237	20	1.1	34	12.03	84
Existing: R-11 CAVITY #3							
Proposed: R19 CAVITY #3							
Measure: INCREASE CAVITY TO R-19							

### Criteria

Ranking Criteria: SIR	Maximum \$ Limit: No Limit
Cutoff: 0	Measures: Interactive

The home's energy efficiency is rated using the HERS Index as defined in the RESNET "Mortgage Industry National Home Energy Rating Systems Accreditation Standards," 2006. An Index of 100 represents a home that meets current energy codes. A lower Index indicates the home uses less energy than a code home; a higher Index indicates the home uses more energy than a code home. The rating considers all energy use in the home. The rating should be used only for comparison, since it assumes average climate and thermostat settings, quantities of hot water, and internal loads for a typical household. Energy costs are based on local energy prices at the time of rating. If energy efficiency improvements are made to the home, or energy prices change significantly, the rating and annual energy costs may change. Although every effort has been made to provide accurate information, this rating does not constitute a warranty, expressed or implied, about the energy efficiency or operating costs of the house. Estimated savings are calculated assuming that the improvements are implemented in the order listed, and in accordance with all local codes and standards. The cost estimates for improvements are established by the local HERS provider.



**General House Specifications  
Ranch Zone 2-B**

<b>SQ FT of HOME</b>	1100	<b>Number of BEDROOMS</b>	3	<b>Construction Style</b>	RANCH
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**Improvement Specifications**

DESIGN ELEMENT/sq ft	DESCRIPTION 2003 MUEC	DESCRIPTION Revised MUEC (equivalent of 2009 IECC)	NOTES	MATERIALS COST OF IMPROVMENT	SOURCE OF INFORMATION	LABOR COST OF IMPROVEMENT
<i>WINDOWS</i>	U =.35	U =.35	No change			
<i>ABOVE GRADE WALL INSULATION</i>	R-21 Grade III *	R-21 Grade III *	No Change or R-13 with R- 5 exterior sheathing			
<i>BASEMENT INSULATION INTERIOR WALL</i>	R-11 Interior Grade III *	R-19 Interior Grade III *	Insulation R-value increase	\$237	R.S. Means	Included
<i>ATTIC INSULATION</i>	R-49 Grade III *	R-49 Grade III *	No change			

\*A grading system is used to evaluate the installation of the material, grade I being the best.

\*\* Please refer to the summary report for an explanation regarding the small increase to the R-value of the insulation.

# Cost/Benefit Analysis Worksheet Nov. 09'

"D-2"

Location	Zone 2
House Type	Two-Story, Standard
Analysis Type	Prescriptive

## COSTS

<i>Down payment amount proportionate to cost of improvements:</i>				
Cost of Improvements	X	Downpayment %		
237	X	0.229		\$ 54.27

<i>Mortgage costs representing cost of improvements (as provided by a mortgage calculator):</i>				
Mortgage Paid in 7 Years @ 5.25%				
84.84				\$ 84.84

<i>Increased property taxes proportionate to cost of improvements:</i>							
Cost of Improvements	X	Taxable Value	X	Millage Rate	X	7 Years	
237		0.5		0.03599		7	\$ 29.85

<i>Increased home insurance costs proportionate to cost of improvements:</i>					
Cost of Improvements	X	Insurance Rate	X	7 Years	
237		0.0033		7	\$ 5.47

<i>Increased mortgage insurance costs proportionate to cost of improvements:</i>							
Cost of Improvements	X	Insurance Rate	/	12 Months	X	84 Months	
237		0		12		84	\$ -

**TOTAL COSTS** \$ 174.44

## SAVINGS

<i>Energy Savings</i>	
<i>Annual fuel price increase calculated at 2%</i>	
Year 1	\$ 20.00
Year 2	\$ 20.40
Year 3	\$ 20.81
Year 4	\$ 21.22
Year 5	\$ 21.65
Year 6	\$ 22.08
Year 7	\$ 22.52

<i>Tax Savings</i>									
<i>Tax savings as a result of improvement dollars spent:</i>									
Cost of Improvements	X	Taxable Value	X	Millage Rate	X	FED Tax Category	X	7 Years	= Savings
237	X	0.5	X	0.03599	X	0.15	X	7	= \$ 4.48

<i>Tax savings as a result of interest paid on energy improvements (as provided by a mortgage calculator):</i>				
Interest Paid In 7 Years	X	FED Tax Category		= Savings
63.54	X	0.25		= \$ 15.89

**TOTAL ENERGY AND TAX SAVINGS** \$ 169.05

**NET BENEFITS FOR FIRST SEVEN YEARS** \$ (5.39)

## IMPROVEMENT ANALYSIS REPORT

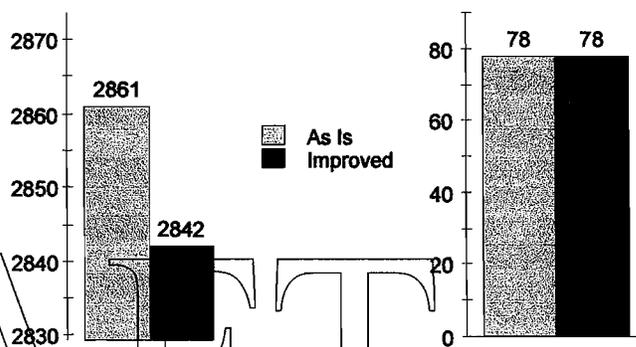
Date: November 19, 2009	Rating No.:	
Building Name: 2 STORY - ZONE 2 - B	Rating Org.: HOME ENERGY ANALYSIS TEAM	
Owner's Name: HOMEOWNER	Phone No.: 810.329.0863	
Property:	Rater's Name: DAVID E. MORAN	
Address: TRAVERSE CITY, MI 49684	Rater's No.: 1014	
Builder's Name:		
Weather Site: Traverse City, MI	Rating Type: Efficiency Options	
File Name: 2 STORY - ZONE 2 - B - 2009.blg	Rating Date: 11/12/09	

### Energy Costs (\$/yr)

### Total Costs (\$/yr)

### HERS Index

End-Use	As Is	With All Improvements	Savings
Heating	1234	1213	21
Cooling	51	52	-1
Hot Water	223	223	0
Lights and Appliances	1248	1248	0
Photovoltaics	-0	-0	0
Service Charge	108	108	0
<b>TOTAL</b>	<b>2863</b>	<b>2844</b>	<b>20</b>

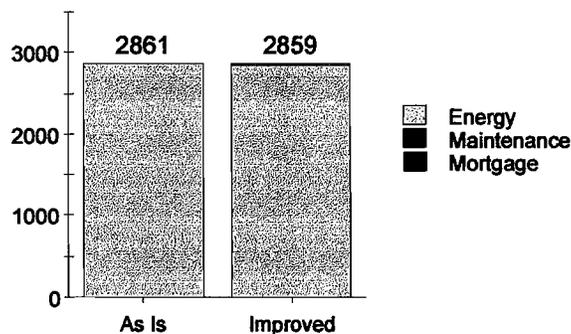


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**Information For Lenders and Appraisers**

Installed Cost of Improvements (\$)	237
Cost Weighted Life of Measure (Years)	30
Mortgage Term (Years)	30
Discount/Mortgage Rate (%)	6.000
Present Value Factor	13.8
Expected Annual Energy Savings (\$)	20
Expected Annual Maintenance Costs (\$)	0
Expected Annual Savings (\$)	20
Increased Annual Mortgage Costs (\$)	17
Present Value of Savings (\$)	271
Expected Annual Cash Flow (\$)	3

### Cost Comparison (\$/yr)



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## IMPROVEMENT ANALYSIS REPORT

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2 STORY - ZONE 2 - B

Page 2

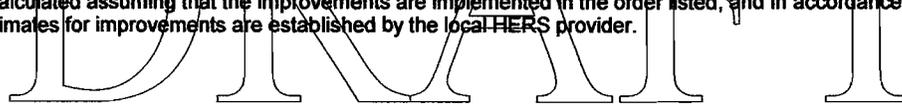
### Recommended Improvements

Component	Life	Cost	Yr Savings	SIR	PV	SP	Index
<b>1. Fnd Wall 1: FW 1</b>	30	237	20	1.1	34	12.01	78
Existing: R-11 CAVITY #3							
Proposed: R19 CAVITY #3							
Measure: INCREASE CAVITY TO R-19							

### Criteria

Ranking Criteria: SIR	Maximum \$ Limit: No Limit
Cutoff: 0	Measures: Interactive

The home's energy efficiency is rated using the HERS Index as defined in the RESNET "Mortgage Industry National Home Energy Rating Systems Accreditation Standards," 2006. An Index of 100 represents a home that meets current energy codes. A lower Index indicates the home uses less energy than a code home, a higher Index indicates the home uses more energy than a code home. The rating considers all energy use in the home. The rating should be used only for comparison, since it assumes average climate and thermostat settings, quantities of hot water, and internal loads for a typical household. Energy costs are based on local energy prices at the time of rating. If energy efficiency improvements are made to the home, or energy prices change significantly, the rating and annual energy costs may change. Although every effort has been made to provide accurate information, this rating does not constitute a warranty, expressed or implied, about the energy efficiency or operating costs of the house. Estimated savings are calculated assuming that the improvements are implemented in the order listed, and in accordance with all local codes and standards. The cost estimates for improvements are established by the local HERS provider.



**General House Specifications**  
**2 Story Zone 2-B**

<b>SQ FT of HOME</b>	2240	<b>Number of BEDROOMS</b>	3	<b>Construction Style</b>	2 Story
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**Improvement Specifications**

DESIGN ELEMENT/sq ft	DESCRIPTION 2003 MUEC	DESCRIPTION Revised MUEC (equivalent of 2009 IECC)	NOTES	MATERIALS COST OF IMPROVMENT	SOURCE OF INFORMATION	LABOR COST OF IMPROVEMENT
<i>WINDOWS</i>	U =.35	U =.35	No change			
<i>ABOVE GRADE WALL INSULATION</i>	R-21 Grade III *	R-21 Grade III *	No Change or R-13 with R- 5 exterior sheathing			
<i>BASEMENT INSULATION INTERIOR WALL</i>	R-11 Interior Grade III *	R-19 Interior Grade III *	Insulation R-value increase	\$237	R.S. Means	Included
<i>ATTIC INSULATION</i>	R-49 Grade III *	R-49 Grade III *	No change			

\*A grading system is used to evaluate the installation of the material, with grade I being the best.

\*\* Please refer to the summary report for an explanation regarding the increase in the R-value

**Attachment E – Building Component Table from the Current MUEC**

**TABLE N1102.1  
SIMPLIFIED PRESCRIPTIVE BUILDING ENVELOPE THERMAL COMPONENT CRITERIA  
MINIMUM REQUIRED THERMAL PERFORMANCE (U-FACTOR AND R-VALUE)**

Exterior Enclosure	Zones		
	1	2	3
Wall Assemblies	R-21	R-21	R-21
Fenestration/Openings (area weighted average of the total area of fenestration units) <sup>1</sup> ,	U = 0.35 (R = 2.85)		
Roof/Ceiling Assemblies <sup>2</sup>	R-49	R-49	R-49
Floors over unconditioned spaces	R-21	R-21	R-21
Slab on grade construction <sup>3</sup>	R-11, 4ft	R-13, 4 ft	R-18, 4ft
Crawl space walls <sup>4</sup>	R-20	R-20	R-20
Basement walls	Continuous Insulation	R-10	R-10
	Cavity Insulation	R-11	R-11
		R-15	R-19

<sup>1</sup> Fenestration units are required to meet this standard for the entire unit.

<sup>2</sup> Skylight U (1/R) factors are required to meet the fenestration requirements set forth in this table for fenestration/openings. Skylights are limited to 10% of the gross roof/ceiling area.

<sup>3</sup> See section N1102.1.6 for additional installation criteria.

<sup>4</sup> See section N1102.1.7 for additional installation criteria.

**Attachment F – Building Component Table from the Revised MUEC  
(Table Excerpt from IECC 2009)**

**TABLE 402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT\***

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION < SHGC <sup>b, e</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE <sup>f</sup>	FLOOR R-VALUE	BASEMENT <sup>c</sup> WALL R-VALUE	SLAB <sup>d</sup> R-VALUE & DEPTH	CRAWL SPACE <sup>c</sup> WALL R-VALUE
1	1.2	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65 <sup>j</sup>	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50 <sup>j</sup>	0.65	0.30	30	13	5/8	19	5/13 <sup>f</sup>	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5 <sup>h</sup>	13/17	30 <sup>g</sup>	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5 <sup>h</sup>	15/19	30 <sup>g</sup>	15/19	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	38 <sup>g</sup>	15/19	10, 4 ft	10/13

**For SI:** 1 foot = 304.8 mm.

- a R-values are minimums. U-factors and SHGC are maximums. R-19 batts compressed into a nominal 2 x 6 framing cavity such that the R-value is reduced by R-1 or more shall be marked with the compressed batt R-value in addition to the full thickness R-value.
- b The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- c "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
- d R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.
- e There are no SHGC requirements in the Marine Zone.
- f Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.
- g Or insulation sufficient to fill the framing cavity, R-19 minimum.
- h "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
- i The second R-value applies when more than half the insulation is on the interior of the mass wall.
- j For impact fenestration complying with Section R301.2.1.2 of the *International Residential Code* or Section 1608.1.2 of the *International Building Code*, the maximum U-factor shall be 0.75 in Zone 2 and 0.65 in Zone 3.